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A SURVEY OF THE MAMMALS OF CHARLEVOIX
COUNTY, MICHIGAN, AND VICINITY

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During the summer of 1923 an expedition working under the auspices of the Michigan Department of Conservation spent the period between June 18 and September 7 in a study of the mammals of Charlevoix County and vicinity. The personnel of the party consisted of J. Van Tyne, Scott Warthin, Jr., Dora Lemon, and the author. Dora Lemon was engaged chiefly in the study of the protozoan parasites of the mammals captured, and her report will appear separately. Also the results of the study of the mammals of Marion Island, in Grand Traverse Bay, made between July 23 and July 28, is to appear in a separate paper.

Much of the native vegetation of Charlevoix County and vicinity has been cut or burned, and the areas of the natural mammal habitats remaining are small and scattered. However, by the extensive use of automobiles we were able to cover a large amount of territory, and it is believed that we have learned quite satisfactorily the distribution of the mam-

mals of the region. We secured also much information about the habitat preferences and about the habits of the species encountered.

TOPOGRAPHY AND SOIL

The topography of Charlevoix County is rolling; especially in the eastern part there are many high hills. With the exception of the old lake beds which occupy the bottoms of some of the lower valleys, the whole region is covered by glacial débris. In the western part of the county the great number of large drumlins are the most important feature in the topography, while in the eastern part of the county the hills are mostly morainic. Along Lake Michigan are a few small sand dune areas.

Lakes, both large and small, are common, and there are a few bogs, but marshes are rare. There are a number of small streams, all draining eventually into Lake Michigan.

The soil is very diversified, due to its glacial origin. The morainic hills in the eastern part of the county are largely sand and gravel, while the drumlin region has somewhat heavier soil.

VEGETATION

Originally the upland of most of Charlevoix County was covered by hardwood forest. Along the streams were found strips of hydrophytic forest dominated by such trees as white spruce, balsam fir, arbor vitae, and tamarack. On the lower and wetter ground there were large arbor vitae swamps, and a few small black spruce and tamarack bogs occurred. On the more sandy soil of some small areas or in more exposed situations occurred a few groves of white and Norway pine and of hemlock.

On the extensive sand areas of eastern Otsego County and in Montmorency County the pines originally covered large areas, while the hardwoods were largely restricted to the heavier clay soil. The jack pine was found here as well as

the white pine and Norway pine. It is probable that some areas of brush and of aspen were always present following forest fires that occurred before the coming of the white man.

At the present time all the stands of pine in the region have been cut, and only a few tracts of hardwood forest remain. In addition, fires have repeatedly burned over large areas, so that a large part of the region is now in various stages of burn, brush, or young forest. Considerable areas are under cultivation, particularly in western Charlevoix County.

EFFECTS OF FIRES ON THE MAMMALS

The changes in the mammal habitats caused by the clearing of the forests and the frequent fires have been very destructive to the native mammals. The mice, shrews, squirrels, and other small mammals are probably not usually killed directly by the fire, but the destruction of their food, and sometimes their homes, kills them just as effectively as though they were burned. Even a ground fire which does not destroy the forest may be quite disastrous for the small mammals, as it destroys the shrubs and herbs and the insects of the forest floor on which these smaller mammals are largely dependent for food.

Following a forest fire of usual destructiveness it is many years before the original vegetation returns to furnish food for the small mammals. Even after the vegetation has become re-established it takes the small mammals many years to migrate back into a region destroyed by an extensive fire. The birds and insects come back much more quickly, as they have greater powers of locomotion. The absence of the mice and other small mammals of course eliminates the marten, fisher, and other carnivorous fur-bearing mammals which depend to a considerable extent upon small mammals for their food.

In virgin hardwood forest in this region the deer-mice, red-backed mouse, and bob-tailed shrew are very abundant, while the chipmunk, red squirrel, flying squirrel, and sometimes the gray squirrel, are usually numerous. Often the snowshoe hare

is common, especially in swampy places. On the other hand, some burned-over areas that we studied in Otsego County were almost devoid of mammalian life, although no fire had been through some of these areas for 10 years or more.

MAMMAL HABITATS

The mammal habitats studied in this region may be listed as follows:

Water lily and pondweed	Dune heath
Stream-border	Poplar dune
Sedge marsh	Pine forest
Reed marsh	Dry brush
Sedge and grass marsh	Bramble
Sedge and sphagnum bog	Aspen
Leather leaf bog	Hardwood second-growth forest
Tamarack and black spruce bog	Hardwood forest
Black spruce and yellow birch forest	Jack pine forest
Swamp brush	Recently burned jack pine
Black ash swamp	Pine barren
Arbor vitae swamp	Aerial
Fir and spruce second-growth forest	Pasture
Sand beach	Cultivated-field
Gravel beach	Orchard
Dune sand	Ruderal
	Edificarian

The mammal communities occupying these various habitats differ from one another in varying degrees, but I shall not attempt to indicate which of the mammal communities deserve to rank as distinct associations, and which should occupy subordinate positions. The classification of the ecologic communities of the state has not yet proceeded to a point where this is possible.

Water lily and pondweed habitat. In Susan Lake, which is well protected from the wind, there is a considerable growth of aquatic vegetation. A rather heavy growth of water lilies and pondweeds occurs in the northern part of this lake, bordering the floating mat of sedges. Muskrat trails lead through the sedges into this habitat.

Stream-border habitat. Many of the smaller creeks and brooks run through swamps or boggy valleys mostly forested by arbor vitae, white spruce, or balsam fir, or covered by second-growth swamps of brush or of young deciduous trees, mostly willow and alder. In these situations the influence of the stream condition does not extend far from the water's edge. Mink and otter are reported to occur along the streams. The beaver formerly built many dams, but it is now extinct in Charlevoix County, although it is still found on the Black River in Montmorency County. One star-nosed mole was taken beside a tiny stream near Boyne Falls, and these animals probably often feed in the water of the creeks and lakes. Probably the muskrat is found also along the streams, although we did not secure any records in this habitat.

Along the larger creeks there are a few small mud-bars, but all those noted were much modified by pasturage, and no careful study was made of any.

Sedge marsh habitat. Marshes are few in the whole region studied. In Charlevoix County there is a good-sized marsh bordering Susan Lake, and a small marsh around a little lake in a glacial basin about one-half mile southeast of Thumb Lake. A few other small marshes occur about some of the smaller lakes. A marsh probably originally occurred at the southern end of the South Arm of Pine Lake, but the site has been extensively altered by the presence of the city of East Jordan. A small cat-tail and sedge marsh is found in the upper end of the mill pond at Boyne Falls, but the constant fluctuations of water level make it quite unnatural.

The Susan Lake marshes are in large part a floating mat. A fairly wide belt of sedge occupies the border next the water, and extends landward sometimes almost to the outer edge of the marsh. The inner edge of the sedge drops off suddenly into deep water, where water lilies are common. Among the sedges are a few water lilies, many bulrushes, numerous pitcher plants, and some twig rush (*Cladium mariscoides*).

Reed marsh habitat. On the Susan Lake marshes, between the sedges and the shore, is a moderately wide belt dominated

by a large rush, probably *Scirpus validus*. Mixed with the rush are abundant sedges of several species and also much twig rush. Near the drier outer border of the marsh the twig rush is dominant over a narrow belt, not over about 5 meters wide. Cat-tails are rare, occurring only in the wetter parts of the marsh, and not forming a belt. The total width of the Susan Lake marsh in its best development is about 100 meters.

Sedge and grass marsh habitat. The marsh around the small lake in the glacial basin just southeast of Thumb Lake is mostly narrow, in general being not over 15 meters wide, but some floating mats occur out from shore, and vegetation has grown completely over one part of the basin. In general this marsh has much grass mixed with the sedges. Owing to heavy pasturing about the edges, the various belts are not well preserved.

Along the railroad right-of-way, along some of the roads, and in some cleared fields in the upper part of Boyne Valley there are patches of marshy meadow dominated by grasses and sedges. The ground is usually quite wet, and in places there is standing water or numerous tiny streams. Ferns, cat-tails, and low willows occasionally occur, and there are often many weeds.

Sedge and sphagnum bog habitat. Beside Black River at the eastern edge of Montmorency County there is a bog having in the middle a considerable area devoid of trees. In this area, which is quite wet and boggy, the ground is covered by a thick mat of sedges and sphagnum. Very few other plants occur. This habitat is invaded on the sides by an open stand of tamarack (*Larix laricina*).

Leather leaf bog habitat. Few bogs now occur in the region studied, although there were probably a number of small ones before the land was all cleared and the bogs burned and drained. In Charlevoix County one small bog occurs about one mile north of Thumb Lake. The road cuts through this bog, and the part to the eastward has been pastured and is much modified, but the part to the west of the road is still (in

1923) apparently in natural condition. In its middle portion this bog is dominated by the leather leaf (*Chamaedaphne calyculata*) which together with sphagnum (*Sphagnum* spp.) forms a thick mat. There are few other plants in this part of the bog.

Tamarack and black spruce bog habitat. The leather leaf of the bog one mile north of Thumb Lake is invaded on the sides by clumps of tamarack (*Larix laricina*). The mat of leather leaf and sphagnum continues between these clumps. Near the outer border of the bog the tamarack is outnumbered by the black spruce (*Picea mariana*) which forms a higher and more compact tree growth. The leather leaf is less luxuriant among the black spruce.

Most of the bog previously mentioned beside Black River on the eastern edge of Montmorency County supports scattered clumps of tamaracks, but near the outer edge the black spruce is dominant. Among the tamaracks is a thick wet mat of sedges and sphagnum and a few other plants. With the black spruce is found also the arbor vitae (*Thuja occidentalis*), and here many characteristic bog plants occur, such as leather leaf, Labrador tea (*Ledum groenlandicum*) and lady's slipper (*Cypripedium* spp.).

Black spruce and yellow birch forest habitat. Around the margins of the bog one mile north of Thumb Lake there is a narrow belt of sapling trees dominated by the yellow birch (*Betula lutea*). This is a transition stage between the black spruce bog and the hardwood forest. In this belt large black spruces are common, remaining over from the bog stage. Seedlings and small saplings of hard maple (*Acer saccharum*) are common under the birches. This belt is about 10 meters wide on the average.

Swamp brush habitat. After an arbor vitae or fir-spruce forest has been cleared or burned in this region the first stage in the redevelopment of vegetation is apparently a marshy meadow, which is quickly followed, if undisturbed, by a heavy growth of brush. The brush stage itself is quickly succeeded

by a growth of trees, leading to the establishment of the original swamp forest.

Willows and alders are some of the first shrubby forms to become established, but larger trees soon follow.

In an extensive area in section 29, south of Boyne Falls, on wet ground which originally had been covered by arbor vitae swamp, the young trees have begun to overtop the shrubs, and the willows and alders are mostly confined to the edges of the habitat. In this habitat arbor vitae is the most common species, but there are many young trees of tamarack, white pine, black spruce, black ash (*Fraxinus nigra*), yellow birch, white birch (*Betula alba papyrifera*), red maple, and some aspens. In the underbrush the dwarf raspberry (*Rubus triflorus*) is common, and dogwood (*Cornus* sp.), witch-hazel (*Hamamelis virginiana*), small willows, and a few grasses, sedges, and low herbs were noted.

Black ash swamp habitat. In a small valley draining into the northern portion of Intermediate Lake there is rather an extensive development of swamp forest dominated by small trees of black ash (*Fraxinus nigra*). Some of the ashes have trunk diameters up to about 10 inches. The area has been cut and burned over. Small arbor vitae are numerous, and it is probable that the area was originally an arbor vitae swamp. There are a few young yellow birch and elm. The ground is wet, but there is no standing water. The underbrush is moderately heavy and includes mountain maple (*Acer spicatum*), yew, and the nettles as common forms. There are many large stumps and decaying logs.

Arbor vitae swamp habitat. Under natural conditions arbor vitae swamps evidently were numerous and extensive throughout Charlevoix County, occupying the bottoms of the broader valleys, some of which, according to Frank Leverett, are old lake bottoms. On the higher plateau region of Otsego and Montmorency counties arbor vitae swamps are far less extensive, being represented usually only by narrow strips along the streams.

At the present time all the arbor vitae swamps in the region are more or less modified by cutting and burning, and many have been entirely eliminated. However, along the upper parts of Bear River, Deer Creek, Boyne River, and in a large area south of Boyne Falls there are still extensive swamps dominated by this species. A part of the swamp in section 29, Boyne Valley Township, is still in probably fairly typical condition, although the larger and best trees have long ago been removed. In this swamp there is a heavy growth of sphagnum, and the water-level is apparently (in summer) only a short distance below the moss. There is an open growth of forest trees, with arbor vitae (*Thuja occidentalis*) dominant, some of the trunks reaching diameters of about 8 inches. The tamarack is common, and there are a few small trees of white pine (*Pinus strobus*), black spruce, and red maple (*Acer rubrum*). Shrubs are common, such as leather leaf, Labrador tea, yew (*Taxus canadensis*), willow, alder, and dwarf raspberry (*Rubus triflorus*). Sedges and horsetails are numerous, and a few bearberries (*Arctostaphylos uvaursi*) occur.

Fir and spruce second-growth forest habitat. In the upper part of Boyne Valley the drainage of the soil is better, in general, and under natural conditions the ground was not so wet as in the arbor vitae swamp. All the original forests of this type have been cut, and only second-growth forests occur. In this second-growth forest the aspen (*Populus tremuloides*), arbor vitae, white pine, balsam fir (*Abies balsamea*), white spruce (*Picea canadensis*) and tamarack make up the majority of the species. Probably the balsam fir, arbor vitae, white spruce, and white pine dominated the native forest in this situation. The ground is moist and filled with humus, but it is not often boggy.

Sand beach habitat. Wide beaches are developed along the shores of Lake Michigan and along the shores of the larger inland lakes of the region, such as Pine Lake. Two parallel belts of environmental conditions can usually be recognized along the sand beaches. Just above the water, in summer, is

a fairly wide belt practically bare of vegetation. Just above this is a belt of sparse vegetation, usually with scattered driftwood. The upper beach, which is beyond the reach even of the winter waves, is sometimes present, forming a third belt.

The vegetation of the middle beach on sand is mostly a sparse growth of sand-binding grasses. Scattered low shrubs of dogwood, juniper, cherry, and willow, and seedling poplars sometimes occur. A number of annuals are sometimes present, and sometimes rushes and sedges; but often the middle beach has no other vegetation than a thin growth of the sand-binding grasses.

On the upper beach, where this is present, the growth of vegetation on sand may not be very greatly different from that of the middle beach, and in many places the sand-binding grasses are the dominant feature. However, driftwood is less in evidence than on the middle beach, and there are usually more shrubs. This belt often serves as a transition to the dune or forest.

Gravel beach habitat. On gravel or stones the middle beach is characterized by the presence of a growth of sedges and rushes, together with a few grasses, annuals, and low shrubs. These grow in the muck held among the stones. The growth of vegetation is moderately heavy in protected places. The most prominent shrubs on the upper beach are the dogwood, willow, and birch.

Dune sand habitat. Low dunes occur at a few places along the shore of Lake Michigan, and some of the dune areas are quite extensive. However, the forests which originally covered most of the dunes have been in Charlevoix County all cut or burned, and we found no place where the original forest could be studied. There seems little doubt that the vegetation on these dunes follows much the same succession as elsewhere in this part of Michigan, and normally the dunes are rapidly captured by vegetation, which leads through the pines to a hardwood forest.

There are usually some areas of moving sand on the face of the dunes, and some of these areas are fairly extensive.

The moving sand areas are usually quickly covered by rather an open growth of the sand-binding grasses. Other common plants are the dogwood, juniper, hairy puccoon (*Lithospermum gmelini*), willows, and rose.

Dune heath habitat. The face of a series of low dunes at the upper edge of the beach about 4 miles southwest of Charlevoix is occupied to a large extent by a low matted growth of bearberry and low juniper. These mats are not continuous, but are broken by small areas of moving sand, more or less held by sand-binding grasses.

On the top and in sheltered places on these low dunes occur numerous clumps of small trees, mostly of balsam fir, arborvitae, Norway pine (*Pinus resinosa*), and white pine. Some clumps of these trees occur in slightly sheltered places on the face of the dunes among the heath. Under natural conditions it is evident that these trees would quickly capture the dunes. But now the dune area is covered only by thickets of shrubs and small trees, which have sprung up following fires, for the area is being pastured heavily by sheep and other stock.

Poplar dune habitat. A small thicket of poplar (*Populus* sp.) was found on a small embryo dune on the upper edge of the beach, about 4 miles southwest of Charlevoix. This was the only poplar dune noted in the region.

Pine forest habitat. In Charlevoix County one stand of white pine (*Pinus strobus*) is reported originally to have covered about 300 acres just north of the present town of Boyne Falls, and other stands of white pine occurred at other places in the county. Joe Stevenson, Deputy Game Warden, who furnished this information, did not know of any stands of Norway pine having occurred in the county, but it is probable that some Norway pine occurred in places mixed with the white pines. A few Norway pines are found today on the shores of Pine Lake in Young State Park, mixed with young white pines. Except the few small trees in the State Park, practically all the pines in the county have been cut, and no stands remain for study.

The sandy soil of the uplands of the eastern part of Otsego County and the western part of Montmorency County were originally mostly covered by pines. These forests were more or less mixed white pine and Norway pine (*Pinus resinosa*), but practically all have been cut at the present time. Only a few small patches of small Norway pines remain, and these have suffered much from ground fires and from cutting, so that it is difficult to determine the native underbrush and surface plants, and the fauna is decidedly changed.

It seems probable that the pines are a transition stage in the development of hardwood forest, which eventually shades out the pines. Numerous large white pines, however, remain in the hardwood forest for many years, towering above the lower maples and other deciduous trees. But the pine seeds are unable to germinate under the shade of the hardwoods. The pine forests naturally persist long on sandy soil, but many hardwood forests do occur on sandy soil, and all the soils except perhaps in the bogs and swamps would eventually under natural conditions have been covered by hardwood forest. Probably no pine stage occurs in the succession on clay soil.

Dry brush habitat. Following fires and clearings many areas in Charlevoix County have grown up to dry brush. These areas are very extensive in the eastern part of the county. The conditions in the dry brush are much varied due to the varying soils, slope exposures, time since the last fire, etc., but all situations are quite arid. On the driest hills the brush is quite scattered, and the stony and sandy space between is covered by a scanty growth of grass and herbs. In more protected localities, or on better soil, the brush may form a dense thicket. The red and black raspberries often are dominant in this brush, at least at first, but this condition is here recognized as a distinct habitat, the bramble habitat. In open spaces there are often thick growths of weeds, such as mullein and thistle. Trees tend gradually to replace the shrubs in the dry brush, and second-growth hardwood forest results.

Bramble habitat. Among the various stages or conditions following fires and clearings in this area the bramble stage may be recognized as particularly widespread and important. In this stage the red raspberry (*Rubus idaeus aculeatissimus*) is dominant, but is accompanied by various other shrubs, such as the blackberry (*Rubus allegheniensis*), red-berried elderberry (*Sambucus racemosa*) and various other shrubs. Small shrubby trees of hard maple and of elm are often found here and the habitat evidently tends to change rapidly toward a hardwood forest.

Aspen habitat. A young growth of aspen is dominant over a large part of Young State Park, on the northern side of Pine Lake. *Populus grandidentata* is the dominant tree on these slopes, and reaches a trunk diameter up to 5 inches. A few trees of quaking aspen, white birch, red maple, cherry, and willow occur. The stand of trees is quite uniform and is rather open. The bracken fern makes a thick growth under the trees, except in some more open places, where the ground is thickly covered by bearberry, wintergreen, mosses, and lichens. The soil is sandy. There are numerous burned stumps of pine, and a pine forest probably originally covered the area.

Hardwood second-growth forest habitat. In the eastern part of Charlevoix County there are a number of good stands of second-growth hardwood forest. Some of these stands contain trees large enough to be of commercial value and some of them are being cut for lumber. It is probable that some of the larger trees are relics left as of no value at the time the original forest was cut. These forests in general occupy the rather steep slopes of the hills. The tree species are similar to those of the virgin hardwood forest, and include as most important the hard maple, beech, elm, linden, and hemlock. In the heavier forest the underbrush is usually rather scanty and is made up largely of seedlings and small trees of the dominant tree species. Other forms noted frequently are *Acer spicatum*, *Cornus* sp., *Corylus rostrata*, *Hamamelis vir-*

giniana, ferns of several species and violets. However, there are many tracts where the trees are small, and sometimes scattered, so that there is often a thick growth of brush and small trees. The ground is usually fairly moist and the soil contains a fair amount of humus or clay.

In well developed second-growth hardwood forest the chief differences from virgin forest are the smaller size of the trees, a lesser amount of humus in the soil, few decaying logs, and decidedly fewer mammals.

Hardwood forest habitat. The climax forest of the region is dominated by the hard maple (*Acer saccharum*). Mixed with the maple are often, but not always, beech, elm, hemlock, yellow birch, and linden. Of these species the yellow birch is probably most characteristic of this type of forest. Some of the trees are very large, hard maple trunks with a circumference at shoulder height of 2.67 meters, and elm trunks of 4.4 meters being noted. The forest crown is high, the shade dense, and the underbrush in general scanty and low. The ground is usually moderately dry, and there are many decaying logs. A thick mat of decaying leaves covers the ground. The soil may be either sand or clay. In virgin forest of this type small mammals are very abundant; their runways follow under and in every decaying log, and ramify in every direction in shallow tunnels under the mat of dead leaves and through the soil.

Originally this type of forest was very extensive in all the region visited, but now most of the forests have been cut or burned, and only a few patches of virgin timber remain. Our study of this type of forest was carried on in the eastern part of Charlevoix County, where 4 or 5 sections of hardwood timber remain, though they are now being lumbered, and in the region just south of Elmira, where 6 or more sections of timber remain in natural state.

Jack pine forest habitat. In the sandy eastern part of Otsego County, and extending on into Montmorency County, there are numerous patches of jack pine (*Pinus banksiana*) forest. However, the frequent fires have left few areas which

have not recently been burned over. One area, comprising at least 160 acres, was studied near the eastern border of Otsego County, a short distance north of the Black River. This area had not had a bad fire for thirty years, nor a ground fire for ten years. Most of the jack pines here are about 30 years old, although a few older trees, of both Norway and jack pine, with trunks up to about 18 inches in diameter, represent remnants of the original forest. The younger jack pines reach trunk diameters up to 6 inches and they grow mostly in rather an open stand, though frequently forming small thickets. The forest floor is thinly covered by a growth of bracken fern (*Pteris aquilina*), sweet fern (*Myrica asplenifolia*), grasses, wintergreen, and small scattered patches of blueberry. Poison ivy, blackberry, raspberry, and strawberry are rare. There are a few low shrubs of cherry, June berry, aspen, and willow. A low moss is common. There are many dead pine needles on the ground, and a few old blackened logs and stumps.

Recently burned jack pine forest habitat. A thick growth of young jack pine on the western edge of Montmorency County, beside the Black River, was burned in the early part of June, 1923. All the vegetation on the ground and practically all the trees were killed by this very hot fire. One month later, on July 11, a scanty growth of herbs, about 1 to 1½ feet high had grown up over the blackened ground. This growth was dominated by bracken fern, with numerous sweet ferns, blackberries, tiny aspens, rare grasses and a few unidentified herbs. A few sprouts of wintergreen and maple were noted. In the dead pine trees many larval wood borers were already working, and the small woodpeckers had been attracted to the district and were feeding on the borers.

Pine barren habitat. Extensive areas of burned-over sandy land in eastern Otsego County, and extending over a large portion of this part of the state, are grown up mostly to a low shrubby growth in which the heaths are most prominent. I do not include in this habitat the heavier growth of brush which occurs on clay soil, nor the patches of jack pine or aspen which have escaped the repeated fires. In the habitat as thus

limited there are scattered shrubs four to eight feet in height, mostly maple, pin cherry (*Prunus pennsylvanica*), June berry (*Amelanchier* sp.) and red oak. Low white oaks (*Quercus alba*) and willows (*Salix* sp.) are rare. There are also rare trees or scattered clumps of trees of jack pine, Norway pine, and red oak, all second growth, and none large in size. The ground is well covered with a growth about 12 to 18 inches high, consisting mostly of sweet fern, blueberries of several species (*Vaccinium* spp.), grass, bracken fern, rose (*Rosa* sp.), and other low shrubs and herbs. The growth is not uniform, but is heavier on north slopes, and on some exposed southwest slopes the ground may be nearly bare. In places small seedling aspens form a conspicuous element in the lower growth, and apparently indicate a following aspen stage for those locations.

Aerial habitat. The aerial mammals include only the bats, of which we secured only *Myotis s. subulatus* and *Lasionycteris noctivagans* in the region.

Pasture habitat. Numerous pasture fields occur in Charlevoix County. They are usually characterized by a scanty growth of low grass, and most commonly occupy the rather steep slopes of the gravelly hills.

Cultivated-field habitat. The most common cultivated crops of Charlevoix County seem to be timothy and clover hay, alfalfa hay, corn, and potatoes.

Orchard habitat. Numerous small fruit orchards occur in Charlevoix County. Many of these have cover crops or weeds growing among the trees.

Ruderal habitat. The waste areas along roadsides and in abandoned fields here, as elsewhere, seem not of great importance from the standpoint of the mammals.

Edificarian habitat. Charlevoix County is only sparsely settled, especially in the eastern half, and houses and other buildings are not abundant.

ANNOTATED LIST OF MAMMALS

Scalopus aquaticus machrinus. Prairie Mole.

Hardwood second-growth forest, Cultivated-field, ridges
ridges Orchard, 3

Near Boyne Falls numerous mole ridges were noted in gardens, cultivated fields, and orchards, and three specimens were trapped. Other mole ridges, probably made by this species, were noted in open, moist, second-growth hardwood forest at the same place.

Condylura cristata. Star-nosed Mole.

Fir and spruce second-growth Arbor vitae swamp, 8
forest, 4

Four were trapped in second-growth fir and spruce forest in Boyne Valley, and one was taken from a house cat in the extensive arbor vitae bog about 2 miles south of Boyne Falls.

Sorex personatus personatus. Masked Shrew.

Fir and spruce second-growth Hardwood forest, 4
forest, 2

In Charlevoix County two were trapped in second-growth fir and spruce forest in Boyne Valley, southeast of Boyne Falls, 1 was taken in virgin hardwood forest near Thumb Lake; in Otsego County 3 were trapped in virgin hardwood forest 4 miles south of Elmira.

July 31, about 9:00 A. M., a long-tailed, small shrew, probably this species, was observed running about in virgin hardwood forest about 4 miles south of Elmira. He was working chiefly around a decaying log where there were numerous small runways, but also ran about over the leaves on the open forest floor. Frequently he disappeared for a short time into one of the numerous openings to the subterranean tunnels. As he ran nervously about, pausing at intervals, he gave constantly a weak, high-pitched twitter, which could be heard 25 feet or more away. The ears were held out very prominently.

Blarina brevicauda talpoides. Bob-tailed Shrew.

Reed marsh, 3	Fir and spruce second-growth forest, 29
Sedge and grass marsh, 6	Bramble, 1
Tamarack and black spruce bog, 2	Aspen, 1
Arbor vitae swamp, 1	Hardwood second-growth forest, 17
Swamp brush, 6	Hardwood forest, 53
Black ash swamp, 7	Cultivated-field, 2

Common and widely distributed in the moist forest and brush habitats. In the region covered by this report, 128 were taken during the summer; in Upper Boyne Valley, at Thumb Lake, Susan Lake, Young State Park on Pine Lake, and Intermediate Lake in Charlevoix County; and 4 miles south of Elmira in Otsego County.

An adult held alive in a mouse trap uttered a high musical twitter when being taken out of the trap, and gave off a rank musky odor. Another adult trapped in a mouse trap had the mouth full of rolled oats, used for bait, showing some use of vegetable food. While mainly nocturnal, one was trapped August 31 sometime between 5:30 A. M. and 4:00 P. M. The uterus of a female taken July 8 near Boyne Falls contained an indeterminate number of what appear to be minute embryos. The mammae of the only individual which showed them plainly consisted of three pairs in the inguinal region.

Myotis subulatus subulatus. Say Brown Bat.

Edificarian, 1

A bat of this species was captured August 28 in the house 2½ miles southeast of Boyne Falls where we had our headquarters. On several evenings in August I saw bats, probably of this species, flying about the yard and orchard, and over the cultivated fields, but they were rare and I did not succeed in shooting one.

Lasiorycteris noctivagans. Silver-haired Bat.

Aerial, 7

On the evenings of August 28, 29, and 30, seven bats of this species were shot as they were flying over roadways beside

second-growth hardwood forest, and high over a roadway through a virgin hardwood forest, about 4 miles south of Elmira in Otsego County.

Ursus americanus americanus. Black Bear.

Bears occur rarely in the eastern part of Charlevoix County according to J. Stephenson. One was reported by residents as having been seen in late July of 1923, a short distance northeast of Thumb Lake. Another was reported in the middle of August about 2 miles north of Boyne Falls. A few are reported to occur throughout the region near Black River where this crosses the Otsego-Montmorency county line.

Canis latrans. Brush Wolf.

J. Stephenson saw tracks, probably of brush wolf, during three winters, 1919-21, near Boyne Falls. Probably all were made by one individual, which he was unable to capture.

Vulpes fulva. Red Fox.

Sand beach, tracks
Dune sand, tracks

Dry brush, reported
Hardwood forest, reported

In Charlevoix County, J. Stephenson reports that the red fox occurs commonly in the four eastern townships, and rarely in Wilson Township and in the western townships. It lives mostly in open brushy places and in virgin hardwood forest. George King reports that it has been common throughout the period of his memory in Montmorency and Otsego counties in the region near his camp on Black River. In early August, tracks were numerous on the sand beach and in the sparse sand-binding grass of the low bordering dunes of the Emmett County Game Refuge about 2 miles west of Cecil, and one skull was seen. The custodian of the refuge reported that in the previous winter he had taken a number at this place.

Urocyon cinereoargenteus cinereoargenteus. Gray Fox.

J. Stephenson reports that formerly this species was common in Charlevoix County, but is now scarce. He killed one

March 30, 1922, in Boyne Valley Township, the last one which he knows has been taken in the county. George King reports that formerly a few occurred in Otsego and Montmorency counties near his camp on Black River, but now it is rare.

Procyon lotor lotor. Raccoon.

Sedge marsh, 1

Dry brush, tracks

August 22, fresh tracks were seen in open dry brush, mostly sumac and cherry with a few aspen, in a low part of Young State Park, not far from Pine Lake. August 23 an adult male was trapped in a narrow part of the Susan Lake marshes, in sedges with a few low bushes, mostly of willow. This situation was only about 10 feet from the border of willows and other shrubs on the landward side of the marsh. J. Stephenson reports that a few occur throughout Charlevoix County.

?*Gulo luscus*. Wolverine.

George King states that he saw, about 1880, the skin of a wolverine which had been captured by an Indian, in Montmorency County, where it was then rare.

Martes americana americana. Marten.

J. Stephenson reports that the marten formerly occurred in Charlevoix County, but there have been no records for many years. George King reports that it was formerly common in Montmorency and Otsego counties near his camp on Black River, but none have been taken in this region for about 20 years. One is said to have been caught in the winter of 1921-22 about 2 miles east of Gaylord, but I did not obtain any more definite information.

Martes pennanti pennanti. Fisher, Black Cat.

George King reports that this species formerly was numerous in Montmorency and Otsego counties, near his camp on Black River, but there have been no records for about 18 years. No record for Charlevoix County was obtained.

Mustela noveboracensis noveboracensis. New York Weasel.

Swamp brush, 1

Ruderal, 1

Tamarack and black spruce bog, 2

Reported by J. Stephenson to be numerous all over Charlevoix County. He states that all turn white in winter. July 7 we saw one run across the road in a heavy growth of swamp brush, about 2 miles south of Boyne Falls. July 6 one was seen to chase an adult female *Microtus pennsylvanicus* across the main automobile road about 1½ miles southeast of Boyne Falls. This was about 6:30 A. M. When first seen the weasel was about 3 feet behind the mouse, and both were running rapidly; there seems no doubt that if we had not interfered the weasel would have caught the mouse soon, for the latter was much frightened and was easily caught in the hand. The weasel, which was a small one, escaped. At the side of the road from which the *Microtus* emerged there was a deep ditch, containing a little water, and with many characteristic *Microtus* runways and burrows through the dense grass.

Two weasels were trapped July 17 and 20, respectively, in burrows and runways in the sphagnum of the outer black spruce part of a tamarack and black spruce bog about one mile north of Thumb Lake. I think that these burrows might have been made by muskrats, which occurred in the bog.

Mustela vison mink. Mink.

Reported by J. Stephenson to be numerous in Charlevoix County. George King reports that a few occur in Otsego and Montmorency counties near his camp on Black River.

Mephitis nigra. Skunk.

J. Stephenson reports that the skunk is common all over Charlevoix County. We saw one that had been run over by an automobile on the main highway beside Susan Lake, and saw another killed in the same manner in Section 12, Wilson Township. George King reports that in the early days there were none near his camp on Black River, but that now a few occur in Otsego and Montmorency counties in the vicinity.

Taxidea taxus taxus. Badger.

Said by J. Stephenson to be somewhat numerous in Charlevoix County. He trapped one June 28, at Bow Lake, Hudson Township. Another was trapped July 20 in Warner Township, Antrim County.

Lutra canadensis canadensis. Otter.

J. Stephenson reports otters scarce in Charlevoix County. One was trapped in the spring of 1922 at Boyne Falls. Another is recorded for December, 1920 or 1921, at Bow Lake, Hudson Township.

Lynx canadensis canadensis. Lynx.

J. Stephenson reports that this species formerly occurred in Charlevoix County, but is now extinct. George King says that it was formerly more abundant than the bob-cat in Otsego and Montmorency counties near his camp on Black River, but is now rare or absent.

Lynx rufus rufus. Bob-cat.

In Charlevoix County, J. Stephenson reports it formerly common, but the last one was killed about 1914. George King reports that a few occur in Otsego and Montmorency counties near his camp on Black River, where it was formerly common.

Peromyscus maniculatus gracilis. Michigan Deer Mouse.

Tamarack and black spruce bog, 1	Hardwood second-growth forest, 36
Bramble, 1	Hardwood forest, 130
	Edificarian, 2

During the summer, 170 were taken at the following localities: One mile north of Thumb Lake; 2½ miles southeast of Boyne Falls, both in Charlevoix County, and 4 miles south of Elmira in Otsego County. It is abundant in virgin hardwood forest, and much less common in second-growth hardwood forest; one was taken in dry raspberry brush a short

distance from tall second-growth hardwood forest, and one was taken in a black spruce bog about 10 yards from the surrounding hardwood forest. Two were trapped in a barn about one-quarter mile from virgin hardwood forest.

July 31, near Boyne Falls, 5 embryos, of a length of 10 mm., were found in one female, and in another there were 3 embryos, 16 mm. long.

Peromyscus leucopus noveboracensis. Northern Deer Mouse.

Sedge and grass marsh, 6	Dune heath, 6
Tamarack and black spruce bog, 3	Bramble, 5
Arbor vitae swamp, 3	Aspen, 9
Swamp brush, 1	Hardwood second-growth forest, 28
Black ash swamp, 5	Hardwood forest, 42
Fir and spruce second-growth forest, 17	Jack pine forest, 1

In all, 136 were taken during the summer, at the following localities: Boyne Falls, Thumb Lake, Young State Park on Pine Lake, Susan Lake, 4 miles southwest of Charlevoix, and Intermediate Lake, in Charlevoix County; and 4 miles south of Elmira, and near Black River at the eastern edge of the county, in Otsego County. It is most common in virgin and second-growth hardwood forest, but is found in numerous other more open habitats. In the hardwood forest it is much less common than *P. m. gracilis*, with which it is often associated, but in the second-growth forest and brush it becomes more common than that species, and occurs in many of the more open habitats where *gracilis* is never found.

Embryos were found as follows:

June 28: Boyne Falls, 4 embryos, 13.5 mm. in length.

July 7: Boyne Falls, 4 embryos, 5 mm.

July 17: Thumb Lake, 5 embryos, 10 mm.

July 21: Thumb Lake, 3 embryos, 12 mm.

July 31: Boyne Falls, 3 embryos, 10 mm.

August 1: Boyne Falls, indeterminate number of small embryos.

August 2: Boyne Falls, 4 embryos, 11 mm.

August 9: Charlevoix, 4 embryos, 3 mm.

Peromyscus maniculatus bairdii. Beach Deer Mouse.

Sand beach, 16
Gravel beach, 3

Dune sand, 3

During the summer, 22 specimens were captured at the following localities in Charlevoix County: Young State Park on Pine Lake; Lake Michigan shore, 4 miles southwest of Charlevoix; and Fisherman's Island. It was found only on the beach and on the immediately adjacent low dunes covered with a scant growth of sand-binding grasses.

Synaptomys cooperi cooperi. Cooper Leming-vole.

Fir and spruce second-growth
forest, 1

Swamp brush, 1

Arbor vitae swamp, 3

Hardwood second-growth forest, 1

During the summer 4 specimens were taken near Boyne Falls, 1 in Young State Park on Pine Lake, and 1 at Susan Lake. All were taken in quite wet woods or brush.

Eutamias gapperi gapperi. Red-backed Vole.

Tamarack and black spruce
bog, 1

Fir and spruce second-growth
forest, 3

Arbor vitae swamp, 4

Hardwood second-growth forest, 1

Swamp brush, 2

Black ash swamp, 9

Hardwood forest, 29

During the summer 49 were taken at the following localities: Boyne Falls; beside Black River at the western border of Montmorency County; Thumb Lake; northern edge of Intermediate Lake in Charlevoix County; and 4 miles south of Elmira in Otsego County. It was found to be most abundant in the virgin hardwood forest growing on nearly level land near Elmira.

In a female taken July 20 near Thumb Lake there were an indeterminate number of very small embryos; in another taken August 14 near Boyne Falls there were 4 embryos of a length of 7 mm.; and in a third taken August 20 at Intermediate Lake there were 4 embryos, each 21 mm. in length. The number of mammae in this species is: pectoral, 2 pairs; inguinal, 2 pairs; total, 4 pairs.

An adult female taken near Black River in Montmorency County and an adult male taken near Elmira had each lost all but 4 and 9 mm., respectively, of the tail, and the remaining stumps had healed over completely.

Microtus pennsylvanicus pennsylvanicus. Pennsylvania Vole.

Sedge marsh, common	Arbor vitae swamp, 2
Rush marsh, common	Fir and spruce second-growth forest, 3
Sedge and grass marsh, abundant	Aspen, 1
Sedge and sphagnum bog, 4	Hardwood second-growth forest, 4
Tamarack and black spruce bog, 3	Cultivated-field, 6

During the summer, 107 were trapped at the following localities: Boyne Falls, Thumb Lake, Young State Park on Pine Lake, and Susan Lake, in Charlevoix County; and near Black River, both near the western edge of Montmorency County and near the eastern edge of Otsego County. Of this number of individuals, 84 were taken in sedge marsh, rush marsh, and sedge and grass marsh, being most common in the latter type of habitat. The 4 recorded from sedge and sphagnum bog were taken in a situation where there were a few scattered trees of invading tamaracks.

Embryos were taken as follows:

June 23: Boyne Falls, 4 embryos, 20 mm. in length.

July 8: Boyne Falls, 5 embryos, 6 mm.

July 13: Black River, western Montmorency Co., 3 embryos, 6 mm.

July 20: Thumb Lake, 6 embryos, 25 mm.; 3 embryos, small.

July 21: Thumb Lake, 3 embryos, 13 mm.; 4 embryos, 18-22 mm.; 5 embryos, small.

August 4: Boyne Falls, indeterminate number of small embryos.

Pitymys pinetorum scalopsoides. Northern Pine Vole.

Fir and spruce second-growth forest, 1

An immature male was taken in wet second-growth fir and spruce forest on July 3, two and one-half miles southeast of Boyne Falls.

Ondatra zibethica zibethica. Muskrat.

Sedge and grass marsh, 2

Tamarack and black spruce bog,
signs

J. Stephenson reports that only a few occur in Charlevoix County. We saw signs in a ditch, containing water, through a tamarack and black spruce bog one mile north of Thumb Lake, and residents reported it to occur here. We also saw characteristic houses and signs in a glacial depression containing a small marsh, one-half mile southeast of Thumb Lake. On the Susan Lake marshes there were a number of trails, and two were trapped near the edge of the marsh.

Rattus norvegicus. Norway Rat.

Edificarian, reported

One was captured August 2 in a place where logs were stored before loading, two and one-half miles southeast of Boyne Falls. It is reported to be common in the houses and stores in the towns of Charlevoix County.

Mus musculus musculus. House Mouse.

Edificarian, 18

Taken in houses and barns near Boyne Falls in Charlevoix County and near Elmira in Otsego County. It is reported to be common in the towns.

Zapus hudsonius hudsonius. Hudson Bay Jumping Mouse.

Sedge and grass marsh, 21

Dune sand, 1

Tamarack and black spruce bog, 1

Hardwood second-growth for-
est, 1Fir and spruce second-growth
forest, 2

During the summer 26 were trapped at the following localities: Boyne Falls, Thumb Lake, and near Charlevoix in Charlevoix County; near Black River in both the western border of Montmorency County and the eastern border of Otsego County. They are rare except in grassy marshes.

Napaeozapus insignis frutectanus. Woodland Jumping Mouse.

Tamarack and black spruce bog, 1	Hardwood second-growth forest, 3
Fir and spruce second-growth forest, 3	

We secured altogether 7 specimens in Charlevoix County, from Boyne Falls and Thumb Lake. The one from the tamarack and black spruce bog was captured in the black spruce at the border of the bog, and not far from the surrounding hardwood forest.

The mammae are in four pairs, as is also the case in *Zapus hudsonius*, and are quite evenly distributed from the pectoral to the inguinal region.

Erethizon dorsatum dorsatum. Porcupine.

Arbor vitae swamp, 1	Pine barren, 1
Gravel beach, signs	Hardwood forest, signs
Recently burned jack pine, 1	Edificarian, 1

Reported by J. Stephenson to be fairly numerous in Charlevoix County; we saw droppings and evidences of gnawing in hardwood forest near Thumb Lake. George King reports it formerly common and still numerous near his camp on Black River in western Montmorency County. We saw one in freshly burned jack pine; it ran into a narrow arbor vitae swamp along a little creek. Another was killed by some resorters in the same region in fairly open pine barren containing a few aspen trees. On the upper gravel beach of Lake Michigan in the Emmett County Game Refuge west of Cecil I saw feces and gnawings on a drift log. In the hardwood forest about 4 miles south of Elmira in Otsego County a great quantity of droppings were noted under one old elm; in the same region one was seen at night gnawing in an old barn.

Marmota monax rufescens. Rufescent Woodchuck.

Sedge and grass marsh, 1

J. Stephenson reports that a few occur in all parts of Charlevoix County. We saw only one, in a marshy place along the railroad about two miles southeast of Boyne Falls. Al-

though we saw large burrows in a few other places we were not sure that they were made by woodchucks. George King reports that a few have always occurred in Montmorency and Otsego counties near his camp on Black River.

Citellus tridecemlineatus tridecemlineatus. Striped Ground-squirrel.

Tamarack and black spruce bog, 2	Cultivated-field, numerous
Hardwood second-growth forest, 2	Orchard, numerous
	Ruderal, numerous
Pasture, numerous	Edificarian, 4

J. Stephenson reports that this species first appeared in Charlevoix County about 1912. It is now fairly numerous and was said by the farmers to be more than usually abundant in 1923. We saw many in cultivated fields, pastures, orchards, and along roadsides in various parts of the eastern section of the county. Two were trapped in July in the midst of tamaracks and leather leaf in a bog 1 mile north of Thumb Lake; they were about 50 yards from the road which runs through the bog and which is continuous with open fields. Some small burrows in the sphagnum of the bog may have been made by this species. We secured several that had burrows under and near an unoccupied house on Black River at the western border of Montmorency County, and trapped two in brush (hardwood slashing) growing up following a cleared hardwood forest near Black River in eastern Otsego County. One was seen along the roadside in Antrim County about 2 miles northwest of Elmira. Burrows were common and several were seen in orchards and pastures in Otsego County, about 4 miles south of Elmira. George King reports that it first appeared about 30 years ago near his camp on Black River in western Montmorency County.

Tamias striatus lysteri. Chipmunk.

Hardwood second-growth forest, 3	Hardwood forest, 7
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Reported to be fairly numerous in Charlevoix County by J. Stephenson, but we did not secure many records. It was

found near Boyne Falls and near Thumb Lake, only in virgin or second-growth hardwood forest. One was seen in low oak brush near Traverse City in Grand Traverse County. Several were noted in Otsego County about 4 miles south of Elmira. George King states that a few have always been found in Montmorency and Otsego counties near his camp on Black River; originally they were mostly confined to hardwood forest, but with the passing of this forest they now occur in brushy places, especially in the hardwood brush that has followed the cutting of the hardwoods.

Sciurus hudsonicus loquax. Red Squirrel.

Tamarack and black spruce bog, 2	Dry brush, 2
Arbor vitae swamp, 3	Hardwood forest, 5
Swamp brush, 1	Jack pine forest, 6
Fir and spruce second-growth forest, 2	Aspen, 2
Hardwood second-growth forest, 8	Orchard, 1
	Ruderal, 1
	Edificarian, 1

Numerous in Charlevoix County. We secured records for near Boyne Falls, Thumb Lake, Charlevoix, and Susan Lake; in Young State Park on Pine Lake it was especially common, feeding in the garbage cans of the camp, and living in the pines and arbor vitae, but it was rare in the aspens. It occurs in a wide variety of timber or brush habitats. George King reports that it was originally abundant in the pine forests of Otsego and Montmorency counties near his camp on Black River, but is now less common. We found many in the jack pines and in a black spruce bog at that place. A few occur in the hardwood forest five miles south of Elmira, in Otsego County, and several were seen in late August in an orchard feeding on the apples, and often running about over an old abandoned house. Two partly eaten apples which were dropped by the squirrels weighed 37 and 80 grams, respectively.

August 3, near Boyne Falls, Warthin saw a red squirrel carrying a double capsule of the beaked hazel, *Corylus ros-*

trata, in his mouth. The capsule, which was secured, contained two nuts, fully grown, but not quite ripe.

A partly albinistic immature male was taken July 3, near Boyne Falls. He was running across the highway, apparently crossing from one clump of trees to another. This specimen is slightly paler than the normal, having numerous white hairs distributed through the pelage, especially on the head. The tail is nearly all white, and is pure white on the end; but towards the base of the tail the hairs become gradually more and more brownish at their bases. The sides and soles of the hind feet have considerably more white than normal, but the front feet are almost normal.

Sciurus carolinensis leucotis. Gray Squirrel, Black Squirrel.

J. Stephenson states that the old settlers in Charlevoix County had no records for this species, and he had seen none in the county until 1923. October 6 he saw a pair in Boyne Valley Township; as he was able to observe them closely the identification is certain. Frank Paddock and his son, residents of the county, report seeing a pair, perhaps the same ones, September 9, about 5 miles east of the place they were seen by Stephenson. George King states that formerly it was numerous in Otsego and Montmorency counties near his camp on Black River, occurring mostly in hardwood forest, but occasionally in pine forest.

Sciurus niger rufiventer. Fox Squirrel.

Dry brush, 1	Hardwood forest, 2
Hardwood second-growth forest, 3	Cultivated-field, 1

J. Stephenson reports that he had never seen any of this species in Charlevoix County until the winter of 1922-23, when he saw one between Boyne City and Boyne Falls. We observed one in hardwood forest 2 miles north of Thumb Lake, one in dry brush and young forest on the dunes 4 miles southeast of Charlevoix, and one running from a cornfield to a second-growth hardwood forest two miles west of East Jor-

dan. J. Stephenson also saw one in Eveline Township, October 7, 1923. September 1 we trapped one in hardwood forest five miles south of Elmira in Otsego County. George King reports that a few now occur in Otsego and Montmorency counties near his camp on Black River, but that none were found in the early days.

Glaucomys volans volans. Small Eastern Flying Squirrel.

Hardwood forest, 2

Two were taken, August 27 and September 1, in virgin hardwood forest four miles south of Elmira in Otsego County.

Glaucomys sabrinus macrotis. Mearns Flying Squirrel.

Arbor vitae swamp, 1

Hardwood forest, 1

Hardwood second-growth forest, 3

During the summer five were taken near Boyne Falls and near Thumb Lake, all in Charlevoix County.

Castor canadensis michiganensis. Woods Beaver.

In the absence of comparative material from the southern peninsula I refer the Charlevoix County beaver to the northern peninsula form. J. Stephenson reports it formerly common in Charlevoix County, and found up to about 1920 along Boyne River. It is now rare or extinct in the county, except that beaver have been reintroduced on Spring Branch. A farmer resident near Thumb Lake told us of a beaver dam on Sturgeon River in Cheboygan County, not far from the Charlevoix County line. George King reports it formerly common in western Montmorency County, near his camp on Black River; it is scarce now, but is increasing in numbers.

Lepus americanus americanus. Snowshoe Hare.

Tamarack and black spruce bog, signs

Fir and spruce second-growth forest, 3

Arbor vitae swamp, 2

Pine forest, 1

Swamp brush, 16

Aspen, 1

Fairly common during the summer in the swamps and bogs of eastern Charlevoix County. J. Stephenson reports that it

is found on high ground as well as in the swamps and bogs. We found it near Boyne Falls, five miles east of Walloon Lake, near Thumb Lake, and in Young State Park on Pine Lake. In Young State Park one was seen among the pines of the tourist camp. In the Emmett County Game Refuge, about three miles west of Cecil, a tiny baby was found, August 9, trapped in a hole in the sand of a growth of small aspens, a few yards from a small swamp mostly of arbor vitae. One was seen near Black River, not far from the western boundary of Montmorency County, in a growth of aspens, and another in a thick arbor vitae swamp. It is reported by George King to be fairly common in the region.

Two females taken June 22 and July 5, respectively, at Boyne Falls, had much milk in the mammae, but contained no embryos. Another female taken July 6 at the same place contained one embryo with a length of 77 mm. There are 4 pairs of mammae, rather evenly spaced from the pectoral region to the anterior part of the inguinal region.

All the snowshoe hares taken during the summer had a heavy infestation of ticks of all sizes on the head, ears, and neck; and the stomach linings of most were heavily infected with red nematodes.

Sylvilagus floridanus mearnsii. Cottontail Rabbit.

Dry brush, 4	Hardwood forest, 1
Hardwood second-growth forest, 2	Pasture, 2
	Cultivated-field, 2

J. Stephenson states that this species first arrived in the county about 1900, and that only a few occur now. We saw a few during the summer, mostly in open brush or open second-growth hardwood forest, or in fields near brush. We secured records for Boyne Falls and Thumb Lake. A rabbit seen by T. H. Hubbell in virgin hardwood forest near Thumb Lake was probably of this species. In July, Crystal Thompson and Mina Winslow, of the Michigan Museum of Zoology, saw a dead one lying in the road in Kearney Township, Antrim County, and saw two live ones along Intermediate Lake in

Central Lake Township. F. W. Holly, of Cecil Bay, reports that it was artificially introduced near Mackinaw about 1899, where it soon became common, but later died off. It first appeared near Cecil Bay about 1918. I saw tracks in the sand of the beach here in August. George King reports it rare, mostly in hardwood slashings, in Montmorency and Otsego counties near his camp on Black River. He states that it was first seen about 1917, although it had appeared near Vanderbilt and near Onaway about 1913 or 1915.

A female taken June 22 near Boyne Falls contained 6 embryos of a length of 10 mm. There are 4 pairs of mammae, rather evenly spaced, the first far forward in the pectoral region, the last barely within the inguinal region.

Odocoileus virginianus borealis. Virginia Deer.

J. Stephenson reports deer rare in Charlevoix County, being found only in the eastern part of the county. We saw no signs of any. Near Black River in Montmorency and Otsego counties, George King reports it somewhat numerous.

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PLATE I

FIG. 1. Lake Michigan sand beach 4 miles southwest of Charlevoix. The belt of driftwood on the beach and the sand-binding grasses of the upper beach and of the face of the low dunes are characteristic. The beach deer-mouse (*Peromyscus maniculatus bairdii*) is characteristic of these beaches. August, 1923.

FIG. 2. Bog one mile north of Thumb Lake. Leather leaf (*Chamaedaphne calyculata*) dominates the middle of the bog; outside this is a belt of scattered tamaracks (*Larix laricina*) and toward the edge of the bog the black spruce (*Picea mariana*) is dominant. A belt of mixed black spruce and yellow birch (*Betula lutea*) is interposed between the bog proper and the hardwood forest on higher ground in the distance. July 30, 1923.



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PLATE II

FIG. 1. Arbor vitae swamp about 2 miles south of Boyne Falls. The view is across a small open place with a pool of water, probably artificially cleared. June, 1923.

FIG. 2. Hardwood forest in Otsego County four miles south of Elmira. The hard maple (*Acer saccharum*) is the dominant tree in this forest; the undergrowth is mostly composed of maple seedlings. July 31, 1923.



PLATE III

FIG. 1. Open grove of Norway pine (*Pinus resinosa*) in eastern Otsego County, near Black River. In the distance are thickets of young jack pine (*Pinus banksiana*). July 11, 1923.

FIG. 2. Pine barrens in western Montmorency County near Black River. July 11, 1923.





