AN ECOLOGICAL SURVEY OF ISLE ROYALE, LAKE SUPERIOR

PREPARED UNDER THE DIRECTION OF
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A Report from the University of Michigan Museum, published by the State Biological Survey, as a part of the Report of the Board of the Geological Survey for 1908.

LANSING, MICHIGAN
WYNKOOP HALLENBECK CRAWFORD CO., STATE PRINTERS
1909

Contents

THE ANTS OF ISLE ROYALE, MICHIGAN.

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Subfamily *Myrmicinae*.

1. *Myrmica brevinodis* Emery var. *canadensis* Wheeler. Several workers from a single colony: 61 (I, 2) H. A. Gleason. "Found on the dry rock ridges under the mats of bearberry and also excavating nests in the crevices of rocks to a depth of some 8 cm." This is the common variety of the subspecies *brevinodis* at higher elevations in Canada and the Eastern States.

2. *Leptothorax acervorum canadensis* Provancher. Workers from three colonies: 63 (I, 2), (I, 1), 77 (I, 2), H. A, G. "Abundant in *Cladonia* clearings and on rock ridges, running about on the surface and through the thin deposits of soil. The specimens of No. 73 were from the rock pools on the shore just south of Tonkin Bay." This ant, like the preceding, extends its range into the Northern and Eastern States, but it is by no means common. It is abundant, however, at higher elevations (8000-9000 ft.) in the Rocky Mountains and at lower elevations in Nova Scotia.

Subfamily *Dolochoderinae*.

3. *Tapinoma sessile* Say. Workers from a single colony: 132 (V, 2) C. C. Adams, "under *Cladonia.*" This is the only Dolichoderine ant which ascends to high latitudes and elevations. I have found it nesting under stones at altitudes of over 10,000 ft. near Cripple Creek, Colorado., and it is common in the Canadian zone throughout the Rocky Mountains. In the Northeastern States it descends to sea-level.

Subfamily *Camponotinae*.

4. *Lasius niger* L. var. *neoniger* Emery. Workers from five colonies: 20 (I, 5) C. C. A., .and 75 (I, 1), 79 (I, 5), 82 (I, 5), 83 (I, 5), H. A. G., "Abundant on the rock ridges and jack pine ridges (I, 2, 5). The nest is always constructed beneath or at the side of a flat or angular stone, at a depth of one decimeter or more. A complicated system of roomy galleries is excavated with passages 1.5-2.5 cm. high by 2-5 cm. broad. This ant was seen to capture and kill a beetle. No. 75 H. A. G, is material from the rock pools." (Gleason).

There are in North America three distinct varieties of the circumboreal *L. niger*, viz., var. *neoniger* Emery, *sitkäensis* Pergande and *americanus* Emery. The first and second have the legs and antennae of the workers and females covered with suberect hairs, and the hairs on the body are also conspicuously abundant. *L. neoniger* is small and black, *sitkäensis* much larger and of a lighter brown or yellowish color. *L. americanus* is small, like *neoniger*, but brown and has few erect hairs on the body and none on the legs and scapes. It is closely related to the palearctic variety *alienus* Forster, and like this form inhabits warm and rather dry localities. It is the common form of niger throughout the Northern States. *L. sitkäensis* occurs in Alaska, Nova Scotia, and in the damp alpine meadows of the Rocky Mountains at altitudes between 8000 and 9000 ft. *L. neoniger* occurs in dryer situations at somewhat lower elevations and is occasionally found even near sea-level in isolated colonies in our northern woods. Varieties (hybrids?) intermediate between *neoniger* and *americanus* also occur in these same localities.

5. *Formica sanguinea aserva* Forel. Workers from two colonies: 78 (I, 2), 72 (I, 2) H. A. G. "This is one of the commonest species on the rock ridges, but constructs its nest either in or under decaying wood. On the ridge north of the light house, a nest (72) was made under a rather small rotten stick, and the soil beneath was composed mainly of finely comminuted fragments of the

wood. The second colony (78) had constructed a nest in the interior of a large decaying log." (Gleason). This subspecies has been taken hitherto only at Toronto (Forel), on the summit of Mt. Washington (Mrs. A. T. Slosson), among the Litchfield Hills of Connecticut (Wheeler) and in Casco Bay, Maine (Wheeler). It is a decidedly boreal form, approaching the typical palearctic sanguined in size and coloration. There were no slaves accompanying the specimens from Isle Royale, a fact which tends to confirm the conclusions of Forel and myself that this subspecies usually lives in pure colonies.

6. *Formica adamsi* sp. nov. *Worker*. Length 3.5-5 mm. Allied to *F. rufa* L. Head, including the mandibles, nearly as broad as long even in the smallest individuals, with straight posterior border, rounded posterior corners, and slightly but distinctly convex sides. Eyes large. Mandibles 7-8 toothed. Clypeus prominently carinate, with broadly rounded anterior border, not produced in the middle. Palpi of moderate length. Antennae slender, scapes nearly straight at the base, funicular joints all distinctly longer than broad, the basal somewhat more slender and longer than the apical joints. Pro- and mesonotum moderately rounded, convex, the latter eliptical and nearly twice as long as broad, the former a little broader than long. Epinotum with subequal base and declivity, the former slightly convex, the latter flattened or slightly concave; the two surfaces in profile passing into each other through a rounded angle. Petiole more than half as broad as the epinotum, in profile with convex anterior and flattened posterior surface and sharp upper border; seen from behind the border is rounded and but feebly or not at all produced upward in the middle. Gaster and legs of the usual shape.

Opaque throughout; only the mandibles, frontal area and sides of the clypeus faintly shining or glossy. Mandibles finely and densely striated. Surface of body densely and indistinctly shagreened.

Hairs and pubescens pale yellow; the latter covering the whole body and appendages, not conspicuous except on the gaster, but even on this region not sufficiently dense to conceal the surface sculpture. Hairs short, sparse and obtuse, in several rows on the gastric segments; on the thorax confined to the upper portions of the pro- and mesonotum, on the head to the clypeus, front and vertex. The hairs on the mandibles are appressed and pointed, on the palpi short but numerous and conspicuous. Legs naked except for a series of pointed bristles on the flexor surfaces of the tibiae and tarsi and a few blunt hairs on the anterior surfaces of the fore coxae.

Sordid brownish red, the smaller specimens somewhat more yellowish red. Gaster dark brown, except a large spot on the base of the first segment and the anal region, which are reddish yellow. A large spot on the pronotum, one on the mesonotum, much of the posterior portion of the head, the distal halves of the antennal funiculi and in many specimens also the coxae and femora, dark brown or blackish. These dark markings are present in the largest as well as in the smallest workers. Teeth of mandibles black.

Described from numerous specimens taken from a single colony: 115 (1, 6) H. A. G. A dozen workers taken by myself on Pikes Peak, Colorado, near timber line, at an altitude of 10,500 to 11,000 ft. differ from the Isle Royale specimens only in having the frontal area smooth and shining, in having the middle of the petiolar border produced upward as a distinct, blunt point, and in the less extensive infuscation of the bead, pro- and mesonotum. These specimens may be regarded as representing a distinct variety, *alpina* var. nov. Both this and the typical *adamsi* may be distinguished from our other North American forms of the *rufa* group by their small size, opaque surface and peculiar coloring and pilosity. The following collector's note on the Isle Royale specimens adds some ethological characters which are not seen in the other small forms of the *rufa* group known to me: "The nests of this ant are one of the most conspicuous features of the drier tamarack swamps. They are rounded-conical in shape, 3-6 dcm. high or even larger and with a diameter at the base about equalling the height. They are composed within of *Sphagnum*, but as would be expected with such material, without any definite system of galleries. The outer surface is thickly covered with leaves of *Cassandra*, probably to prevent loss of moisture by evaporation from, the interior. They are frequently placed near or under a bush of the *Cassandra*, but the same covering is used if no *Cassandra* is near." (H. A. Gleason).

7. *Formica rufa obscuriventris* Mayr. Workers from six colonies: 46 (I, 1), 47 (I, 1), 63 (I, 2), 76 (I, 2), 114 (I, 6), 14 (112) H. A. G. "This subspecies occurs on the rock beaches (I, 1, 46, 47) where it forages about on the surface and in crevices but is more abundant on the jack pine ridges (I, 5, 63) and on the rock clearings (I, 2, 76)."

I recently described this subspecies as *F. dryas*, but an examination during the past summer of some of Mayr's types in Professor Forel's collection, shows that in so doing I created a synonym. Mayr's original description based on specimens from Connnecticut is entirely inadequate, and the list of localities which he later cited for *obscuriventris* shows that he lumped together a number of different forms belonging to the *rufa* group. The name *obscuriventris*, therefore, should be restricted to the form having the characters of my *F. dryas*. This ant is rare in the Eastern and Northern States and evidently belongs to the boreal fauna.

8. *Formica fusca* L. var. *subsericea* Say. Workers from 11 colonies: 23 (I, 5), 102 (V, 2), 131 (V, 2), C. C. A., and 80 (I, 5), 81 (I, 5), 100 (I, 5), 102 (I, 5), 223 (V, 3), 224 (V, 3), 226 (V, 3), 227 (V, 3) H. A. G. Also specimens from a single colony on Mackinac Island (3, H. A. G.). "A common ant on the jack pine ridges (I, 5, 80, 81, 100, 102). It constructs its nests under rocks in moist soil (100) and was observed to capture beetle larvae (103). The specimens collected in the rock-clearings at Siskowit Bay (V, 3, 223, 224, 226, 227),

constructed circular, flat-topped craters 6 dcm. in diameter, covered with debris of balsam and spruce needles and frequently with growing plants on them." This is the common form of the circumboreal *F. fusca* throughout Canada and the northern states. At higher altitudes on the Rocky Mountains it passes into the more silvery red-legged var. *argentata* Wheeler, a form which also occurs even near sea-level but very sporadically in the Atlantic States.

9. *Formica fusca* L. var. *neorufibarbis* Emery. A few workers from two colonies: 1.5 (I, 1) and 20 (I, 1) H. A. G. in vials with specimens of *Lasius neoniger* and *Camponotus whymperi*. Of the numerous varieties of *F. fusca* this is the most boreal, being known only from Alaska and British America as far east as Labrador and Nova Scotia, and from higher altitudes in the Rocky Mountains (9,000 to 12,500 feet). It forms rather small colonies under stones and logs in moist or shady places.

10. *Camponotus herculeanus* L. var. *whymperi* Forel. Workers from 10 colonies, with larvae and pupae: 15 (I, 1), 18 (I, 1), 22 (I, 1), 30 (I, 1), 62 (I, 2), 140 (I, 3) H. A. G. and 105 (V, 2), 126 (V, 11), 148 (III, '04), 149 (III, '04) C. C. A. "Although an abundant species on the rock and gravel beaches (15, 18, 22 H. A. G.) where it forages for dead insects, its actual home appears to be the ridges. On the dry ridges it occurs singly, usually in soil under stones (62, H. A. G.). It was also collected (140 H. A. G.) in the dense balsam fir woods, where it forages over the surface. This variation in habit leads to the conclusion that it belongs properly to the rock ridges." Like the preceding variety of *F. fusca*, *C. whymperi* is a truly boreal ant. It is our North American representative of the typical paleo-boreal *C. herculeanus* and in the United States is known to occur only at considerable elevations in the Rocky Mountains (above 8,000 feet) and on the summits of the Green Mountains of Vermont. The types of *whymperi* were taken in the mountains of Alberta, B. C., by the noted mountain climber, to whom the variety was dedicated. I have seen specimens from Nova Scotia (Russell) and Labrador (Henshaw).

The foregoing series of Formicidae, though represented by only ten different forms, is of considerable interest on account of its pronounced boreal character. Only two of the forms (*Formica subsericea* and *Tapinoma sessile*) are abundant at ordinary elevations in the northern states. *Myrmica canadensis*, *Leptothorax canadensis*, *Formica aserva*, *F. obscuriventris* and *Lasius neoniger* occur sparingly in the same region, but always in situations which indicate that they are not in their optimum environment or station, or where they seem to represent the laggards of a wave of post-glacial migrants to more northern latitudes or higher altitudes. *F. adamsi*, *F. neorufibarbis* and *Camponotus whymperi* are exquisitely boreal ants of circumscribed alpine distribution in the United States, but probably of extensive range in British America.

THE COLD-BLOODED VERTEBRATES OF ISLE ROYALE.

DR. ALEXANDER G. RUTHVEN.

The collection which has served as the basis for this report was made by the University of Michigan Museum expedition to Isle Royale, in the summer of 1905. The report should be considered as supplementary to the papers upon the fish, amphibians and reptiles of the island, published in 1905. (Ruthven, 1905, pp. 107-112.) This, the second expedition to Isle Royale, has added a number of species to the fauna, and has established the fact that most of the previously known forms extend throughout the entire length of the island, which was, of course, to be expected.

The amount of data on this fauna accumulated by the two expeditions is considerable, when it is considered that up to 1904 practically nothing was known of the cold-blooded vertebrates of the island. Our knowledge, however, is still very incomplete. In the case of the fishes this is due to the fact that no systematic attempt was made by the field parties to secure these forms, and the specimens obtained are, in most instances, those that came most easily to hand. The list is, therefore, undoubtedly very incomplete both as regards the number of species and their distribution. On the other hand, particular attention was paid to the amphibians and reptiles, and, although there is still much to be discovered concerning the local distribution of the species, the complete list includes nearly all of the species which would be expected to occur on the island.

Nature of the fauna.—The cold-blooded vertebrate fauna of Isle Royale, as at present known, consists of eighteen fish (exclusive of *Triglopsis thompsoni*, which was taken in deeper waters of Lake Superior), one toad, one tree toad, three frogs, the mud puppy, and two snakes.*

Affinities of the fauna.—Adams, on a previous page, has dwelt at length on the fact that Isle Royale has never been connected with the main land since glacial times, a fact that is of first importance in discussing the origin of the fauna. Most of the fish obtained on the island occur both in the inland waters arid in the bays and coves about the shores. Since they are, moreover, forms of general distribution in the Great Lakes drainage system, occurring also in Lake Superior, their presence on Isle Royale is easily explained. To account for the presence of the inland, brook-dwelling forms, however, another explanation must be sought; for such species as the common stickleback, nine-spined stickleback, black-head minnow and *Leuciscus neogaeus* can hardly be conceived as able to cross the fifteen miles of open lake intervening between the island and the nearest mainland. At present we have no data that throw light on this problem.

*As elsewhere stated (Ruthven, 1905, pp. 109-112) *Hyla versicolor* and *Thamnophis sauritus* have been recorded from Isle Royale, but the records cannot be verified.

The same difficulties arise in attempting to account for the origin of the amphibian and reptile faunas. As in the case of the fish, the species are all of general distribution in northeastern North America, but, with the exception of the mud puppy, none of the species recorded from the island are aquatic, and, as they also belong to groups which are very sensitive to cold, they could neither reach the island through the water in summer or over the ice in winter. The theory of involuntary transportation thus seems to be the only tenable one. At present the most plausible explanation for the presence of the reptiles and amphibians (with the exception of the mud puppy, which might swim across) found on the island is that they have been transported on driftwood.

Unlike several of the other groups of animals, and the flora, the amphibian-reptile fauna is not strongly boreal in its affinities. It is true that the forms which are found on the island also range to the northward, but the principal range of the species is to the southward, and only one species (*Rana septentrionalis*) does not extend rather far south in eastern North America. The southern affinity of this fauna is undoubtedly due to the fact that the amphibians and reptiles are both pre-eminently warm climate groups, and the representatives in this region are those few that are able to endure the colder climate.

ANNOTATED LIST.

Pisces.

1. *Catostomus commersonii* (Lacépède). Common Sucker. Taken in the southeast coves of Rock Harbor (III. 6). As this species was found in a similar habitat at the south end of the island in 1904, it is undoubtedly to be found in all of the suitable bays and coves along the shores, and probably also in the larger inland lakes.

2. *Pimephales promelas* Rafinesque. Black-head Minnow. Specimens of this fish were taken in Sumner Lake (III. 5). This is the only locality known for the island.

3. *Leuciscus neogaeus* (Cope). As in the case of the Black-head Minnow, this species was only taken in Sumner Lake (III. 5).

4. *Coregonus quadrilateralis* Richardson. Menominee Whitefish. This species, a common food fish in Lake Superior, was taken in Siskowit Lake (V).

5. *Argyrosomus artedi* (Le Sueur). Lake Herring. Taken by the 1905 expedition in Rock Harbor and Lake Desor (VII. '04). Like the Sucker this fish, which is a common Great Lakes species, probably occurs in most of the larger inland lakes.

6. *Argyrosomus nigripinnis* Gill. Blue-fin; Black-fin. This fish was only found in Rock Harbor.

7. *Cristivomer namaycush* (Walbaum). Mackinaw Trout; Lake Trout. Adult specimens were taken in Rock Harbor, and a single immature specimen (41 mm. in length) in Benson Brook (II. 1).

8. *Salvelinus fontinalis* (Mitchell). Brook Trout. The 1905 expedition secured specimens of the Brook Trout only in Benson Brook (II, 1). As it was found on the southern end of the island, in Washington Harbor and river, in 1904, it may be considered as occurring throughout the length of the island, in suitable habitats.

9. *Lucius lucius* (Linnaeus). Common Pike; Pickerel. Taken in Sargent Lake. This is apparently the only Isle Royale record.

10. *Eucalia inconstans* (Kirkland). Brook Stickleback. This species was found in the following localities: Tamarack swamps, Siskowit Lake (V. 5); Spruce swamp, Siskowit Lake (V. 11); Sumner Lake (III. 5). It is probably to be found in most of the ponds and small streams on the island.

11. *Pygosteus pungitus* (Linnaeus). Nine-spined Stickleback. The Nine-spined Stickleback is represented in the collection by specimens from the "Bulrush and Delta zone at the western end of Rock Harbor" (III. 3), and from Tobin Harbor (IV).

12. *Percopsis guttatus* Agassiz. Trout Perch. This fish was taken about a small island in Tobin Harbor (IV. 6).

13. *Perca flavescens* (Mitchell). Yellow Perch. Taken in Forbes Lake (II. 5). This species is probably to be found in most of the larger inland lakes as well as in the coves and harbors about the island. It was taken in Washington Harbor in 1904.

14. *Cottus ictalops* (Rafinesque). Miller's Thumb. This cottid was found along the shores of Rock Harbor (III. 6) and the island in this harbor (III. 2). As it was found in a similar habitat at the southern end of Isle Royale in 1904, it may be considered to occur throughout the entire length of the island in this habitat.

15. *Uranidea franklini* (Agassiz). There are specimens of this form in the collections, labeled Rock Harbor and Benson Brook (II. 1).

16. *Triglopsis thompsoni* Girard. Three specimens of this rare species were taken from the stomachs of Lake Trout (*Cristivomer namaycush*) taken by fishermen off the east coast of Isle Royale. Jordan and Evermann write of this form as follows: "Deep waters of the Great Lakes; not common; known from Lake Michigan and Lake Ontario; doubtless a relic of a former arctic marine fauna, and descended from a species of Onocottus." Bollman (1890, p. 225) records a specimen from Torch Lake. Michigan, which was also found in the stomach of a Lake Trout.

17. *Lota maculosa* (Le Sueur). Lake Lawyer; Burbot. Taken in Tobin Harbor (IV. 5) and Rock Harbor (III).

Amphibia.

1. *Necturus maculosus* (Rafinesque). Three immature amphibians that are undoubtedly this species were taken in Benson Brook. They are very young and lack the dorsal fin and stripes. Dr. L. Stejneger, who has kindly

examined these specimens for us, states that the limbs and gills are proportionately shorter than the smallest in the U. S. National Museum. It should be noted here that Yarrow (1883, p. 144) has previously recorded this species from the island.

2. *Bufo americanus* (LeConte). Common Toad. The capture of a number of specimens of this species on the northern part (II) establishes its occurrence throughout the length of the island.

3. *Hyla pickeringi* (Storer). Pickering's Tree-frog. This amphibian was taken in the woods on the northern end of the island (IV. 8), and in the woods (V. 4) and Tamarack swamps (V. 5) in the vicinity of Siskowit Lake. It probably occurs also on the southern end of the island, although it was not taken by the 1904 expedition.

4. *Rana septentrionalis* Baird. Mink Frog; Northern Frog. A single specimen of *R. septentrionalis* was secured at Sumner Lake (III. 5). This establishes the presence of the species on Isle Royale, a point that has hitherto been in question, owing to the unidentifiable condition of the specimens taken on the island by Dr. A, E. Foote (see Ruthven 1904, 110). Miss Dickerson (1900, 225) writes of the habits of this, frog as follows: "The Northern Frog is described as decidedly a river frog; it is never captured in lakes and ponds." Our observations are exactly the reverse, all of the specimens taken on both expeditions having been found about the shores of the inland lakes.

5. *Rana clamitans* Baud. Green Frog. As represented by the collections of the 1905 expedition, this is the common frog of the island. Numerous specimens were taken on the shores of Rock Harbor (I. 1), at Sumner Lake (III. 5), and Siskowit Lake (V). Although it was not found on the southern end of the island in 1904, it doubtless occurs there.

6. *Rana sylvatica cantabrigensis* (Baird). Northern Wood Frog. This frog is now known from practically the entire length of the island. Specimens were taken by the 1905 expedition at Forbes Lake (II. 5), the small island in Tobin Harbor (IV. 6), and at Siskowit Lake (V. 5).

Serpentes.

1. *Storeria occipitomaculata* (Storer). Red-bellied Snake. This little snake is the characteristic reptile of Isle Royale. It was taken by the 1905 expedition at Rock Harbor (I. 7 and IV. 5) and Siskowit Lake (V. 5). No notes are available on the habits of the individual specimens obtained, but they are doubtless similar to those noted in 1904. As the variability of the scutellation of this snake has apparently never been determined, I add the scale formulas of the specimens examined.

Museum No.	Dorsals.	Supra-labials.	Infra-labials.	Tempo-rals.	Oculars.	Sub-caudals.	Ventrals.	Total length.	Tail length.
33475.....	* 15	6	7	1–2 1–1	2–2	.....	115	.....	.....
33476.....	15	6	6	1–2	2–2	46	122	250	60
33478.....	15	6	7	1–2	2–2	48	124	263	63
33493.....	15	6	7	1–1	2–2	40	121	230	59
33494.....	15	6	7	1–2	2–2	41	121	200	40
33408.....	15	6	6–7	1–3	2–2	43	127	298	61
33409.....	15	6	7–6	1–3	2–2	43	126	310	59
33410.....	15	6	7	1–2 1–1	2–2	42	123	294	58
33411.....	15	6	7–6	1–1 1–2	2–2	42	125	291	56
33412.....	15	6	7–8	1–1	2–2	.....	122	.....	.....
33413.....	15	6	7–?	1–2 1–1	2–3 2–2	39	120	238	49
33414.....	15	6	7	1–1	3–2 2–2	43	127	243	52
33415.....	15	6	6	1–2 1–1	2–2 3–2	46	119	233	55
33416.....	15	6	6	1–2	2–2	48	120	235	60
33417.....	15	6	7	1–2	2–2	.....	120	.....	.....

* In these specimens there is no decrease in the number of scale rows on the posterior part of the body. (Compare Ruthven, 1908.)

2. *Thamnophis sirtalis* (Linnaeus). Garter-snake. Garter-snakes were taken in the following localities: Light house clearing (I, 7), Ransom clearing (II, 1), Shore of Siskowit Lake (V, 1), Sumner Lake (III. 5), Tamarack Swamp Bock Harbor (V, 5), and Siskowit Bay. The specimens of this snake obtained vary greatly in color. A number, like the few obtained in 1904, would be referred unhesitatingly to variety *parietalis*, were it not for the fact that there are other specimens in the collection which have a smaller amount of red on the sides, as well as some in which it is entirely wanting. When the series is examined as a whole it is quite evident that the specimens are intermediate between the typical form and variety *parietalis*, which is not surprising since the island lies in the latitude of the known "intermediate zone" to the southward (see Ruthven, 1908, p. 168).

This, however, in no way vitiates the statement made in 1904 that the presence of this snake on the island is an evidence of a western affinity in the fauna; for the frequent presence of a considerable amount of red pigment on the sides and the tendency toward the fusion of the upper row of spots, indicate that the Isle Royale specimens are more closely related to the western parietalis than to the garter-snake of eastern Canada and Northern Michigan, which belongs to the typical form, in that it never has the interspaces of the first row of spots entirely suffused with red, nor the upper row of spots usually fused.

A number of specimens from Rock Harbor, differ so much from the usual color of Isle Royale specimens as to merit special mention. The ground color in these individuals is black or blackish. The stripes are dark greenish, the dorsal being indistinct. The spots of the first row are distinct, the interspaces being of a light bluish color; the upper row of spots is usually fused except for short bars or spots of bluish. Belly dark blue with a black band on the outer margin of each scute. Supralabials dark blue, bases of the second to the fifth, white. Iris black. These specimens are identical with those from New Hampshire described by Allen (1899, 64) as *pallidula*; that they are only dark individuals of the form which inhabits the entire island is shown by the numerous "intermediate" specimens in this collection.

References.

Allen, G. M.
1899. Notes on the Reptiles and Amphibians of Intervale, New Hampshire. Proc. Bost. Soc. Nat. Hist., XXIX, 63-75.

Bollman, C. H.
1890. A Report upon the Fishes of Kalamazoo, Calhoun, and Antrim Counties, Michigan. Bull. U. S. Fish Com., 1888, 219-225.

Dickerson, Mary E.
1906. The Frog Book. New York.

Jordon, D. S. and Evermann, B. W.
1898. The Fishes of North and Middle America. Bull., 47, U. S. Nat. Mus., Vol. II.

Ruthven, A. G.
1905. The Cold-blooded Vertebrates of the Porcupine Mountains and Isle Royale, Michigan. Ann. Rept. Geol. Surv. Mich., 1905, 107-112.
1908. Variations and Genetic Relationships of the Garter-snakes. Bull. 61, U. S. Nat. Mus.

Yarrow, H. C.
1883. Check List of North American Reptilia and Batrachia. Bull. No. 24, U. S. Nat. Mus.

ANNOTATED LIST OF THE BIRDS OF ISLE ROYALE, MICHIGAN.

BY MAX MINOR PEET.

1. Introduction.

Our observations on the birds of Isle Royale extended over the period between July 5 and September 22, 1905. Three parts of the island were studied, namely Rock Harbor, Siskowit Bay (especially near the outlet of Siskowit Lake), and Washington Harbor. The party remained at Rock Harbor from July 5 to August 1; at Siskowit Bay from August 1 to August 17; and at Washington Harbor from August 17 to September 22. At Rock Harbor the observations were made by O. M'Creary, N. A. Wood, and Dr. R. A. Brown. At Siskowit Bay the work for the first week was carried on by M'Creary and Wood, as Brown had left the island; on August 8 they were joined by the writer. On our arrival at Washington Harbor M'Creary left the island, and the work was continued by Wood and the writer until September 1, when the former was called home. However, he was forced by severe storms to remain on Washington Island at the mouth of the harbor until September 5, and while there made a number of observations which are included under their respective heads. The observations during the remaining period (September 1 to September 22) were made by the writer. Before joining the party at Siskowit Bay, he had spent three days, August 5 to 8, at Washington Harbor, the observations giving some idea of the bird life at that place before migration had set in.

Practically all the birds observed at Rock Harbor were nesting, those observed within a few days after our arrival at Siskowit Bay may also be considered as breeding, but after about the first of August it is not safe to say whether the bird nested there or was an early migrant. As an example of this we may cite the case of the Tennessee Warbler, which probably did not nest on the island, and yet was first observed there August 2. Unless the nest was found or young unable to fly, we did not consider them as breeding in that vicinity, if seen after August 1. In the case of the waders, the earliest migration date must be placed in the latter part of July.

Under the head of stations, the particular habitats in which the birds were actually found are given with their numbers, so that a fuller description of the conditions existing there can be easily obtained by referring to that number under the "Description of Stations." It must not be supposed that the birds were limited to the station in which they are recorded. In all probability the birds noted in one tamarack swamp would be found in nearly every similar habitat on the island. But owing to the limited time spent here it was of course impossible to examine every locality, and so the records simply indicate the particular habitats in which the species under discussion were actually found. If observations were conducted for a sufficiently long period, the majority of the birds on the island would probably be recorded for nearly every habitat even if they did not breed in them; especially would this be true during migrations. It is not my intention, therefore, to give every habitat in which a particular species *might* be found, but rather to give the habitats which are preferred by that bird,—conditions which can be said to be characteristic of that species.

When a species was seen before the opening of migration, and yet no other signs of its breeding were found, it was considered simply as a resident, and the first and last dates when it was noted are given. The migration records of the resident birds are probably nearly all later than they should be, but the dates are given when they were first seen in actual migration. Many of the birds were still migrating at the time I left the island (September 21), and in such instances this is the last date given, and signifies that the migration of the bird was still under way. More extended observations on this interesting movement of the birds can be found in the paper "The Fall Migration of Birds," which is included in this volume. The paper on "The Ecological Distribution of Birds" should also be consulted for a discussion of that phase of the work.

From July 5 to September 22 we recorded 63 summer residents, 3 winter residents, 31 migrants, and 14 permanent residents, making a total of 111 species. In 1904 we observed eight birds which were not recorded the second year; these were: Sora, American Coot, Least Sandpiper, Short-eared Owl, Bronzed Grackle, American Goldfinch, Clay-colored Sparrow, and White-breasted Nuthatch. Besides these, the Clubhouse people described three other forms, the Snowy Owl, Snow Bunting, and Lapland Longspur, making a total of 122 species known to occur on the island. Many ducks

come to the island, but the descriptions given by the fishermen were of no help in their determination. A complete list of the birds observed during the summer and fall of 1905, arranged as "Summer Residents," "Migrants," "Winter Residents," and "Permanent Residents," is included in this paper. Forty-two species were found breeding.

I have attempted to make this more than a simple annotated list— a list giving nothing but the occurrence, relative abundance, and dates of migration. Besides this usual data, I have given as complete a life history of each species as I could, using nothing but the original records secured by the expedition. All habitat records are also included so that the characteristic environment of the birds may be understood.

I wish to acknowledge my indebtedness to Mr. Chas. C. Adams for the opportunity of accompanying the expedition, and for his kindness and assistance in the preparation of this paper.

Specimens representing nearly every species found on the island were secured and are now in the collection of the University of Michigan Museum. For the determination of certain specimens we are indebted to Mr. H. C. Oberholser of the Smithsonian Institution.

2. Classified List of Birds Observed in 1905.

*1. Summer Residents. *=Breeding.*

*1. Pie-billed Grebe.
*2. Loon.
*3. American Herring Gull.
*4. American Merganser.
*5. Hooded Merganser.
*6. American Bittern.
7. Spotted Sandpiper.
8. Marsh Hawk.
9. Sharp-shinned Hawk.
10. Coopers Hawk.
*11. American Goshawk.
12. Red-tailed Hawk.
13. Red-shouldered Hawk.
14. Pigeon Hawk.
*15. American Sparrow Hawk.
16. American Osprey.
*17. Saw-whet Owl.
18. Black-billed Cuckoo.
*19. Belted Kingfisher.
20. Yellow-bellied Sapsucker.
*21. Flicker.
22. Whip-poor-will.
23. Night Hawk.
24. Chimney Swift.
25. Ruby-throated Hummingbird.
26. Olive-sided Flycatcher.
27. Yellow-bellied Flycatcher.
28. Alder Flycatcher.
29. American Crow.
30. Vesper Sparrow.
*31. Savannah Sparrow.
*32. Slate-colored Junco.
*33. White-throated Sparrow.
*34. Chipping Sparrow.
*35. Song Sparrow.
*36. Swamp Sparrow.
*37. Cliff Swallow.
*38. Barn Swallow.
39. Tree Swallow.
40. Bank Swallow.
*41. Cedar Waxwing.
*42. Red-eyed Vireo.
*43. Nashville Warbler.
44. Black-throated Blue Warbler.
*45. Myrtle Warbler.
*46. Magnolia Warbler.
47. Bay-breasted Warbler.
*48. Black-throated Green Warbler.
*49. Oven Bird.
50. Grinnell's Water-thrush.
*51. Mourning Warbler.
*52. Canadian Warbler.
53. American Redstart.
54. Winter Wren.
55. Brown Creeper.
*56. Red-breasted Nuthatch.
*57. Chickadee.
*58. Golden-crowned Kinglet.
*59. Wilson's Thrush.
*60. Olive-headed Thrush.
*61. Hermit Thrush.
*62. American Robin.
*63. Blue Bird.

2. Migrants.

1. Baldpate.
2. Green-winged Teal.
3. American Scaup Duck.
4. Canada Goose.
5. Wilson's Snipe.
6. Yellow Legs.
7. Greater Yellow Legs.
8. Solitary Sandpiper.
9. Killdeer.
10. Broad-winged Hawk.
11. Kingbird.
12. Phoebe.
13. Least Flycatcher.
14. Thick-billed Redwinged Blackbird.
15. Rusty Blackbird.
16. White-crowned Sparrow.
17. Lincoln Sparrow.
18. Migrant Shrike.
19. Philadelphia Vireo.
20. Blue-headed Vireo.
21. Black and White Warbler.
22. Tennessee Warbler.
23. Cape May Warbler.
24. Black-poll Warbler.
25. Palm Warbler.
26. Connecticut Warbler.
27. Wilson Warbler.
28. American Pipit.
29. Catbird.
30. Ruby-crowned Kinglet.
31. Gray-cheeked Thrush.

3. Winter Residents (migrants from the north).

1. Horned Lark.
2. Pine Grosbeak.
3. Northern Shrike.

4. Permanent Residents.

*1. Prairie Sharp-tailed Grouse.
*2. Bald Eagle.
*3. Great-horned Owl.
*4. American Hawk Owl.
5. Hairy Woodpecker.
6. Downy Woodpecker.
7. Arctic Three-toed Woodpecker.
8. Northern Pileated Woodpecker.
9. Blue Jay.
*10. Canada Jay.
*11. Northern Raven.
12. Purple Finch.
13. White-winged Crossbill.
14. Pine Siskin

3. Annotated List.

1. Podilymbus podiceps (6). Pied-billed Grebe.

Range: British Provinces southward to Brazil, Argentine Republic, and Chili, including West Indies and Bermuda, breeding nearly throughout its range.

Stations: Washington Harbor, X ‘04; Washington River, II ‘04.

Breeding: Brood of 5 young, Aug. 18.

The Pied-billed Grebe was not found either at Rock Harbor or Siskowit Bay, but was a common summer resident at Washington Harbor, frequenting the river and upper end of the Harbor.

Breeding Notes: A family consisting of two old birds and five young were seen almost daily at that place. They seldom came out into the harbor. Although very shy when approached from land I succeeded in getting quite close when in a rowboat. They were never seen to take wing, generally diving or swimming rapidly away upon the approach of danger. Sometimes when badly frightened, instead of diving, they would rise upon their small wings so that their feet just touched the surface and in this way half ran, half flew across the water. The young were still unable to fly by the middle of September, and I doubt if the parents had completed their moult sufficiently to use their wings much either. During the rainy days when the creek was swollen and very rapid the grebes generally stayed out in the harbor near the river's mouth. A shallow spot covered with water plants and grasses near the bend in the river was their usual feeding place.

2. *Gavia imber* (7). Loon.

Range: Northern part of northern hemisphere. In North America breeds from the northern tier of states northward; ranges in winter south to the Gulf of Mexico and Lower California.

Stations: Rock Harbor, III, 2; Summer Lake, III, 5. Siskowit Bay, V, 1; Siskowit Lake, V, 6. Washington Harbor, X, '04.

Breeding: Two young, two or three days old, were taken on August 10.

Common summer resident throughout the island, as shown by such records as these: "Seven loons seen in the west end of Rock Harbor, July 13" and "eight adults seen at Siskowit Bay, August 1st." These birds had not left the island September 21st, as the fishermen reported them at this time.

They appeared to be more common at the northern end of the island and at Siskowit than at Washington Harbor. It is doubtful whether any nested in the immediate vicinity of the latter place.

Breeding notes: From their actions a pair were supposed to be breeding on Simmer Lake (III, 5) during July, but no nest was found. As long as any one was in sight the pair remained together, calling and diving continuously, often coming up many rods from their diving point.

On August 10th, a pair of adult birds were found with their two young on Siskowit Lake. The birds were swimming together with their young close beside them. Although apparently not more than two or three days old, they were expert divers and could swim under water much faster than the boat could be rowed when pursuing them. When approached, the parents swam rapidly away, leaving the young to take care of themselves, which they seemed perfectly capable of doing, and would have, had it not been for the use of a shot gun. As the young were approached, they swam rapidly away at right angles to each other. Upon being closer pressed they dived, swimming under water for twenty or twenty-five feet. This was kept up until they were procured. The young at this early age were capable of performing that remarkable feat for which the adults are so noted—the act of swimming at different depths with the head still above the surface. This is not done by diving, but simply by sinking the body lower down as a fish might lower itself; no special motion is noticeable, the sinking being gradual, and seemingly without effort. Towards the last the young swain with only the head out of water. One which was only wounded we kept alive twenty-four hours, after which it was killed as there was no food which we could easily procure for it. When placed in a basin of water it swam briskly about, seldom using the whole leg, but simply the foot, bending at the upper end of the tarsus, which, was moved back and forth with a fanning motion, the toes folding back on the forward stroke. It showed little fear, even when taken in the hand. Occasionally it uttered a call or cry, much resembling that of a young turkey. In the stomach of the other was found a dragon-fly nymph and four small fish about an inch and a half to two inches long, which shows that the fish diet is acquired early in this species. Low marshy land suitable for nesting sites occurred in some part of nearly every lake or bay on the island, and probably many breed here every year.

Miscellaneous notes: Many loons are caught each year on "set lines” and also in the gill nets on the shores of the island. One fine male was brought to the party by a fisherman, which was caught this way. The line had been sunk where the water was about 100 fathoms deep and about ten miles out in the lake from the Rock Harbor light-house. The line was down twenty fathoms, and this loon is supposed to have swam down this distance and taken the small herring used as a bait. The fisherman reported that this was a very common occurrence, the birds sometimes being found at the great depth of fifty and sixty fathoms; but this seems improbable. These birds roamed about much in the evening and during the night, their loud peculiar cry being heard at all hours as they passed over the camp. Severe storms like those during the first few. days of September drove the birds into the seclusion of Washington Harbor, where they were usually in pairs, and very shy.

3. *Larus argentatus smithsonianus* (51a). American Herring Gull.

Range: North America generally, breeding from Maine, northern New York, the Great Lakes and Minnesota northward; in winter, south to Cuba and Lower California.

Stations: Rock Harbor, I, 1; III, 2.
Siskowit Lake and vicinity, V, VIII, '04.
Long and Menagerie Islands, V, 10.
Washington Harbor, X '04, River, II '04.

Breeding: Young seen August 1 and 6.

Very abundant, their numbers at places being counted in thousands. This was the only gull seen on the trip. Gathering on the rocky islands in such numbers as to make them look like one-solid mass of white, their cries were almost deafening. In the evenings they visited the various places where the fishermen had thrown away the fish cleanings. At these feasts the water would be fairly covered with the birds, which would remain feeding long after dark. No matter on what part of the island, within a mile or so of the water, these gulls were nearly always in sight.

Breeding notes: On August 1st, near Chippewa Harbor, a brood of these young were seen swimming with their parents, the former being unable to fly. On August 6th a visit was made to the breeding grounds of these species at Siskowit, V, 10. *Fig. 45*. Here a chain of small islands runs nearly parallel to the shore and about three miles distant from it. The largest of these is nearly two miles long, and from a few rods to a fourth of a mile wide. It is composed of red sandstone, which rises out of the lake at an angle of about 20°. The rocks are almost bare of vegetation, but above the wave swept zone there is a narrow belt of shrubs and small trees.

As the island was approached, the rocks could be seen covered with the adult birds, which, however, soon took wing and circled about our heads, making a great noise. As we landed, many of the young birds jumped into the water and swam, hastily away to the gathering flock of adults which was forming just out of range. Others ran and hid in the small bushes, while some, particularly the youngest, merely squatted down between the rocks, Fig. *58*, their mottled, downy plumage furnishing such excellent protective coloring that many were actually passed over in the first search. The great mass of young remained about a quarter of a mile out in the lake, while overhead the parents flew and screamed. The nests were built in crevices, *Fig. 59*, and nooks in the rocks from near the water's edge to the top of the ridge which in some places was from ten to twenty feet high. Most of them were placed on the southern exposure and were composed of grass, sticks and such rubbish as was easily accessible. No fresh eggs were found, and the young birds appeared to be a month or more old.

The young when frightened squatted flat on the bare rocks, or squeezed themselves up in small nooks and crannies, trusting to their protective coloration for safety. It is a common practice among the fishermen at Washington Harbor to take the newly hatched young from the nest and raise them at their homes. Some who have a few chickens take the eggs and place them under a setting hen. These young soon become as tame as chickens, and feed upon any form of table refuse. The writer procured five of these young from some fishermen. They ranged in size from one about two months old and nearly able to fly to a little downy fellow scarcely three weeks old. These had all been obtained on some rocks just outside of Washington Harbor. They came into the writer's possession on August 8, and in a few days were turned loose on the beach in front of our camp on Siskowit Bay.

They ate everything offered them, vegetable as well as animal matter. Fish seemed to be particularly relished. Whatever they ate was swallowed entire if it could possibly be gotten into the mouth. One such instance was especially ludicrous. A northern red squirrel with simply the skin and head removed was fed to the youngest. Because of the weight it was with considerable difficulty-that the squirrel was started in the right direction. The body was too long, so that when swallowed, the tail still protruded from the gull's mouth. By stretching its neck as high as possible, most of the tail disappeared, only to appear again as soon as the gull dropped its head down on its shoulders, and closed its eyes in the satisfied manner evinced by all the young gulls after a good meal.

Often when food was given to them they picked it up and walked to the water, swashing it around several times before eating. The downy young never ventured into the water where they would have to swim, preferring to stand on the beach where the waves would just lap their feet. The older ones often swam out a considerable distance from land and made the acquaintance of a young wild gull able to fly. After a few days this latter bird became tame enough to come on the beach to be fed. One of the most characteristic habits of the young gulls was to walk to the water's edge where the waves would just wash their legs, and dive the head down into the water, raise it quickly and throw the water over their backs, at the same time giving the tail a few jerks sidewise. This performance was repeated many times each day, often not five minutes apart. The young which had acquired their full plumage, but were not able to fly, could usually be told from those which were able to do so, by their manner of holding the head. The former rarely held the head erect, either when on the water or land, usually holding it well forward and often on a level with the back, while those able to fly held the head erect and nearly straight above the breast. The change appeared to take place immediately after the first flight. For many days before this occurred the young gull would be seen jumping up and down on the beach, often to a height of two or three feet, flapping its wings rapidly at the same time. The first flight of our largest gull occurred one afternoon after one of these performances. Making a short run down the sloping beach it rose on its wings with a few rather uncertain strokes and sailed out

over the harbor. The flight must have covered half a mile when it returned and alighted on the water near camp. Its alighting was anything but graceful, for not being used to this new method of locomotion, it raised its wings straight over its back .and dropped heavily into the water, nearly submerging itself. When it rose to the surface and had completely arranged its feathers, it held its head upright, like the adult gulls, as if proud of its performance.

General Notes: The Herring Gull's manner of feeding was interesting. When small bits of fish were thrown on the water, the birds would fly down and just pat the water with both feet, at the same time lowering the head and picking up the morsel with the bill, not even stopping in their flight. When the piece was too large to pick up, the bird alighted near it, and either picked it to pieces or swallowed it whole. They were often seen dropping into the water from a considerable height, apparently catching small fish. The Herring Gull is sometimes taken on set lines like the loon, only in this case the hook must be near the surface. While on "Long Island" (V, 10) the dried body of an adult bird was found with a large fish hook attached to a short line in its throat.

The majority of these birds go south with the freezing of the lake; a few, however, remain throughout the winter around the fishermen's huts. Wherever a cut is made in the ice at this time, many of these gulls may be found.

4. *Merganser americanus* (129). American Merganser.

Range: North America generally, breeding south in the United States, to Pennsylvania and to the mountains of Colorado and California.

Stations: Lake Superior (Rock Harbor), I, 1. Ill, 2. Ill, 3. II, 4.
Siskowit Bay, V, 1. Siskowit Lake, V, 6.
Washington Harbor, X, '04.

Breeding: July 13, young; also July 27.

The American Merganser is a rather common species on the island, breeding in suitable localities.

Breeding Notes: The fisherman reported several families of adults and young at McCargoe Cove on July 11, and on the 13th a female with several young was seen in the west end of Rock Harbor (III, 3). A much larger flock of young was seen with the female at this same place on July 27th.

At Siskowit Lake (V, 1), on August 1, a large flock of young not yet able to fly were found, and on August 8 another flock barely able to use their wings were met near the Siskowit Islands. As many as twenty-two young were counted with one female. No young were found this year on Washington River, but several were seen out in the Harbor, which might have been raised here.

5. *Lophodytes cucullatus* (131). Hooded Merganser.

Range: North America generally, south to Mexico and Cuba, breeding nearly throughout its range.

Stations: Lake Superior (Rock Harbor), I, 1.
Sumner Lake, III, 5.

Breeding: Young observed July 27.

This species was quite rare, being observed only three times on Sumner Lake (III, 5) July 26, 27, 29, and at the Caribou Islands on several occasions.

Breeding Notes: From the actions of the single females seen at Sumner Lake they were thought to have young in the vicinity, but none were found. On July 27 a female and six young were seen on the Caribou Islands. The young were very small, not more than two weeks old, and by rowing fast they were overtaken, but escaped by diving. This same flock was seen in this vicinity several times afterwards.

6. *Mareca americana* (137). Baldpate.

Range: North America from the Arctic Ocean south in winter, to Guatemala and Cuba. Breeds chiefly north of United States.

Station: Washington Harbor, II, ‘04.

Migration: Sept. 5.

On September 5 a single individual was found on Washington River, II, ‘04. It was poorly colored; perhaps an immature specimen.

7. *Nettion carolinensis* (139). Green-winged Teal.

Range: North America. Breeding chiefly north of the United States and migrating south to Honduras and Cuba.

Station: Washington Harbor, II, '04.

Migration: September 4,

A flock of five appeared in the Harbor on the morning of September 4 but soon disappeared.

8. *Aythya marila* (148). American Scaup Duck.

Range: North America, breeding far north. South in the winter to Guatemala.

Stations: Siskowit Bay, V.
Washington Harbor, X, ‘04.

Migration: Aug. 4 to Sept. 1.

This duck was very rare here. One pair was found on Siskowit Bay near Wright's Island on August 4. Just before the hard storm which commenced September 1, a flock of these birds came into the harbor and were seen near Washington Island (X, '04).

9. *Branta canadensis* (172). Canada Goose.

Range: Temperate North America, breeding in the northern United States and British Provinces; south in winter to Mexico.

Stations: Washington Harbor, I, '04.

Migration: September 16.

On the afternoon of September 16, a solitary Canada Goose was observed flying over the island in a southerly direction. The residents on the island reported that in late October great flocks of geese pass over, sometimes stopping for a few hours, but never remaining for any length of time.

10. *Botaurus lentiginosus* (190). American Bittern.

Range: Temperate North America. South to Guatemala, Cuba, Jamaica and Bermuda.

Stations: Shore of Sumner Lake, III, 5.

Breeding: Dead young found on July 18.

Only one of this species was seen during both years, although there are many haunts which seem suitable for it. On July 18 and again on the 25th a single individual was flushed from the grassy bog along the edge of Sumner Lake.

Breeding Notes: An old nest was found July 18. It was on a grassy tuft in the bog, and contained an addled egg and two dead young. The nest consisted simply of a depression in the mat of green and dry grass.

11. *Gallinago delicata* (230). Wilson's Snipe.

Range: North and Middle America. Breeding from the northern United States northward; south in winter to the West Indies.

Stations: II, '04, Washington Harbor.

Migration: August 27 to September 21.

On August 27, one of these snipe was found in the marshy spot near the mouth of the river, and again on September 20 another was found in the same place. They were very wary and were only found by walking through the grass from which they were flushed. On several occasions, birds which might have belonged to this species were met after dark along the road to Wendigo, but owing to their very rapid flight, identification was uncertain.

12. *Totanus flavipes* (255). Yellow-legs.

Range: America in general, breeding in the cold temperate and subarctic districts, and migrating south in winter to southern South America.

Stations: Bulrush Zone and Delta, III, 3, Rock Harbor. Siskowit Bay, Beach, V, 1. Washington Harbor, I, '04.

Migration: July 26 to September 15.

On July 26 a bird of this species was seen at close range at III, 3. Three others stopped on the bluff above the river September 15. They showed little fear, and appeared curious as I approached.

13. *Helodromas solitarius* (256). Solitary Sandpiper.

Range: North America. Breeding occasionally in the northern United States, more commonly northward and migrating southward as far as the Argentine Republic and Peru.

Stations: Siskowit Bay beaches, V. 1.
Washington Harbor, I '04.

Migration: August 6 to September 15.

This sandpiper was rather common throughout August at Siskowit Bay, being found mostly on the bare wave swept rocks. True to its name, it was rarely seen when not alone. The pure white underparts and olive fuscous head and back made it quite conspicuous as it teetered back and forth on the rocks. They were seldom seen at Washington Harbor, although on September 5 small flocks were seen all along the road to Wendigo. They were picking up food and paid little attention to the writer, simply running ahead a few feet when approached too closely.

14. *Actitis macularia* (263). Spotted Sandpiper.

Range: North and South America from Alaska, south to Southern Brazil. Breeds throughout temperate North America.

Stations: Rock Harbor, I, 1. Siskowit Lake, V, 6.
Siskowit Bay, V, 1. Menagerie Island, V, 10.
Washington Harbor, I, '04; X, '04.

Resident and Migrants: July 26 to September 16.

The Spotted Sandpiper appeared to be rare at the northern end of the island, but was rather common at the other two localities where observations were made. It was seen almost daily at Siskowit and was by far the most common wader seen on the trip. At Washington Harbor they often came around the dock and were also met with along the river and the road parallel to it. At this latter station the birds were probably migrants as they were not seen regularly, being present one day and absent the next with perhaps a day or two between their visits.

15. *Oxyechus vociferus* (273). Killdeer.

Range: Temperate North America, breeding north to Newfoundland and Manitoba, migrating to the West Indies and Central America and northern South America.

Stations: Rock Harbor region, II, 2. Washington Harbor, I '04.

Migration: July 13 to August 5.

Only one of these birds was seen at 'the northern end of the island; this was on July 13 when one was seen flying over the tamarack swamp (II, 2). No others were found until August 5 when a flock of three were seen feeding on the grassy slope of the first clearing (I, '04),

16. *Pediocaetes phasianellus campestris* (308b). Prairie Sharp-tailed Grouse.

Range: Plains and prairies of the United States east of the Rocky Mountains; north to Manitoba; east to Wisconsin and Illinois; south to New Mexico,

Stations: Partial clearings along Benson Brook, II, 1.
Old Burning, V, 9.
Old clearing and burning at end of Siskowit Bay, VII '04.

Breeding: July 25, female with young.

The Prairie Sharp-tailed Grouse was found at Rock Harbor and Siskowit Bay by our party and was reported at Washington Harbor by the residents who called it a pheasant. At the latter place during the full of 1904, I observed what I still think was a young of this species, but as it was not procured, the record for this part of. the island must depend almost entirely upon the reports of the keepers of the clubhouse and the fishermen. It was nowhere very abundant, but probably occurred much more plentifully than our observations would tend to indicate, as those parts which seem to be favorable for its home were the least worked by our party.

Breeding Notes: On July 25 a female accompanied by three young, about half grown, was found in a clearing on a small rock ridge near Benson Brook (II, 1). Mr. Kneutson of Park Place reported July 20, that the grouse nested regularly at his clearing (IV, 5) and that several broods of young had recently been seen there. He also said that during the previous fall he had found them very plentiful and tame at the clearing at McCargoe Cove (II, 4). The Malone boys at Menagerie Light-House reported these birds to be quite common breeders at the clearing when the old town stood near the head of Siskowit Bay.

Miscellaneous Notes: A Myrtle Warbler's nest was found July 7 near the head of Tonkin Bay (IV, 7), lined with feathers of the Sharp-tailed Grouse and Canada Jay. An adult bird was secured August 5 in a burnt clearing near the outlet of Siskowit Lake (V, 9). The crop contained fifteen fresh June-berries and three grasshoppers. On August 13, three adults were seen in the large clearing near the head of Siskowit Bay (VIII, '04). This was once a prosperous mining town but has been deserted since about 1879. A forest fire swept away nearly all the buildings, and since that time a second growth of birch, alder and low brush has covered a large part of it. But many acres are still bare or overgrown with long grass, principally timothy. It was in this clearing that the birds found the most favorable conditions, and were therefore more abundant here than at the other stations. An adult female, about half moulted, was taken here on September 16. Its crop contained seeds and berries with portions of grasshoppers and other insects. The birds as a rule were very wary, and when approached either took wing or ran swiftly through the long grass. Their flight was swift and direct, accompanied by a whirring noise as they arose. During the fall they make local migrations and are reported to visit the clearings of Washington Harbor in quite considerable numbers. One was thought to have been seen here during the latter part of August by Michael Hollinger, a hired man at the Club-house.

17. *Circus hudsonius* (331). Marsh Hawk.

Range: North America in general. Breeds throughout its North American range.

Stations: Rock Harbor, Tamarack and Spruce Swamp, II, 2, 5. Washington Harbor, I '04.

Resident: July 13 to September 12.

On July 13 one of these birds was observed in a tamarack swamp at the end of the island. At Washington Harbor a female was seen flying over the clearing August 6, and again a female was found September 1 in a tamarack swamp on Washington Island.

Two old males were seen together several times on September 8 and again on the 12th in the trees bordering the first clearing, chasing small birds, probably Savanna Sparrows.

18. *Accipiter velox* (332). Sharp-shinned Hawk.

Range: North America in general. Breeds south to Panama through-out its North American range.

Stations: Spruce and Balsam Forest, I, 2-3; Forest, V, 4.
Washington Harbor, I '04 (clearing); Forest, II '04; Clearing and Forest, X '04.

Resident: July 26.

Migration: Began about the first of August, continuing throughout our stay.

The Sharp-shinned Hawk was first seen July 26 at the western end of Rock Harbor. Only one specimen, a fine male, was found at Siskowit August 15, but at Washington Harbor it was rather common the first of August, and so increased in numbers that during September it became even more abundant than the Sparrow Hawk.

The Sharp-shinned Hawk, more than any of the other raptorial birds, timed their migration to that of the warblers and sparrows upon which they preyed. During migration they increased gradually from day to day, those which came in from the north remaining with those already here instead of passing on to the south, probably because of the very favorable feeding grounds offered by the clearings.

19. *Accipiter cooperi* (333). Cooper's Hawk.

Range: North America from southern British America south to southern Mexico. Breeds throughout its range.

Stations: Rock Harbor, II, 2; Washington Harbor, I '04.

Resident: July 18 to September 12.

This was one of the rarest hawks on the island although food was very abundant. It might be that the clearings were not extensive enough. One was seen at Rock

Harbor (I, 2) July 18. Also at Washington on August 24, 29, 31 and September 12. On this last date several came to the first clearing in search of small birds, many of which they caught in the burned area where Savanna and Lincoln Sparrows were quite abundant.

20. *Accipiter atricapillus* (334). American Goshawk,

Range: Northern and Eastern North America, south in winter to the middle states and southern Rocky Mountain region; casually west to Oregon. Breeding range restricted to the Canadian towns of the United States and northward.

Stations: Rock Harbor beach, I, 1, 4.

Breeding: Young seen and secured on July 26, 1905.

This rare hawk was seen but twice, once on a tree at the edge of the beach (I, 1) and again in the birch and spruce forest near the tamarack swamp (I, 4). This latter bird was secured and proved to be a young male. Professor W. B. Barrows, in a recent letter to the writer, gives this bird in Michigan as a "winter visitor," "irregular and no nesting data." The specimen secured was probably raised on the island, as July 26, the date when taken, is very early, for the migration of hawks especially for the immature birds, even in this northern region. Although a few Sparrow and Sharp-Shinned had already appeared at Washington Harbor at this date, they were nearly all old birds, and I think had simply gathered there from the surrounding territory. From all observations made, it seems evident that the young of the hawks do not migrate until some time later; therefore it seems probable that this immature male was bred on the island.

21. *Buteo borealis* (337). Red-tailed Hawk.

Range: Eastern North America, west to the Great Plains, north to about 60°, south to eastern Mexico. Breeds throughout its range, except possibly the extreme southern portion.

Stations: Rock Harbor, II, 1.

Resident: July 14.

The Red-tailed Hawk was only observed once during the two seasons spent on the island. This specimen was seen flying over a small clearing (II, 1) at Rock Harbor on July 14.

22. *Buteo lineatus* (339). Red-shouldered Hawk.

Range: Eastern North America to Manitoba and Nova Scotia; west to Texas and the Plains; south to the Gulf states and Mexico. Breeds throughout its range.

Stations: Rock Harbor, IV, 1.

Resident: July 20.

Like the Red-tailed, this hawk proved to be very rare, the only record being that of July 20 when one was seen pursuing a pair of Bald Eagles near the head of Tobin Harbor.

23. *Buteo platypterus* (343). Broad-winged Hawk.

Range: Eastern North America, from New Brunswick and the Saskatchewan region to Texas and Mexico, and thence southward to northern South America and the West Indies. Breeds throughout its United States range.

Stations: Washington Harbor, I, ‘04 (clearing), X, ‘04.

Migration: August 30, September 5 and 12.

This hawk was rare on the island and was only observed as a migrant. A single specimen was seen at the camp clearing (I, ‘04) on August

30 and another on September 5 at Washington Island (X, '04). Several were found September 12 accompanying the large bird wave. They were exceedingly shy and there might have been many present during the large bird waves, which, owing to this trait, were not identified.

24. *Haliaëtus leucocephalus* (352). Bald Eagle.

Range: North America at large, south to Mexico, northwest through the Aleutian Islands to Kamchatka. Breeds locally throughout its range.

Note. "The birds from Alaska and much of British America are considerably larger than those from farther south, and on this account have been separated as a distinct race (*Haliaeetus leucocephalus alascanus* Townsend)." Thus this new subspecies occurring in northern North America makes the old name of the Bald Eagle (*Haliaeetus leucocephalus*) apply simply to the southern form. Without doubt the ones seen here are referable to the southern form.

Stations: Rock Harbor, III, 2; Tamarack Swamp, II, 2; Tobin Harbor, IV, 7.
Siskowit Lake, V, 4.
Washington Harbor, X, '04; along Washington river, II, '04.

Breeding: July 20 two young still in the nest. Juily 24 an immature bird was seen at II, 2 and another at Siskowit Lake August 5. On August 8 a nest with one young was seen near Siskowit Lake.

This species was rather common when we consider how few large birds of prey are usually found in a limited district. They were seen at Bock Harbor, Siskowit Bay and Washington Harbor; only a lone male was seen at the latter place, however, and probably none bred in the vicinity.

Breeding Notes: On the morning of July 20 when near the head of Tobin Harbor (IV, 7) a large female flew out over the boat scolding and snapping her bill, as though, a nest were near. A Pigeon. Hawk soon attacked her, the eagle turning completely over in its efforts to strike its tormentor. The male shortly made his appearance, and a, little further on the nest was discovered in a small ravine. It was situated in a, tall poplar tree about sixty feet from, the ground. The nest itself was very large, about five or six feet across the top and six „ or seven

feet deep, and had probably been, used for several years, the additions made each year soon making it quite bulky. It contained two young, one of which flew from the nest when approached. An immature bird was seen in a tamarack swamp (II, 2) near McCargoe Oove on July 24. On August 5 another young bird was seen at Siskowit Lake (V, 9) and on August 8 a nest was found about 125 yards north of the same lake in a small burning. It was situated in a dead Norway pine about sixty feet from the ground and was composed of sticks, making a mass at least four feet across. One young was in the nest. As the tree was approached the old birds circled overhead snapping their beaks, but did not dare to approach very closely. The immature specimen was procured and proved to* be nearly feathered and about as large as the adults.

At Washington Harbor an old white-headed male was a frequent visitor, a dead limb of a giant white pine tree which stood near the shore being its favorite perch.

25. Falco Golimiba-rius (357). Pigeon Hawk.

Range: The whole of North America south to the West Indies and South America. Breeds chiefly north of the United States.

Stations: Trail to Siskowit Lake, V, 4.

Washington Harbor, clearing, I, '04.

Resident: July 20.

Migrant: August 5 to September 16.

The little Pigeon Hawk was rather rare here, but became more common during the fall migration. On July 20 one wras seen near the head of Tobin Harbor pursuing a Bald Eagle. It was seen several times annoying these great birds at Rock Harbor and Siskowit Bay.

Breeding Notes: A young male was taken August 6 near our camp at Siskowit. Its cry closely resembled that of a Flicker.

I saw this species at Washington Harbor on August 5, 6, and 7 and again on the 23rd. After that it was occasionally seen, usually along the border of the road and clearings, until September 16, when the last specimen was taken. The only time when they occurred in appreciable numbers was during the large wave of September 12. At this time flocks of 6 or 8 were quite common and must have caused considerable damage to the warblers and sparrows on which they seemed to be feeding entirely.

Like the other small hawks, they preferred the border of clearings but were not as often seen far away from the forest as were the Sharp-shinned and Sparrow Hawks. Places where the forest had been cleared away and had not yet grown up to alders and birches, seemed to be the favorite haunt, but some were found in the heavy balsam forest where the other hawks just spoken of rarely ventured.

26. *Falco sparverius* (360). American Sparrow Hawk,

Range: North America east of the Rocky Mountains, and from Great Slave Lake south to Northern South America.

Stations: Spruce and Balsam Forest, I, 2-3. Partial clearing, I, 1.
Clearing along Benson Brook, II, 1.
Rock Ridge Clearing, II, 3. Forest, V, 4.
Washington Harbor clearing, I, '04, II, ‘04, X, '04.

Breeding: No nests were found but immature specimens were seen throughout July, August and September.

Migration: About August 1 until after September 21.

The Sparrow Hawk was not very common at Rock Harbor and was not often seen at Siskowit Bay. But at Washington Harbor they were very abundant and during the first part of the season considerably outnumbered all other species of raptores. They frequented the clearings, feasting on the swarms of grasshoppers which everywhere infested the open. The stumps at the edge of the first clearing were fairly covered with the legs and wings of these insects which had been pulled off before the bird would swallow them.

27. *Pandion haliaetus carolinensis* (364). American Osprey.

Range: North America from Hudson Bay and Alaska, south to the West Indies and northern South America. Breeds throughout its North American range.

Stations: Rock Harbor, I, 1. Siskowit Lake, V, 6. Washington Harbor, X, ‘04.

Resident: Observed from July 5 to September 21.

These birds probably breed on the island, although no nests or young birds were found. They were often seen soaring over Rock Harbor in search of food, dropping into the water to catch a fish which would be taken to some near by land, the bird soon returning and repeating the act.

At Siskowit Bay two Ospreys were seen presumably catching herring, on August 2. These small fish often swam near the surface and were caught by the Herring Gulls as well as by the Ospreys, Loons and Kingfishers. During the time observations were made at Washington Harbor in 1905, only two individuals were seen, both at Washington Island. Several were observed at the upper end of the Harbor during the previous year.

28. *Cryptoglaux acadica* (372). Saw-whet Owl.

Range: North America at large, breeding from the Middle States northward, and in mountainous regions of the West southward into Mexico.

Stations: Washington Harbor, X, ‘04. In forest near Washington river, II, ‘04.

Breeding: Young in first plumage August 30.

This little owl may have been much more abundant on the island than our records would seem to indicate, its diminutive size and nocturnal habits easily permitting it to escape observation. The first record we have for the island was the capture of an adult bird on July 24 by two fishermen of Washington Harbor. The owl had evidently been lost in the fog as it settled on the fishing tug when about 4 miles out in the lake.

Breeding Notes: The other record was of a juvenile male taken in the balsam forest at this harbor. This specimen was sitting in an alder bush about two feet from the ground near the river. It possessed the beautiful brown plumage of the first moult and was undoubtedly bred near by. When dissected, a young deer mouse was found in the crop. For several nights past deer mice caught in exposed traps set near this place had been pulled out and it is possible that it was the work of this owl or its parents.

29. *Asio magellanicus occidentalis* (375). Great Horned Owl.

Range: Western United States, from Minnesota and Kansas to Nevada, southeastern Oregon, Utah, and Montana; south in winter to Iowa.

Stations: Washington Harbor, clearing, I, '04.

Resident: Throughout the year.

Breeding Notes: Three young were taken August 26, 1904 at the second clearing, Washington Harbor. These were the youngest specimens found and still possessed a considerable amount of the first downy plumage. This year (1905) the owls were observed practically throughout our stay at the Harbor (August 18 to September 16). These were mostly adults, although a few young were seen which were nearly full grown. The thick balsam forest was their usual hiding place by day, and at night they frequented the borders of the road and clearings where they could secure their prey. Two of the specimens procured this season were found sitting on the roofs of the deserted houses at Wendigo (in the third clearing). Here the numerous White-footed Mice and Northern Hares furnished them with an easily procured food, and small birds were therefore probably seldom molested. Often the remains of hares were found along the road, showing where one of these birds had feasted. Of course many hares were killed by the lynx, but as a rule these animals carried their victims into the brush to devour them while the owls usually ate theirs in the open. Then too the lynx rarely ate the intestines while the owls nearly always did. These birds appeared at the clearings just at dusk, and sometimes in rainy weather they were seen along the road even at midday. Their actions when observed just after dusk reminded one of the love antics of the Flicker. Sitting on the end of the ridgepoll of a deserted house, they would bow and turn one way and then the other, bowing at every movement until their breast nearly touched the roof. They showed little fear at this time of night, and in fact appeared curious at our approach.

The Great Horned Owl was not seen at any other station by our party but was reported at Siskowit Bay by the Malone boys. They are reported to be much more common in winter than in summer and several pairs of wings were seen which had been taken at this season.

30. *Nyctea nyctea* (376). Snowy Owl.

Range: Northern portions of the northern hemisphere. In North America, breeding wholly north of the United States; in winter migrating south to the Middle States, straggling to South Carolina, Texas, California and Bermuda.

The Snowy Owl is a regular winter resident on the island and several were shot there during the winter of 1904. None were seen by our party, but the descriptions given by the club-house keepers leave no doubt of their identity.

31. *Surnia ulula caparoch* (377a). American Hawk Owl.

Range: Arctic America, breeding from Newfoundland northward and migrating in winter to the northern border of the United States. Occasional in England.

Stations: Old burning at Siskowit Bay, V, 9.

Breeding: Young August 4.

We have only one record of the Hawk Owl for the island, but this breeding record is one of the first authentic records for the United States. About 9 o'clock in the morning of August 4 an adult Hawk Owl was seen sitting on the top of a tall dead tree in a small burning (V, 9) near the outlet to Siskowit Lake. The sun was shining brightly, but appeared not to effect the Hawk Owl as it would the common species. A short distance away a young bird still in the downy plumage was found. When first seen it was sitting on a dead stub like a Sparrow Hawk, but soon went to another stub, uttering a shrill cry as it flew. The young bird was taken, and is now in the museum collection.

32. *Coccyzus erythrophthalmus* (388). Black-billed Cuckoo.

Range: Eastern North America, west to the Rocky Mountains, breeding north to Labrador, Manitoba, and eastern Assiniboia; south in winter to the West Indies and the valley of the Amazon. Accidental in the British Islands and Italy.

Stations: Partial clearing, II, 1.

It will be seen that Isle Royale lies very near the northern limit of the cuckoo's range. It was accordingly quite rare here, the only records being those of July 6, 7 and 9 at Benson Brook (II, 1).

33. *Ceryle alcyon* (390). Belted Kingfisher.

Range: North America from the Arctic Ocean south to Panama and the West Indies. Breeds from the southern border of the United States northward.

Stations: Harbor, III, 2. Bulrush zone and Delta, VII, 3.
Siskowit Bay, V, 1. Siskowit Lake, V, 6.
Washington Harbor, X, '04. Washington River, II, '04.

Breeding: An occupied nesting hole was found July 27 and another on the 28th. Also an old one August 6.

Migration: The last Kingfisher was seen September 16.

Throughout the island the Belted Kingfisher was a rather common summer resident, preferring the banks of streams and the shores of the lakes and harbors, although it was occasionally found in the cedar and tamarack swamps.

Breeding Notes: Near Light-house Peninsula (II, 1) a nest of this species was found July 27. It was dug in a sandy bank and probably contained young as the adult birds were frequently seen entering it. Another nest was found on the 28th near the trail to Sumner Lake (III, 4). At Washington Harbor, on August 6, a nest was seen which the club-house keeper said contained 6 young the latter part of June or the first of July. The hole had been dug in a sandy bank, *Fig. 17*, about 5 feet high on the road to the second clearing and quite near the river.

The Kingfishers were very common along Washington River, and probably there were more seen here than at all the other localities on the island put together. They were usually found sitting upon a leafless birch limb overhanging the water, from which position they often sallied out to snatch up a fish or chase a companion. On the open lake the birds were commonly seen hovering about 30 or 40 feet above the water until a fish was located, when, closing the wings, they would make a sudden perpendicular drop, often completely disappearing from sight. On the Washington River they fed quite extensively upon brook trout.

34. *Dryobates villosus leucomelas* (393a). Northern Hairy Woodpecker.

Range: Northern North America south to about the northern border of the United States.

Stations: Tamarack and Arbor Vitae Swamps, I, 4.
Balsam Forest I, 3.
Along Benson Brook, II, 1.
Forest, V, 4.
Washington Harbor, clearing and burned area, I, '04.

Resident: Observed from July 12 to September 12. This Woodpecker is rather rare throughout the island. On July 12 one was procured in the balsam forest back of the Light-house (I, 3), and on the 13th one was taken in the birches along Benson Brook. They were found in nearly every kind of environment from the cedar and tamarack swamps, balsam and spruce forest, and open birch woods to the camp clearings and old burnings. They were rarely seen at Siskowit and seldom at Washington Harbor. Probably nearly all are resident throughout the year although none were seen after September 12.

35. *Dryobates pubescens medianus* (394c). Downy Woodpecker.

Range. Northern and eastern North America west to British Columbia and the eastern edge of the Plains; south to the Gulf of Mexico.

Stations: Siskowit Bay; Forest, V, 4.
Washington Harbor, clearing and burned area, I '04.

Resident: July 22 to September 17.

The first of this species was seen July 22 and was met with every now and then until September 17, although like the Hairy, it probably stays all winter. It was found in all locations, but preferred burnings and the more open birch woods.

36. *Picoides arcticus* (400). Arctic Three-toed Woodpecker.

Range: Northern North America from the Arctic regions south to the northern United States (New England, New York, Michigan, Minnesota and Idaho), and in the Sierra Nevadas to Lake Tahoe.

Station: Washington Harbor, clearing along road and burned area, 1, '04.

The Arctic Three-toed Woodpecker was observed only at Washington Harbor, where it was very rare, only two specimens being found, September 7 and 12.

37. *Sphyrapicus varius* (402). Yellow-bellied Sapsucker.

Range: Eastern North America north to about Latitude 63° 30' (north of Fort Simpson), breeding from Massachusetts northward; south in winter to the West Indies, Mexico and Costa Rica.

Stations: Forest, V, 4. Washington Harbor, balsams at edge of clearing, I, '04.

Migration: September 13.

A single specimen was found September 13 among the balsams at the edge of the road (I, '04). This was a young female and probably was raised on the island.

38. *Ceophloeus pileatus abieticola* (405a). Northern Pileated Woodpecker.

Range: Formerly the heavily wooded region of North America south of about Latitude 63°, except in the southern Rocky Mountains; now rare or extirpated in the more thickly settled parts of the eastern states.

Stations: Siskowit Bay, Forest, V, 4.

Washington Harbor, edge of clearing, I, '04, also dense forest.

Resident: Throughout the year. First seen Aug. 3; last on Sept. 18.

None of these birds were observed at Rock Harbor, but evidences of their work were numerous. Several were seen at Siskowit Bay and one near Siskowit Lake trail (V, 7). On August 8 two were heard near our camp, and by clapping the hands in imitation of their hammering they were called within fifty or sixty feet of us, when one was procured. Another was taken on August 8 near camp (V, 3).

They were very often heard at Washington Harbor and were seen quite often, usually in the morning, but in rainy weather their call could be heard all day. Several stubs containing nesting cavities were found and some of the birds procured were young of the year. The woodpeckers preferred the forest where large dead or dying trees were to be found, usually in the vicinity of clearings, the large birches usually being selected when feeding, possibly because they decayed much more rapidly and contained more larvae than the balsams arid spruce. Unless called, the birds were very shy and difficult of approach, although when busily engaged in digging into a tree they would not leave until nearly forced to for the sake of safety. Nearly all the smaller woodpeckers protect themselves by dodging around the trees, but the Pileated, possibly because of its large size, rarely attempts this, but flies away with a rapid, undulatory motion. When in full flight the white in the wings is very striking and seems to catch the attention when otherwise the bird might pass by unnoticed in the dark woods.

39. *Colaptes auratus luteus* (412). Northern Flicker.

Range: Northern and. eastern North America west to the eastern slope of the Rocky Mountains and. Alaska. Occasional on the Pacific slope from California northward.

Stations: Rock Harbor; Spruce and Balsam Forest, I, 2-3. Tamarack and Arbor Vitae swamps, 1, 4.
Partial Clearing, I, 1; along Benson Brook, II, 1, II, 4.
Siskowit Bay, Forest V, 4; Old Burning, V, 9.
Washington Harbor, border of forest and open clearing, I, ‘04.

Breeding: A young of the year was taken July 31.

While not a rare bird, it was not very abundant in the east end of the island, undoubtedly owing to the scarcity of suitable timber to nest in. Several individuals were seen, the first one on July 6 at the edge of the balsams along the clearing from the light-house to the fisherman's cottages at Rock Harbor (I, 3). They were occasionally noted in the cedar swamp at the end of Tonkin Bay (I, 4), and also in the birch forests near McCargoe Cove (II, 4). A young of the year was taken July 31 in the balsam-spruce forest (I, 3).

They were rather scarce at Siskowit Bay probably because the timber was mostly green balsam and spruce, as this bird prefers clearings and burned areas where it can get larvae from decaying trees, or where ant hills are abundant. The most favorable conditions existed at Washington Harbor where large clearings afforded the much coveted ants as well as dead trees. At this point, therefore, the birds were very common and continued to increase in number throughout our stay. Many of these birds were found dead during September but I was unable to determine the cause; it might possibly have been due to some parasite. The keeper at the club-house told me that the birds continued to increase through October and that towards the end of the season hundreds died, but he did not know the cause of their death. The Flicker probably gathers at the southwestern end from all over the island and possibly many come from the north shore, remaining here where such favorable conditions exist, until cold weather necessitates their journey onward.

40. *Antrostomus vociferus*. (417). Whip-poor-will.

Range: Eastern North America to the Plains, and from Latitude 50° south to Guatemala.

Stations: Border of clearing, II, 1.

One of these birds was heard calling in the edge of the clearings along Benson Brook.

41. *Chordeiles virginianus* (420). Night Hawk.

Range: Northern and eastern North America, west to the great plains and central British Columbia, and from Labrador south through tropical America to the Argentine Republic.

Stations: Rock Harbor, Light-house peninsula, I.
Siskowit Bay, V, 1.
Washington Harbor, clearing, I, ‘04.

Resident: July 6 to September 1.

First seen July 6 as it was passing over the Rock Harbor light-house. It appeared to be rare in this locality. On August 10, 11, 14, it was also observed at Siskowit, but was rare here also. At Washington Harbor it was very common, feeding either singly or in pairs or small flocks in all the clearings. Much of the food was taken on the wing, but grasshoppers were greatly relished, and these the birds pursued on the ground. There is little doubt but that these birds breed here in the clearings, but owing to the lateness of the season, no nests were found. I see no reason why these birds should not be found more plentiful at the other localities unless the clearings are hardly extensive enough to furnish the conditions best suited to them. Insect food seemed abundant everywhere on the island, so it seems that clearings were what was lacking. The birds commenced their migration towards night, and a little after sunset large flocks would be seen drifting slowly toward the south, catching their evening meal while on the way.

42. *Chaetura pelagica* (423). Chimney Swift.

Range.—Eastern North America, north to Labrador and the fur countries, west to the Plains, and passing south of the United States, in winter, at least to Jalapa, Mexico and Cozumul Island.

Stations: Rock Harbor, I. Washington Harbor clearings, I, '04.

Resident: July 8 to August 19.

These birds were only occasionally seen at Rock Harbor, commencing with July 8. On August 1 it was found at Siskowit and the lighthouse keeper on Menagerie Island said that two pairs of these swifts nested in the chimney of the light-house, but he thought they had left about the first of August. At Washington Harbor, on August 19 a pair of these birds was observed circling over the clearings and nearby river, just at sunset. These were the only ones observed here either year.

Isle Royale being wooded for the most part with conifers and having very few buildings upon it, the cavities used by chimney swifts for nesting places are of course almost wanting. Conifers rarely offer any cavities except where the woodpeckers have dug out their burrows in the dead trunks so common in old burnings. Perhaps this is the reason why more were seen at Rock Harbor than at the other localities as at this station there were extensive burnings. Probably as Isle Royale becomes more settled and chimneys and other nesting places become more plentiful the Chimney Swift will become abundant, as it already is in some of the towns on the northern shore of Lake Superior.

43. *Trochilus colubris* (428). Ruby-throated Humingbird.

Range: Eastern North America, to the Plains, north to the fur countries, breeding from Florida to Labrador, and south, in winter, to Cuba, Mexico and Veragua.

Stations: Menagerie Island, V, 10. Washington Harbor clearing, I, '04.

Resident: August 17 to 22.

A pair of these birds were seen on August 17 hovering over some flowers on Menagerie Island. They were said to be seen here nearly every day and probably bred near.

A single male was seen on several occasions during August and September in the clearing at Washington Harbor. The cultivated nasturtiums and some wild flowers furnished it food. More of this species would probably live on the island if it were lumbered, thus making more extensive clearings where wild flowers could grow.

44. *Tyrannus tyrannus* (444). Kingbird.

Range: North America north to New Brunswick and Manitoba; rare west of the Rocky Mountains; winters in Central and South America.

Station: Washington Harbor, I, '04.

A single individual came to the clearing on the afternoon of September 4.

45. *Sayornis phoebe* (456). Phoebe.

Range: Eastern North America, west to eastern Colorado and western Texas, and from the British Provinces south to eastern Mexico and Cuba, wintering from the south Atlantic and Gulf States southward. Breeds from South Carolina northward.

Station: Washington Harbor, I, 704.

Migration: August to September 12.

The Phoebe was quite common throughout August and the first part of September leaving on the twentieth of the latter month. It was probably migrating, as I believe none nested at this end of the island. The edges of the clearings and along the road were the favorite places, and especially those parts where there were small burnings, the leafless bushes making ideal perches from which they would sally forth in true flycatcher fashion. Both young and adults were seen, sometimes in little groups of three or four.

46. *Nuttallornis borealis* (459). Olive-sided Flycatcher.

Range: North America, breeding from the northern and the higher mountainous parts of the United States northward to British Columbia, and the Saskatchewan River. Accidental on the Lower Yukon and in Greenland. In winter, south to Central America, Columbia and Peru.

Stations: Rock Harbor, alder zone, I, 1. Tamarack and spruce swamps, II, 2, 5, IV, 7. Siskowit Bay, old burning, V, 9, V, 11. Washington Harbor, X, '04.

Resident: July 17 to September 3.

A rather common summer resident at Rock Harbor and Siskowit Bay and probably at Washington Harbor, although only one was seen there this year. In 1904, however, they were fairly common. On July 20, at the head of Tobin Harbor, one of these birds was seen, which probably had a nest close by, as it flitted from tree to tree, scolding and showing other signs of distress, which usually indicates a nest or young in the vicinity.

A pair was taken July 17 in a tamarack swamp (II, 2). They were quite common in open tamarack, spruce and cedar swamps, usually perching on top of the highest dead trees, and uttering at short intervals a loud, harsh cry. After a short flight for an insect, they generally returned to the same perch. At Siskowit one was taken August 11 in a tamarack-spruce swamp (V, 11) where they were fairly abundant. In nearly every swamp visited two or three pairs of these birds were found, their harsh cry attracting instant attention. As a rule they were

found in pairs with sometimes a third, perhaps a young one. The only record for Washington Harbor was one observed September 3 on Washington Island (X, '04).

47. *Empidonax flavicentris* (463). Yellow-bellied Flycatcher.

Range: Eastern North America west to the Plains, and from southern Labrador south through the eastern Mexico to Panama, breeding from the Northern states northward.

Stations: Rock Harbor, tamarack and arbor vitae swamps, I, 4, II, 2.
Tamarack and Spruce forest, II, 2, 5.
Washington Harbor, near river, II, 04.

Resident: July 14.

Migrant: September 13.

A pair of this species was seen in a tamarack swamp (II, 2) on July 14, and an adult female taken. Another pair was found in a cedar swamp (I, 4) July 26. These birds were sitting on top of high birch trees and one uttered a note which resembled that of the Wood Pewee. None were noted at Siskowit and only one at Washington Harbor. On the morning of September 13 an adult male was found dead near the river. It did not lie there the evening before, so probably died while passing over during the night. Many other species were found dead on this same morning, the day after the great wave, but no outward indications were evident which would point to the cause of death. It might be noted here that the temperature was a number of degrees below freezing. See discussion under head of "Perils of Migration."

48. *Empidonax traillii alnorum* (466a). Alder Flycatcher.

Range: Eastern North America from the Maritime Provinces and New England westward at least to northern Michigan, etc., breeding from the southern edge of the Canadian Fauna northward; in winter south to Central America.

Stations: Rock Harbor, alders, II, 1.
Washington Harbor, alders, II, '04.

The Alder Flycatcher appears to be very rare from our data, but owing to its small size and to the fact that much of its time is spent in thick alder bushes or the tops of the forest trees, it seems probable that it is more common than it appeared to be. Small Flycatchers were often seen in these situations, but could not be procured and without doubt many of these were alders. A single specimen was procured August 26 in a clump of tag alders near Washington River (II, '04).

49. *Empidonax minimus* (467). Least Flycatcher.

Range: Chiefly eastern North America, west to eastern Colorado and central Montana, south in winter to Central America. Breeds from the Northern Stales northward.

Stations: Washington Harbor, I, '04, II, '04.

Migration: August 20 to September 14.

The Least Flycatcher was noted only in migration, but some of the immature specimens were so young as to warrant the supposition that they breed on the island. The first were seen on August 20, and were abundant the rest of August and during the first large waves of September. They preferred the dead brush of the burning and the low open alders and birches along the road and clearings.

50. *Otocoris alpestris* (474). Horned Lark.

Range: Northeastern North America, Greenland, and northern parts of the Old World; in winter south in eastern United States to the Carolinas, Illinois, etc.

Stations: Washington Harbor, clearing, I, '04.

Migration: September 13 to 21.

Large flocks of Horned Larks appeared at the first clearing early in the morning of September 13. The birds continued to increase in number for several days, and were found almost entirely at the first clearing, which was considerably the largest. They were eminently birds of the open, not even being found in the most open forest. They showed little preference between the plowed ground and the grassy meadow, and fed. on insects as well as seeds. Little fear was shown, and when shot at upon the ground they often rose up in a whirling flock and after circling about the clearing would return to the same spot. It was a common occurrence to see them rise suddenly, seemingly without cause, and fly rapidly away only to wheel about and return to their old feeding grounds after having gone a quarter of a mile or so. Occasionally American Pipits were seen in company with them, but usually because the feeding grounds of the two flocks overlapped. The first flocks numbered from 30 to 50, but soon they grew to two or three hundred, the birds being very gregarious at this time of the year and seldom found alone. In a good series taken at random from different flocks the females seemed to predominate. The birds were all highly colored, especially the males.

51. *Cyanocitta cristata* (477). Blue Jay.

Range: Eastern North America to the Plains, and from the Fur countries south to Florida and eastern Texas.

Stations: Rock Harbor, clearing along Benson Brook, II, 1. Siskowit Bay, Forest, V, 4; clearings, V, 1. II, 2. II, 3. Ill, 5. Washington Harbor, clearing, I, '04; Forest, II, '04.

Resident: July 13 to September 20.

Without doubt many of the Blue Jays winter on the island and none were seen which showed any indications of even a local migration, either from one part of the island to another or to the mainland. They were fairly common in the swamps and along the rock ridges at Rock Harbor. On July 13 several were seen in a tamarack swamp (II, 2) and a flock numbering six or seven were found along a rock ridge (II, 3), feeding in the mountain alders along the edge of the rock clearing. They were also noted at Sumner Lake on July 26. At Siskowit they were only

occasionally met with, one specimen being taken on the trail to Siskowit Lake (V, 4) August 15. At Washington Harbor they were very common and were recorded nearly every day of our stay. The Blue Jays preferred the dry open birch forest and clearings or old burnings. Occasionally they were found in the swamps and also in the balsam forest along the river. It was, however, a bird of wide distribution and was liable to occur in any habitat.

52. *Perisoreus canadensis* (484). Canada Jay.

Range: Northern New York, northern New England, and northern Michigan, northward to Arctic America.

Stations: Rock Harbor, tamarack and Arbor Vitae Swamps, I, 4; Partial Clearing, II, 1.
Clearing along Benson Brook, II, 1.; Tamarack and Spruce Swamp, II, 2, 5.
Siskowit Bay, Forest, V, 4.
Washington Harbor, clearing, I, '04; Forest II, '04, III, '04.

Breeding: July 7. Adult with young.

The Canada Jay is a common resident throughout the year, but appeared to be less abundant at Rock Harbor than at the other localities visited. It was found in nearly every form of habitat, but was most common about clearings and especially those where scraps could be picked up from camps. In the forest they showed a decided preference for coniferous trees and even when hunting for food about the camps they chose the balsams rather than birch or alder.

Breeding Notes: A female with one young was seen on July 7 near the Light-house at Rock Harbor, and on July 25 an old bird was found with two young. Occasionally both parents would be found together accompanied by one or two young.

53. *Corvus corax principalis* (486a). Northern Raven.

Range: Northern North America, south to British Columbia, northern Michigan, New Brunswick, Maine, New Jersey, North Carolina, etc.

Stations: Rock Harbor, Tamarack and Arbor Vitae Swamps, I, 4; Clearing I, 1.
Siskowit Bay, trail to Siskowit Lake, V, 4. VII, '04.
Washington Harbor, clearing, I, '04.

Breeding: See below.

The Northern Raven was nowhere common but seemed to occur in limited numbers all over the island. Three were seen in a cedar swamp (I, 4) on July 29, and a skeleton was found previous to this on the rocks near the light-house (I, 1). They were occasionally seen at Siskowit during August, usually flying overhead or at some natural clearing near the beach. At Washington Harbor they were only visitors, coming every now and then to the clearings where they fed on the grasshoppers which were so abundant. They were very wary.

Breeding Notes: Earle Kneutson of "Park Place" (IV, 5) said this species nested in the vicinity. While exploring the ruins of the deserted town (VII, '04) near the head of Siskowit Bay on September 10, a nest of the Northern Raven was found in the old stamp mill. It was placed in the small hollow formerly occupied by the metal plate upon which the head of the stamp fell. The side walls of the stamp mill are broken down in places so that the entrance to the interior was simple. The nest was about four feet square and the deepest part about a foot deep, and was composed of sticks varying in size from a quarter inch to three quarters in diameter and a foot to three feet long. Several tail feathers of the Raven were found in different layers of the nest showing that in all probability the mass was the accumulation of several years of nest-building and repairing. Smaller feathers were scattered about the nest and floor. The lining consisted of small sticks and roots loosely laid together, but forming quite a compact mass in connection with the other material.

The floor of the building was strewn with pellets consisting principally of fishbones, skeletons of small mice, and some insect remains. Under some of the rafters this had accumulated to such an extent that the deposit was four or five inches in depth. In places it was weathered so badly that it appeared simply as a mass of brownish earth.

54. *Corvus brachyrhynchos* (488). American Crow.

Range: North America from the Fur Countries to the southern border of the United States. Locally distributed to the west.

Stations: Rock Harbor, Beach, I, 1; Spruce and Balsam Forest, I, 2-3; clearing along Benson Brook, II, 1; IV, 9; III, 3.
Washington Harbor, clearing, I, '04; Forest, VI, '04.

Resident: Throughout our stay.

The Crow was not common at any locality visited. It was occasionally met along the shore of Rock Harbor (I, 1) where it fed on the cleanings thrown out by the returning fishermen. Several were observed in the birch forest at the top of Greenstone Range (IV, 9) and also at the-Bulrush Zone and Delta at the western end of Rock Harbor (III, 3), but the natural and artificial clearings proved to be the most favorable for these birds throughout the island. They were quite rare at Siskowit Bay, but proved to be quite common at times at Washington Harbor. Here they resorted to the clearings and roads where they fed greedily upon the swarms of grasshoppers. No nests were found, but young of the year were more abundant than adults at Washington Harbor. The residents reported that these birds leave the island the last of October.

55. *Agelaius phoeniceus fortis* (498). Thick-billed Redwing.

Range: Breeding range, Mackenzie River, Athabasca, and other interior districts of British America. During migrations, the Great Plains, from eastern base of Rocky Mountains to Manitoba (Red River settlement), Iowa (Burlington, October), Indian Territory (Beaver Creek, November) western Illinois (Henderson County, Morgan County, March) northern Kentucky (Mason Co., December) and southward through more southern Rocky Mountains to Arizona (Fort Verdi, December, February; Big Chino Valley, March), and western Texas (El Paso, February).

Stations: Washington Harbor, clearing, I, '04; forest along river, II, '04.

Migration, August 19 to Sept. 20.

By all odds the most abundant black bird on the island. On July 14 a Red-winged Blackbird was seen in a marsh at Rock Harbor, but was not procured, so identification, where so slight a difference exists as between the species and subspecies, was impossible. It is my opinion that this was the common Redwing (*Agelaius phoeniceus phoeniceus*) and not the northern form. On August 19 large flocks of the latter form, came to the clearing at Washington Harbor (I, '04). On the day previous several specimens of *phoeniceus* were taken, but none were seen after this. The keeper at the club-house said none of these blackbirds had been seen before this date, and as we found none on any other part of the island (unless the one previously mentioned should have been *fortis*) it seems probable that this form does not breed on the island, and only appears here during the spring and fall migration. The people at the club-house reported that large numbers of Red-winged Blackbirds came to the island in the spring,

About fifty specimens in all were procured, which proved to be *fortis*. None were in the black plumage, and the scarlet shoulder patches were just showing through the pin feathers of those taken during August. A young male taken on September 16 was just about half moulted. The underparts, except down the breast bone, have black feathers edged with brown; the central line and feathers covering the abdomen are still unmoulted and are fuscous with whitish borders. The head, throat and nape also unmoulted, as are the first four primaries. The next five are new, and the remainder old. Nearly all the secondaries are new, while the tertiaries are still unchanged. Only the central tail feathers have been moulted. The specimen thus presents a mottled appearance, glossy black alternating with brownish fuscous, the cinnamon tipped secondaries and back feathers adding to the appearance. The epaulets are a rich orange-brown, a few, particularly at the bend of the wing, being tipped with black. The plumage of the entire series varied greatly, according to the sex, stage of moult, and also individual variation. Some, males and females, have a decided pinkish tinge to the throat while others have a rich yellow sometimes grading into orange. As a rule the first four primaries seem to be the last feathers on the body to moult. A few adults taken on August 20 have moulted entirely, but the majority, especially the young, had just started to moult at this date. Stomach examinations showed the food to consist largely of grasshoppers, which were very plentiful at the clearing. These birds were larger than the average male which, as a rule, was considerably larger than the female.

The birds usually came in flocks numbering from a dozen to fifty or more. They came to the first clearing quite regularly throughout August, usually frequenting the brushy area, but extending out into the grassy meadow in pursuit of the grasshoppers. When shot into, the remnants of the flock would often wheel several times around the gunner's head, allowing themselves to be fired at repeatedly before leaving. These birds migrated almost entirely by day and toward dusk were often seen preparing to roost in a alder thicket at the first clearing. That the birds actually remained there for the night was several times demonstrated when they were driven from their retreat long after night fall.

56. *Euphagus carolinus* (509). Rusty Blackbird.

Range: Eastern North America, west to Alaska and the Plains. Breeds from northern New England, Northern New York, and Northern Michigan northward. Accidental in lower California.

Stations: Washington Harbor, clearing and burned area, I '04.

Migration: September 15 on.

Large flocks of Rusty Grackles appeared at the clearings on September 15 and were abundant the rest of the time I remained on the island. Males and females were in about equal proportion, and while the sexes were often found together in the same flock, there appeared to be flocks composed wholly of one sex. Like so many of the other migrants, they were seldom found out of a clearing, where they crammed themselves full of grasshoppers. As a rule the birds were more wary than the Northern Redwing, and were difficult of approach when in the open, but when gathered into the brushy areas of the first clearing they probably felt more secure, as here I had no difficulty whatever in procuring specimens. The residents reported them abundant here during the spring migration.

57. *Quiscalus quiscula aeneus* (511b). Bronzed Grackle.

Range: From the Alleghanies and southern New England north to New Foundland and Great Slave Lake, wrest to the eastern base of the Rocky Mountains, and south to Louisiana and Texas. In migrations, the southeastern states, except Florida and the Atlantic coast district south of Virginia.

The Bronzed Grackle was not observed this year, and only one specimen was noted here in 1904. This one

was secured August 19 at the third clearing (I, '04), and not at Station II, as published in the report of last year.

58. *Pinicola enucleator* (515). Pine Grosbeak.

Range: Northern parts of the northern hemisphere, breeding in North America from northern New England, Quebec, and Rocky Mountains in Colorado, and about Lat. 37° in the Sierra Nevada; northward nearly to the limit of trees; south in winter irregularly into northeastern United States.

Stations: Siskowit Bay, Trail through Balsam-Birch forest, V, 4.

August 14, M'Creary found two Pine Grosbeaks in the Balsams (V, 4). These were the only birds observed, but the species is probably much more common and we simply did not chance to observe them. This is the more likely as the Grosbeaks make little noise and keep in the tops of the conifers. As the greater part of the forests on the island are so dense that the tops are practically shut off from sight to one below, the birds could easily pass unnoticed.

59. *Lanius ludovicianus migrans* (622a). Northern Loggerhead Shrike.

Range: Greater part of the United States east of the Great Plains, but very local in more eastern districts; breeding north to New Brunswick (York County), Maine (Bangor), New Hampshire (Hanover), Vermont (Mount Mansfield, etc.), northern New York (Lewis and St. Lawrence counties), Quebec (Montreal), Ontario (Hamilton; Kingston; Beaumans), Michigan, Wisconsin and Minnesota, and southward to Midland Virginia and western North Carolina, Kentucky (probably also Tennessee), and eastern Kansas; in winter southward to Mississippi, Louisiana and Texas (El Paso, February; Fort Clark, January; West Caranchua Creek, January; Washburn, August).

Stations: Washington Harbor, clearing, I, '04.

A single individual was seen at the Camp clearing (I, '04) on August 23.

60. *Carpodacus purpureus* (517). Purple Finch.

Range: Eastern North America from the Atlantic coast to the Plains. Breeds from the Middle States northward.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-3; Partial clearing, II, 1; Clearing near Benson Brook at II, 1. Siskowit Bay Forest, V, 4; old burning, V, 9. Washington Harbor, border of clearing, I '04; Forest, II, '04.

Resident: July 7-August 28.

The Purple Finch was rather uncommon all over the island. A fine male was taken on July 7 in the balsam and spruce forest (I, 3) at Rock Harbor and on July 24 a large flock was seen in the balsams just back of the light-house (I, 3). It was only observed a few times at Siskowit, but usually in the balsam forest. At Washington Harbor the only time it was observed was August 28. Although the bird was most abundant in the balsam-spruce forest, it also frequented old burnings, the borders of clearings and tamarack and cedar swamps.

61. *Loxia leucoptera* (522). White-winged Crossbill.

Range: Northern parts of North America, south into the United States in winter. Breeds from northern New England northward.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-3; Tamarack and Spruce Forest, II, 2, 5.

Resident: July 13 to the last of July.

The White-winged Crossbill was quite common at the upper end of Isle Royale, but was not observed at Washington Harbor this season, although it was observed several times there in 1904. At Rock Harbor they were usually found in the sphagnum bogs (II, 2, 5) and late in July were seen several times near the light-house feeding on the pine cones.

62. *Spinus pinus* (533). Pine Siskin.

Range: North America generally, breeding in the British Provinces, Rocky Mountains, Sierra Nevada, and high mountains of Arizona, south to Lower California and the mountains of Mexico to Orizaba. Also breeds sparingly in northeastern United States.

Stations: Rock Harbor. Spruce and Balsam Forest, I, 2-3; Partial clearing, II, 1. Washington Harbor, Forest, II, '04.

Resident: July 9-Septeniber 18.

The Pine Siskin was only occasionally recorded from the vicinity of Rock Harbor, and not at all from the other localities. On July 9 while rowing around the islands in Rock Harbor (I, 1) several of these birds were seen and heard singing as they fed among the balsams on the edge of the islands. They were also observed on July 13 in a tamarack swamp (II, 2) and were seen several times in the forest near Rock Harbor Light-house.

63. *Poœcetes gramineus* (540). Vesper Sparrow.

Range: Eastern North America to the Plains, from Nova Scotia and Ontario southward; breeds from Virginia, Kentucky and Missouri northward.

Stations: Washington Harbor, II, '04.

Migration: August 22.

An immature Vesper Sparrow, the only one seen, was secured on August 22 in a strip of brush on the banks of Washington River.

64. *Passerculus sandwichensis savanna* (542a). Savanna Sparrow.

Range: Eastern North America, breeding from the northern United States to Labrador and Hudson Bay Territory.

Stations: Washington Harbor, clearings and burned areas, I, ‘04.

Breeding: An immature specimen taken August 6.

Migration: August 31 on.

While at Washington Harbor the first part of August several Savanna Sparrows were seen and a young one barely out of the nest was secured on the 6th. They were frequenting the clearings, and the immature specimen procured was taken near one of the old houses at the first clearing. Upon our return to this locality on August 16 none were seen and they were absent until August 31, when a large wave of Savannas struck the island. For the remainder of my stay these sparrows were present, but the majority had passed on to the south, either slowly or with some of the other large waves. This species was very partial to the clearings and was especially abundant along the road where the very short grass did not interfere with their motions. The birds were quite tame and even entered the houses by the open doors and windows. During one day of the large wave a dozen or more were thus caught in the house I was living in, most of these entering my work room.

65. *Zonotrichia leucophrys* (554). White-crowned Sparrow.

Range: North America at large, breeding chiefly in the Rocky Mountains, the Sierra Nevada and northeast to Labrador. South in winter to the Valley of Mexico.

Stations: Washington Harbor, clearings and burned area, I, '04.

Migration: September 12 on.

This year the White-crowned Sparrow was much later in migration than in 1904, as none were seen until September 12 while the first date of the previous season was September 1. They were quite rare and were never seen in flocks of more than 5 or 6. The clearings, roadside, and old burnings were the favorite resort, but occasionally they were found busily scratching among the fallen leaves along the river.

66. *Zonotrichia albicollis* (558). White-throated Sparrow.

Range: Chiefly eastern North America, west to the Plains, north to Labrador and the Fur countries. Breeds from Montana, northern Wyoming, northern Michigan, northern New York, and northern New England northward, and winters from Massachusetts southward. Accidental in Utah, California, and Oregon.

Stations: Rock Harbor, natural rock clearings, 1, 2; Balsam-Spruce Forest, I, 3; Lake and Bay Beaches, I, 1; Jack Pine Ridge, I, 5; Sphagnum-spruce Bog, I, 6; Benson Brook and Ransom Clearing. II, 1; Tamarack Swamp, II, 2; Shore of Forbes Lake, II, 5; Rock Ridge Clearing, II, 3; Small Island, III, 1, Shore of Sumner Lake, III, 5. Siskowit Bay, Balsam-Birch forest, V, 4; Beach, V, 1; Outlet of Siskowit Lake, V, 9; Rock Clearing, V, 3; Clearing, VIII, '04.

Washington Harbor, Clearing and Burned area, I, '04; Along river II, ‘04. Tamarack Swamp, V, ’04.

Breeding: Young able to fly, July 7.

Migration: Last seen September 17.

The White-throated sparrow was very common throughout the Island, where it inhabited the open swamps and borders of rock clearings, although it was found in limited numbers in nearly every station examined. It can easily be considered one of the birds of general distribution on the island, chiefly frequenting certain habitats but not by any means restricted to these specific environments. These sparrows were seldom found feeding in the clearings any distance from shelter, but were usually seen along the borders of the forest or in the more open areas. Low, damp places where the decaying leaves formed a thick mat on the cool earth were favorite feeding grounds. They were often associated together in small flocks of six or eight, the young as a rule outnumbering the adults. Their food apparently consisted largely of fallen seeds and small insects which they found under the ground rubbish by vigorous scratching, much like a barn-yard fowl. We found the White-throats rather timid, and when first startled they usually dived into the nearest thicket, soon to appear, however, if no further move was made, as if forgetful of our presence. Throughout the breeding season and even during September their plaintive song could be heard at almost any hour of the day and often in the night. It was usually rendered from some low branch or pile of brush; and in fact the birds were seldom found above the lower branches, the major part of their time being spent on the ground. In flight the White-throats closely resemble the Song Sparrow, flying low for short distances dropping suddenly out of sight.

Breeding Notes: On July 7 several young White-throated Sparrows, just able to fly, were seen with their parents at the edge of a clearing. A nest containing the nearly full fledged young was found in the grassy marsh around Summer Lake (III, 5) July 17. It was placed in a bunch of grass at the foot of an alder, and consisted entirely of dried grasses. The nest was placed about a foot above the water. Another nest was found July 18 in a tussock of grass at the foot of a willow bush. It was held about a foot above the water as was the previous one. The edge of the lake was only a couple of feet away, and a wave would have destroyed it had there been heavy winds. The forest was about two rods distant. Four bluish-white eggs heavily arid irregularly spotted with brown were found in the nest, which was composed entirely of grasses. Many White-throats were heard in this habitat. Young able to fly and take care of themselves were seen throughout our stay at all parts of the island.

67. *Spizella socialis* (560). Chipping Sparrow.

Range: Eastern North America, west to the Rocky Mountains, north to Great Slave Lake, and south to eastern Mexico, breeding from the Gulf States northward.

Stations: Rock Harbor, natural rock clearings, I, 2; Open Balsam-Spruce forest, I, 3.
Siskowit Bay, Trail through Balsam-birch forest, V, 4; Outlet of Siskowit Lake, V, 9.
Washington Harbor, Clearing, I, '04. Border of forest along roads and river, II, '04.

Breeding: Chipping Sparrow and nest seen July 20.

Migration: These sparrows were seen throughout our sojourn on the island, but were migrating; those seen one day might be replaced by new flocks from the north the next.

The Chipping Sparrow was only abundant during the migrations; at other times it was of very local distribution, and occurred in limited numbers. The dense coniferous forest is unsuited to this sparrow, and this fact probably explains its comparative absence at Siskowit Bay camp where the clearings were very limited. They were usually found in pairs or families until the middle of August, when they collected into flocks numbering from a dozen or so to fifty or sixty.

Breeding Notes: The only nest which we found was placed in a birch in the spruce and birch forest near the light-house. The nest was in a little opening, and I doubt if the bird ever nests in the dense forest if other conditions are available.

68. *Junco hyemalis* (567). Slate Colored Junco.

Range: North America, chiefly east of the Rocky Mountains, breeding from the higher parts of the Alleghanies, the Catskills, and the mountainous parts of southern New England northward; south in winter to the Gulf States. Casual in California and Arizona.

Stations: Rock Harbor, Jack Pine Ridge, I, 5; Rock Ridge clearings, II, 3. IV, 1. Ill, 5.
Siskowit Bay, Forest, V, 4. V, I. V, 2. V, 3.
Washington Harbor, Clearing, I, '04; Forest, II, '04.

The Junco was a common species throughout the island, frequenting clearings, rock ridges, and old burnings. Several were seen on the Jack pine ridge along Conglomerate Bay (I, 5) on July 10, and the next day they were abundant on the rock ridge at Sargent Lake (II, 3). On July 19 a large flock was observed feeding in a small clump of dwarf cedars at Scovill Point (IV, 1). They were also noted at Sumner Lake (III, 5) on July 28. At Siskowit they were fairly abundant, preferring the natural and artificial clearings. They were quite plentiful at Washington Harbor, frequenting the same places as at the other localities. No nests were found but young in nearly all stages of plumage were seen throughout our stay.

69. *Melospiza cinerea melodia* (581). Song Sparrow.

Range: Eastern United States to the Plains, breeding from Virginia and southern portion of Lake States northward to the Fur Countries.

Stations: Rock Harbor, Lake and Bay Beaches, I, 1; Benson Brook and Ransom Clearings, II, 1; Small islands, III, 1. Siskowit Bay, South Shore of Siskowit Lake, V, 6; Outlet of Siskowit Lake, V, 9; Long Island Gull Rookery, V, 10. Washington Harbor, clearings, I, '04.

Resident: Rock Harbor, July 5. Siskowit Bay, Aug. 5. Washington Harbor, August 21.

Migration: None seen after August 24.

The Song Sparrow probably bred on the island, although no nests were seen. They were usually found feeding on the ground, scratching among the leaves and debris after the fashion of the White-throated Sparrows, although not to such a large extent as these latter birds.

70. *Melospiza lincolnii* (583). Lincoln's Sparrow.

Range: North America at large, breeding chiefly north of the United States (as far north as Fort Yukon) and in the higher parts of the Rocky Mountains and Sierra Nevada; south in winter to Panama.

Stations: Washington Harbor, clearings and burned areas, I, '04.

Migration: September 12 to 15.

Lincoln's Sparrow was very common September 12, 13, 14 and 15 at Washington Harbor. They were found along the roads, particularly the borders where the underbrush was thick, and in the clearings. They were very difficult of approach, skulking in the ground hemlock and rubbish along the roads or hiding in the piles of brush in the old burning at the first clearing.

71. *Melospiza georgiana* (584). Swamp Sparrow.

Range: Eastern North America to the Plains, accidently to Utah, north to the British Provinces, including Newfoundland and Labrador. Breeds from the Northern States northward, and winters from Massachusetts southward to the Gulf States.

Stations: Rock Harbor, Bulrush Zone and Delta, III, 3; III, 5.

Breeding: Adults accompanied by one young seen July 26.

Several of these birds were heard singing at the mouth of a little stream near the wrest end of Rock Harbor (III, 3). This was an ideal spot for this species as the stream was slow and deep, with grassy bogs and alder bushes along its banks. Others were noted on a grassy bog around Sumner Lake (III, 5). The single immature specimen observed was found at the west end of Rock Harbor, July 26.

72. *Petrochelidon lunifrons* (612). Cliff Swallow.

Range: North America north to the limit of trees, breeding south to the valleys of the Potomac and the Ohio, southern Texas, southern Arizona, and California; Central and South America in winter. Not recorded from Florida or the West Indies.

Stations: Rock Harbor, Scovill Point, IV, 1.

Breeding: Occupied nests July 19.

The Cliff Swallow was only found at one place on the island and only several pairs were seen here.

Breeding Notes: At Scovill Point (IV, 1) on July 19 a number of Cliff Swallows' nests were found placed on the bare face of the rocks. They were above the reach of the waves and were usually protected above by shelving of rock. The nest was composed of mud and lined with feathers but could not be examined closely. The probabilities are that they contained young, as the old birds continually flew to the nest and then away again, chattering all the time.

73. *Hirundo erythrogaster* (618). Barn Swallow.

Range: North America in general, breeding from the Fur Countries south into Mexico; visits the West Indies in migrations, and winters in Central America and South America.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-8. Menagerie Island, V, 10.

Breeding: August 17, nest with young.

On July 9 a flock of these swallows stayed around the light-house and neighboring islands for some time and finally flew away toward the south.

Breeding Notes: At Menagerie Island we saw four nests in a small boat-house, on August 6. Several pairs of adults were flying about the buildings. On August 17 they were again seen and a fifth nest containing young was found, this time built against the bare cliff about twenty feet above the waves. A shelving of rock a few feet above protected it from the rain. This nest contained four young nearly able to fly. An old nest was placed a little ways from this one and in a like location.

74. *Iridoprocne bicolor* (614). Tree Swallow.

Range: North America at large, breeding from the Fur Countries south to New Jersey, the Ohio Valley, Kansas, and Colorado, etc., wintering from South Carolina and the Gulf States southward to the West Indies and Guatemala.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-3.
Menagerie Island, V, 10.

Resident: July 17 to August 1.

A flock of twelve Tree Swallows was observed flying about Rock Harbor Light-house on July 20 and 21. It was also observed here on August 1.

75. *Clivicola riparia* (616). Bank Swallow.

Range: Northern hemisphere; in America south to the West Indies, Central America, and northern South America; breeding from the middle districts of the United States northward to about the limit of trees.

Stations: Rock Harbor, Ransom Clearing, II, 1.

A single specimen of the Bank Swallow was seen July 25 at Ransom Clearing (II, 1) near the mouth of Benson Brook. The scarcity of this species is probably due to the lack of suitable nesting places on the island. Scarcely a bank suitable for their burrows was found by our party.

76. *Totanus melanoleucus* (254). Greater Yellow-legs.

Range: America in general, breeding from Iowa and northern Illinois etc., northward, and migrating south to Chili and Argentine Republic.

Stations: Siskowit Bay, Beach, V.

A single specimen of the Greater Yellow-legs was seen on the beach at Siskowit Bay on August 1.

71. *Ampelis cedrorum* (619). Cedar Waxwing.

Range: North America at large, from the Fur Countries southward. In winter, from the northern border of the United States south to the West Indies and Costa Rica. Breeds from Virginia, southern Alleghanies, Kentucky, Kansas, Arizona, etc., northward.

Stations: Rock Harbor, Jack Pine Ridge, I, 5; Balsam-Spruce forest, I, 3; Benson Brook and Ransom Clearing, II, 1; Rock Ridge Clearing (burned over) II, 3; Small Island, III, 1.
Siskowit Bay, Border of Rock Clearing, V, 3; Trail through the balsam-birch forest, V, 4; Outlet of Siskowit Lake V, 9.
Washington Harbor, border of clearings, I, '04; Forest along river, II, '04; Washington Island, X, '04.

Breeding: See below.

The Cedar Waxwing was a rather uncertain bird in its distribution. Unless held to a limited region by its nest, it wandered about and was seldom seen in the same locality two days in succession. We usually found them in flocks of from 5 or 6 to 15 or 20. Small berries were greedily devoured by them, as well as insects, the latter often being taken on the wing. In this they were very graceful and rivalled the true flycatchers, their strong, graceful flight, together with their quickness making them quite expert on the wing. As a rule they were very quiet, especially in the vicinity of their nest. The Waxwing was usually found in open places, as borders of clearings, along water ways, and at sphagnum bogs.

Breeding Notes: A nest containing 5 eggs was found July 10 in a Jack pine tree on the Jack Pine Ridge, I, 5. It was held against the trunk by two small branches about ten feet from the ground. The eggs were greenish

brown speckled with black. The nest was composed of moss, gray lichen, and grasses and was lined with rootlets and the soft gray tree lichen. July 20 several nests were found on a small rocky island, III, 1. The nests were placed in small spruces and cedars and were from eight to fifteen feet above the ground. All were built of the gray hanging lichen which grew on the neighboring trees. Another nest of the Waxwing was found July 27 on a small island in Rock Harbor. It was about six feet from the ground in a White Cedar, and was composed of the usual gray lichen. It contained two nearly hatched young, and one egg. July 28 a nest was found on a horizontal limb of a birch, about ten feet from the ground. It contained three young. On two small islands in Rock Harbor 14 Waxwing nests were found. Here the nests ranged from three to twelve feet above the ground. Another nest was found July 28 which was placed on a limb overhanging the lake, and about ten feet above it. It contained several young. July 29 a nest was found along the path to the fisherman's cabin. It was on a birch about twenty feet from the ground, the highest nest seen. The nests of the Cedar Wax wings were placed in both conifers and deciduous trees, but all were composed of the gray tree lichen.

78. *Lanius borealis* (621). Northern Shrike.

Range: Northern North America, south in winter to the middle portions of the United States (Virginia, Kentucky, Kansas, Colorado, Arizona, northern California). Breeds north of the United States.

Stations: Washington Harbor, clearings at edge of forest, I, ‘04.
Washington Island, X, '04.

Migration: September 1 and 9.

At Washington Island (X, '04), September 1, a Northern Shrike was seen eating a small bird it had just caught. Another was seen in the first clearing September 9.

79. *Vireo olivaceus* (624). Red-eyed Vireo.

Range: Eastern North America west to Colorado, Utah, and British Columbia; north to the Arctic regions; south in winter from Florida to northern South America. Breeds nearly throughout its Northern American range.

Stations: Rock Harbor, Partial Clearing, II, 1; along Benson Brook, II, 1.
Rock Clearings, II, 3. Birch forest, III, 4. Forest, V, 4.
Siskowit Bay. Old Burning, V, 9. Washington Harbor. Along road in alders, I, 04.

Breeding: July 13, nearly full grown young.

Migration: September 12.

These birds seemed to prefer the more open growths of timber such as the birch forests which contained more or less of an undergrowth of aspens, such as was found along Benson Brook (II, 1), where many were seen. On July 20 we found this species in the valley at the west end of Tonkin Bay (IV, 7) in a second growth of birch and aspen. It was also found on the trail to Sumner Lake (III, 4) on July 27. At Siskowit it was not nearly so common and was observed only two or three times at Siskowit Lake.

It was observed only as a ram migrant at Washington Harbor. Only one, an adult male, being taken, September 12.

Breeding Notes: Probably the Red-eyed Vireo bred quite commonly in all suitable localities, but no nests were found. A pair was seen feeding nearly full grown young along Benson Brook (II, 1) on July 13.

80. *Vireo philadelphicus* (626). Philadelphia Vireo.

Range: Eastern North America north to Hudson Bay; south, in winter, to Costa Rica and Panama. Not recorded from Mexico or the West Indies. Breeds from, Maine, New Hampshire, and Manitoba northward.

Stations: Washington Harbor Clearing, I, ‘04.

Migration: September 12.

The Philadelphia Vireo was by far the rarest of this family, only one pair being seen throughout our stay this year. These two were found on the morning of September 12 among the low alder bushes along the road between the first and second clearings (I, ‘04). The year before one was seen September 1 in about the same locality.

71. *Vireo solitarius* (629). Blue-headed Vireo.

Range: Eastern North America to the Plains, north to Hudson Bay and Fort Simpson. South, in winter, to Guatemala. Breeds from southern New England and the northern part of the Lake States northward.

Stations: Washington Harbor, alders at edge of clearing, I, ‘04.

Migration: August 30; September 12.

The Blue-headed Vireo was only observed on two occasions. On August 30 a pair was seen feeding in a low birch along the road from the first clearing (I, ‘04), and on September 12 another was noted in the same place also feeding among low birches and alders.

82. *Mniotilta varia* (636). Black and White Warbler.

Range: Eastern United States to the Plains, north to Fort Simpson, south in winter, through Central America and the West Indies to Venezuela and Columbia. Breeds from Virginia and southern Kansas northward, and winters from Florida and the Gulf States southward.

Stations: Siskowit Bay, Old Burning, V, 9. Washington Harbor, forest along river, II, ‘04.

Migration: August 3 and 31.

One of these warblers was seen on August 3 among the alders and dogwoods which formed a dense thicket at the outlet to Siskowit Lake. No others were seen until August 31, when a single individual was procured in an alder thicket along Washington River (II, ‘04).

83. *Helminthophila ruficapilla* (645). Nashville Warbler.

Range: Eastern North America to the Plains, north to the Fur Countries, breeding from the northern United States northward. Mexico and Guatemala in winter.

Stations: Rock Harbor, Lake and Bay Beaches, I, 1; Natural Rock Clearings, I, 2; Balsam-spruce forest, I, 3; Tamarack and Arbor Vitae swamps, I, 4; Benson Brook and Ransom Clearing, II, 1.
Siskowit Bay, Trail through Balsam-Birch forest, V, 4; outlet of Siskowit Lake, V, 9.
Washington Harbor, border of clearing, I, '04.

Breeding: July 11, 5 young.

Migration: Migrating at Washington Harbor from August 25 to Sept. 12.

The Nashville Warbler was usually seen near the tree tops, especially along the border of clearings. They showed quite a preference for the vicinity of high, open mixed forests.

Breeding Notes: We found a Nashville Warbler's nest in the side of a bluff about eight feet high. The nest was placed about two feet from the foot of the cliff, which was not quite perpendicular at this point. The nest was almost hidden by the moss, and was composed of moss from the trees, the lining being made of grasses. It contained five young, still in the down. There were several birch and spruce trees close to the nest, completely shading it from the sun. The top of the cliff was bare rock and entirely exposed. The parents fed in the tamarack swamp near by, but refused to come close to the nest while we were near.

84. *Helminthophila peregrina* (647). Tennessee Warbler.

Range: Eastern North America, breeding from northern New York and northern New England northward to Hudson Bay Territory; in winter south through Mexico to Costa Rica and Columbia.

Stations: Siskowit Bay, Forest, V, 4. Washington Harbor, clearings, I, '04, Forest, II, '04.

Migration: August 2 to September 18.

The Tennessee Warbler was perhaps the most abundant species of this family on the island, although it was only recorded as a migrant. The first seen was on August 2 in the coniferous and birch forest near our camp at Siskowit (V, 4). They were observed regularly after this date, but never in very large numbers. We noticed these birds soon after arriving at Washington Harbor (August 19). In a few days their numbers were greatly increased and they continued plentiful until the first of September, when their numbers gradually diminished until the 8th, after which time only scattered individuals were observed. On August 20 we saw flock after flock of these beautiful birds among the scrub growth of alder, birch, and balsam, along the road (I, '04), and also along Washington River (II, '04). They were evidently gathering for the long journey south and were busy feeding in the brush and low trees. On August 22 a large flock came into the door yard, feeding about the doorstep on crumbs which had been thrown there. They were also noticed diligently hunting over some wild mustard, scanning every leaf and blossom carefully.

85. *Dendroica tigrina* (650). Cape May Warbler.

Range: Eastern North America, north to Lake Winnepeg and Hudson Bay Territory, wrest to the Plains; breeds from northern New England northward; winters in the West Indies.

Stations: Siskowit Bay, Forest, V, 4.

Migration: August 15.

This species was seen August 15 in a tamarack swamp (V, 5) at Siskowit. About six or seven birds were seen in company with several other migrating warblers. This is the only record we have for the island.

86. *Dendroica caerulescens* (654). Black-throated Blue Warbler.

Range: Eastern North America to the Plains, breeding from northern New England and northern New York northward to Labrador, and in the Alleghanies south to northern Georgia; West Indies and Guatemala in winter. Accidental on the Farallon Islands, California.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-3.; Tamarack and Arbor Vitae Swamps, I, 4; Tamarack and Spruce Swamp, II, 2-5; Siskowit Bay, Forest, V, 4; Washington Island, Clearing, I, '04; Forest, II, '04.

Migrant: August 28; September 12.

The Black-throated Blue Warbler was not common on any part of Isle Royale. We found them in the spruce, tamarack and balsam forests and swamps, especially where there was considerable underbrush. No young were seen, although it undoubtedly bred on the island, as males and females were seen as early as July 8.

87. *Dendroica coronata* (655). Myrtle Warbler.

Range: Eastern North America, chiefly straggling more or less commonly westward to the Pacific; breeds from the northern United States northward, and winters from southern New England and the Ohio Valley southward to the West Indies, and through Mexico to Panama.

Stations: Beach at Rock Harbor, I, 1; Spruce and Balsam Forest, I, 2-8; Small Islands, III, 1. Forest, V, 4; Old Burning, V, 9. Washington Harbor, clearing, I, '04; forest, II, '04.

Breeding: Nest and young, July 7 and July 27.

Migration: Last seen on September 12.

The Myrtle Warbler was fairly common in the balsam and spruce forest, but was often found feeding along the rocky shores. Although a tree nester, and principally an arboreal feeder, it commonly descended to the ground in search of food; this was particularly noticeable on the

bare rocks along the shore of Bock Harbor. They were not as common at Siskowit, and only scattered migratory flocks were observed at Washington Harbor.

Breeding Notes: A nest containing four well feathered young was found on July 7. It was situated in a Jack pine on the extreme edge of a cliff, and about forty feet above the water. The nest was placed at the end of a horizontal limb, about ten feet from the ground, six feet from the trunk of the tree, and directly over the water. It was composed of balsam twigs and needles and lined with feathers of the Sharp-tailed Grouse and Canada Jay, being a little larger than a Chipping Sparrow's. No overhanging branches afforded the nest any protection from the sun or storms. The surrounding trees were Jack pines and spruces. The bird flew directly to the nest as long as the observer was out of sight, but at other times it approached very cautiously, and when about fifty feet from the nest it would drop close to the ground, flying low until almost under the nest. It always left the nest by flying low along the top of the cliff. There was very little underbrush within fifty yards of the tree on which the nest was situated, and the surrounding Jack pines and spruces were scattered so that the sun had access to the ground. The small plant life was composed mostly of mosses and heath plants.

On July 27 another nest was found, this time on an island at the north side of Rock Harbor. It was placed on a horizontal limb of a white spruce about six feet from the ground. Like the first one this overhung the water, but not so far above it. It was composed of small twigs and grasses, lined with feathers and contained three young about two days old. On July 28 a young Myrtle Warbler just out of the nest was found on a small island (III, 1). Four nests were found on two small islands near the end of Rock Harbor, one of which contained small and nearly full-fledged young July 21. The other two were empty, but gave evidence of having been recently used. They were all in coniferous trees and ranged from six to ten feet above the ground.

No nests were found at Siskowit, probably because the breeding season was nearly over, and due, in part also, to our short stay at this location. A juvenile male was taken here on August 3, and several were seen feeding in the tree tops near the outlet of Siskowit Lake (V, 9) August 5. At Washington Harbor they were observed on August 5, 6 and 7; after our return, from August 18 to September 12.

88. *Dendroica maculosa* (657). Magnolia Warbler.

Range: Eastern North America west to the base of the Rocky Mountains, and casually to British Columbia; breeding from northern New England, northern New York, and northern Michigan, to Hudson Bay Territory and southward in the Alleghanies to Pennsylvania. In winter, Bahamas, Cuba, and south through eastern Mexico to Panama.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-3; Grove of Evergreens, I, 1, I, 4; Spruce and Cedars along Benson Brook, II, 1, II, 4. Siskowit Bay, Forest, V, 4. Washington Harbor, clearing, I, '04; Forest, II, '04.

Breeding: July 7, female and young.

Migration: August 28, September 12.

Magnolia Warblers were common in the balsam and spruce forests and also in the second growths of birch at all three localities, but could not be called migrants.

Breeding Notes: A female was seen feeding a young bird in the top of a birch tree on July 7. The same day a female was found in a spruce thicket feeding a young bird which had just enough feathers to enable it to fly six or eight feet. Another brood of four young were found just back of the light-house in a thicket of birch. These were scarcely able to fly, two being caught by hand. The following day (July 8) several families were found in the tamarack and arbor vitae swamps (I, 4). One brood was large enough to fly. They were also found quite regularly along Benson Brook (II, 1) and at McCargoe Cove (II, 4).

General Notes: During migration the birds preferred the banks of the river and the roadside, although scattered individuals were occasionally met with in the more open parts of the coniferous forest, especially where it was sufficiently open to allow the growth of birches.

89. *Dendroica castanea* (660). Bay-breasted Warbler.

Range: Eastern North America, north to Hudson Bay. Breeds from northern New England and northern Michigan northward, in winter south through eastern Mexico (rare) and Guatemala to Columbia.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-3; Rock Ridge Clearing, II, 3. Forest on Trail to Siskowit Lake, V, 4. Washington Harbor, clearing, I, '04; Forest, II, '04.

Resident: July 7.

Migrant: August 28; September 12.

Only a few of these birds were seen and it is probably an uncommon summer resident throughout the island. A fine adult male was seen feeding in the balsam-spruce forest (I, 3) July 7. On July 14 another male was observed in a thick second growth of birch, aspen and spruce, near the edge of the tamarack swamp (II, 2). From its actions we thought a nest was near, but it could not be found. A badly moulting male was taken August 8 near Siskowit Lake. At Washington Harbor it was observed only as a migrant, being observed from August 28 to September 12. At times, particularly during Warbler waves, they were abundant, but among all those observed, only a few adult males were seen, and the young greatly outnumbered the females.

90. *Dendroica striata* (661). Black-poll Warbler.

Range: Eastern North America west to the Rocky Mountains, north to Greenland, the Barren Grounds, and Alaska, breeding from northern New England and the Catskills northward. South in winter to northern South

America, but not recorded from Mexico or Central America.

Stations: Washington Harbor, clearings, I, '04; Forest, II, '04.

Migration: August 25 to September 25.

At first the Black-polls were rather uncommon, but they rapidly increased in numbers until August 26, when the great wave of this species commenced.

91. *Dendroica virens* (667). Black-throated Green Warbler.

Range: Eastern North America to the Plains, north to Hudson Bay Territory, breeding from Connecticut and northern Illinois northward, and south along the Alleghanies to South Carolina. In winter, south to Cuba and Panama. Accidental in Greenland and Europe.

Stations: Rock Harbor, Natural Rock Clearing, I, 2; Balsam-spruce forest, I, 3; Tamarack and Arbor Vitae swamps, I, 4; Sphagnum-spruce bog, I, 6; Tamarack swamp, II, 2; Forbes Lake, II, 5; Birch Forest, III, 4.
Siskowit Lake, Balsam-Birch Forest, V, 4.
Washington Harbor, Border of Clearings, I, '04; Forest along river, II, '04.

Breeding: Young with adult seen July 9.

The Black-throated Green Warbler fed on the ground as well as in the tops of the trees, but the latter place was much preferred, and, except during the breeding season, when they hunt everywhere for food, they were usually found there.

Breeding Notes: A young Black-throated Green Warbler was seen in company with the male on July 9 in the tamarack swamp, I, 4. July 11 a nest containing young was found in a cedar tree about 20 feet from the ground. It was composed of moss and grass. The nesting site was in a rather open spot where the trees were mostly cedar and birch, and only a little underbrush and low vegetation was present. When we were near the nest the female Black-throat moved anxiously about from limb to limb, keeping up a constant chirping, but would riot approach closely. Another nest containing young was found the same afternoon. Both parents were very nervous in their movements, remaining within a few feet of the observer and scolding constantly. The male had food in its month when first seen. A male, female and young were found in a birch forest July 27.

92. *Dendroica palmarum* (672). Palm Warbler.

Range: Northern interior to Great Slave Lake; in winter South Atlantic and Gulf States, the West Indies and Mexico. Of rare but regular occurrence in the Atlantic States in migration.

Stations: Washington Harbor, clearings, I, '04; Forest, II, '04.

Migration: August 28 to September 21 on.

The Palm Warbler was second in numbers only to the Tennessee. From August 28 to the middle of September these birds were always found in considerable numbers along the road connecting the clearings. It was also found in the first clearing, usually near the border where the alders and other shrubs furnished a large share of its insect food as well as a protection from the numerous hawks. The birds were quite tame and often came into the house through the open doors and windows. The birds have a characteristic habit of jerking the tail up and down, which serves as an aid to identification at quite a distance. As a rule they were usually found in flocks, usually numbering about thirty or forty.

93. *Seiurus aurocapillus* (674). Oven-bird.

Range: Eastern North America, north to Hudson Bay Territory and Alaska, breeding from Kansas, the Ohio Valley, and Virginia northward. In winter Florida, the West Indies, southern Mexico, and Central America to Panama.

Stations: Rock Harbor, Sphagnum-spruce bog, I, 6; Benson Brook, II, 1; Birch forest, III, 4; Tamarack swamp, I, 4.
Siskowit Bay, Balsam-Birch forest, V, 4; Tamarack swamp, V, 5.
Washington Harbor, borders of clearings, I, '04; found along river, II, '04.

Resident: Rock Harbor, July 8. Siskowit Bay, Aug. 12.

Breeding: Young seen August 12.

The Oven-bird was not common on the island and occurred only in limited numbers in its favorite habitats, such as the cool, damp forest along the streams and in the tamarack swamp. No nests were found, but young able to care for themselves were taken in the tamarack swamp (V, 5) August 12. It was uncommon even in migration and was last seen September 12.

94. *Seiurus noveboracensis notabilis* (675a). Grinnell's Water Thrush.

Range: Western United States, from Indiana and Illinois westward to California, and north into British America. Casual in migrations eastward to the Atlantic coast. Winters from the southern border of the United States southward to Lower California, Mexico and northern South America.

Stations: Rock Harbor, Along Benson Brook, II, 1; Forest, V, 4; Siskowit Lake, V, 6; Old Burning, V, 9.
Washington Harbor, Clearing, I, '04; forest along river, II, '04.

Migration: August 5 to September 12.

On August 5 several Grinnell's Water Thrushes were seen at the edge of Siskowit Lake (V, 9). They frequented the borders of the lake, secreting themselves in the dense masses of fallen tree tops and rubbish. They were afterwards seen running along on the bare rocks and sand, at a distance being similar in their

actions to the Spotted Sandpiper, as both birds run in about the same manner with the accompanying tipping up and down motions. These Water Thrushes could be as truly called "tip ups" as the Sandpiper and were often found standing on a rock or log tipping up and down and wig-wagging the tail. It was occasionally found on the Lake Superior shore near camp, but was nowhere as common as on the inland lakes or streams. At Washington Harbor they were found along the road, in the dense balsam forest and along the river. During rainy days, especially, the Water Thrushes were quite common along the road, more particularly in the damp places where the alders thrived. Usually the birds were in pairs and were very shy. About the only way specimens could be procured was to call the birds near by sucking or kissing the hand to make a noise resembling that of a young bird in distress. This seldom failed to bring a pair or two of excited birds within a few feet. As soon as the deception was discovered they were quick to seek the protection of the long grass on the banks of the stream or of a nearby rubbish heap.

This bird probably breeds on the island, although nothing definite was determined. While at Washington Harbor earlier in the season I shot a young Water Thrush unable to fly, but could not find it among the dense underbrush and ground hemlock which covered the ground. An adult with three or four young was seen with it, but it was too dark under the thick balsams to see the color of the breast, or determine in and other way whether it was Grinnell's or the Small-billed Water Thrush.

95. *Geothlypis agilis* (678). Connecticut Warbler.

Range: Eastern North America, breeding north of the United States (Manitoba, Ontario). Northern South America in winter.

Stations: Washington Harbor, clearing at edge of forest, I, '04.

Migration: September 12.

Several Connecticut Warblers were seen during the large wave of September 12. They were found singly in the damp alder thickets along the road. In actions they reminded one of the Water Thrush, running along the fallen logs and keeping out of sight as much as possible.

96. *Geothlypis philadelphia* (679). Mourning Warbler.

Range: Eastern North America to the Plains, breeding from the mountainous portions of Pennsylvania, New England, New York, and northern Michigan northward. Central America and northern South America in winter. Accidental in Greenland.

Stations: Rock Harbor, burned area of rock ridge clearings, II, 8; Shore of Benson Lake, II, 1.

Breeding: July 11, young seen.

An adult female Mourning Warbler was seen near Benson Lake July 11, and near the outlet into Benson Brook an immature bird was seen on the same day.

97. *Wilsonia pusilla* (685). Wilson Warbler.

Range: Eastern North America, west to and including the Rocky Mountains, north to Labrador, Hudson Bay Territory, and Alaska. Breeds chiefly north of the United States, migrating south to eastern Mexico and Central America.

Stations: Washington Harbor, forest near river, II, '04.

Migration: August 31, September 5.

Wilson's Warbler was one of the rarest of this family, only two birds being observed on the island. On August 31 a female was seen catching insects over the river and also picking something off the leaves on an overhanging alder bush. The other was a male and was found in nearly the same place.

98. *Sylvania canadensis* (686). Canadian Warbler.

Range: Eastern North America, west to the Plains, and north to New Foundland, southern Labrador and Lake Winnipeg; south in winter to Central America and northern South America. Breeds from the higher parts of the Alleghanies and the more elevated parts of southern New York and southern New England, northward.

Stations: Rock Harbor, Alder zone, I, 1.

Breeding: July 8.

Just above the beach at the head, of the bay at Rock Harbor is a partial clearing fringed with alders, and here among the bushes, fallen trees, alders, birches, and spruce we found a number of warblers, among them being the Redstart, Canadian and Nashville Warblers. The Canadian gave unmistakable evidence that it had a nest near by containing young. It scolded and fussed, approaching the intruder and fluttering rapidly away as if frightened at every movement in its direction, all the while holding food in its mouth.

99. *Setophaga ruticilla* (687). American Redstart.

Range: North America, north to Fort Simpson; west regularly to the Great Basin, casually to California and Lower California; breeding from the middle portion of the United States northward. In winter, the West Indies, southern Mexico, Central America, and northern South America.

Stations: Rock Harbor, Alder zone, I, 1; Benson Brook, II, 1.
Siskowit Bay, Outlet of Siskowit Lake, V, 9.
Washington Harbor, borders of clearings, I, '04; forest along river, II, '04.

Breeding: August 3 a male and young were seen.

Migration: Last seen September 8.

The Redstart was a much rarer breeder on the island than one would suppose. It was not near the limit of its range in any direction, and the conditions were the same as found elsewhere where it is quite plentiful. During migration it was quite common, but it never occurred in flocks like the Tennessee or Blackpolls, but was usually

found associated with flocks of other species. The only young bird found was on August 3, when a male Redstart was seen feeding a young one near the outlet of Benson Brook, II, 1.

100. *Anthus pensylvanicus* (697). American Pipit.

Range: North America at large, breeding in the higher parts of the Rocky Mountains and sub Arctic districts, and wintering in the Gulf States, Mexico and Central America. Accidental in Europe.

Station: Washington Harbor, clearings, I, '04.

Migration: September 18 on.

Large flocks of the American Pipit appeared in the first clearing at Washington Harbor on September 19. More also came on the next two succeeding days and probably continued to come, but on the 21st I left the island for the south. They came in flocks numbering from 30 to 150 and 200. The grassy clearing was preferred to the plowed area, possibly because it offered many more insects at this time of year. Small seeds, probably of the wild grasses, were found in some of the stomachs. The birds as a rule were not shy, even flying around one's head and alighting within a few feet after being shot at. When in the long grass it was sometimes difficult at a distance to distinguish them from Palm Warblers, as the latter has much the same colored back, and often resorted to the same places to feed. On the open ground of course there was no such difficulty. Even when in the field the exceedingly long hind toe nail is very conspicuous. The Pipits were very nervous in their actions, only feeding in the same place a few moments at a time and then rising up in a scattered flock they drew close together into one compact mass of whirling birds and flying a short distance would wheel around and return to the same location.

101. *Galeoscoptes carolinensis* (704). Catbird.

Range: Eastern United States and British Provinces west to and including the Rocky Mountains; occasional on the Pacific coast, from British Columbia south to Central California, Breeds from the Gulf States northward to the Saskatchewan. Winters in the southern states, Cuba, and Middle America to Panama, Bermuda, resident. Accidental in Europe.

Stations: Washington Harbor, forest near river, II, 1.

Migration: September 12.

Only one individual of this species was seen during the two years of work here. Late in the afternoon of September 12 I took a single specimen as it was passing through a dense thicket of mixed alder, birch and balsam on the steep banks near the river.

102. *Olbiorchilus hiemalis* (722). Winter Wren.

Range: Eastern North America generally, breeding from the northern parts of the United States northward, and in the Alleghanies south to North Carolina, and wintering from about its southern breeding limit southward.

Stations: Rock Harbor, Tamarack and Arbor Vitae swamps, I, 4; III, 5; burned clearing near I, 1; thick undergrowth along Benson Brook, II, 1; Tamarack and spruce forest, II, 2, 5.
Siskowit Bay, forest, V, 4.
Washington Harbor, forest near river, II, '04.

Resident: July 13 to September 18.

These little birds were very partial to the tamarack and cedar swamps where they would be heard singing from the very tops of the tallest trees. They were often found in a small tamarack swamp (II, 2) at the west end of Rock Harbor and in the tamarack swamps around Sumner Lake (III, 5). A pair was suspected to nest in a small tamarack swamp, (I, 4) but the nest could not be found in the thick tangle of logs and brush. It was often heard singing along the shores of the lakes and bays, preferring places where there was a rank growth of ground hemlock. We found it fairly common all through the regions studied, but in each place the birds were found in the same environment. Those taken at Washington Harbor were found in the wet, dark forest along the river.

103. *Certhia familiaris fusca* (726). Brown Creeper.

Range: Eastern North America, breeding from the northern and more elevated parts of the United States northward, and casually further south, migrating southward in winter.

Stations: Rock Harbor, Tamarack and arbor vitae swamps, I, 4. Siskowit Bay, Forest, V, 4. Washington Harbor, Forest, II, '04.

Resident: July 26.

Migration: August 22 to September 19.

This species was not common anywhere on the island and was rare at Rock Harbor. It was confined principally to the balsam-spruce forests and cedar swamps. At Siskowit it was often seen in the balsam-birch forest, being much more common than at either Rock Harbor or Washington Harbor. In all probability it nested on the island, but no nests or young were found. Even during migration it was uncommon and was usually found accompanying flocks of Chickadees, Golden-crowned Kinglets, or Red-breasted Nuthatches. Sometimes all of these birds would be found together.

104. *Sitta canadensis* (728). Red-breasted Nuthatch.

Range: North America at large, breeding from northern New England, northern New York, and northern Michigan northward; and southward in the Alleghanies, Rocky Mountains and Sierra Nevadas; in winter south to about the southern border of the United States.

Stations: Rock Harbor, Balsam-spruce forest, I, 3; Tamarack and Arbor Vitae swamps, I, 4; Edge of Ransom Clearing, II, 1; Tamarack swamp, II, 2; Border of Forbes Lake, II, 5; Conifers along trail to

Sumner Lake, III, 4.
Siskowit Bay, Conifers along trail through Balsam-birch forest, V, 4; Tamarack swamp, V, 5; Arbor Vitae swamp, V, 8; Tamarack-spruce swamp, V, 11.
Washington Harbor, forest along river, II, '04; Tamarack swamp, V, '04; Conifers around camp clearing, I, '04.

Breeding: Young able to take care of themselves were seen throughout the season.

Migration: Last seen September 12.

The Red-breasted Nuthatch was quite common on the island, but was somewhat local in its distribution. The tamarack, arbor vitae, and spruce swamps were their favorite resorts, but they were often seen along the borders of the clearings where the conifers predominated. Practically all of their food was obtained on the various forms of evergreens.

105. *Parus atricapillus* (735). Chickadee.

Range: Eastern North America, north of the Potomac and Ohio valleys.

Stations: Rock Harbor, Natural rock clearings, I, 2; Balsam-spruce Forest, I, 3; Tamarack and Arbor Vitae swamps, I, 4; Benson Brook and Ransom clearings, II, 1; Tamarack swamp, II, 2; Forbes Lake, II, 5; Conifers along trail to Sumner Lake, III, 4.
Siskowit Lake, Trail through Balsam-Birch forest, V, 4; Tamarack swamp, V, 5; Outlet of Siskowit Lake, V, 9; West end of Siskowit Bay, VIII, '04.
Washington Harbor, Border of clearings, I, '04; Forest along river, II, '04; Tamarack swamp, V, '04; Washington Island, X, '04.

Breeding: On July 7 a nest was found with young and on August 10 a nest with 4 young.

The Chickadee was abundant throughout the island, but, except during the nesting season, it roamed about in small flocks from place to place, the conifers near camp being well populated one day, and the next day all would be gone. These small flocks were probably single families, or at most two or three families together. As soon as the young were able to leave the nest they commenced these local excursions and probably never returned to the nesting site except by chance. Their clear-whistle mating song, "Péto," was heard throughout July and August and occasionally even in September. The Chickadees were often found in company with flocks of Red-breasted Nuthatches and Brown Creepers, especially as the migration season came on.

Breeding Notes: On July 7 a nest of the Chickadees was found in a hollow birch tree in the spruce and birch forest (I, 3). It contained several partially fledged young. Another nest was found August 10 in a dead birch tree about ten feet from the ground. The entrance was very small, there being scarcely room enough for two of the little ones to stick their small heads out at once. The parents flew to the nest with a moth or other small insect about once a minute. Four young were found, but on the next day (August 11) they had left the nest and were seen sitting in a small balsam, their parents industriously feeding them.

106. *Regulus satrapa* (748). Golden-crowned Kinglet.

Range: North America generally, breeding in the northern and elevated parts of the United States and northward, migrating south in winter to Guatemala.

Stations: Rock Harbor, natural rock clearings, I, 2; Balsam-spruce forest, I, 3; Tamarack and Arbor Vitae swamp, I, 4; Sphagnum-spruce bog, I, 6; Benson Brook and Ransom Clearing, II, 1; Tamarack swamp, II, 2; Forbes Lake, II, 5; Conifers, III, 4.
Siskowit Bay, Balsam-spruce forest, V, 4; Tamarack swamp, V, 5; Arbor Vitae swamp, V, 8; Tamarack-spruce swamp, V, 11.
Washington Harbor, Border of clearings, I, 04; Conifers along river, II, 04; Tamarack swamp, V, '04; Washington Island, X, '04.

Breeding Notes: Nest partially completed July 7. It contained 8 eggs on July 21.

The Golden-crowned Kinglet was very common throughout the island, usually occurring in small flocks of from fifteen to twenty. They were found wherever suitable conditions existed, namely, coniferous habitats, as balsam, spruce, tamarack, and arbor vitae forests and swamps. The birds were never shy, and were only momentarily disturbed by the discharge of a gun. Their song was one of the most common sounds of the forest, and is described in MCreary's notes as *tsee tsee-tsee-tsee.*

Breeding Notes: A pair of Golden-crowned Kinglets were seen July 6 with food in their mouth and giving every indication that they had young near. July 7 a pair was seen building a, nest in a tall spruce. The birds were gathering the moss from the ground for nesting material. The nest was placed about 25 feet from the ground and was composed of green mosses partially lined with a white down-like substance. The site chosen was near the top of a small rocky hill where the forest was not very dense. The nest was nearly finished and was suspended from two limbs near the trunk of the tree. When next examined, July 21, it contained eight eggs. It was now composed of green ground moss, together with the long gray strands of the tree lichen, and was lined with fur from the Northern Hare. Its dimensions were four inches deep, and 4 inches in diameter, with a circular opening 1½ inches in diameter. In the balsam-spruce forest near camp we found a nest containing 6 young August 10. The structure was placed about thirty

feet from the ground and five feet from the top of a tall, slender spruce. Both parents were carrying small moths and other insects to the young. This was a late nest, as young Kinglets had been seen early in July. The nest was suspended from a couple of small limbs, was composed of gray lichen and green moss, lined with Northern Hare fur, and was considerably larger than the nest previously described, the outside depth being about 6 inches.

107. *Regulus calendula* (749). Ruby-crowned Kinglet.

Range: North America south to Guatemala, north to the Arctic coast, breeding chiefly north of the United States, and in the Rocky Mountains, the Sierra Nevada, and the mountains of Arizona.

Stations: Washington Harbor, borders of clearings and forest, I, '04, II, '04.

Migrations: September 5 to 15.

The Ruby-crowned Kinglet was rather rare, especially if compared with its abundant relative, the Golden-crowned. A few were observed migrating on September 5. Both males and females were found in the little flock which passed slowly down the river, feeding on the insects about the alder bushes; small flocks, perhaps only families, as they seldom numbered more than five or six, were seen on the 7th, 8th and 9th. The birds were found again on the 12th, but this time they were much more common, and considerable flocks numbering twenty-five or thirty were seen. Only a few were seen on the 15th, the last day they were observed.

108. *Hylocichla fuscescens* (756). Wilson's Thrush.

Range: Eastern United States to the Plains, north to Manitoba, Ontario, Anticosti, and Newfoundland. Breeds from northern New Jersey and the northern part of the Lake States northward; winters sparingly in Florida, but chiefly south of the United States.

Stations: Rock Harbor, Spruce and Balsam Forest, I, 2-8; Sphagnum and Spruce Bog, st. I, 6; Along Benson Brook, II, 1. II, 4. Ill, 3. IV, 7.
Siskowit Bay, V, 4; Partial Clearing, II, 1.
Washington Harbor, Clearings, I, '04; Forest, II, '04.

Migration: August 24; September 14.

The Wilson's Thrush was very common on nearly all parts of the island, living in the balsam forests. This bird was first seen July 6and was common throughout July and August. At Rock Harbor it was observed in all the balsam-spruce forests and was often seen along Benson Brook (II, 1) at McCargoe Cove (II, 4) and on the rock ridges near Sargent Lake (II, 3). They were also found among the birches and balsams at the west end of Rock Harbor (III, 3). It was occasionally seen in the birch forest near the head of Tobin Harbor (IV, 7) and at Siskowit Bay, V, 4.

109. *Hylocichla aliciae* (757). Gray-cheeked Thrush.

Range: Eastern North America, west to the Plains, Alaska, and eastern Siberia, north to the Arctic coast, south, in winter, to Costa Rica. Breeds chiefly north of the United States.

Stations: Washington Harbor. Clearings, I, '04. X, '04.

Migration: September 5, 12 to 21 when observations closed.

The first record was a specimen found dead at Washington Harbor on September 5. (X, '04). This was at the close of a heavy gale lasting since the first, and the bird had flown against a lighted window during the night previous. Many other species were killed at this same place during this storm, the lighted windows proving a much more fatal place during storms and on cloudy nights than during clear weather, probably because the birds fly lower on such nights. This specimen was killed on the north side of a pavilion. No others were seen until September 12, when in company with thousands of other migrants, it was very abundant in the clearings.

Large flocks were seen every day throughout the remainder of my stay, the bolder of clearings and the roadways being the places where they were the most abundant.

110. *Hylocichla ustulata swainsoni* (738a). Olive-backed Thrush.

Range: Eastern North America and westward to the Upper Columbia River and East Humbolt Mountains, straggling to the Pacific coast. Southward in winter to Cuba, Guatemala, Nicaragua, Columbia, Ecuador, and Peru. Casual in Bermuda. Breeds in the northern Alleghanies, the Catskills, the mountainous parts of southern New England, southern Sierra Nevada, and northward.

Stations: Rock Harbor, Beach at Rock Harbor, I, 1; Spruce and Balsam Forest, I, 2-3.
Partial clearing, I, 1, II, 1; Partial clearing along Benson Brook, II, 1; Rock Ridge clearings, II, 3.
Siskowit Bay, Forest, V, 4.
Washington Harbor, Clearings, I, '04; Forest, II, '04.

Breeding: July 8 nest with 3 young. August 3, two young just able to fly.

Migration: From about the middle of August to September 17. The Olive-backed Thrush was a common breeder throughout the island and was one of the most abundant thrushes during migration. The dense heavily shaded forest offered the most favorable conditions and except during migration it was seldom found in any other location. The damp places bordering streams were a favorite resort, the birds being usually found on the lower border of the balsam and spruce or among the decaying leaves and rubbish at their bases.

Owing to the dense shade the lowest branches usually died, and dropped off, so for a height of three to five feet it was relatively open. It was this rather open, yet heavily shaded condition which seemed to be best suited to these thrushes during the breeding season. They were also found in dense alder thickets and resorted to the border of the woods and the roadside during the migration.

Breeding Notes: On July 8 an Olive-backed Thrush's nest was found in the balsam-spruce forest at Rock Harbor (I, 3). The nest was situated on a horizontal spruce limb about five feet from the ground. The tree stood at the edge of a small rocky opening. It was placed about four feet from the tree trunk and was quite conspicuous. The nest was composed principally of dead grasses with moss and the long thread-like tree lichens woven in. Rootlets and leaves formed the lining. Three very young birds were found. Only one adult was seen and this one proved very shy, refusing to return to her young while being watched. During the forenoon the sunlight fell directly upon this nest, so exposed was its position at the edge of the rocky clearing, but in the afternoon it was shielded by a high wall of rocks about twenty feet distant.

On August 3 a female Olive-backed Thrush was found accompanied by two young just able to fly. They were feeding in a thicket of maple and mountain ash at the edge of a small clearing on one of the islands in Siskowit Bay.

111. *Hylocichla guttata pallasii* (759b). Hermit Thrush.

Range: Eastern North America, breeding from the northern Alleghanies, the mountainous parts of southern New England, southern New York, and northern Michigan, etc., northward and wintering from the northern states southward.

Stations: Rock Harbor, Balsam-spruce Forest, I, 3.
Siskowit Bay, Balsam Birch Forest, V, 4.
Washington Harbor, borders of clearings, I, '04;
Forest near river, II, '04.

Breeding: A young bird was taken July 7.

Migration: August 22; September 14.

The Hermit Thrush probably breeds throughout the islands in suitable localities. No nests were found, but the immature specimen taken July 7 is probably a breeding record, as none of these birds were observed migrating until August 22. They were never abundant, but during part of the period were nearly as common as the Olive-Backed. The dense clumps of mountain maple were the favorite habitat.

112. *Merula migratoria* (761). American Robin.

Range: Eastern North America to the Rocky Mountains, including eastern Mexico and Alaska. Breeds from Virginia and Kansas northward to the Arctic coast; winters from southern Canada and the northern states (irregularly) southward.

Stations: Rock Harbor, Rock Ridge Clearing, II, 3.
Washington Harbor, Clearings, I, '04; Open Forest, II, '04; X, '04.

Breeding: July 11, nest with setting bird.

Migration: September 8 to 21 on. The residents reported large flocks in October.

This bird is rather rare, considering the island as a whole, but occurs in limited numbers wherever favorable conditions exist. The clearings, both natural and artificial, at Rock Harbor afforded suitable habitats, and at this place most of the Robins were found. At Siskowit they were reported by the light-house keeper as occasionally nesting on Menagerie Island and at the large clearing near the end of the bay (VII, '04) a few were observed September 9 and 10. These latter were probably migrating. They were regular nesters at Washington Harbor, the clearings and other changes brought about by the agency of man, furnishing conditions better suited to their needs than the balsam-spruce forest which covered the island. Our observations at this latter point were so late in the season that no nests or young birds were found, but the resident at the club-house (I, '04) and also on Washington Island (X, 04) reported that the birds nested at both places during the latter part of June. Only scattered individuals were observed at the club-house until September 6, when the real migratory movement commenced.

Breeding Notes: A nest with the female setting upon it was found July 11. It was situated in a small birch tree on the edge of a clearing on one of the rock ridges along the trail to McCargoe Cove (II, 3). The nest was placed about fifteen feet from the ground. Several pairs of these birds were observed at similar locations and probably nested wherever found.

113. *Sialia sialis* (766). Blue Bird.

Range: Eastern United States to the eastern base of the Rocky Mountains, north to Manitoba, Ontario and Nova Scotia, south in winter from the middle states to the Gulf States and Cuba.

Stations: Washington Harbor, clearings and burned area, I, '04.

Breeding: Found near nest August 18.

Migrating: August 22 to September 12.

The Blue Bird is a rare summer resident on the island. None of this species were observed during our stay on the island the year previous, and the few families which came to the clearing at Washington Harbor were the only ones observed throughout this season.

Breeding Notes: A nest of this bird was found in a birch stub near the edge of the third clearing. It was located in a Downy Woodpecker's hole about fifteen feet above the ground. On this date, August 18, the young had left the nest, but still kept in its immediate vicinity.

NOTES ON ISLE ROYALE MAMMALS AND THEIR ECOLOGICAL RELATIONS.

BY DR. CHAS. C. ADAMS.

I. Introduction.

The following notes on the mammals should be considered supplementary to those published concerning the collections made by the Museum party during 1904.* The specimens were largely collected by N. A. Wood and Max M. Peet, although others were taken by Dr. R. A. Brown, O. M'Creary and W. P. Holt. Unfortunately the ecological relations of the mammals could not receive the attention in the field which their importance deserved.

For the determination of all doubtful specimens we are indebted to: Dr. C. Hart Merriam, Chief of the Biological Survey of the U. S. Department of Agriculture; to Mr. W. H. Osgood and Mr. E. W. Nelson of the same survey; and to Dr. Glover M. Allen, of the Boston Society of Natural History, for the determination of certain bats.

In the references to the literature, no attempt has been made to cite all authorities for the ecological notes or those of geographic range, but enough are given to furnish an index to such literature as will be of special interest to the Michigan student.

Although Isle Royale is an almost uninhabited region, except for the summer visitors, yet its original condition has been modified in several important respects. Thus forest fires have at various times swept over large areas of the eastern half of the island, and trappers have exterminated the beaver and perhaps other species.

The location of the old trading posts is of interest because of their relation to mammal remains, such as antlers, which have been, and may be again found. Dr. Lane ('98, p. 3) cites the location of several of these posts and others are given on the U. S. Land Office map by Ives; these different posts were located as follows:

1. Near Washington Harbor, Sec. 2, T. 63 N., R. 39 W. American Fur Co.

2. Head of Siskowit Bay, Sec. 2, T. 63 N., R, 37 W. American Fur Co. Trading post and fishery.

3. On south shore of Siskowit Bay, Sec. 35, T. 64 N., R, 37 W. American Fur Co. Trading post and fishery.

4. Near Hay Bay, Sec. 24, T. 64 N., R. 37 W. Hudson Bay Co.

5. On the north shore of Fish Island, Sec. 35, T. 67 N., R, 34 W. American Fur Co. Trading and fishing post.

6. Near Card Point. (cf. Lane, '98, p. 3.)

*An Ecological Survey in Northern Michigan, 1906, pp. 131-133.

It would be of considerable interest if the records of the fur companies could be examined for information bearing upon the original mammal fauna of the island. It is not unlikely that the Otter, *Lutra hudsonica hudsonica* (Desm.), was a member of this fauna; it would be more surprising if it were not. Near the east end of Todd Harbor there is an Otter Lake, but it is very difficult to determine how much reliability can be put on such place names, as evidence of the former occurrence of animals. The most notorious case in Michigan is that of the Wolverine (which may also have been a resident of Isle Royale), where in spite of the fact that Michigan is called the "Wolverine" State and there are such place names, yet no undoubted records of the occurrence of this animal are known, (cf. An Ecological Survey of the Porcupine Mountains and Isle Royale, p. 131.) In the present connection it is therefore of interest to note that there are several place names about the Isle Royale archipelago which have evidently been derived from the fauna, of which at least one member has become extinct. Reference is made to such names as Beaver and Caribou Islands and to Beaver Lake near the east end of Todd Harbor. Other animal place names worth mentioning in this connection are the following: Fish (island), Pickerel (cove), Angleworm and Chicken-bone (lakes, descriptive of their form), Hawk and Gull (islands). The abundance of pickerel, hawks and gulls upon Isle Royale make such names quite appropriate.

As almost nothing of a general character has been written on the mammals of Michigan, it has been thought desirable to depart from the usual form of an annotated list and include such brief ecological notes as could be secured from available literature, while the geographic data are intended to orient each species geographically.

The following is, so far as known, a complete list of the mammals recorded from Isle Royale:

1. *Rangifer caribou* (Gmelin). Woodland Caribou.

2. *Sciurus hudsonicus* (Erx.). Hudson Bay Red Squirrel.

3. *Castor canadensis* Kuhl. Northeastern Beaver.

4. *Peromyscus canadensis umbrinus?* (Miller). Isle Royale White-footed Mouse.

5. *Evotomys gapperi* (Vigors). Common Red-backed Mouse.

6. *Fiber zibethicus* (Linn.). Muskrat.

7. *Lepus americanus* (Erx.). Hudson Bay Varying Hare.

8. *Lynx canadensis* (Kerr). Canada Lynx.

9. *Mustela americana* (Turton). Eastern Marten.

10. *Putorius vison* (Schreber). Mink.

11. *Putorius cicognani* (Bonap.). Small Brown Weasel.

12. *Putorius noveboracensis* (Emmons). New York Weasel.

13. *Myotis subulatus* (Say). Say's Brown Bat.

14. *Myotis lucifugus* (Le Conte). Le Conte's Brown Bat.

15. *Vespertilio fuscus* (Beauv.). Brown Bat.

2. Mammal Successions.

While it was not possible to make a detailed study of the ecological distribution of the mammals yet a few relations seem evident which may prove suggestive to others. The succession of vegetation has long been recognized, as it was well known that burned forest lands will in time become invaded by herbaceous plants, later by shrubs, and finally by a forest. Yet the fact that there must be similar animal successions has attracted but little attention and, so far as known to the writer, no definite attempt has even been made to determine mammal successions, much less to recognize the need of formulating its laws. Successions of vegetation initiated by man were recognized long before those in nature, but it seems that the students of animals have not only neglected "natural" successions but also even those influenced by man. *A priori* no one can doubt but that there must be mammal successions correlated with environmental changes upon which mammals are dependent. To resolve such a problem as this demands more than a recognition of the species involved and needs a, knowledge of their life history, habits and their environmental relations. On account of the preliminary character of this work only a few suggestions will be attempted at this place.

As the level of the Glacial and post-Glacial antecedents of Lake Superior were lowered, Isle Royale began a new biotic cycle; from a reef in the lake it became transformed into an island. But the history of the island even prior to its emergence must be considered because the pre-Glacial topography and the overriding ice both left a record of their influence upon its surface in the form of parallel ridges and depressions. Thus the Isle inherited from the past certain characters which are conspicuous features of the animal environment even today. These irregularities of the surface produced rocky flats and ridges, or rock bound basins, which in all probability were thoroughly wave washed and cleared of soil as the waves fell from them. The inheritance of these depressions, rock surfaces and ridges, allows us to consider two sets of original conditions. That of the depressions with their lakes, ponds and swamps, and that of the ridges or rock surfaces with openings or "rock clearings." The first will be called the Lake-Pond-Swamp series.

1. Lake-Pond-Swamp Series.—From the large lakes upon the island all gradations of conditions are found leading to the forested swamps. The shore line of the island itself should also be mentioned in this connection as its conditions and mammal fauna, in protected parts must be much like that of the larger lakes upon the island. To these marginal conditions must be related the Muskrat, Mink, and perhaps the Otter and the Beaver. All of these animals will traverse the open water but are more truly amphibious or frequenters of the margin. The dryer shrub or Cassandra zone is likely to be invaded by Hares, as is clearly shown by their numerous run-ways, while wandering Lynx, Mink and Weasels may also be expected here in search of their food, while the open area over the water and marsh are likely to furnish a flight area for bats. It should not be inferred, however, that these mammals do not occur in other conditions, but rather that they are representative or dominant forms in such an environment.

The dynamical relations of such conditions should be considered for their bearing upon the laws of environmental changes. With the falling of the Lake level the beach zone moves downward and is invaded by a. land flora and fauna. This same change of level, supplemented by inwash, vegetable and animal debris, and possibly the down-cutting of outlets tends to drain basins and allow the encroachment of the open marginal zone upon the open or deeper water. At the same time this marginal open zone, as a solid substratum develops, tends to become invaded by Tamarack, Black Spruce and Arbor Vitae, and still later by the balsam and white spruce forest. But while attention has only been directed to the conspicuous forest cover, it should be remembered that the entire environment, the water, soil, ground cover, light relations, animal foods, etc., are also undergoing a transformation.

Correlated with the invasion of the open swamp by the forest is the arrival of the Red Squirrel; while as the forest becomes denser and a shade develops under the trees conditions are produced which are favorable for the Red-backed Mouse. These forested swamps are likely to have a poor ground fauna, as the forms likely to frequent the open are greatly reduced in numbers or excluded, while the wet ground tends to exclude many forms of the balsam forest. But as these forested swamps become dryer, the balsam and white spruce tend to invade them and thus one is able to see all stages of transition, from the open water to that of the balsam-spruce forest. With regard to the mammal fauna, these relations may be briefly summed up as follows: from the open water to the balsam-spruce forest there is a relatively simple change, from the dominance of the aquatic and marsh types (supplemented by the bats) to land forms which are terrestrial, as the weasels, terrestrial and arboreal, as the Lynx, and arboreal as the Marten, and aerial as the bats which frequent the margins.

Let us now consider the second series, which begins with land rather than open water, and trace its general succession.

2. The Land Series.—As the lake level fell from the island, rock surfaces were exposed which surrounded the wet and damp depressions. In all probability these surfaces had but little soil, like the exposed wave-washed beaches of today. These flat rock surfaces and ridges have probably had quite different histories or successions from that of the depressions, although both were originally open, yet this was due to very different causes; in the case of the lake this may have been because a substratum was lacking, while on the rock surface there was no soil and hence the openings or "rock clearings." Thus bare or lichen covered rocks offer little that is attractive to mammals, although bats might

take shelter here during the day under loose rocks, and patrol the open at night; yet it is not until there has been an accumulation of soil in the crevices, so that the Bearberry, Pennsylvania Cherry, Cladonia or scattered Jack Pines get a foothold, that the Varying Hare, Red Squirrel and Caribou can find their food here. In turn comes the Lynx, Weasels and perhaps the Marten in search of the vegetarians. Here again the Bats, Red Squirrel, Hare and Lynx are pioneer mammals invading open unforested areas. As the soil increases in depth on such surfaces, a bordering zone of Aspen and Birch spreads over the surfaces and slopes in a manner similar to the encroachment of the sedge zone upon the open water of a lake, and tends to restrict the open areas. These in turn are followed by a zone of Balsam and White Spruce, so that in time these surfaces tend to become completely forested, just as the depressions tend to have a similar fate. With these forests comes the exclusion of the bats, while the Red Squirrels increase, and the Hare tends to frequent the forest margins, where many go to feed in the openings at dusk. With the dryer substratum and more diversified vegetation the conditions are evidently more favorable for the White-footed Mouse, which with the Squirrels and Hares become dominant forms, and prove attractive to Weasels, Marten and Lynx. These mammals are the representative balsam-spruce forest types; and it is not improbable that if such a forest becomes transformed into a maple-yellow birch type, the character of the mammals but little changed, with the possible exception of the relative abundance of some species.

Briefly summed up, the general succession of mammal types—from the "rock clearing" to the balsam-white spruce or hardwood forest—is thus seen to be a change from the dominance of the forms frequenting the open to those of the forest. The final result of both the lake and the land series is thus seen to be practically the same—both lead to the dominance of the forest types. Such observations and influences, which attempt to correlate environmental changes with the habit and habitat relations of the mammals, point to a general conclusion which should prove useful in field work: that each habitat, swamp, conifer or hardwood forest, etc. should not only be considered as a unit of environment, but even more—*as parts of a series of changes or stages in the continuous development of the animal environment*. Standing upon the top of the Greenstone Range, one may see this entire series of conditions, varied, to be sure, and confusing to many, yet in many ways relatively simple and free from chaos.

3. Faunal Affinities and Migrations.

1. The Geographic Affinities of the Fauna.—As determined by the present geographic range of the species and varieties of mammals found on Isle Royale, the fauna is emphatically of the northeastern biotic type (Adams, '05, p. 58). This is the dominant fauna of the region from Labrador westward, between Hudson Bay and Lake Superior into the Mackenzie basin, and only enters eastern United States to a limited degree, except on mountains. The representative forms are: Caribou, Red Squirrel, Beaver (typical form), White-footed Mouse, Red-backed Mouse, Bare, Lynx, Marten and the Small Brown Weasel. In case these forms range westward into the Rocky Mountains and to the Pacific Coast, they are represented by another variety, except in the case of the Lynx. The Muskrat, New York Weasel, Mink (typical form) and Say's Brown Bat are forms ranging far into southeastern United States, some reaching west to the Rocky Mountains or the Pacific Coast. Le Conte's Brown Bat and the Brown Bat have such extensive ranges to the south of the United States as clearly to suggest a dispersal from the south.

To determine close faunal affinities, much weight must be given to the geographic range of the varieties or forms whose affinities are to be determined. In a region whose fauna has undergone extensive migrations, within comparatively recent times, as in the case of glaciated North America, many allied varieties have had a very different history and such forms must be subordinated in the faunal comparison to those that have had similar histories. For this reason the post-Glacial migrations of the fauna of eastern North America make the north and south relations stronger than those between the east and the west because there is a closer genetic relationship between forms along the same general migration route than between those of very distinct routes and histories.

2. Post-Glacial Origin of the Fauna.—The geographic affinities of the mammal fauna of Isle Boy ale have been shown to be with those of the region north of Lake Superior, and representative of the coniferous forest region of central and eastern Canada. There now remains to be considered the approximate post-Glacial geographic origin of this northern fauna. But before this subject can be understood, special attention should be directed to the fact that an extensive barrier in the form of a series of Glacial and post-Glacial lakes and even the Champlain Sea (cf. Taylor, '05, pp. 103, 106 and 107) stood between the advancing fauna from the south and Canada. All these barriers were not contemporaneous, yet some of them, generally several extensive ones, have been present since the decline of the Wisconsin ice sheet. This barrier was only interrupted, as far as many mammals have been concerned, by narrow streams, such as, the Saint Clair, Detroit, Niagara and St. Lawrence rivers. Even these must have retarded many forms, except during the winter, if they were not amphibious or flying species. The significance of this barrier seems to have been generally overlooked, but a moment's reflection will show its important influence upon the post-Glacial origin of the biota of eastern Canada.

On account of the presence of the ice sheet on both sides of Hudson Bay, and its longer duration at the Labradorian center, we may safely dismiss the question of the fauna under consideration as being of immediate northern origin. On the other hand we have much

positive information which shows that there were centers of preservation of biotic types south of the ice margin in the United States. For these reasons our problem becomes one of tracing the probable northern and perhaps eastern migration routes from these centers of preservation to the region vacated by the retreating ice sheet.

Therefore, keeping in mind the major interruptions of the water barrier and the fauna! affinities of Canada east of the Great Plains, it appears that the major routes into Canada have been, in the east, up the Hudson and Champlain valleys, along the Appalachian range up the Hudson and Mohawk valleys and thence around both ends of Lake Ontario—routes for the coastal and Appalachian types. The Ohio valley types invaded Ontario around both ends of Lake Erie, especially some of the more recent southern and Mississippi forms, around the western end. Perhaps a limited number of western forms have entered Ontario through the Upper Peninsula of Michigan and a very large number of Mississippi valley, and to a lesser degree western types, around the western end of Lake Superior. The Mackenzie basin seems to have been invaded largely up the Mississippi and down the Red River valleys, the Plains also sending their quota. These routes are largely shown by the affinities of the present biota and have in all probability functioned throughout post-Glacial times, because there have been no marked changes in the major routes, with the exception perhaps of the drainage changes which have influenced the fresh-water life. With such general relations in mind, we are in a position to consider the geographic origin of the northern Ontario fauna.

In considering the post-Glacial invasion of northern Ontario from the southern centers of preservation, it is evident that the barren ground types must have traversed this region en route to the northern position which they now occupy. But relicts of this type have not been recognized among the mammals, although it seems very probable that some invertebrates have lingered. Miller (‘97, pp. 6-8) evidently considers that the exposed north shore of Lake Superior, shows marked Hudson Bay affinities, but is not able to decide whether or not this area is limited to the Lake coast. Of the five mammals which he lists as showing these northern affinities, only two, the Caribou and White-footed Mouse, occur on Isle Royale. Miller evidently did not recognize any barren ground relicts in the fauna, yet its Hudsonian affinities may belong, in part, to this class. The barren ground relicts, when present in the coniferous forest belt, may be expected to occur in open swamps, talus or other open rock areas or habitats, as these conditions will most nearly approach those of the open barren grounds.

With the amelioration of the glacial climate, the barren ground forms were replaced by an invasion of the stunted tree growth and its associated fauna. The coniferous forest association, in all probability, invaded the north shore region, not only around the western end of Lake Superior but also from the east, where it lingers even today as a dominant type upon the higher mountains, thus preserving a continuous record to the present day; while to the westward this type has not lingered so far to the south because of the absence of favorable mountain habitats. On account of the present great extent of this biotic type in the east, a more rapid northward extension may have taken place there, but the mountainous character of the country, the various water barriers westward to Niagara, and possibly the longer duration of the ice in the northeast may have retarded this advance, so that a relatively more rapid extension took place from Michigan into southwestern Ontario and around the western end of Lake Superior (cf. Taylor, ‘05, p. 107, map). It therefore seems quite probable that the north shore region was invaded both from southern Ontario and from around the western end of Lake Superior.

Returning now to the immediate origin of the Isle Royale mammal fauna, it is quite evident that with the exception of the bats, this fauna reached the island from the north shore of Lake Superior. There is perhaps another possibility, but one which seems highly improbable, and that is, that the island was stocked from the south shore of the Lake at that time during post-Glacial migrations, when it contained a more boreal type of fauna. But when we consider the fact that the Superior basin since Glacial times has had much the same general form as the present lake, it seems probable that lake currents similar to those of the present lake existed, and under such circumstances the north shore fauna, especially to the eastward, would be favored. The ice bridge between the island and the north shore permits direct communication with that shore during the winter. The method of arrival for various mammals must of course remain largely conjectural, but the following methods seem probable; the bats by direct flight; the Caribou, Hare, Lynx and Marten probably over the ice; the Red-backed and White-footed Mouse, Red Squirrel and perhaps the Weasels by means of driftwood and lake currents; the aquatic forms, Muskrat, Mink, Beaver, and perhaps Otter, by swimming.

4. Annotated List.

1. *Rangifer caribou* (Gmelin). Woodland Caribou.

Many reports are in circulation concerning the occurrence of Caribou upon Isle Royale, and jet I have learned of but two records in the literature, and these refer only to antlers. Baird ('57, p. 634) figures, from the Smithsonian Collection, an antler from an adult Caribou from Isle Roy ale (No. 900), and Gillman ('73, p. 751) gives the following information: "During a recent visit (May, 1873) to Isle Royale, Michigan (Lake Superior), interesting evidence of the former presence of the Caribou (*Rangifer caribou* Aud. and Bach.), long extinct there, was brought to my observation. I have now in my possession two relics—the greater parts of the horns of this animal—which were picked up at different points on the island. The antlers are much decayed, one being a

mere shell, and. besides, they had been gnawed by rodents. Such specimens, often of great size, are frequently discovered of late at this isolated place."

Mr. Gillman has recently written to me that these antlers were many years ago presented to Columbia College. But upon inquiry, it seems that it is not possible now to find them.

Dr. A. C. Lane, State Geologist of Michigan, sends me the following records from his Isle Royale note book: "Note book 115, p. 72, September 25, 1895. Forbes found a Caribou horn 2½ feet long."

On account of the limited information on this subject I was therefore pleased to secure the following observations from the men who had only recently seen the live animals upon the island. Two trappers, Victor Anderson and his son, John, spent the winter of 1903-1904 trapping upon the isle. On March 27, 1904, John Anderson saw two Caribou at Blake's Point, on the northeast end of the island, and on the same day his father drove two Caribou, on the ice, from the head of Rock Harbor eastward to the outlet of the Harbor near Middle Islands. These two Caribou; were very tame, so that Anderson, who had no gun, was able to get within about 200 feet of them. Anderson said that at this time the island was connected with the mainland, on the north, by ice. On April 16, 1905, Anderson, his son and several fishermen saw 9 Caribou on the ice in the channel near their fishing camp on Rock Harbor near the Light-house. At this time the lake was open but Rock Harbor was still frozen over, as the ice remained in the harbor for some little time after the ice broke up in the lake. These facts clearly indicate that Caribou must have been upon the island during the past summer, and the following observation tends to substantiate this inference. On September 9, 1905, Michael Hollinger, an experienced trapper, and Max M. Peet, of this expedition, saw, about four miles out from Washington Club, on the Desor trail (III, '04) a small bunch of low maples which had been broken down, the branches, bark and leaves stripped off, and the small branches eaten away. The work was fresh, as the leaves were only wilted, and the exposed wood was not discolored. Hollinger was confident that this was the work of the Caribou.

The following information, which was reported to me by Mr. J. H. Malone, Keeper of the Menagerie Island Light on Siskowit Bay, is suggestive for its bearing on the question of the origin of the Caribou upon the Isle. John Erickson was fishing through the ice, about 5 miles out from Pigeon Point, Minn., and at one time saw 11 Caribou on the ice in the direction of Isle Royale. This clearly suggests a satisfactory method by means of which these animals could easily reach the island.

Ecological Notes.—According to Canton, Caribou frequent marsh and swamp grounds, a characteristic which is in decided harmony with the physical conditions of the area it inhabits. It is adapted to these conditions in several ways, as is shown not only in its feeding upon plant life and frequenting damp and wet places, but also in the character of its feet. Caton ('77, p. 90) says: "In traveling through the snows, or soft marshy ground, the Caribou throws his hind feet forward, so as to bring the leg into something of a horizontal position, spreads wide his claws, and broad accessory hoofs, and thus presents an extraordinary bearing surface to sustain him on the yielding ground, and so he is enabled to shuffle along with great rapidity, where any other large quadruped would mire in a bog, or become absolutely snowbound. The Reindeer [Caribou] alone leaves in his track the marks of all four of his hoofs belonging to each hind foot, and specimens show the effects of attrition on these secondary hoofs, and prove that they serve a useful purpose in the economy of the animal." Still another adaptation is of interest. During winter, the frog of the Caribou's hoof is entirely resorbed (Elliot, '02, p. 268), thus producing a sharp rimmed concave surface well adapted for walking upon the ice.

In addition to the swamp plants used for food, the branches and leaves of trees are frequently eaten, but the characteristic food is the "reindeer lichen or moss" (*Cladonia*). This lichen is very abundant on Isle Royale where the soil is too shallow and physical forces too severe for most other plants to grow, as on the south shore of the island (V, 2) and upon the ridges. These lichen growths are very characteristic of the area over which the Caribou ranges in Northeastern North America. The region has been so recently glaciated and the soil removed so that extensive patches of these lichens occur scattered through the forests and are as characteristic of the region as are its swamps and coniferous forests. This kind of food is therefore of general occurrence throughout its geographic range.

The female Caribou is remarkable in the possession of antlers, a characteristic in the deer family, as a rule, of males only; they are, however, much smaller in size than those of the male. Caribou antlers are further remarkable for their variety of form, the antlers from the same individual, according to Caton ('77, p. 89), having as little in common as those from different individuals. The old males, as a rule, shed their antlers annually before the last of December, but the young males retain them longer, the yearlings till spring and the females still later, until after the young are born.

The breeding season, according to MacFarlane ('05, pp. 679, 678) occurs in September and October, and the young, one or two, are born the following spring.

The migration habits of Caribou are of considerable interest and may have an important bearing upon the differentiation of the Woodland and Barren Ground, *R. arcticus* (Rich), forms. In the vicinity of York Factory on the west coast of Hudson Bay, the Woodland Caribou (Preble, '02, p. 41) migrates to the coast in the spring and returns inland about the middle of October and during November. In addition to this summer seaward migration of these coastal ones, there is also a summer southward movement to the interior (Georgeson, '04, p. 378). At least some of the more northern Barren Ground

Caribou during the summer also migrate to the coast near Hudson Bay as well as near the mouth of the Mackenzie River (MacFarlane, '05, p. 681), and inland, at Reindeer Lake, Keewatin (MacFarlane, '05, p. 684), there is a distinct northward spring migration during the last of April and May, and a return movement during late October, November and December. The breeding season is during September and October, and as this period is much the same for the two forms, the northward migration of the Barren Ground Caribou and the southward migration of the Woodland Caribou, has a distinct tendency to isolate these two types during their early fall breeding season; a result which in time would certainly influence their specific differentiation. Similar relations in the past may be one of the causes for the differences which are today recognized. MacFarlane ('05, p. 680) states that the two forms do not associate. The seaward migration is probably limited to those in the vicinity of the coast and does not influence the inland forms to a marked degree. These seasonal migrations are very suggestive of the influence which climate, and, in part, the resultant habits, may have upon habit and specific differentiation.

Geographic Range.—The Woodland Caribou ranges northward, in forested regions, from Labrador, Nova Scotia, and Maine, (formerly northern New Hampshire and Vermont), on the east, westward through Quebec and Ontario along the north shore of Lake Superior, where Miller reports it very abundant, (Isle Royale) Michigan; northern Minnesota; Manitoba; Saskatchewan (Cumberland House) to Athabasca, and Great Slave Lake, Mackenzie (cf. Grant, '02, p. 18).

Aside from the Isle Royale records, the only other record of the occurrence of Caribou in Michigan is that given in Caton ('77, p. 87) whose statement is as follows: "If it was ever abundant south of Lake Superior, where it was found when the copper and iron mines first invited extensive settlements there, the fact is not well attested, and I cannot learn that any have been met with south of that Lake within the last twenty years or more."

Fossil reindeer remains have been found in a number of Pleistocene deposits, far to the south of their present range (cf. Hay, '02, p. 686) and clearly show that they formerly occurred in New York, New Jersey, Pennsylvania, Kentucky and Iowa. The extreme southern localities may be due to southern winter migrants. It is not improbable that among these fossil remains, several forms occur, as even today the ranges of the various forms are not sharply defined, and as our knowledge of the recent species has been greatly extended in recent years, these fossil remains are in need of critical study. Fossil Caribou are of special interest on account of their bearing upon the Glacial and post-Glacial dispersal of these animals. These facts clearly suggest an extensive migration from the vicinity of the glacial border northward into the barren grounds. As the Woodland Caribou, even in its migrations, tends to remain near the forests, their fossil remains may furnish valuable suggestions concerning the southern extension of forests during the Ice Age.

2. *Sciurus hudsonicus* (Erx.). Hudson Bay Red Squirrel. The Red Squirrels were exceedingly abundant, especially in the coniferous forests. The Squirrels, Hares, White-footed Mice and Lynx are the representative mammals of the island. The most conspicuous as one walked through the forest were the Squirrels, whose abundance and persistent barking repeatedly attracted attention. A total of 40 specimens was secured from the following localities: I, 1, 2, 3, 4; II, 5; V, 2, 3, 4, 5 and I, '04. They were seen or heard at or near the following additional places: I, 5; III, 2; IV, 9; V, 7; I, '04 and II, '04. Only a few of the details of occurence will be given. Squirrels were abundant in the forests about the Light-house at Rock Harbor (I, 3) and along the path to the fishing camp; also fairly abundant on the Jack Pine ridge on the north side of Conglomerate Bay (I, 5), and in the woods about the margin of the Sphagnum-spruce bog (I, 6). They also occurred in the hardwood forest at the top of the Greenstone Range (IV, 9), near the head of Tobin Harbor. Along the Haytown trail, north of Siskowit Bay (V, 7), they were apparently not abundant, in fact very few birds or mammals were seen along this trail, and the forest was noticeably silent and in marked contrast to the forest at other places. The small heaps of bluish cone scales of the Balsam were several times seen marking the place where a squirrel had taken its meal. Our camp at Siskowit Bay (V, 3) was surrounded by a balsam-spruce forest, which fact explained the abundance of squirrels at this place. Much the same general conditions prevailed along the trail to Siskowit Lake (V, 4) where they were also abundant. At Washington Harbor, along the road to Wendigo (I, '04), squirrels were very abundant, particularly young ones.

Ecological Notes.—MacFarlane ('05, p. 749) states that this squirrel "makes its nest in a tree and has usually, once a year, from four to six, and occasionally as many as seven young." Merriam ('86, p. 218) states that in the Adirondacks of New York the young Red Squirrels are born about the first of April. On Sept. 17, 1905, Max M. Peet saw a squirrel about 20 feet above the ground, tearing away loose bark from a, birch tree and carrying it away, presumably to be used in the construction of a nest.

Only a few observations were secured upon the food habits. While fishing for trout in the outlet of Siskowit Lake, Mr. K. Neutson saw a Red Squirrel running with a mushroom in its mouth, Max M. Peet also saw young squirrels eat similar fungi at Washington Harbor. He further reported that traps baited with nuts (hickory, peanut and walnut) did not prove attractive to them. Along the Wendigo road (I, '04) at Washington Harbor I saw a young squirrel examine some very low red raspberry bushes, evidently in search of berries. It secured one and stood up to eat it, but dropped down and approached within a few feet of me its curiosity momentarily getting the better of its hunger.

Notes on the Specimens Collected.—This series contains both young and adults collected during July and August of 1904 and 1905, and includes two specimens taken in winter pelage by a trapper. In all there are 52 specimens, 40 of which were taken during 1905. An examination of these specimens brings out some interesting relations regarding the seasonal moults of pelage and its consequent color changes. These changes, as they occur about New York City, in the Southeastern Red Squirrel (*S. hudsonicus loquax* Bangs), have been studied by Allen ('90). This is the common Red Squirrel of Southern Michigan. The characteristic differences between the winter and summer pelages may be briefly stated thus: The winter pelage (from Michigan specimens), as a rule, is long and dense, with a bright rufous median dorsal band, very conspicuous ear tufts, body without distinct lateral black stripe, lower parts of body grayish white, sides of body yellowish olive, arid soles of feet furred; the summer pelage is short, lacks the conspicuous rufous median band, the ear tufts, and the fur on the soles. It acquires a very distinct lateral black line, the lower parts are whitish or yellowish, and the upper parts suffused with rufous.

The spring moult, according to Allen, begins in April or May and is nearly completed during June and July. By the fall moult, a winter pelage is acquired during the months of November and December. This undergoes slight change, with the possible exception of an increasing intensity of the broad rufous band during February and March. The gradual character of these changes suggests that this process may be an almost continuous one.

A few specimens taken near Ann Arbor, Michigan, early in November, show the transition from the summer to the winter pelage. In some specimens the ear tufts are becoming prominent, the rufous on the tail is becoming intensified and is moving forward along the mid-dorsal line. One specimen (No. 32991) taken November 17, 1905, has but few long hairs upon the ears but has a very broad intense rufous dorsal band, a distinct black lateral line and is white below. Another (No. 33000), taken December 2, 1905, has the dorsal rufous band, well developed ear tufts and lacks the lateral black line. It seems probable that the time of spring moulting will prove to come during April and May, as in New York, but specimens are not available by which this can be determined for southern Michigan.

Turning now to the Isle Royale specimens some interesting differences become evident when the winter pelage is compared with that of similar specimens of *S. hudsonicus loquax* from Michigan. Unfortunately there are only two specimens in winter pelage from Isle Royale, and one of these skins (No. 32138) lacks ears and feet. The other (No. 33066) was taken early in January, 1904; both were collected by trappers. In these specimens the dorsal rufous band is only slightly developed, about to that degree of general rufous suffusion seen in summer specimens of *S. hudsonicus loquax* from southern Michigan. The difference between the two forms is very striking when they are placed side by side. In one specimen of *hudsonicus* the ear tufts are barely developed, and in both specimens the lateral black stripe is indistinct; the lower parts are dirty white or plumbeous; sides of the body olivaceous gray and the pelage long. In one the soles are densely furred. The summer pelage of *hudsonicus* apparently retains the rufous median stripe as in winter but is somewhat obscured by the general rufous suffusion of the upper surface, the amount of rufous having been increased on the sides; the ear tufts are, of course, lacking; the lateral stripe becomes black and conspicuous; lower parts whitish or yellowish; above olivaceous or suffused with rufous but much paler than *S. hudsonicus loquax* in the corresponding pelage, soles bare, and the pelage short. A few immature specimens (Nos. 33072, 33074, 33076, 33078) taken between July 27 and Aug. 11, are quite as gray as the January specimen, the lateral black line and the under parts corresponding closely to it. An adult male (No. 33050) belongs in the same category but is even more gray than either winter skin. The amount of fur on the soles is perhaps the most marked seasonal change with such specimens. In other words, the seasonal color changes are not well developed in some specimens.

It is evident from the above observations that, if the two winter specimens are representative, the seasonal color changes are much less pronounced in *hudsonicus* (some individuals, in all probability, hardly changing in color at all) than in *S. hudsonicus loquax*. This of course does not mean that there are no moults, but that moulting is not accompanied by a marked color change. Such observations also suggest that the Bed Squirrels, in the northern part of their range, may not show as marked seasonal color contrast as is seen farther to the south. But this point can only be definitely determined by the aid of a larger series of winter specimens than are at present in the Museum collection. From a somewhat different point of view, Allen (798, p. 253) remarks "All the forms of the *S. hudsonicus* group present two well-marked phases of individual color variation, particularly in the summer pelage, namely, a rufous phase and an olivaceous phase, the former usually predominating in about the ratio of 4 to 3, with a considerable proportion of intermediates, which connect the two principal phases. The two principal phases are usually so well marked that were they separated geographically, it would be natural to regard them as subspecies. For this reason a small series of specimens from a given locality is apt to be unsatisfactory."

Allen's law of the increase of intensity of color from the north southward is well illustrated by the Red Squirrels in Michigan. The paler form, *S. hudsonicus*, occurs to the north, on Isle Royale, and the brighter, more rufous forms *hudsonicus loquax* to the south, in the remainder of Michigan. It is also worthy of note that the seasonal contrasts in pelage are apparently less marked in the northern than in the southern part of the State.

Geographic Range.—The typical form of the species has an extensive northern transcontinental range from Labrador, New Brunswick and Vermont, westward to the north shore of Lake Superior in Ontario; Isle Royale, Michigan; North Dakota; Manitoba; Mackenzie basin to Alaska and the Pacific Coast.

This extensive geographic range in the Canadian forested region and in Alaska is of special interest. The far northern range of this form and its great abundance suggest that it is well adapted to the region it inhabits. It is evidently a Glacial or post-Glacial migrant into most of its present northern range, as the entire area (excepting part of Alaska) lies within the region glaciated by the Wisconsin Ice sheet. It seems probable therefore that, at the time of the maximum extension of this sheet, this squirrel frequented largely the coniferous forests at its southern border—east of the Rocky Mountains—and as this sheet retreated northward it spread with the forests into the area now occupied. It also seems likely that their main headquarters were in the region south of the Great Lakes and eastward, because the probable aridity of the Great Plains in Glacial times would be unfavorable to extensive forest growth. The Glacial and post-Glacial migrations of the Red Squirrels, as far as they can be inferred, may explain some of the peculiarities of their present range. The Red Squirrel is a representative member of what I have elsewhere called the Northeastern Biota (Adams, '05), some of whose members have, in Glacial and post-Glacial times, invaded the glaciated region from the south and have spread northwest to the Pacific coast in Alaska as well as eastward, in Labrador, to the Atlantic coast.

It also seems probable that the geographic isolation and the peculiarities of the Black Hills Red Squirrel (*S. hudsonicus dakotensis* Allen) may be explained, in part, if it be considered a glacial relict which has become isolated by the change of climate attending the decline of the Ice Age. The incomplete development of the lateral black line, which usually occurs in the summer pelage of this group, is of special interest in this connection.

In addition to the typical form there are 9 or 10 varieties of this species which have a range from southern Alaska to Washington, Oregon, Idaho, northern Utah, Montana, Wyoming, South Dakota, southern Minnesota, Wisconsin, northern Illinois, Indiana, southward to North Carolina and northward to Labrador. The Red Squirrels are doubtless one of the best groups of North American mammals for a study of the laws of geographic variation, and is a group of undoubted Mexican or Central American origin (cf. Coues & Allen, '77, p. 670); the Isle Royale form being the one which has departed the fartherest from its region of origin. This species, judging from its geographic range, has apparently crossed the Rocky Mountains from the east, perhaps near the Canadian boundary.

3. *Castor canadensis canadensis* Kuhl. Northeastern Beaver. In all probability the Beaver is extinct upon Isle Royale, although it formerly occurred there. We saw no one who had any recent information of its occurrence. Mr. J. H. Malone, reported that a Mr. Butterfield had seen a beaver dam on a creek at the head of Hay Bay in 1878. About that time Mr. Malone found beaver cut stumps and remains of a dam on the short stream which forms the outlet of Siskowit Lake. The U. S. Land Office map indicates the site of "old" beaver dams as follows: SW. ¼ Sec. 13, T. 64 N., R. 38W. NE. ¼ Sec. 15, T. 64 N. R, 37W. and NE. ¼ Sec. 9, T. 63 N., R. 38 W. The Survey furnishing the data for this map was made by Wm. Ives in 1848.

Ecological Notes.—The Beavers of Michigan have been given more study than any other native mammal found in the State, and at the same time they have perhaps contributed more toward our knowledge of the natural history of the American species than those from any other locality. The extensive and important investigations referred to were made in Marquette County about 50 years ago by Lewis H. Morgan, and were published in 1868 in his volume entitled "The American Beaver and His Works." This publication, to which reference should be made for a detailed account of the habits and activities of this animal, has become a classic in American natural history.

In brief the life history is as follows: The breeding season, according-to MacFarlane ('05, p. 742), occurs in January and February, at which time the males fight fiercely. The young, blind at birth, are born during April and May, and are suckled for several weeks, but soon begin to eat the succulent stems and roots of plants. The young are believed to remain with parents for 2 or 3 years, and to breed at about the age of three. They are most prolific at about middle age, when they usually produce from 4 to 6 at a birth, and occasionally even 8 or 9. The Indians believe that they reach the age of 12 to 15 years (Morgan, '68, p. 222). There is a tendency for beavers to migrate (Morgan, '68, p. 137), especially when a region becomes overstocked, and very naturally they follow the streams.

Their food consists of roots of grasses and water plants, including the water-lily, the bark of aspens, fresh willow branches, birch, the leaves of deciduous trees, and late in winter even of wood itself. The winter supply of food is stored under water. The burrows, lodges, dams, and meadows that result from the activities of this animal have aroused much popular interest, but space can not be allowed to describe these in detail. There is a very extensive literature devoted to this phase of beaver life. The Beaver is essentially a burrowing animal, so that the margins of the waters which they frequent contain numerous burrows or tunnels. These are from 10 to 15 feet long and open, at the lower end, a foot or so below the water; from this point they incline upward to within a few inches of the surface of the ground, thus allowing for the necessary ventilation of the burrow. Morgan reports that in the case of the river-inhabiting beavers the upper

ends of these tunnels are occasionally indicated by a pile of cuttings a foot or so high, and that it is probable that from such a beginning as this beaver lodges have been developed. Of these lodges there are several modifications, but their essential features are a burrow with submerged entrance, which leads upward into a chamber above the surface of the water. As a rule these lodges are located on the bank a few feet back from the water, but they also occur at the margins of streams or lakes, and within the ponds made by the dams. It is very evident that all of these lodges are but variations of the same fundamental plan.

The beaver dams excite much interest, and the completed dams may be quite extensive affairs as some are even several hundred feet long and over 6 feet high, causing the submergence of many acres of land. But it should be borne in mind that such feats are not the work of a single pair or family, but are the results of generations of industrious beavers. These dams are begun on a small scale, in all probability by a single pair or family, and in the course of time each generation contributes its share toward the repair and extension of the dam, so that in time it may become a very composite structure and perhaps of great extent. The dams, like the burrows and lodges, are built upon a simple plan, and susceptible of much, modification in different conditions. Thus on small streams according to Morgan, where the banks are ill defined, the usual form of dam is one composed of sticks and poles, whose upper or water face is reinforced and plastered over with earth, stones and sod, while on larger streams or where the banks are well defined with a deep channel and uniform current, the stick and bank work becomes buried and obscured by the large amount of earth, mud and stones composing it. In order to understand the utility of these dams and the resulting ponds, it is necessary to recall the fundamental burrowing character of the beaver, whose burrows and lodges require a submerged entrance, whose winter food must be stored in the bottom of these ponds, the protection thus afforded as a retreat from enemies; and there is yet another important relation which remains to be considered. In a large part of Northeastern North America a marginal zone of floating vegetation, bordered by tamaracks and spruces, tends to line the banks and margins of such streams ponds and lakes as are frequented by beavers. But these conifers are not only unavailable for food, but form a barricade between the water and the hardwoods, aspens, birch, etc. (the food of the beaver) which occupy the higher ground. A further disadvantage of this zone of plant life is that it is very unstable, often even floating, and furnishes no solid ground for burrows, which are the final retreats of the beaver when in danger. Thus the formation of a dam, and the consequent drowning of this unfavorable zone of plant life, tends to bring the water's edge nearer to the hardwoods and solid ground. But to credit all these advantages to the beaver's intelligence is unnecessary because the habit of building dams is of greater geographic extent than these marginal conditions. It seems more probable therefore, that such a habit has proved to be of special advantage under such conditions, rather than that these conditions have developed the habit.

The beaver meadows are grassland areas, sedges largely, which invade the shallow water and tend to replace the bordering conifers drowned out by the formation of the dams. Such grasslands may be quite extensive, and even occupy many acres, but such results are only secondary products, as far as the beaver's needs are concerned, for although the grass stems and roots are eaten to some extent and may be useful in plastering over their houses and in repairing the dams, yet they are apparently not essential features in their economy.

Geographic Range.—The typical form of this species has a range throughout northeastern North America northward to the tree limit from New Brunswick; Maine; New York; Quebec; Ontario; Michigan; Idaho; Mackenzie (Ft. Simpson); Alaska Peninsula and Yukon Valley and Alaska.

There are three geographic varieties ranging south of the Canadian or typical form; one in southeastern United States; another in the Rocky Mountains, and the third on the Pacific coast. Pleistocene beaver remains have been found in New York, Pennsylvania, New Jersey, Virginia, Tennessee, South Carolina, Ontario and Oregon. It is thus seen that for the species as a whole, these fossils do not indicate a range in Pleistocene times materially different from that of the present time,

The Glacial or post-Glacial extension of range of the Canadian Beaver, from the Atlantic Coast to the Pacific Ocean in Alaska and north to the tree limit, is a range much like that of the Hudson Bay Red Squirrel, and suggests a somewhat similar history. The great development of beavers in this northern region appears closely related to the physical conditions brought about by base leveling and glaciation—the poor drainage, as shown by the innumerable swamps, ponds and lakes and their small and sluggish streams.

In addition to the great abundance of the food plants there is the further favorable physical condition of deep snows, which fall before the soil or ponds freeze to a great depth, and thus make conditions favorable for beavers on account of the protection afforded from deep frost, which may close up the entrances to their burrows, houses, etc.

4. *Peromyscus canadensis umbrinus?* Miller Isle Royale White-footed Mouse. This mouse was perhaps the most abundant mammal upon the island. It occurred in a great variety of situations as is indicated by specimens taken at the following stations; I, 3, 4, 7; III, 4, near 6; V, 1, 3, 4; I, '04; and II, '04. These stations include a variety of conditions, balsam-spruce forests, tamarack and arbor vitae swamps; second growth of birch following a burn, and specimens were even taken in the Light-house. As there was some doubt as to the identity of certain specimens secured in 1904, the entire series of 55 specimens, including 46 taken in 1905, were

sent to the Biological Survey and have been examined by Mr. W. H. Osgood who pronounced them *umbrinus?* [=*P. maniculatus* Wag. *cf*. N. A. Fauna, No. 28, p. 41, 1909.]

Ecological Notes.—Almost nothing is known of the life history of the variety *umbrinus*; it is only known from the vicinity of the northern shore of Lake Superior and Keewatin and the typical form *P. canadensis* fares but little better because the accounts of *P. leucopus* are confused with it. It seems safe to conclude, however, that it is a forest inhabiting species feeding upon seeds and nuts, but Preble (‘02, p. 50) reports it as invading houses in Keewatin and as rare in swamps. It is also probable that they are active during the winter, at least on Isle Royale. The Beaked Hazel (*Corylus rostrata*) perhaps furnishes them part of their winter food.

Geographic Range.—Known elsewhere only from Peninsular Harbor (types), and Nipigon, Ontario. Compared with the typical form this is a dwarf and melanic variety. A similar dwarfing and darkening of this species occurs upon Roan Mt., N. C., and upon the mountains of southwestern Penn. (var. *nubiterrae*). A third variety, *abietorum*, occurs in Nova Scotia. The typical form of the species ranges from New Brunswick, western Massachusetts and central New York to northern Michigan and the north shore of Lake Superior, in Ontario.

5. *Evotomys gapperi* (Vigors). Red-backed Mouse. Although our parties trapped extensively in the vicinity of our camps, during 1904 and 1905, yet no specimens of this mouse were secured. The authority for its occurrence upon the island is the 10 recorded specimens (Nos. 7725, 9966 to 9974) given by Coues ('77, p. 145) and collected by B. A. Hoopes. These mice were "excessively abundant and universally distributed" on the shore of Lake Superior according to Miller (‘97, p. 15). It is therefore surprising that is was not secured in abundance on Isle Royale. Michael Hollinger described to Max M. Peet a mouse which the house cat had caught during the winter and brought to the Club House. There were two of these specimens, which were described as reddish brown, short tailed mice, and which Hollinger said were quite different from the White-footed mice with which he was familiar. It seems probable that these were Red-backed mice.

Ecological Notes. Very little seems to be known concerning the breeding habits of this mouse. Merriam ('86, p. 272) reports that in the Adirondacks he has examined females taken during April which contained four young,, and one taken early in June was nursing her second brood; still later in the season, on October 4, a female was taken containing 4 young. Kennicott ('58, p. 90) found in Minnesota a nest with 8 young, and another litter of 5 or 6. He also states of the nests that "with the exception of one placed in a stump, they were all situated on the top of the ground, under logs. They were slightly formed of a small quantity of soft leaves and grass." Their food, according to Merriam, consists of seeds, berries, roots, and the bark of trees and shrubs. In addition to these materials Rhoads ('03, p. 93) states that they feed upon the leaves and stems of many weeds and grasses, various nuts and even land, snails. Upon Isle Royale both Beaked Hazel nuts and snails are abundant. Rhoads further states that during the winter it subsists "almost entirely on the leaves of the evergreen strawberry bush, *Euonymus americanus*, which grows abundantly in the cedar swamps and damp hemlock forests."

The habitat of this mouse is of special interest and has been described by Batchekler ('96, p. 192) as follows: "One may look for it with some confidence in almost any large tract of wet ground that retains its moisture through the summer, but is not subject to serious floods, and which bears a growth of woods sufficiently heavy to afford a dense shade, so that the ground beneath, and the roots of the trees, are covered with a deep carpet of sphagnum. If the older trees have been suffered to die a natural death, and their stumps and fallen trunks lie slowly rotting on the ground, half-concealed by the sphagnum, the chance of finding it is certainly not lessened. One of the most evident peculiarities of such a spot as this, in southern New England, is that the dense shade and the abundant evaporation maintain a temperature during the hottest summer weather that is far below that of the surrounding country. In these respects of coolness, moisture, and shade, there is a striking resemblance to the woods *Evotomys gapperi* inhabits in extreme northern New England and other parts of the Canadian zone."

Geographic Range.—The typical form of this species ranges northward from Massachusetts, New York, Pennsylvania, northern Michigan, through southern Canada, westward to the Rocky Mountains. Miller (‘97, p. 15) reported it universally distributed on the north shore of Lake, Superior, and Kennicott ('58, p. 90) states that he found Red-backed mice (perhaps *loringi*) the most numerous in Minnesota (near Breckinridge) in low, heavily timbered valleys, although they were common on higher ground. There are 5 recognized varieties of this species; one, *ochraeus*, is confined to the White Mts. of New Hampshire; a second, *rhoadsi*, is only known from New Jersey; a third, *loringi*, is found in "timbered valleys along the edge of the plains in Minnesota, and eastern North and South Dakota" (Elliot); the fourth, *galii*, is from the mountains of Colorado and Montana; and the fifth, *saturatus*, is from the mountains of north-eastern Oregon, Idaho and British Columbia.

The geographic and topographic isolation of these varieties is worthy of special notice. The occurrence of a local firm (*loringi*) of a forest inhabiting species, in the forested valleys upon the plains is of special interest in showing how topographic and geographic influences may favor isolation.

6. *Fiber zibethicus* (Linn.). Eastern Muskrat. No specimens were taken by our party in 1905, but two specimens were found in 1904, at Washington Harbor by Max M. Peet (I, '04); and early in the spring of 1905 Charles Preulx secured one specimen from the same place—the small island near the mouth of Washington Creek. A few additional locality records were secured this season. Victor Anderson, the trapper, reported muskrats abundant at Sumner Lake (III, 5), and numerous broken *Anodonta grandis footiana* Lea shells were found there by N. A. Wood. Similar broken shells of the same form—were also found by Wood at Sargent's Lake, while I found such shells abundant at the end of the McCargoe Cove trail (II, 4). John Anderson reported muskrat houses at Fish Island Bay and at Tobin Harbor during the fall of 1904. There is an abundance of *Anodonta* and *Lampsilis* upon the island, especially of the former, which occur upon sandy shores, such as are found near the head of Rock Harbor. It may be a question as to how much broken shells should be taken as evidence of the presence of Muskrats, but the trapper's statements of occurrence are in harmony with the evidence from the shells. Perhaps part of the damage to these should be credited to the Mink.

Mike Johnson, fisherman, reports that he has seen the Muskrat at Chippewa Harbor. Mr. J. N. Malone, Keeper of Menagerie Island Light, several years ago found a, Muskrat in the cellar of the Lighthouse (X, 10), and caught two near the camp in Siskowit Bay (V, 3).

Ecological Notes.—The Muskrat is one of the most generally known of our native mammals but although much has been written of its habits, much more is yet to be learned. In several respects its habits are similar to those of the Beaver, although they are not at all closely related. Thus both are aquatic, burrowing, house-constructing animals with submerged entrances to their houses. Both have been reported (Morgan, '68, p. 138) to exhale under the ice, and after allowing the bubbles a moment's exposure, to reinhale them, and continue their journey under the ice. Such similiarities, if true, are very interesting because they illustrate the independent acquirement of similar traits along distant lines of descent; due apparently to the influence of similar environments.

The life history is about as follows, but apparently varies in different localities. Thus in Pennsylvania, the young, according to Rhoads, ('03, p. 105) are born "at all seasons." This statement seems remarkable as Kennicott ('57, p. 107) states that "from five to seven young— more or less—are produced in April or May," and Merriam ('86, p. 283) states that in the Adirondacks of New York "It brings forth from five to nine young at a birth, and is said to raise three litters in a season." Farther north in Saskatchewan (MacFarlane, '05, p. 738) reports that the females are said to begin breeding when about a year old and give birth to "but two litters the first, and three each succeeding season for a time." The number of young in each litter varies from 8 to 20. In British Columbia the females are said to have three litters each season and to successively diminish in fertility with each brood. The species thus appears to be more fertile in the northern part of its range.

The food of muskrats consists of grasses and water plants, and includes a wide range of vegetable food. In addition to this vegetable food, occasionally dead fish and mussels (*Unionidae*) are eaten in quantities, as is shown by the abundance of shells along the banks of streams and the margins of ponds and lakes. Such heaps of shells are generally credited to the Muskrat, but the Mink, as has been suggested, may share in this. Direct observations bearing upon this point are very desirable, but the usual nocturnal habits of the Muskrat doubtless account for the limited information on this subject. There is a surprisingly small amount of direct information, in the accessable literature, on the relation of Muskrats to the mussels. Thus Kennicott ('57 p. 106) states that "Collecting them [mussels] from the bottom, it carries them in its teeth to a log or stone, where, sitting, upon its haunches, and grasping them in the fore-paws, it opens the shells with the incisors as skillfully as it could be done with an oyster-knife." * * * "I have observed that those species with thin shells are more sought for, and have often found large specimens of *Unio plicatus* unopened among the piles of empty shells, the muskrat apparently considering them not worth the trouble of gnawing apart the valves at the back, in which manner the heavy shells are sometimes opened." The Muskrat, like the Beaver, does not hibernate in winter but leads an active life, which means that they require a food supply throughout the winter. This they are usually able to secure under the ice, where they may store a supply, or by eating their lodge (Merriam, '81, p. 277), but in exceptionally cold winters or during a dry season, their winter supply may be frozen up; under which circumstances they may be frozen in their winter quarters, or must search for food above ground.

Extensive burrows are made in the banks of streams or In the shores of the bodies of water which they frequent, and in these they usually rear their young, although the houses or lodges may also be so used, especially in swampy areas. These lodges are generally built in the fall for winter use, and are constructed of grass, roots, mud and sticks; within this is a chamber, reached by a submerged passageway, leading under the ice.

Drouth, disease, large owls, Mink and perhaps the Otter are the most prominent native enemies of muskrats.

The conditions which cause migration are of interest on account of their bearings upon the geographic range and isolation of muskrats. Severe cold may shut off their supply of submerged food and necessitate a migration during the winter; also during the summer a change of residence may be necessitated by drouth, especially of those species which inhabit shallow ponds. This no doubt in part explains the occurrence of those animals which are occasionally taken far from water. Such migrations will not only explain in part the transference of these animals from one drainage system to another, but also the populating of isolated bodies of water.

Geographic Range. An examination of the ranges of the five species of described muskrats, as given in Elliot's recent Check List (‘05, pp. 252-255), clearly shows that very little is known of the range of these common animals; and at the same time their somewhat anomalous geographic relations suggest that the interrelations of these species must be imperfectly understood. Similar relations are suggested by the data concerning *zibethicus*, of which there are five varieties in addition to the typical form. This latter form ranges from Labrador to the Gulf States and northward, east of the Rocky Mountains, to Keewatin. As to its occurrence in earlier geological deposits, muskrat remains have been found in the Pleistocene deposits of South Carolina, New Jersey and Pennsylvania.

The post-Glacial changes within the glaciated portion of their range presents an interesting problem. Thus starting with a poorly drained glacial topography, the inwash from the surrounding hills, the accumulation of vegetable and animal remains, the perfecting of drainage lines due to the down-cutting of outlets, and other effects of running water, would all tend to encroach upon the poorly drained areas and convert them into dry land habitats; while, at the same time, there would tend to be a corresponding increase of stream habitats to a certain degree. Such changes as these would begin on the surface first exposed by the retreat of the ice; and since the ice retreated in a northerly direction, the southern margin of this drift would first be exposed to the general processes of metamorphism (in the sense of Van Hise) in the zone of weathering (so far as the soil was concerned) and to erosion (so far as the topography was concerned); and as the retreat continued these processes would extend their range of influence northward, and thus give to the environment a definite dynamic trend.

Fortunately, direct observation clearly shows that the processes just outlined in a general way have been active on all the drift surface. In general, the drift first exposed is the most metamorphosed and eroded and the best drained, while those regions which were later exposed are less metamorphosed and eroded, and imperfectly drained.

This gives ground for the opinion that as the ice retreated to the north there has been a general extinction, from the south northward of the poorly drained habitats whose origin was due to the glacial topography. Perhaps a more definite statement of these effects, from the standpoint of processes, would be that the direction of extinction was a resultant, determined by the direction of the ice retreat and the lines along which the drainage later developed.

The above remarks on the dynamics and history of the muskrat environment are of special interest on account of their bearing upon two problems as follows: first, the probable post-Glacial migrations of their optimum environment, as it thus seems probable that there has been a post-Glacial northward migration of the most favorable habitat for the muskrat; and second, on account of its influence upon the habits of muskrats. The muskrat is essentially a burrowing animal, and this is perhaps an older habit than house building. It is therefore of interest to know that the muskrats of the southern range are primarily bur-rowers, rather than lodge builders. In the south, below the glacial lake area, they frequent the sea coast, coastal plains, and streams, but find relatively few small bodies of water, which are so abundant farther north. Except along the coast, these habitats are generally or relatively isolated, in striking contrast with their relative proximity in the north. These southern muskrats as a rule especially those inhabiting streams do not construct houses, but live in burrows.

Turning now to the northern part of the muskrat’s range, from Labrador to the Mackenzie basin and southward into the glacial lake belt—the most extensive lake and swamp area on earth,—muskrats are found in the greatest abundance and development. Here instead of the relative isolation, as in the more southern part of its range, it finds an almost continuous habitat, of considerable geographic extent, and it is in this area that they are lodge builders, in addition to being bur-rowers, especially those that live about the swampy margins of ponds and lakes. This general change of habits between northern (Minnesota) and southern (Ohio) muskrats was pointed out by the Herrick (cf. ‘91, pp. 15-18; or Herrick '92, p. 212).

It is thus seen that a close relation exists between the habits and the habitats of this animal; thus, whether or not they live in burrows or lodges, is determined, in part, by the local topography and geological history. Such observations show the need of detailed locality studies of animals, in which the interrelations of the habits and the environment will be given primary attention. From such investigations, it will in the future be possible to prepare maps showing the topographic and geographic distribution of habits, just as other characteristics of the North American mammals, such as color, dimensions, etc. have been carefully investigated and mapped. But so far as known to the writer, no particular attention has been given to this phase of geographic problems. The muskrat would furnish an excellent subject for such an investigation on account of its extensive range, abundance and evident response to its environment.

But before leaving this subject, attention should be directed to the fact that while the above remarks apply primarily to the Muskrat, yet they have a much more general bearing, and apply equally well not only to many animals, but also, it is probable, to the habitat relations of many plants.

7. *Lepus americanus* Erx. Hudson Bay Varying Hare. With the possible exception of the White-footed Mouse, the Hare is the most abundant mammal upon Isle Royale. In all 27 specimens were taken from the following localities: I, 2, 3, 6; II, 2; III, 4, 5; V, 3, 4; I. ‘04, VIII, ‘04 and V, ‘04. Evidence for their presence occurred at the following additional stations: I, 5; II, 3; IV, 5, 9; and VII, '04. It is thus seen that their distribution was quite general and their abundance was equally

characteristic. Although frequently found in the forest there was an apparent preference for open areas. This was suggested by the well defined paths or runways seen in sphagnum swamps, in *Cladonia* openings and on the jack pine ridges. The shallow soil with its attendant rock openings combined to produce an extensive area of favorable habitats for them; supplementing this is an abundance of vegetable food and a relatively small number of carnivora.

Ecological Notes.—The food habits seem to be quite varied as shown by the variety of trees and shrubs whose bark and twigs had been eaten. All such injury seen was attributed to hares, as it occurred close to the ground in places frequented by them. The most extensive injuries to vegetation were on the jack pine ridge (I, 5) where the smaller lower branches of the Jack Pines had been eaten off up to about three feet above the ground. The cut ends clearly showed that the branches had been bitten off. The young Wild Red Cherry (*Prunus pennsylvanica*) growing in the crevices of the lava were often cut back, the bark removed and stems killed by the injury; *Amelanchier* showed similar injury. Along the trail to McCargoe Cove (II) Rock Maple, aspens and alders were seen with the bark injured. Max M. Peet observed the bark eaten from birches and Ground Hemlock at Washington Harbor, and from apples at Siskowit Bay (near VIII, '04).

At dusk the Hares came out to feed in the clearing about our camp at Siskowit Bay (V, 3), and were quite tame, coming close up to the camp. On a small island in Siskowit Bay, about ½ mile west of camp they were exceedingly abundant at dusk in a small clearing at a fishing camp. They were also abundant at Washington Harbor, along the road from the Club House to the old mining camp—Wendigo—and in the clearings at Neutson's Resort (IV, 5).

A very young specimen was taken (IV, '04) Aug. 22, 1905. whose total length was 190 mm. This shows that young are born in August, and it perhaps represents the last brood of the season. The size of other young specimens (215 and 310 mm.) suggest that at least one brood has preceded the one just mentioned, although it is probable that the broods are not sharply defined.

A very interesting periodic variation in the fertility of the Varying Hare (*L. americanus macfarlani* Merr.) has been pointed out by MacFarlane ('05, p. 740) who says "A litter usually consists of three or four; but when on the 'periodic' increase, females are known to have as many as six, eight and even ten at a time, and then gradually return to three or four." This periodicity he also shows (l, c., pp. 691, 692, 710) is of fundamental ecological importance in the nature history of the fur bearing carnivores of the far north. The staple food of the Lynx is Hare, so that when the latter decline in fertility and abundance, the Lynxes, not only also become reduced in number but are even known to starve. The Marten and to a much less degree the Mink also seem to be influenced in a similar manner.

Dr. Merriam ('86, p. 306) thinks that in the Adirondack Mountains there may be two litters in a season, of from four to six, the former being the usual number. The first litter is born late in May.

Upon Isle Royale in addition to those mentioned, other possible enemies of hares, at least for the young, may be the weasels, and the hawks, owls and the Bald Eagle.

There is an interesting seasonal variation of habitat (Merriam, '86, p. 305), in the Adirondack Mountains of New York; during the summer they tend to frequent the coniferous forests, and in winter the swamps, alder and spruce thickets bordering lakes and beaver meadows.

Notes on Color Variation.—A series of 27 specimens was secured during July and August, the examination of which shows that there is a considerable color variation. In order to understand the significance of this it is necessary to have a general idea of the nature of the seasonal color changes of the Varying Hare. These hares have a brown summer coat and in winter a white one; and from this seasonal change or variation is derived the name Varying Hare. The difference in color is due to a change of pelage which occurs in the spring and fall; as one coat is shed another of a different color, grows and replaces it, proving conclusively that the white color is not due to a bleaching of the summer coat as some have supposed. Unfortunately this subject has not been investigated in Michigan, so that we do not know the exact period in spring and fall at which these moults take place. It would be of value and of interest to know how the time of moulting varies in different parts of the State.

This moulting process has been studied in detail by Allen ('94), from whose paper the following outline of the laws of moulting are taken. The fall moult (l. c. p. 121) begins "with the feet and ears, the sides of the nose and front of the head, which often become radically changed before the body is much affected; while as regards the body, the change begins first at the base of the tail and extreme posterior part of the back, and at the ventral border of the sides of the body, working thence upward toward the median line of the back and from behind anteriorly; the crown of the head and a narrow median line over the shoulders and front part of the back being the parts last changed. In the spring the order of change is *exactly the reverse*, the moult beginning on the head and along the median line of the anterior half of the dorsal region, extending laterally and gradually to the ventral border of the sides of the body and posteriorly to the rump, and then later to the ears and down the limbs to the feet, which are the parts last affected, and which often remain but little changed till the head and body have pretty completely assumed the summer dress."

The Museum collection, however, contains a specimen of *L. americanus phaenotus* Allen (determined by E. W. Nelson) from Houghton, Mich., which shows that the early stages of the fall moult may begin late in October (No. 31806, Oct. 30, collector, W. H. Grant), as the nose,

ears, legs and lower hind parts of the body, are well advanced with the white pelage. The hind legs are only slightly mottled with fulvous although the upper parts of the fore legs still retain a considerable amount of this color. The remainder of the body is in the brown or summer pelage. Two April specimens *Lepus americanus* Erx. (determined by E. W. Nelson) from Luzerne, Oscoda, Co., Mich., (No. 31396, 31397, collector, J. A. Parmalee) have the white winter coat, and the upper parts of the hind feet more mottled with fulvous than in the Houghton specimen, while the upper parts of the fore feet are much more fulvous. It is hoped that by calling attention to the fragmentary character of our knowledge of the moulting of the Michigan hares others may be induced to secure the spring and fall specimens needed to complete the history of this process in northern and southern Michigan.

With regard to the moulting of the Isle Royale hares, but little is known, but a few observations made by Max M. Peet are of interest. The following notes were made by him September 13, 1905, at Washington Harbor: A large Hare whose ears and the upper part of the hind legs were conspicuously white crossed the Wendigo road (I, '04). Others were seen which had apparently not begun to change, even on the ears or feet two were shot which had much white on the ears. In general the adults appeared to change first. Other specimens were seen at close range with white patches on the legs, especially on the hind ones, while the ears were apparently unchanged.

From the above observations it seems probable that the Isle Royale hares begin their fall moult about the middle of September. This is somewhat earlier than might have been expected from the observations of Miller made at Peninsular Harbor, Ontario, on the north shore of Lake Superior. He reports ('97, p. 8) that one specimen was taken October 5, in which the white winter pelage had begun to appear upon the ears and buttocks while others secured "about two weeks later had nearly completed the moult." It seems likely that there may be a considerable amount of individual variation in the moulting process. This is very clearly shown by an examination of the upper sides of the hind legs in the series secured from Isle Royale.

Geographic Range.—The typical form of this hare has an extensive northward range from Labrador and New Brunswick westward through Ontario, north of Lake Superior; Isle Royale, Michigan; northwestward to Alaska and the tree limit on the north. In 1900 Miller (p. 117) reported that "The northern varying hare occupies the wooded portions of Labrador. Its southern limit is not definitely known; but the animal does not reach the northern border of the United States." The specimens found last season (1904) by the Museum party thus appear to be the first recorded from the United States. Miller ('97, p. 8) records it common on the north shore of Lake Superior and Preble ('02, p. 59) states that it is "quite generally distributed throughout the region between Lake Winnipeg and Hudson Bay."

A decayed hare was found, July 6, upon the beach in a cove south of the Light-house (I, 1). It was, of course, impossible to determine whether the specimen came from the immediate vicinity or had been washed in from a distance. The abundance of table refuse (orange rinds, chicken bones?, etc.) stranded at the head of this cove suggested that at least part of the material came from the open lake to the northeast. This inference is further supported by the fact that the lake currents, as mapped by Harrington, favor this interpretation. The occurrence of the dead hare is of interest in connection with the question of the direction of origin of the mammal fauna upon the island and its relation to lake currents and the lake drift.

8. *Lynx canadensis* Kerr. Canada Lynx. A lynx skull was picked up at the Ransom clearing (II, 1) at Rock Harbor; its fractured condition suggested that it had been killed by a trapper. Victor Anderson and son, John, secured 48 skins during the winter of 1903 and 1904. Most of these were from about three miles southeast of the head of Rock Harbor, in the vicinity of Lake Richie. Lynx tracks were seen abundantly on the jack pine ridge on the north side of Conglomerate Bay (I; 5), also along the trail to McCargoe Cove, from the top of the Greenstone Range to the end of the trail. William Garnish, of Ashland, Wis., was camping at McCargoe Cove and reported that lynx tracks were abundant in the clearings about the old mines. Tracks were also observed on the top of the Greenstone Range near the head of Tobin Harbor (IV, 9). A few tracks were noticed in the small rock clearings in the forest along the trail from camp (V, 3) to Siskowit Lake (V, 4). Near this trail, at the margin of a tamarack swamp (V, 5), tracks were found upon hummocks, and in another swamp (V, 11) in the sedge zone. Such observations suggests that the Lynx roams about everywhere through the swamps and over the ridges. Several years ago, Mr. J. H. Malone secured two lynx near the outlet of Siskowit Lake.

I secured a lynx skull from a mummified body found hanging on a tree where it had been left by Chas. Preulx along the Desor trail (VII, '04) through the hardwoods. Charles Preulx, Keeper of the Washington Club, has for several years trapped lynx at the head of Washington Harbor. Most of the specimens have been taken along the Desor trail, not far from the Club House. He uses fish and Hare for bait. During the past summer he kept one alive in a cage for about a month, and then sent it alive to Duluth, Minn.

In September Max M. Peet often saw the remains of Hare along the Desor trail and the Wendigo road, evidently marking the place where a lynx had taken a meal. He saw two live lynx on the Wendigo road (I, '04) about September 15; and a few days previous to this Chas. Preulx also observed one here. Two were caught in Preulx's traps, at the beginning of the Desor trail, but escaped.

The Lynx apparently wanders about over much of the island and seems to frequent in particular the rocky ridges, at least the tracks were especially abundant in

such places. The Hare and Red Squirrels furnish an abundance of food for them. Attention has already been called to the close correlation, noted by MacFarlane, between the abundance of Hare and Lynx in Canada.

Ecological Notes.—The life history of the Lynx, in outline, is as follows: the breeding season occurs in April and May; in June and July from two to five and occasionally six young are born in a partly blind condition. They are "about the size of a puppy" and are suckled for about two months (MacFarlane, '05, p. 692). Reference has elsewhere been made to their dependence upon Hares, and to their remarkable periodical fluctuations in abundance. In their native haunts the food, in addition to the Hares, consists of eggs, birds of various kinds, small mammals and young deer.

Geographic Range.—The Lynx has an extensive range, on the east from New Foundland; Maine; New York; Pennsylvania; Isle Royale, Mich.; Mackenzie Basin to Alaska, and northward nearly to the tree limit. At the extremes of its range this species becomes differentiated into two local forms, while the typical form has an extensive range in the intermediate territory. It has also been found in the Pleistocene deposits of Pennsylvania.

Miller ('97, p. 44) states that he has no authentic record of the Lynx for Ontario. On account of their abundance on Isle Royale this seems rather remarkable.

9. *Mustela americana* Turton. Eastern Marten. During the past season Chas. Preulx took eleven Martens along the Desor trail (III, '04) among the maples. Hollinger secured one near the creek (II, '04) and another on the ridge north of Beaver Island. Fish were used as bait.

Ecological Notes.—The breeding season occurs but once a year, during February and March, and the young, 6 to 8 in a litter, are born blind. Their nests are made preferably in hollow trees, under logs, and in holes in the ground (MacFarlane, '05, p. 711), or by robbing a squirrel of its nest (Coues, '77, p. 95). Its food consists of mice, squirrels and rabbits, supplemented by other small animals such as birds and their eggs, frogs, toads, fish, etc.

This animal, as well as the Hare and Lynx, shows the same kind of periodical variation in abundance, and MacFarlane ('05, p. 710) brings forward the following interesting observations bearing on this subject: "In years of plenty the marten is very numerous throughout the entire northern forest region; but is not uniformly so at the same time in every section of country all over the immense territories covered by the Hudson's Bay Company's trading operations. When it is abundant or scarce, say in the northern and western departments, it will generally be found that there is an important and corresponding increase or decrease in the southern and Montreal departments. The natives maintain that lynxes and martens migrate from the north and west to the east and south, and that when they have attained their height in numbers for several reasons, the great bulk (no section is ever totally devoid of martens) of those who escape capture resume the return march until the next period of protracted migration. It must be admitted that many old fur traders have come to entertain similar views from their own personal experience and observation. I think the aforesaid twenty-five years' London sales statement adds strength to the migration theory, and is otherwise of some interest." The natives also maintain that there is a fluctuation in the birth rate corresponding to this periodical abundance. Such migratory tendencies as above mentioned could not help but have an important bearing upon the geographic range and the interbreeding opportunities of these animals.

Geographic Range.—The typical form of this species has a range from Labrador; Nova Scotia; Massachusetts; Northern Pennsylvania; Quebec; Ontario; Michigan, southern Keewatin; Saskatchewan; Alberta ; south on the mountains into Colorado; Utah; northwestward into eastern Oregon; Washington and British Columbia; and eastward to Hudson Bay on the north (Rhoads, '02, p. 445). A second form, of this species *brumalis*, is restricted to the coast of Labrador; a third, *actuosa*, ranges north of latitude 55° to the tree limit, from western Labrador westward to the Rocky Mountains nearly to the U. S. boundary and westward to the Coast Ranges of British Columbia into Alaska; a fourth form *abietinoides*, is restricted to the interior of British Columbia, the Selkirk and Gold ranges; and a fifth *abieticola*, is only known from Saskatchewan. So much differentiation of the type seems rather remarkable when combined with the marked migratory tendencies of the species and suggests that these wanderings may not be as extensive as has been supposed or that these movements are quite local in character.

10. *Putorius vison* (Schreber). Northeastern Mink. Three specimens of mink were secured at Isle Royale. One was taken at camp on Siskowit Bay (V, 1) where it was shot by N. A. Wood at the water's edge during the day time; the second specimen was caught in the fish house at Malone's fishing camp, just east of our camp on Siskowit Bay. A steel trap had been baited with a Herring by Frank Malone. The third specimen was taken by W. A. Maclean, at the west end of Grace Harbor.

Victor Anderson saw a Mink on July 1.6, on the mainland at Rock Harbor, about opposite Middle Island. He reported it as abundant on the north of the Isle, at Fish Island, during the winter of 1903 and 1904, and also reported it from Tobin Harbor. Charles Preulx secured 18 skins during the past winter at Washington Harbor, most of which came from the harbor at the Club House, but a few were found upon the neighboring ridges.

There can be but little doubt that this animal is of general distribution over the island in moist and wet places. To what degree broken, mussel shells (*Anodonta*) may be credited to the Muskrats alone is uncertain, as the Mink may share in this mischief.

Max M. Peet saw numerous mink tracks, Sept. 16, (II, '04) along a small stream, where mink had eaten a Grinnell's Water Thrush, Hermit Thrush, and a few days previously an Oven Bird.

An entry in the University Museum Catalogue records a, specimen of mink (No. 3595) from Isle Royale, collected in 1868 by Dr. J. C. Gubbs, and presented to the Museum by Dr. A. E. Foote.

Ecological Notes.—The breeding season for mink occurs in February and March, at which time the males wander about a great deal; the young are born about six weeks later, or usually in April. The young, which are born blind, remain so for about five weeks. There are usually five or six young in a litter, but the number varies and there may be only three, and it is reported to be subject to a periodical increase similar to that of the Hare. When on the increase, there may be as many as 8, 10 or 12 in a litter (MacFarlane, '05, p. 714). In each litter one sex is said to predominate (Cones, '77, p. 182). In the fall the young begin to shift for themselves, as Minks live solitary lives, not in pairs, and may frequently be seen swimming about, presumably in search of new quarters. This tendency, with the wanderings by day and night of the males during the breeding season, combined with his promiscuous tendencies, must have a marked influence toward favoring interbreeding. The females reach their growth in about a year, but the males require about a year and a half, although they are somewhat smaller than the females. Their nests are formed in burrows, hollow logs, muskrat burrows or other cavities, and the female makes for the young a compact nest out of leaves, grass and straw, and lines it with her own fur.

The Mink is very fierce, and so courageous that it will not hesitate to attack animals larger than itself, such as hares, muskrats, etc. Its amphibious habits allow it to procure food from both the land and water: Thus snakes, frogs, mussels and fish are secured from the water by diving (Webster, '89, p. 176), while birds and their eggs, and mammals are found on land. In pursuit of its prey, Kennicott ('58, p. 103) says: "It follows the track by scent, like a dog."

Geographic Range.—This species has an extensive range over most of North America. The typical form however, ranges from Labrador and the Arctic Sea, westward to the north shore of Lake Superior, Ontario, to the Rocky Mountains, Michigan, northern Pennsylvania and New York. In spite of its activity, four other forms have become more or less differentiated but their ranges are not well defined, lacustris occurs west of Hudson Bay, *energumenus* from Pacific Coast from British Columbia to Alaska, *ingens* from the Yukon Valley and *vulvivagus* from the Gulf States.

11. *Putorius cicognani* Bonap. Bonaparte's or Least Weasel. Only one specimen was secured, and this is a white skin taken by Michael Hollinger in the vicinity of the Club House, at the head of Washington Harbor, on December 31, 1904. (No. 33016).

Dr. Merriam ('96, p. 6) has called attention to the close correlation between the geographic range of the *cicognani* group of weasels and the field mice (*Microtus*), but upon Isle Royale these mice are apparently lacking; it is probable therefore that the White-footed mice form an important element in their food.

Ecological Notes.—Very little seems to be known of the breeding habits of this species. It is reported (Coues, '97, p. 109) to have three litters of young a year, with four or more, frequently five, in a litter. The nest, located in a, depression in the ground or a hollow tree, is composed of dry vegetation. The female shows almost unlimited courage in the defense of her young. The food consists of small mammals, birds and eggs, and insects. As to its native habitat preferences, in the Adirondacks Merriam ('86, p. 54) says: "It inhabits all parts of the wilderness, being found along water-courses, in deep swamps, and on rocky ledges and mountain sides." Like the Mink, it tracks its prey by scent.

The seasonal color changes of this weasel are of special interest. Rhoads speaking of Pennsylvania weasels ('03, p. 172) says "Bonaparte's weasel always turns white in winter even in its most southern distribution, but the New York weasel [*P. noveboracensis*] in the transition and austral zones very rarely turns white, the winter pelage being merely paler than that of summer."

Geographic Range.—The typical form ranges over forested areas of Labrador; New England; New York; Pennsylvania, in the mountains; Ontario; Northern Michigan; Minnesota; Colorado; British Columbia and Southeastern Alaska. In 1896, Merriam said: "It probably occurs also in northern Michigan and Wisconsin." Merriam ('96, p. 12) recognizes two varieties: *richardsoni* ranging from British Columbia and the interior of Alaska to Hudson Bay, and *alascensis* from southern Alaska.

12. *Putorius noveboracensis* De Kay. New York Weasel or Ermine. Two specimens were secured; one a small pale brown skin and skull (No. 33015) on December 31, 1904, by Michael Hollinger, near the head of Washington Harbor, and the other a much larger white skin taken in January, 1905, (No. 33019). Both of these specimens are referred to this species with doubt by Dr. Merriam.

Ecological Notes.—The breeding season occurs in February or March, and the young are born in April and May. The number of young in a brood appears to vary greatly, from two to a dozen, although four to six is perhaps the average number (Coues, '77, p. 125, 134). In the Adirondacks Merriam ('86, p. 60) says "from four to six young are commonly brought forth early in May." The female is smaller than the male.

The food of the weasel consists mainly of small mammals and birds, but even animals much larger than itself, as the ruffed grouse, cottontails, and, about settlements, chickens, fall to its share. Upon Isle Royale, in all probability, the Hares and Grouse come into this class. Its habit of climbing trees, while of great advantage to it, proves to be the opposite for birds. Like the Mink, it follows its prey by scent. Kennicott ('58, p. 106) was of the opinion that it preferred rocky, hilly and forested regions. The frequency with which it occupies the burrows of other animals suggests that it does not burrow with ease, although according to Kennicott, it burrows in the snow. It also lives a solitary life.

Reference has already been made to the two seasonal moults of this species as compared with the Least Weasel. This color change, as in the case of the Varying Hare and Red Squirrel, is due to a fall and spring shedding of the old pelage and to the growth of a new one. Winter specimens from the vicinity of Ann Arbor, Mich., vary in color from dark brown, through chocolate colored specimens, to white, while specimens taken November 6 (No. 34139) and November 18 (No. 30019) are white excepting a suffusion of pale brown hairs along the mid-dorsal line, the former specimen having much more brown, especially on the head and neck.

Geographic Range.—Southern Maine; New York; Pennsylvania; New Jersey; south to North Carolina and west to Illinois; and north to Michigan. A southern variety, *notius*, occurs in North Carolina.

13. *Myotis subulatus* (Say). Say's Brown Bat. Only two specimens of this species were secured; one by means of a broom in the case of one which entered the Club House on the evening of August 23, 1905, and the other on September 4, was also taken in the house at Singer's resort near the mouth of Washington Harbor.

Ecological Notes.—The females usually give birth to two young (cf. Merriam, '86, p. 195). Some species of bats migrate southward from the northern part of their range (Rhoads, '03 p. 209, Howell, '08). This species has been known to enter abandoned houses in such vast numbers as to become an intolerable nuisance, nearly 10,000 having been killed in one house, (Smith. Ann. Kept, for 1861, pp. 407-409). They take flight not only at dusk but at nearly dawn, and their flight toward and over water has suggested that not only food but water is sought there.

Geographic Range.—Nova Scotia; Rupert House, Quebec; Ontario; Maine; Mass.; New York; Perm.; Md.; Va.; West Va.; Tennessee; Michigan; Indiana; Illinois; Missouri; Wisconsin; Minnesota; Colorado; Alberta. There is a variety of this species, *Keenii*, occurring in British Columbia.

14. *Myotis lucifugus* (Le Conte). Le Conte's Brown Bat. Nine specimens of this species were secured by Max M. Peet between August 23 and September 6, at Washington Harbor (I, '04). At dusk several were shot while flying over the Harbor.

A few bats were seen on wing, which perhaps belonged to this species, as it was apparently the most abundant form, or to *M. subulatus*. The last bat seen on the wing by Peet was about Washington Harbor, September 15. A small dark colored bat was startled from a loose projecting rock on the face of the cliff on the jack pine ridge (I, 5). A few days later one was flushed at nearly the same place. A bat flew into the Light-house at Rock Harbor but was not secured. Bats were also seen at camp on Siskowit Bay (V, 3). One specimen was taken in 1904 by Peet at Washington Harbor.

Two specimens were received from Michael Hollinger, who secured them November 30, 1904, at the Club House (I, '04). These evidently hibernated in the cellar as they were found on wing in the house after a fire had been built in the cellar.

This species had previously been collected from Isle Royale by B. A. Hoops, No. 5319, U. S. Nat. Mus. (Allen, '93, p. 80)". Allen also records three specimens from Grosse Isle, Midi., collected by Rev. C. Fox, (No. 5500, 5501, 5505 U. S. N. M.); another specimen (No, 5354) was taken by S. F. Baird on the Detroit River. Miller in his revision of the family *Vespertilionidae* (1897) examined no Michigan specimens of this species.

Ecological Notes.—On account of the difficulties in determining bats, their life histories are much confused. This species Todd found hibernating in the caves of Pennsylvania (Rhoads, '02, p. 208), and the November specimens show that it hibernates on Isle Royale.

Geographic Range. This bat has the most extensive geographic range of any of the mammals on Isle Royale. The typical form ranges from southern Alaska east of the Rocky Mountains throughout North America, yet in spite of its powers of locomotion, two local forms are known; *longicrus* ranges from Puget Sound and Wyoming south to northern Mexico and Lower California, and *alascensis* which is restricted to the northern British Columbia and the coast region of southern Alaska. The differentiation of these forms, in the case of a flying mammal, suggests that the mountains form to some degree a true barrier within the range of this species.

15. *Vespertilio fuscus* Beauv. Brown Bat. One specimen was taken at Washington Harbor (I, '04) on August 19.

Ecological Notes.—-Fisher (Merriam, '86, p. 184) remarks that this species is the last to appear in the evening and that they are "particularly fond of fields well surrounded by trees." It is an abundant species about human habitations and hibernates.

Geographic Range.—The typical form of this species ranges from California over the United States except

Florida, and northward into British Columbia and Ontario. There are eight forms of the species ranging over the West Indies and south into Guatemala, and Costa Rica.

V. References.

Adams, Chas. C.
1905. The Postglacial Dispersal of the North American Biota. Biol. Bull., 9, pp. 53-71.

Allen, H.
1893. A Monograph of the Bats of North America. Bull. U. S. Nat Mus., No. 43.

Allen, J. A.
1874. On Geographical Variation in Color among North American Squirrels. Proc. Bost. Soc. Nat. His., XVI, pp. 276-294.

Allen, J. A.
1894. On the Seasonal Change of Color in the Varying Hares (Lepus americanus Exrl.). Bull Am. Mus. Nat. His., VI, pp. 107-128.

Allen J. A.
1890. On Seasonal Variations in Color in Sciurus hudsonicus. Bull. Am. Mus. Nat. His., Ill, pp. 41-44.

Allen J. A.
1898. Revision of the Chickarees, or North American Red Squirrels (Submenus Tamiasciurus). Bull. Am. Mus. Nat. His., X, pp. 249-298.

Allen, J. A.
1899. The North American Arboreal Squirrels. Am. Nat., XXXIII, pp. 635-642.

Baird, S. F.
1857. Mammals. "Pacific Railroad Survey Report." VIII.

Bangs, O.
1896. Notes on the Synonomy of the North American Mink, with Description of a New Subspecies. Proc. Bost. Soc. Nat. His., XXVII, pp. 1-6. Pls. 1 & 2.

Batchelder, C. F.
1896. Some Facts in Regard to the Distribution of Certain Mammals in New England and Northern New York. Proc. Bost. Soc. Nat. His., XXVII, pp. 185-193.

Bell, R.
1898. On the Checkeree, or Red Squirrel (Sciurus Hudsonicus (Pennant). In W. Mill's The Nature and Development of Animal Intelligence, pp. 75-78. New York.

Caton, J. D.
1877. The Antilope and Deer of America. New York.

Coues, E. and Allen, J. A.
1877. Monograph of North American Rodentia. Report of the U. S. Geol. Survey of the Territories (Hayden). XI. Dept of the Interior. (Contains a valuable bibliography of N. A. Mammals, pp. 255-264, 951-1081.)

Coues, E.
1877. Fur-bearing Animals: a Monograph of the North American Mustelidae. U. S. Geol. Survey of Territories (Hayden). Miscel. Pub. No. 8.

Coues, E. and Yarrow, H. C.
1875. Report upon the Collections of Mammals made in Portions of Nevada, Utah, California, Colorado, New Mexico and Arizona, during the years 1871, 1872, 1873 and 1874. Report upon Geographical and Geol. Explorations and Surveys West of the One Hundredth Meridian (Wheeler). V, pp. 35-129, 969-976,

Elliot, D. G.
1905. A Check List of Mammals of the North American Continent, the West Indies and the Neighboring Seas. Field Columbian Mus., Pub. 105. Zool. Ser. VI.

Roosevelt, T. and Others.
1902. The Caribou. The Deer Family, pp. 257-287. New York.

Foster, J. W. and Whitney, J. D.
1850. Report on the Geology and Topography of a Portion of the Lake Superior Land District in the State of Michigan. Part 1, Copper Lands, House Ex. Doc., 1 Series, 31 Cong. IX.
1851. Report on the Geology of the Lake Superior Land District. Pt. 2, The Iron Region. Senate Doc. Special Sess. 32nd Cong. III.

Georgeson, C. C.
1904. Reindeer and Caribou. U. S. Dept. Agric. Bureau of Animal Industry. Circular No. 55. Also 20th Ann. Rept. Bureau of Animal Industry, 1903, pp. 377-390.

Grant, Madison.
1902. The Caribou. Seventh Ann. Rept. N. Y. Zool. Soc.

Gillman, Henry.
1873. The Caribou on Lake Superior. Amer. Nat., VII, p. 751.

Hay, O. P.
1902. Bibliography and Catalogue of the Fossil Vertebrata of North America. Bull. U. S. Geol. Survey, No. 179.

Howell, A. H.
1908. Notes on Diurnal Migrations of Bats. Proc. Biol. Soc. Wash., XXI, pp. 35-38.

Herrick, C. L. and Herrick, C. Judson.
1891. Biological Notes upon Fiber, Geomys and Erethizon. Bull. Sci. Lab. Denison Univ., Vol. VI, pp. 15-25.

Herrick, C. L.
1892. Mammals of Minnesota. Geol. and Nat. Hist. Survey of Minnesota, Bull. No. 7.

Jackson C. J.
1850, Geological and Mineralogical Reports. Senate Doc. 1 Sess. 31st Cong., Ill, pp. 371-935.

Kennicott, R.
1857. The Quadrupeds of Illinois, Injurious and Beneficial to the Farmer. Rept. of the Comm. of Patents for the year 1856. Agriculture, pp. 52-110.
1858. The Quadrupeds of Illinois, Injurious and Beneficial to the Farmer. Report of the Comm. of Patents for 1857. Agriculture, pp. 72-107.

Lane, A. C.
1898. Geological Report on Isle Royale, Michigan. Geol. Surv. Of Michigan, VI, Pt. 1.

MacFarlane, R.
1905. Notes on Mammals Collected and Observed in the Northern Mackenzie River District, Northwest Territories of Canada, with Remarks on Explorers and Explorations of the Far North. Pro. U. S. Nat. Mus., XXVIII, pp. 673-764.

Merriam, C. Hart.
1886. The Mammals of the Adirondack Region. New York.

Morgan, L. H.
1868. The American Beaver and His Works. Philadelphia.

Miller, G. S. Jr.
1897. Notes on the Mammals of Ontario. Proc. Bost. Soc. Nat. His., XXVIII, pp. 1-44.
1897a. Revision of the North American Bats of the Family Vespertilionidae. N. A. Fauna, No. 13, U. S. Dept Agric., Div. of Biol. Surv.
1900. Key to the Land Mammals of Northeastern North America. Bull. N. Y. State Museum, No. 38.

Osgood, W. H.
1909. Revision of the Mice of the American Genus Peromyscus. North Amer. Fauna, No. 28, U. S. Dept. Agr., Bur. Biol. Surv.

Osgood, W. H. and Bishop, L. B.
1900. Results of a Biological Reconnissance of the Yukon River Region. North Amer. Fauna, No. 19, U. S. Dept. of Agric., Div. of Biol. Survey.

Preble, E. A.
1902. A Biological Investigation of the Hudson Bay Region. North Amer. Fauna, No. 22, U. S. Dept. of Agric., Div. of Biol. Surv.
1908. A Biological Investigation of the Athabaska-Mackenzie Region. North Amer. Fauna, No. 27, U. S. Dept. Agr., Bur. Biol. Surv.

Rhoads, S. N.
1898. Contributions to a Revision of the North American Beavers, Otters and Fishers. Trans. Amer. Phil. Soc., N. S. XIX, pp. 417-439.
1902. Synopsis of the American Marten. Proc. Acad. Nat. Sci. Phila., Liv. pp. 443-460.
1903. The Mammals of Pennsylvania and New Jersey. Philadelphia.

Taylor, F. B.
1905. A Short History of the Great Lakes. Dryer's Studies in Indiana Geography, (Terre Haute), pp. 90-111.

Webster, C. L.
1889. Observations on Putorius vison. Amer. Nat., XXIII, pp. 176-177.

ERRATA ISLE ROYALE REPORT.

[original publication]

Page 2, line 29, for *and the* read *for the*.
Page 5, line 30, for *sources* read *resources*.
Page 11, line 43, for *larger* read *large*.
Page 13, line 11, for *White Spruce* read *Black Spruce*.
Page 14, line 7, for *has been* read *had been*.
Page 15, line 16, for *Cicada* read *Tibicem*.
Page 16, line 40, for *anti-lion* read *ant-lion*.
Page 19, line 28, for *hardwood* read *hardwoods*.
Page 21, line 24, for *Hibbiscus* read *Hippiscus* (and elsewhere in the report).
Page 21, line 25, for *versicolor* read *pickeringi*.
Page 21, line 48, for *Limnaea* read *Lymnaea* (and elsewhere in the report).
Page 22, line 26, for *2F* read *26*.
Page 22, line 43, for *Aechna* read *Aeschna*.
Page 26, line 21, for *Grophaena* read *Gyrophaena*.
Page 27, line 2, for *billow* read *billowy*.
Page 29, line 14, for *Fig. 45* read *Figs. 45 and 57*.
Page 46, line 21, for *the bearing of the latter* read *their*.
Page 47, line 46, for *e* read *4*.
Page 48, line 14, for *Fig. 53* read *Fig. 55*.
Page 50, line 33, for *f* read *5*.
Page 61, line 28, dele (*Fig. 29*).
Page 63, line 10, dele *Fig. 30*.
Page 63, line 16, for *Lake* read *Lakes*.
Page 64, line 3, for *Fig. 22* read *Fig. 16*.
Page 65, lines 48 and 49, for *Formica adamsi*i read *Formica adamsi*.
Page 65, lines 50 and 51, dele *No. 114*.
Page 77, line 27, for *Grophoena* read *Gyrophaena*.
Page 93, line 25, for *XI* read *VI*.
Page 110, line 6, for *condition of weather* read *condition of sky*.
Page 135, line 31, for *fostered* read *forested*.
Page 152, line 29, for *Burns, F. Z*. read *Burns, F. L*.
Page 158, line 43, transpose *Buprestid*s and *Trichias*.
Page 159, line 9, for *Grophoema* read *Gyrophaena*.
Page 161, line 44, for *Their* read *their*.
Page 188, line 28, dele *William*.
Page 205, line 46, for *Bolitobius* read *Boletobius*.
Page 205, line 46, for *Ney Jersey* read *New Jersey*.
Page 257, line 17, read *Salticidae=Attidae*.
Page 261, line 43, for *Jassidaeae* read *Jassidae*.
Page 284, line 28, for *61-62* read *Figs. 61-62*.
Page 306, line 26, dele *3*.
Page 306, line 28, add *3*.
Page 306, line 29, add *S. elongata*.
Page 342, line 25, for *Fig. 45* read *Fig. 57*.
Page 350, line 35, add *Fig. 60*.
Page 354, line 17, add *Fig. 17*; line 20, dele *Fig. 17*.
Page 393, line 15, for *influences* read *inferences*.
Page 397, line 7, for *Canton* read *Caton*.
Page 407, line 26, for *J. N. Malone* read *J. H. Malone*.
Page 419, line 14, for *Hoops* read *Hoopes*.