FERNS AND FLOWERING PLANTS

OF ISLE ROYALE · MICHIGAN

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BY

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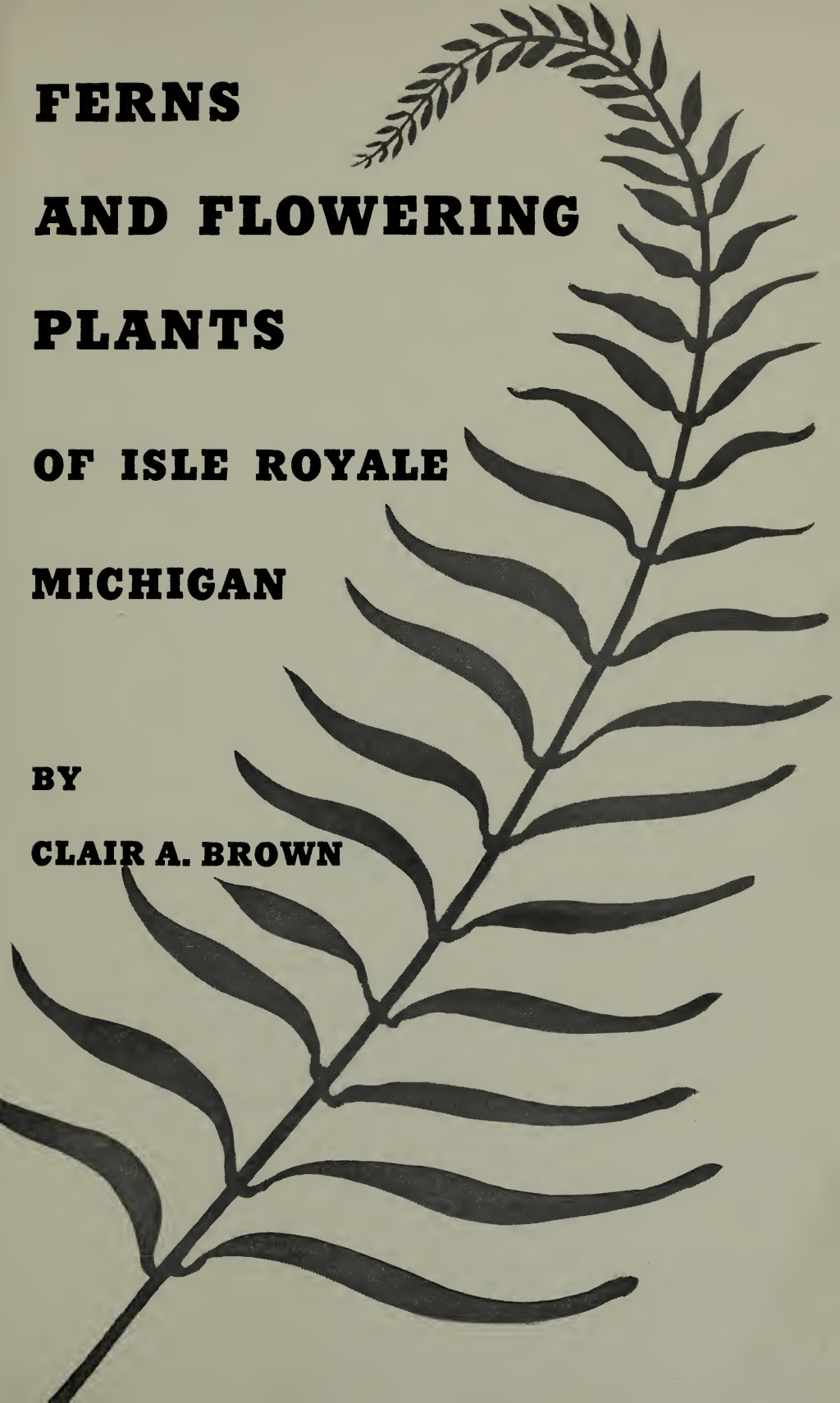

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The field survey was made under the authorization and appropriation of the fifty-fifth legislature of the State of Michigan. The survey was directed by the Museum of Zoology, University of Michigan, and the botanical studies were made under the supervision of the University Herbarium.

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• I •

INTRODUCTION

IN 1929 the fifty-fifth legislature of the State of Michigan appropriated funds for a survey of Isle Royale, entrusting the study to the University of Michigan under the general direction of the director of the Museum of Zoology. The project was divided into four parts: anthropology, botany, geology and geography, and zoology. Prof. C. H. Kauffman, former director of the University Herbarium, planned the botanical survey just previous to his fatal illness.

The botanical study was made from June 27 to September 22, 1930, by a party from the University Herbarium. In order that the study might be as complete as was possible during the time available, responsibility for the major groups of plants was divided among the members of the party. A. H. Povah had charge of the study of the cryptogamic flora with the exception of the ferns and was assisted by J. L. Lowe. The writer was responsible for the study of the ferns and flowering plants and was assisted by J. B. McFarlin.[1]

• II •

LOCATION AND PHYSIOGRAPHY

ISLE ROYALE is located in the northwestern part of Lake Superior in the latitude of 48° N., and in the longitude of 89° W. The island lies with its long axis northeast-southwest, nearly parallel to the north shore of the lake. Thunder Cape, the nearest point of the Canadian mainland, is about 15 miles northwest of Isle Royale, and Port Arthur, Ontario, is about 30 miles to the northwest. The island is about 45 miles long, about 7 miles wide in the widest portion, and has an area of 210 square miles.

The geology of Isle Royale has been discussed in several reports, the latest of which is Lane's (41–42)[2] comprehensive treatment. The dif-

[1] The results of the survey which have thus far been published are as follows: Murie, Adolph. The Moose of Isle Royale. Univ. Mich. Mus. Zool. Misc. Pub., No. 25, 44 p. 1934; Povah, Alfred, H. W. The Fungi of Isle Royale, Lake Superior. Pap. Mich. Acad. Sci., Arts and Letters, 20: 113–156. 1935; Taylor, Wm. Randolph. Phytoplankton of Isle Royale. Trans. Microsc. Soc. 54: 83–97. 1935; Thorpe, Frances J., and Povah, Alfred H. The Bryophytes of Isle Royale, Lake Superior. The Bryologist 38: 32–46, 1935; Hedrick, Joyce, and Lowe, J. L. Lichens of Isle Royale, Lake Superior. The Bryologist. (Accepted.)

[2] Figures in parentheses refer to Literature Cited, p. 88.

ferent rock formations are in narrow strips, nearly parallel with the long axis of the island. These rocks are composed of successive lava flows interbedded with sandstone and conglomerates, all of varying thickness, and belong to the Keweenawan series of the pre-Cambrian.

After the formation of the lava beds, this area passed through a period during which there was an elevation of the rock strata, erosion, depression, depositions of new material, then elevation, tilting, and faulting, all of of which resulted in the formation of long narrow ridges with intervening valleys, which lie parallel to the long axis of the island. The rock strata were tilted toward the south shore of Lake Superior, and the degree of tilting varies from 9° to 43° in various places. Then softer strata disintegrated, leaving the truncated ridges with gentle slopes on the southern side and with abrupt, steep slopes on the northern side. The ridges are mainly flat-topped, and the main one, commonly called the Greenstone Ridge, is a divide which extends in the center and for the entire length of the island. This is broken into low gaps in three or four places. On this ridge there are three places which have an elevation above 500 feet according to contours drawn by Lane in 1908. Unpublished studies of George M. Stanley show that the highest portion of the Greenstone Ridge is on the southwestern part of the island and has an elevation close to 800 feet above lake level.

Near the north shore of the island is another ridge, the Minong Trap Ridge, which extends nearly the length of the island and is above the 300-foot contour line. South of the Greenstone Ridge is a ridge which is much broken but contains many points reaching above the 300-foot level. In addition to these main ridges there are many smaller intervening ones.

Drainage is mostly parallel with the ridges. Some of the small streams in the intervening valleys empty into Lake Superior at the northeastern end, and others flow to the southwestern end. A few streams flow crosswise of the island in low gaps.

There are many lakes on the island, which vary in size from a few hundred feet in diameter to one, Siskowit Lake, with an area of several square miles.

The shore lines are mainly rocky with steep cliffs on the northern side of the island and with deep water close to shore. The northeastern end of the island has several long narrow deep harbors which are formed by the ridges projecting out into the lake.

Isle Royale was probably overridden by the Superior Lobe of the Wisconsin ice sheet which may account for the thinness of the mineral soil over most of the island. A number of subsequent ancient lakes are supposed to have covered Isle Royale.

· III ·

CLIMATE

COMPLETE climatic records for Isle Royale are not available. Adams (2) secured data of temperatures for Isle Royale for 26 days in July as follows: Mean 58° F., mean maximum 79° F., mean minimum 46° F.; and from August 2 to 17 a mean of 59° F., mean maximum of 71° F., and mean minimum of 47° F. Cooper (12) records for Rock Harbor a mean maximum of 72° F. for July and August and mean minima 54° F. and 55° F. for July and August, respectively. He reports somewhat lower averages for the adjacent Menagerie Island. Darlington (18) records temperatures for the Porcupine Mountains on the south shore of Lake Superior very comparable with those reported by Cooper for Isle Royale. However, a study of the records of Port Arthur, Houghton, and Duluth indicate that the north shore of Lake Superior averages 5° or more colder for the mean annual temperature.

The exact length of the growing season for Isle Royale is not known. The number of days for the growing season in the Porcupine Mountains as given by Darlington is 99 (June 6 to Sept. 16). The average length for Houghton is 149 and for Duluth 150. Port Arthur records indicate about 144 days. Our party reached Isle Royale on June 28 and from that day until we left, September 23, no signs of frost were seen. Adams mentions a frost on August 22, 1905, at Washington Harbor. It is the belief of the writer that the period between June 15 and September 15 is usually without frosts, and it is probable that the frostless season is longer due to the moderating influence of the lake. There is still less information in regard to rainfall for the island. Cooper (12) concluded from the records of Menagerie Island that the precipitation for Isle Royale is probably near that of Port Arthur. An examination of the record of Port Arthur gives an average annual precipitation of 23.7 inches. For Houghton the average is 25.28 inches and for Duluth 29.97 inches. The precipitation for Isle Royale probably falls within this range.

· IV ·

HISTORY

IN 1840 Douglas Houghton visited Isle Royale. He spent a week sailing from one place to another around the island. His observations which have not been published are recorded in his journal, now in the library of the University of Michigan. Being primarily interested in the geology of the island, his discussion of the vegetation is brief.

In 1847 William Ives conducted a rectangular survey of the island. The surveyors were required to record in their field notes, along with other data, the kinds and sizes of trees on which they placed their blazes and the vege-

tation and soils of each township. The records of Ives, kept at the Land Office, Department of Conservation, Lansing, Mich., therefore contain considerable information concerning the flora as it existed at that time.

During the same year a party headed by Dr. C. T. Jackson, geologist for the United States Government, visited the island to make a geological survey. George J. Dickenson and James McIntyre, members of the party, contributed articles concerning the botany of the island to Jackson's report (37). J. W. Foster, another member, and J. D. Whitney who visited the island in 1848, in a joint report (32) on the copper lands of the Lake Superior region give a description of the vegetation of Isle Royale. In a later report (33) concerning the geology of the Lake Superior district they list the plants collected, including a few from Isle Royale.

The next collection of plants was apparently made by Thomas C. Porter, a botanist from Pennsylvania, who visited the island in 1865 with Charles E. and Aubrey H. Smith and Joseph Leidy. W. L. McAtee (43) has published a very interesting letter written by him to Dr. W. J. Beal giving a list of additions to Beal's Flora of Michigan. Porter lists a number of his own collections made in the vicinity of Rock Harbor, Isle Royale.

The herbarium of the University of Michigan contains a number of specimens collected on Isle Royale in 1868 by a party headed by Dr. A. E. Foote. Apparently very little is known concerning this expedition. After considerable search a brief account was found in a report by Prof. A. Winchell (45) to the Board of Regents from the museum of the University of Michigan. It is stated that 560 species of plants were observed on the island and the following is noted: "Dr. A. E. Foote, 275 specimens of dried plants from Isle Royale, numbering about 360 specimens, embracing half a dozen of the rare fern *Allosourus achrostichoides* and the same number of *Aspidium fragrans*."

The next visitor to record information in regard to the flora was Henry Gillman (34, 35), the bulk of whose collections are deposited in the Gray Herbarium and the herbarium of Columbia University. He visited the island in 1873.

Although there is no published record of further botanical exploration until 1900, herbarium records and collections indicate that the island was visited and specimens collected by J. H. Sandberg, J. H. Ily, O. A. Farwell, O. B. Wheeler, G. A. Marr, A. A. and S. W. Robinson, and D. H. Rhoads.

In 1900 W. A. Wheeler (54) of the University of Minnesota, spent 2 weeks at Tobin Harbor and published a short article on some of the rarer plants which he found. One of the most outstanding was *Oplopanax horridum*, the Devil's Club.

Dr. C. E. Allen and C. S. Stuntz, of the botanical department of the University of Wisconsin, were on Isle Royale from August 7 to September 14, 1901. Their camp was near the deserted lighthouse on the peninsula

at the southern entrance to Rock Harbor. They made about 1,500 collections from all the major groups of plants with the exception of the algae. A list of the Hepaticae, collected by them, was published by George H. Conklin (16). The results of their investigations concerning the other groups were not published, due largely to the death of Mr. Stuntz.

Dr. Allen has kindly placed at our disposal lists of the mosses, grasses, and sedges which they collected. The sedges were determined by G. P. Van Eseltine and the grasses by Dr. A. S. Hitchcock. Specimens of these have been placed in the National Herbarium. The mosses were determined by Dr. G. E. Nichols, and one set was deposited in the herbarium of the University of Michigan.

Dr. Bruce Fink collected lichens on Isle Royale in 1902 and E. T. and A. S. Harper collected lichens and fungi in 1904.

In 1904 the University of Michigan expedition to the northern peninsula of Michigan, under the direction of Dr. A. G. Ruthven (1), was on Isle Royale from August 13 to September 15. This party selected Washington Harbor, on the southwestern end of the island, for headquarters. Ruthven called attention to the predominance of boreal plant societies and to the occurrence of certain plants and animals which have a western and northwestern range. In the limited time at their disposal they listed 91 species of plants for Isle Royale. Apparently specimens of these have not been preserved.

On July 5, 1905, a University of Michigan museum party under the direction of Dr. C. C. Adams (2), made camp at the abandoned lighthouse at Rock Harbor. Most of the party left September 5, one member staying to study the fall migration of birds. The object of this expedition was to make coordinated studies of the relations of the plant and animal life to their surroundings, with special attention given to the investigation of the genesis and succession of events. As a basis, stations were established where the existing plants and animals were thoroughly studied.

W. P. Holt was assigned the task of studying the flora. He (2) has published a report in which the principal plant societies are discussed "under four heads, viz: bog societies, shore societies, forests, and burnings." He lists 43 species of lichens, 38 species of mosses, 35 species of pteridophytes, and 238 species of spermatophytes, making a total of 364 plants for Isle Royale. It is unfortunate his collections have apparently been lost, since there are some plants listed which have not been found by subsequent investigators.

Dr. H. A. Gleason (2), one of the Adams party, has given in his report an excellent discussion of the various habitats and has shown the relationship between the habitat and the development of the climax forest.

W. S. Cooper spent the summers of 1909 and 1910 studying the ecological relationships of the vegetation of Isle Royale. From the results of this study he published five papers (10, 11, 12, 13, 14). In his annotated list of the flora of Isle Royale Cooper lists 519 species and varieties.

· V ·

GENERAL DESCRIPTION OF THE VEGETATION

FOR PURPOSES of discussion it is convenient to divide the island into three sections and describe each of these sections separately. We will first discuss the northeastern end, comprising the region northeast from Chippewa Harbor to McCargoe Cove (R. 34 W.). This region contains many diverse habitats and it is the purpose at this time to give a generalized discussion rather than a detailed one.

Viewed from the lake two rather distinct variations in the composition of the forest are apparent. The larger masses of light green, round-topped deciduous trees stand out in contrast with the dark green spire-shaped coniferous patches which are scattered among them. Interspersed are openings which contain little vegetation, compared with the forested areas. The forest, however, is the dominant, and is composed of *Abies balsamea*, *Betula alba* var. *papyrifera*, *Populus tremuloides*, *Picea canadensis*, and *Thuja occidentalis*. The ratio of one species to another varies in different sections of this area. A close examination of such areas apparently consisting largely of deciduous trees shows, however, that *Abies balsamea* is in reality the most abundant species. It is concealed under *Betula alba* var. *papyrifera*, and is not evident from the lake. The prominent dark green coniferous areas are usually swamps in which there are fewer dedicuous trees.

The general ground cover of the forest is composed of such shrubs as *Viburnum pauciflorum*, *Taxus canadensis*, and *Rubus parviflorus*. Some of the typical herbs of the forest are *Aster macrophyllus*, *Linnaea borealis* var. *americana*, *Clintonia borealis*, *Lycopodium annotinum* and *L. complanatum*. A closer examination of certain areas shows parctically pure stands of Populus and Betula. These even-aged stands of temporary species suggest the presence of fire through these particular regions a number of years ago. In fact there is no place on Isle Royale visited by the writer that does not show some evidence of fire, either by the presence of charred stumps and logs or of plants that usually follow fire.

Between Rock Harbor and Tobin Harbor there are many openings in the forest. In places not protected by the sheltering chain of islands there are many rocky beaches which vary in width. That this peninsula has been overrun by fire many times is shown by the stands of *Betula alba* var. *papyrifera*, *Populus tremuloides*, and *Abies balsamea* of different ages. The openings, which have been called rock openings, are probably of two origins; first, natural, in that the vegetation has not been able to form sufficient soil over the rock to allow invasion of the forest trees, and second, openings which were at one time forested, but the severity of fire and

subsequent rains have washed away most of the organic soil, leaving the bare rock. Both of these openings are being vegetated through a succession of lichens, mosses and heath shrubs. Here and there in the crevices where there is sufficient soil and a few stunted trees exist.

About 3 miles southwest of Rock Harbor post office, on a southerly slope, the *Pinus Banksiana* xerophytic forest is very abundant. On the side of the peninsula near the head of Tobin Harbor there is a dense

FIGURE 1.—Looking northward from Mount Objibway. Thunder Cape in the background. Note the scattered dark patches of conifers, rock openings, and the prevalence of deciduous vegetation.

stand of young *Abies balsamea*. These trees average about 4 inches in diameter, and on the ground are many dead trees which range from 2 to 4 inches in diameter. These are so thick that it is extremely difficult to make one's way through the woods.

The peninsula lying between Tobin Harbor and Duncan Bay is covered with a dense forest growth. The Greenstone Ridge runs the length of this peninsula and if we follow it from the tip of Blake Point to Mount Franklin (sec. 12, T. 66 N., R. 34 W.), we pass through a dense woods composed of *Abies balsamea*, *Betula alba* var. *papyrifera*, and *Picea canadensis*. As we near the head of the harbor, we notice the occurrence of occasional trees of

Pinus Strobus and *Pinus Banksiana*. Then, abruptly, we pass from a mixed coniferous woods to an almost pure stand of Populus and Betula, an old burn. If we follow the ridge from Mount Franklin to Mount Objibway (sec. 24) of the same township, the most conspicuous feature is the abundance of large, old stumps of *Pinus Strobus* (figs. 2 and 3) and *Thuja occidentalis*. We find these on the top of the ridge whether the vegetation present is Abies-Betula-Populus, or Populus-Betula. *Acer saccharum* and *A. rubrum* are also present.

In the vicinity of Pickerel Cove, the northern slopes of the small ridges are covered with a dense growth of *Picea mariana*, *Abies balsamea*, and *Betula*

FIGURE 2.—Stub of white pine (*Pinus Strobus*) on the crest of the Greenstone Ridge north of Lake LeSage. This pine must have started growth when there was more humus covering the bed rock.

alba var. *papyrifera*. South of Pickerel Cove we pass through many acres of a mixture of Abies-Betula-Populus. All stands show the effect of fire. This is especially apparent in the vicinity of Sargent Lake, Angleworm Lake, and Lake Benson. Near the abandoned lighthouse at the southern entrance to Rock Harbor, *Abies balsamea* and *Picea canadensis* are abundant. Coniferous vegetation is particularly plentiful around Conglomerate Bay, the north side of Sumner Lake, and in the region between Conglomerate Bay and the old lighthouse.

The center section of the island lies southwest of the above-described section, between R. 34 W. and R. 37 W. This area has suffered much from fires and the composition of the forest varies in different localities. Some of the more protected areas show much larger and better timber than

FIGURE 3.—Looking southwest over a low gap in the Greenstone Ridge, west of Lake LeSage. Note the pine logs in the foreground and the scattered coniferous vegetation.

FIGURE 4.—White pine stubs on Greenstone Ridge between Siskowit Lake and Hatchet Lake. Thirty-one stubs were found on a 5-acre plot. Fire has killed the timber. Siskowit Lake is in the background.

others. The general aspect of the center portion is not much different from that of the northeastern end.

The slope in the southeast side of Lake Richie is composed of nearly pure *Thuja occidentalis* which varies from 6 to 20 inches in diameter. The main ridge of the Greenstone, which extends through secs. 7, 8, 9, T. 66 N., R. 35 W., south of Lake Harvey, contains many areas of living *Pinus Strobus* of moderate size. In this vicinity *Pinus Strobus* had its best development, judging by the size and abundance of old logs and stubs. One 5-acre plot in secs. 22–23, T. 65 N., R. 36 W., has 31 pine stubs on it (fig. 4). The islands in Lake Harvey, which apparently have not been touched by

FIGURE 5.—Looking northeast on Isle Royale. Hatchet Lake is visible on the left. Note the general burned-over aspect.

fire, or only by very light fires, show the best stands of *Pinus Strobus* on Isle Royale. The island near the southern shore had 125 trees which vary from 18 to 30 inches in diameter. A good needle duff with sparse herbaceous growth is found under them.

In secs. 17, 18, 19, T. 65 N., R. 35 W., just north of Siskowit Lake, the forest is composed of *Abies balsamea*, *Betula alba* var. *papyrifera*, some *Thuja occidentalis* and *Picea canadensis*. To the left of this we find evidences of an old burn because the composition of the forest changes to *Populus tremuloides*, *Betula alba* var. *papyrifera*, and *Abies balsamea*. From here to the top of the ridge, secs. 22, 23, and parts of 14, 15, T. 65 N., R. 36 W., the smaller growth of the same species suggests either a fire of more recent origin than that in the first locality or that the destruction of the soil has prevented the trees from reoccupying this area with the same rapidity as in the other sections (fig. 5).

On the south side of Siskowit Lake, east of the outlet, the forest is composed of some large specimens of *Picea canadensis* with an understory of Abies, Picea, and Betula which are considerably smaller both in diameter and height. The land-office survey recorded that fire had been through this area and that *Betula alba* var. *papyrifera* was one of the trees following it and replacing the burned *Pinus Strobus*. *Acer saccharum* and *Betula lutea* were found in parts of secs. 7, 8, T. 66 N., R. 35 W.

The third division of the island lies southwest of R. 36 W. For this section it is important to note the presence of *Acer saccharum* and *Betula lutea* on the Greenstone Ridge from the vicinity of the Washington Club to Lake Desor, a strip nearly 10 miles long. *Acer saccharum* and *Betula lutea* form the dominant part of the vegetation. *Thuja occidentalis*, *Picea canadensis*, and *Abies balsamea* occur as minor constituents. A few old specimens of *Pinus Strobus* still persist. Previous workers have limited the distribution of the hardwood forest to the crest of the ridge. The elevation of the Greenstone Ridge, however, does not sharply limit the hardwood forest to the ridge. The valley between the Greenstone Ridge and the adjoining ridge on the south contains at the bottom large amounts of good-sized *Thuja occidentalis*, some *Betula lutea*, and *Abies balsamea*, and a few specimens of *Picea canadensis*. Arbitrary grouping by percentages would separate this site from that on the top of the ridge due to the greater abundance of *Thuja occidentalis* in the valley as compared to that on the top of the ridge. *Acer saccharum* is only occasionally present.

In the vicinity of Grace Harbor, Abies, *Betula alba* var. *papyrifera*, and Picea are the most abundant and this general type of forest covering continues on much of the lowlands in this area, with the exception of the typical Thuja-Abies swamp, which lies between the head of Siskowit Bay and Lake Feldtmann.

• VI •

CHANGES IN THE VEGETATION DUE TO VARIOUS FACTORS

A. INSECTS

THE accounts of the early visitors to Isle Royale mention tamarack as occurring in swamps, and on upland soils. Ives praised the tamarack in one section, saying they were handsome trees and the best seen for building purposes. The accounts of later scientists who have made a study of the vegetation of the island all mention tamarack in swamps and as an indicator species of the bog forest.

Today there is very little tamarack on Isle Royale. Living tamarack is found only in such habitats as rock crevices, bogs, and occasionally on the top of rock ridges. No specimens of tamarack over 2 inches in diameter breast high were seen, and these could not be classed as common. In the

bog forest around certain bog lakes, such as Moose Lake, Hidden Lake, Sumner Lake, Forbes Lake, and the bog on Raspberry Island dead trunks of this species were found.

Probably the larch sawfly (*Lygaeonematus erichsonii* Hart.) is responsible for the killing of the tamarack. The damage done by this insect is enormous. The death of tamarack timber to the extent of 1 billion board feet has been attributed to this insect in the State of Minnesota from 1916 to 1924.

The past few years there has been considerable concern about the spruce budworm (*Cacoecia fumiferana* Clems.), an insect which was originally found on spruce, but prefers balsam and will attack spruce when its favorable host is not present. Balsam is possibly the most abundant tree in the forests of Isle Royale. The spruce budworm had not been reported from Isle Royale previous to this investigation. In the vicinity of Rock Harbor there was little evidence of the presence of this pest. On July 5 the writer and his assistant moved to Washington Harbor in order to collect the early flora in that locality. As the motor boat skirted the south shore and northeastern end of the island it was noted that the dark green color of healthy conifers formed a decided contrast to the brownish color of diseased conifers particularly noticeable southwestward from Chippewa Harbor to Washington Harbor. Here the trees were examined and the needles on the twigs of the growth of the last year or two were brownish, more or less adherent to the twig by the web of the larval stage of this insect. The severity of the infestation can be judged by the fact that it was estimated that from 75 to 95 percent of all small twigs on particular trees had turned brown, and from 75 to 95 percent of all the balsams were attacked. Different localities on the southwestern part of the island showed varying amounts of infestation. In the vicinity of Lake Richie the balsams showed about 75 percent damage of the individual trees, and about that percentage of the stand was attacked (fig. 6).

It is impossible to state at this time what will be the effect on the forest succession if the major portion of the balsam is destroyed in the next few years by this pest. There is, however, a very serious side to this destruction of the balsam which must be considered and which will be discussed under the effect of the moose on the vegetation.

B. MAMMAL DAMAGE

The study of the moose and their food habits was not within the field covered by the writer. A detailed account of this study is given in the report of Dr. Adolph Murie (see footnote 1). However, inasmuch as there has been a decided effect upon the vegetation since the arrival of the moose on Isle Royale, it will be discussed to some extent here.

The accounts of the early visitors and surveyors hitherto quoted indicate that certain plants, namely, ground hemlock and hazelnut, were very

abundant over all the island. The reports of Adams and Cooper with accompanying photographs record the abundance of water lilies in certain bog lakes. Thus from the historical accounts and scientific studies, made before the arrival of the moose on Isle Royale, we have an index with which to compare the present studies.

The aquatics, particularly the water lilies, are now conspicuous by their absence. Figures 22, 46, and 47 of the Adams report, and figure 34 of Cooper's account (12) show the leaves of the water lilies numerous on the

FIGURE 6.—Dense stand of balsam near Lake Richie which has been attacked by the spruce budworm.

surface of the water, particularly on Sumner Lake and Moose Lake. It is probable that the same condition existed in the other shallow bog lakes. Today water lilies are almost completely absent in these lakes. The yellow cow lily was collected in flower only where protected by a tangle of logs and brush. The white water lily was not found. In Moose Lake and Hidden Lake as well as in some of the other bog lakes, large numbers of seedlings of water lilies were observed, and even these were sought by the moose.

A more conspicuous damage is that noticed in the sedge mats of bog lakes where the aquatic vegetation was once prevalent, as for example at Moose Lake and Hidden Lake. The margin of the sedge mat of a bog lake is normally smooth in outline, but here the margin is irregular because pieces break out of the margin under the weight of the moose. These pieces form little semifloating hummocks in the water. The region back from the

margin has been churned into a sea of mud with here and there a plant which has escaped destruction (figs. 7 and 8). This damage is by no means common throughout the island, but rather is typical of specific areas in which the moose have congregated.

Rank growth of healthy, green, ground hemlock was not found anywhere on the main island in what could be called abundance, or in sufficient abundance to be an impediment to walking. Much ground hemlock was seen which was straggly in appearance and which appeared to have been either severely browsed or trampled, perhaps both. Outlying islands such

FIGURE 7.—Remains of sedge mat of Moose Lake. Note how the trampling by the moose has churned up the mud and destroyed the sedge mat vegetation, also the dead bog trees in the background.

as Smithwick Island, Mott Island, and Passage Island have large amounts of rank growth of ground hemlock which have not been browsed or only slightly so.

The feeding on balsam shows up in two ways—the browsing of small branches and twigs followed on small trees by the breaking of the leader sometimes 3 or 4 feet from the tip, and the stripping of the bark. Balsam is one of the principal foods left following the exhaustion of the ground hemlock as an important food source for moose. It is likely that if the spruce budworm is able to destroy the majority of the balsam on Isle Royale as it has done elsewhere, the moose in the next few years will have to turn to some other plant as a source of food.

The food of the moose has not been confined to the aquatics, ground hemlock, and hazelnut, for many plants show evidence of having been browsed by them. The moose appear to be fond of bark of various trees and during the spring are able to strip off long pieces of it, especially from such trees as mountain ash and aspens. Some trees have been particularly barked 4 and 5 years in succession, as can be determined by counting the annual rings under the healing edge of the scar.

The purely mechanical damage to plants is important. In the vicinity of licks and wintering quarters the constant tramping has worn paths through

FIGURE 8.—Another view of Moose Lake. Illustrations in earlier publications show this pond practically filled with water lily pads and a dense sedge mat around the pond.

the forest. These paths vary in width and in depth, in many places the humus is destroyed and the path worn down into the mineral soil (fig. 9). The soil in the vicinity of wintering quarters is cut up by countless hoofprints to such an extent that the herbaceous vegetation is destroyed. Shrubs are trampled and trees barked so that it is easy to recognize the winter quarters. Around the lick at Lake Eva practically all the organic soil has been destroyed, and many of the roots of the trees have been exposed.

Following is a list of species that the moose have used for food, some to a greater extent than others. Plants on which the writer has seen the moose feed are indicated with a plus sign. The others have been attributed to the moose inasmuch as they are the only large herbivorous animals on Isle Royale which could be responsible for the browsing.

TREES

Populus tremuloides+
Pyrus americana+
Betula alba var. papyrifera+
Abies balsamea+
Acer spicatum
Acer rubrum
Acer saccharum

HERBS

Aster macrophyllus
Heracleum lanatum+
Castalia odorata
Nymphaea americana
Potamogeton spp.
Najas flexilis

HERBS—Continued

Elodea canadensis
Cornus canadensis+
Osmunda regalis
Osmunda claytoniana+

SHRUBS

Taxus canadensis
Corylus rostrata
Diervilla lonicera+
Salix sp.
Cornus stolonifera+
Viburnum pauciflorum+
Sambucus racemosa+
Rubus parviflorus+
Amelanchier spp.

C. FIRE

In regions where mining is prevalent, it has been the custom to set fires so that the rock strata would be exposed, and thus the chances of locating ore would be greater. The first wave of exploration and prospecting for copper on Isle Royale started in 1843 and continued for a few years. The surveyors in 1847 recorded the presence of recent burns in the vicinity of Conglomerate Bay and Rock Harbor near the Ramson Clearing, or what is now called the Daisy Farm.

The abundance of hazelnut recorded by Ives in various localities suggests that old burns were prevalent in various parts of the islands, for hazelnut is a shrub which is considered an indicator of former fires. Ives, as hitherto quoted, notes that white birch replaced white pine in the region north of Siskowit Lake.

The decline of prospecting by 1850 led to a general desertion of the island until the revival of the mining interests in 1870. An old white pine in Brady Cove which showed a catface scar due to fire was cut to ascertain the date of the fire in that locality. It was found that the fire occurred about 1872. A white birch near this pine had 56 countable annual rings and must have started a few years after the fire. Fire also occurred on the west side of the outlet to Siskowit Lake about 1898, and on Smithwick Island in 1894. Holt and Cooper have called attention to the even-aged stands of white birch of different age classes, and stated that they represent areas burned at different periods.

It was the observation of the writer that some signs of fire could be found at every place visited on the island. The hard maple–yellow birch areas show signs of having been burned, but the fires must not have been as severe as in other sections of the island because they did not eradicate the hard maple. On the hillside to the south of Lake Richie there is a stand

of large, old white cedars, on which no signs of fire were readily observable. It, however, had been burned at some remote time because when moss was removed from some of the large logs the charred wood underneath was revealed.

The writer wishes to call attention to plate 9 in Lane's geological report on Isle Royale The Delta and Terraces at McCargoe Cove. In the foreground there are numerous white birches and poplars, evidently not very large. On the hill in the background, the most conspicuous feature, aside from the terraces, is the fire-killed vegetation. Surely this area was

FIGURE 9.—Margin of grass zone of delta swamp at head of McCargoe Cove. Mineral soil exposed in center foreground due to trampling by the moose.

burned over after the fire of 1872, because there is more than a 20-year interval since the fire of 1872 and the date this photograph was taken.

The possibility of a second fire a few years previous to 1894 can be seen by comparing Lane's photograph with figure 49 of Cooper's account (12). This picture of the same locality was taken in either 1909 or 1910 from a different point of view. The striking feature of this illustration, compared with the other, is that the hill in the background is clothed with a dense mixed forest composed of balsam, birch, and populus as the predominating trees. Thus from these two photographs we have an index to the change that has taken place. In the summer of 1930, when the writer worked in this district, it was impossible to find a point where a comparable photograph could be taken because the vegetation on the hills and the edge of the delta was so thick that it was not possible to obtain a view of this area.

The damage done by fire depends upon the severity of the fire. Cooper has indicated two types of fires; one which is severe enough to destroy the humus, and the other which is less severe and does not destroy the humus. The destruction of the organic matter in the soil, if followed by rains, would result in washing away from the slopes much of the inorganic soil that had been formed over the rocks. Evidence of this can be seen in several areas. Figure 2 shows a white-pine stub of good size with the roots extending out over bare rock. This photograph was taken on the top of the Greenstone Ridge. When the seedling first germinated there must have been enough

FIGURE 10.—Old burn on Greenstone Ridge between Siskowit Lake and Hatchet Lake. Two white pine stubs are still standing. The log in the foreground is white cedar

soil and humus over the rock for it to get a start and maintain itself for several years, until its roots reached a deeper soil in the nearby crevices. Fires apparently sweep through this area, resulting in the death of the pine and destruction of the humus. Rains must have been responsible for the removal of the inorganic soil, leaving the pine roots exposed on bare rock. This may account for the practically bare rocks on the steeper slopes of the Greenstone Ridge. The frequence and size of the old stumps and logs testify to the luxuriousness of the pine and white cedar that once grew there (figs. 2, 3, 5, and 10).

In Angleworm Lake and Lake Harvey, which are not bog lakes, there is a thick deposit of silt on the bottom especially near the shores. This silt contains much organic matter and fragments of charcoal, evidently material which has washed down from the adjoining steep slopes.

Thus it would seem possible for an area which once produced pine abundantly to be returned to an early stage of succession through the agency of fire. The bare rocks may again, through a long period of time, become covered with a layer of both inorganic and organic soil, and may eventually reach a point where they can support a pine forest. Of course, rock crevices have caught some of this soil that was removed by erosion. It is in these crevices and on the rocks thinly covered with soil that we find the mixture of plants so common on the ridges. In this shallow soil grasses, foliose lichens, ericaceous shrubs, and other herbs and shrubs form the characteristic vegetation of the rock openings. Shrubs and trees that will gradually repopulate the area will obtain their start in the rock crevices.

The succession following fire is difficult to trace with any degree of accuracy because most places on Isle Royale have been burned once and some areas many times. Also, the particular stage of development at the time of the fire and the neighboring stages will effect the type of regeneration that follows fire. Certain characteristic plants appear and parts of the cycle can be interpreted.

Fireweed (*Epilobium angustifolium*), Everlasting (*Anaphalis margaritacea*) are two of the characteristic herbs which follow fires. After them come such shrubs as red raspberry (*Rubus idaeus* var. *aculeatissimus*, *Rubus parviflora*, *Diervilla lonicera*) and hazelnut (*Corylus rostrata*). Then in a few years other herbs such as bracken (*Pteridium aquilinum*) and *Aster macrophyllus* enter the burn. *Betula alba* var. *papyrifera*, *Prunus pennsylvanica*, and *Populus tremuloides* start in this type of vegetation, and after a time *Abies balsamea* and *Picea canadensis* appear when the soil, shade, and moisture conditions have reached a place favorable for their development. The rapidity of the regeneration depends upon the severity of the fire. If the fire is light enough so that very little organic matter is destroyed, sprouts from the birches and seeds of the birches and aspen will quickly revegetate the area along with certain characteristic herbs and shrubs.

D. NATURAL CHANGES

There are some natural changes in the vegetation that have taken place since the Adams party and Cooper made their studies on Isle Royale.

Adams' photograph of the head of Conglomerate Bay (fig. 4 of the Adams report) shows that the vegetation occurred some distance back from the beach and that low herbs and shrubs grew nearest the beach. What was apparently the margin of vegetation in 1905 is now covered with a dense growth of herbs and shrubs. Alders have invaded the beach very close to the upper limit of wave action.

While it is impossible to locate in the Raspberry Island bog any definite boundaries of the former limits of the different societies, certain changes were noticed. Cooper wrote, "The sedge mat is composed almost en-

tirely of *Carex limosa* L. (Mud sedge) (fig. 38). Occasional bare muddy spots are nearly free of sedge, but support a scattered growth of Menyanthes and *Drosera anglica* Huds. (narrow-leaved Sundew). These appear to represent the youngest stage now existing in this habitat." This bare mud area is now covered by a sedge mat of *Carex limosa* and persisting in it is Menyanthes, *Drosera rotundifolia*, *D. longifolia*, *Vaccinium oxycoccus*, and scattered patches of sphagnum. Also there has been apparently a change in the relations of Chamaedaphne and Ledum, judging from Cooper's description. In the marginal zone the alders do not appear to be as abundant as

FIGURE 11.—Bog on Raspberry Island. Looking northeast from center of bog.

formerly reported. Balsam, white birch, and black spruce also have invaded the bog more than they had in 1910 (figs. 11 and 12).

Cooper (15) has reproduced several photographs that were taken with an interval of 17 years. The photographs of the tree habitats show a decided change, whereas the moss and lichen habitat photographs show little change.

A comparison of figures 13 and 14 of this report (fig. 14 is fig. 50 of Cooper's) will show some of the more conspicuous changes that have taken place in the delta swamp at the head of McCargoe Cove. Some damage has been done to this area by the moose.

One of the most noticeable changes is the increase in *Alnus incana*. Most of the area designated by Cooper as burned swamp forest has been taken

over by the alder, although there is a narrow strip adjacent to the upland where *Betula alba* var. *papyrifera*, *Populus tremuloides* and *Abies balsamea* have entered.

Shrubs have encroached on the grasses and in the grass area there are also a few scattered trees. One part of the grass area now has on it several medium-sized white birches. The vegetation underneath them has however been trampled out by the moose.

FIGURE 12.—Looking southwest in the same bog as in figure 11. Note dead trees in the background.

The sedge mat bordering on the aquatic zone is irregular in outline. Along the stream particularly in the bends there are good sedge mats between the stream and the alders.

Aquatics are limited to a few species of entirely submerged plants. Cooper stressed the richness of the aquatic flora here.

• VII •

ANNOTATED CATALOG

IN THE following catalog an attempt has been made to list all the species of ferns and flowering plants that have been collected on Isle Royale. Under each species the observations obtained in the 1930 survey are given first. These are followed by citations of collections by others, with references to published reports in parentheses. The specimens collected in 1868 by the party from the University of Michigan are designated "Foote" or

"University Party" as labeled in the University Herbarium. Species collected by others but not obtained in 1930 are incorporated with proper citation introduced by the phrase "Only by." It has not been possible to verify the determinations of all such records. The arrangement and nomenclature of Gray's Manual (47) for the flowering plants and Christensen's Index Filicum (9) for the ferns have been followed for the most part.

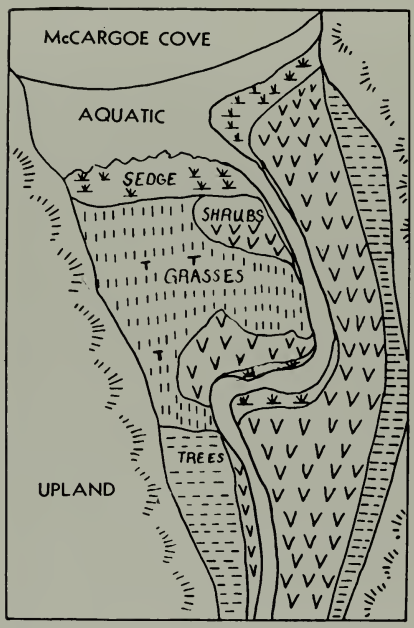

FIGURE 13.—Sketch to show changes in the delta at the head of McCargoe Cove.

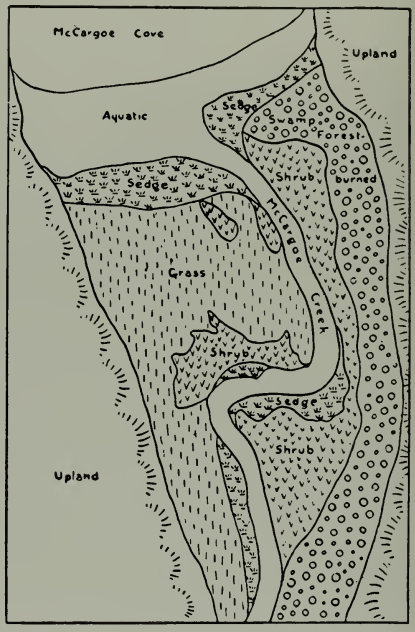

FIGURE 14.—Sketch map of the delta at the head of McCargoe Cove. Copied from Cooper.

Grateful acknowledgment is made for the identification of collections in the following groups: Salix by C. R. Ball, Carex by G. P. Van Eseltine, Poa by A. S. Hitchcock, Amelanchier by K. M. Wiegand, Rosa by E. W. Erlanson, Viola by H. D. House, and certain composites by M. L. Fernald. The writer is also indebted to J. H. Ehlers for helpful suggestions in the identification of other groups.

In the citation of localities, names appearing on the maps published by the Michigan Geological Survey and the United States Lake Survey have been used. For localities not designated on these maps the names now in common usage have been employed.

It should be noted that there are some discrepancies concerning names of certain locations in various publications. Ruthven called the stream which empties into Washington Harbor, Washington Creek. The following year Holt wrote of Washington Creek as the stream which Ruthven called

Washington River, and Washington Brook for the stream called Washington Creek. Local usage, at present, calls the first stream Washington Creek, and the second stream Grace Creek.

Cooper had his headquarters at Park Place, which has now become Rock Harbor post office. Ramson Clearing, the site of one of the early settlements, is now without a dwelling, and is locally called the Daisy Farm. Sucker Lake of Cooper's publications has been dignified with the appellation "Hidden Lake." The pond near Tobin Harbor in sec. 5, T. 66 N., R. 33 W., has been glorified with the name "Moose Lake." Mount Franklin, sec. 12, T. 66 N., R. 54 W., and Mount Objibway, sec. 21 of the same township, are two high points near the northeastern end of the island.

In the following catalog 671 species and varieties are listed. Specimens from the 1930 expedition have been deposited in the Herbarium of the University of Michigan.

POLYPODIACEAE (Fern Family)

Polypodium vulgare L. *Polypody.* Widely distributed on rocks and in rock crevices; also University Party, Mrs. Prescott, and Ruthven (1), Holt (2), Cooper (14).

Adiantum pedatum L. *Maiden Hair Fern.* Only by Ruthven (1), "Occasional in the balsam fir and spruce woods", and Holt (2), "Sparingly distributed in the mesophytic forest. Trail to Sumner Lake and at Washington Club."

Pteridium aquilinum (L.) Kuhn. *Bracken.* Widely distributed in old burns, dry rocky places, and occasional in coniferous woods; also university party, and Ruthven (1), Holt (2), Cooper (14).

Cryptogramma acrostichoides R. Br. *Rock Brake.* Common on rocks in heath mat and rock shore crevices. This was considered a rare fern by the early collectors and consequently was collected by many of the early visitors as can be seen from the following list: Porter, A. A. and S. W. Robinson, Foote, Mrs. Prescott, Harrington, and Wheeler (54), Beal (4), based on authority of Dr. Lyons, Holt (2), Cooper (14).

Cryptogramma Stelleri (Gmel.) Prantl. *Slender Cliff Brake.* On conglomerate outcrop between Siskowit Bay and Siskowit Lake. This plant normally occurs on calcareous rocks. The conglomerate rocks of Isle Royale are cemented together with calcium carbonate (42), and this outcrop has on it a white deposit which was evidently left by seepage. Not previously reported.

Asplenium Trichomanes L. *Maiden Hair Spleenwort.* Apparently restricted to the rock cliffs in the vicinity of Siskowit Lake, although it may occur in the vicinity of Rock Harbor. Beal (4) cites T. C. Porter for the occur-

rence of this species on Isle Royale. Porter's letter (43), which has recently been published does not list this species, and he reported collecting only in the vicinity of Rock Harbor; also Holt (2).

THELYPTERIS FRAGRANS (L.) Nieuwl. var. HOOKERIANA Fernald (24). *Fragrant Shield Fern.* Widely distributed on the interior cliffs and rock shore crevices; also Foote, Harrington, Gillman, and Beal (4), Holt (2), Cooper (14).

DRYOPTERIS LINNAEANA Chr. *Oak Fern.* Widely distributed in mixed woods; also Foote, and Holt (2), Cooper (14).

DRYOPTERIS PHEGOPTERIS (L.) Chr. *Beech Fern.* Widely distributed with the oak fern; also Mrs. Prescott, and Beal (4), Ruthven (1), Holt (2), Cooper (14).

DRYOPTERIS MARGINALIS (L.) Gray. *Evergreen Wood Fern.* Pickerel Cove, Dr. A. Murie; also Foote. Not previously reported.

DRYOPTERIS CRISTATA (L.) Gray. *Crested Shield Fern.* Black ash swamp Mount Franklin trail, Tobin Harbor, wet mixed woods 1 mile north of Siskowit Lake, outlet of Sargent Lake in McCargoe Cove; also Cooper (14).

DRYOPTERIS SPINULOSA (Müll.) Ktze. *Common Shield Fern.* Frequent in mixed woods and along streams and bogs; also Foote, and Holt (2), Cooper (14).

DRYOPTERIS SPINULOSA (Müll.) Ktze. var. INTERMEDIA (Müll.) Gray. Mixed woods Grace Harbor. Not previously reported.

DRYOPTERIS SPINULOSA (Müll.) Ktze. var. DILATATE (Müll.) Gray. Bog forest Raspberry Island, balsam-spruce woods Smithwick Island; also Foote, and Cooper (14).

DRYOPTERIS FILIX-MAS (L.) Schott. *Male Fern.* Only by Holt (2), "Fairly abundant in rich moist woods. Especially abundant near Benson Brook."

DRYOPTERIS THELYPTERIS (L.) Gray. *Marsh Shield Fern.* Only by Holt (2), "Wet margins of bogs, and other low, wet places. Common in such places. Forbes Lake. Sumner Lake", and Cooper (14), "Sedge zone, bog succession, frequent; bog forest."

ATHYRIUM FILIX-FEMINA (L.) Roth. *Lady Fern.* (8) Widely distributed in moist woods, occasional in rock crevices; also Foote, University Party, and Cooper (14).

ATHYRIUM ACROSTICHOIDES (Sw.) Dield. *Silvery Spleenwort.* Grassy marsh, Mott Island. Head of Pickerel Cove. Not previously reported.

CYSTOPTERIS FRAGILIS (L.) Bernh. *Fragile Fern.* Common on rocks, in woods and rock shore crevices; also Holt (2), Cooper (14).

CYSTOPTERIS BULBIFERA (L.) Bernh. *Bladder Fern.* Only by Holt (2), "Thinly scattered on moist, shaded cliff faces. Cliff near Rock Harbor Lighthouse", and Cooper (14), "McCargoe Cove. Rare".

Woodsia ilvensis (L.) R. Br. *Rusty Woodsia.* Widely distributed on interior cliffs and occasional in rock shore crevices; also Foote, and Holt (2), Cooper (14).

Onoclea sensibilis L. *Sensitive Fern.* Widely distributed on margins of streams and lakes; also Holt (2).

Matteuccia Struthiopteris (L.)Todaro. *Ostrich Fern.* Occasional along streams, Tobin Harbor, Brady Cove; also Holt (2), Cooper (14).

OSMUNDACEAE (Flowering Fern Family)

Osmunda regalis L. *Royal Fern.* Widely distributed in moist habitats along lakes and streams, Angleworm Lake, Chickenbone Lake, Todd Harbor, Wallace Lake, Lake Harvey, Forbes Lake, also Foote, and Holt (2) "Forbes Lake, only locality", Cooper (14) "Same occurrence as noted by Holt".

Osmunda Claytoniana L. *Interrupted Fern.* Moist, shady, mixed woods, apparently widely distributed, also Foote, and Holt (2), and Cooper (14).

Osmunda cinnamomea L. *Cinnamon Fern.* Only by Holt (2), "Moist thickets and low ground. Forbes Lake", and Cooper (14), "Stream bank in climax forest; Sargent Lake Trail near Rock Harbor".

OPHIOGLOSSACEAE (Adder's Tongue Family)

Botrychium Lunaria (L.) Sw. *Moonwort.* Old burn Passage Island, lichen mat, rock opening Rock Harbor; also Foote (5), Lyons, Harrington, and Gillman (34), Holt (2), Cooper (14). The Foote collection in the herbarium of the University of Michigan has two specimens on the sheet, one typical, the other with a long stalked sterile blade, typical of the following species.

Botrychium onondagense Underwood. Outlet of Sargent Lake in McCargoe Cove. Not previously reported. Jennings (38) reported a collection of this species from Thunder Cape as "probably the most northernly known".

Botrychium matricariae (Schrank) Spreng. *Grape Fern.* Moist shady habitats, and frequent in mixed woods on drier soils, McCargoe Cove, Angleworm Lake, Lake Benson, near Lake Richie; also Cooper (14).

Botrychium lanceolatum (Gmel.) Ångstroem var. angustisegmentum Pease & Moore. In sod ground along shore, Rock Harbor. Not previously reported.

Botrychium virginianum (L.) Sw. *Rattlesnake Fern.* Widely distributed in moist woods, Mott Island, McCargoe Cove, Washington Harbor, Tobin Harbor, Siskowit Lake outlet, Lake Eva, Passage Island; also Foote, and Holt (2), Cooper (14), "Bog forest, occasional". Butters (8)

has recently described variety *Laurentinum* and cites a specimen of Cooper as belonging to this variety, stating, however, it "cannot be identified with entire certainty." The plants collected by this survey were not in the proper stage of maturity for varietal determination.

EQUISETACEAE (Horsetail Family)

EQUISETUM ARVENSE L. *Common Horsetail.* Occasional in diverse habitats, mixed woods Washington Harbor, gravel beach Rock Harbor, sedge mat of bog Raspberry Island, margin of rock pool Scovill Point; Foote, and Ruthven (1), Holt (2), Cooper (14).

EQUISETUM SYLVATICUM L. *Wood Horsetail.* Balsam-spruce swamp, Rock Harbor; also Holt (2), "Moist woods Benson Brook. Noted in one locality only." Cooper (14), "Bog forest, abundant."

EQUISETUM PALUSTRE L. *Swamp Horsetail.* Sedge mat of bog, Washington Island, Margin of delta swamp McCargoe Cove; also Holt (2), Cooper (14).

EQUISETUM FLUVIATILE L. *Water Horsetail.* Common aquatic of bogs and delta swamps; also Holt (2), Cooper (14).

EQUISETUM HYEMALE (L.) var. ROBUSTUM (A. Br.) Eaton. Gravel point on Grace Island, Washington Harbor, sod ground Daisy Farm, Rock Harbor. Not previously reported.

EQUISETUM SCIRPOIDES Michx. *Sedgelike Horsetail.* Moist habitats, Tobin Harbor, Rock Harbor, Washington Island, Mott Island, McCargoe Cove, Siskowit Lake outlet; also Holt (2), Cooper (14).

LYCOPODIACEAE (Club Moss Family)

LYCOPODIUM SELAGO L. *Fir Club Moss.* Margin of bogs and rock pools Passage Island, rock crevices Scovill Point; also Holt (2), Cooper (14).

LYCOPODIUM LUCIDULUM Michx. *Shining Club Moss.* Frequent on diverse habitats, Washington Harbor, Rock Harbor, Scovill Point; also Foote and Holt (2), Cooper (14).

LYCOPODIUM INUNDATUM L. *Bog Club Moss.* Only by Cooper (14), "Sedge zone of bog succession, Forbes Lake."

LYCOPODIUM ANNOTINUM L. *Stiff Club Moss.* Widely distributed on the island in diverse habitats; also Foote, and Ruthven (1), Holt (2), Cooper (14).

LYCOPODIUM CLAVATUM L. *Common Club Moss.* Widely distributed; also University Party, and Ruthven (1), Holt (2), Cooper (14).

LYCOPODIUM CLAVATUM (L.) var. MONOSTACHYON Grev. & Hook. Rock openings Rock Harbor, occurs with the species. Not previously reported.

Lycopodium obscurum L. *Ground Pine.* Old burn Passage Island, bog forest Rock Harbor, hard maple–yellow birch woods along the Lake Desor Trail; also Ruthven (1), Holt (2), Cooper (14).

Lycopodium complanatum L. *Trailing Ground Pine.* Old burn Passage Island, south shore of Tobin Harbor; also Foote, and Ruthven (1), Holt (2), Cooper (14).

SELAGINELLACEAE (Selaginella Family)

Selaginella selaginoides (L.) Link. Moist sheltered rock crevices and margins of streams and swamps, Washington Harbor, Scovill Point, Hay Bay, Rock Harbor; also Foote, Stuntz and Allen, and Beal (4), Cooper (14).

Selaginella rupestris (L.) Spring. Common in rock opening with lichen mats; also Foote, and Holt (2), Cooper (14).

ISOETACEAE (Quillwort Family)

Isoetes macrospora Dur. *Quillwort.* Mud and gravel bottom of Tobin Harbor in 3 to 5 feet of water. This was the only fruiting collection of this species. Cooper (14) reported it from "Sheltered bays, delta streams, and inland lakes; depth up to 1 meter. Tobin Harbor; Amygdaloid Lake; Chippewa Harbor; Hay Bay."

Isoetes Braunii Dur. *Quillwort.* (46) Aquatic in sandy or mud bottom of streams and lakes at a depth from 1 to 6 feet. Pickerel Cove, Beaver Lake, Lake Eva, Chickenbone Lake, Siskowit Lake, Lake Benson, head of Rock Harbor. Not previously reported. Holt (2) reported an unidentified species from the head of Rock Harbor, and Ruthven (1) one unidentified species from Lake Desor.

TAXACEAE (Yew Family)

Taxus canadensis Marsh. *Ground Hemlock.* Formerly very abundant all over the island, now on the road to extinction. Very little ground hemlock was seen that had not been either heavily browsed or trampled by the moose. Outlying islands such as Passage Island, Smithwick Island, Mott Island, and Wright Island have abundant ground hemlock which has not been browsed. According to Cooper (12) ground hemlock will not stand dense shade and this may be partly the cause of some of the straggly growth seen. Also Foote, and Ruthven (1), Holt (2), Cooper (14).

PINACEAE (Pine Family)

Pinus Strobus L. *White Pine.* Large individual trees are scattered in various localities on the island. Occasional in the Abies-Betula-Picea woods, and relics in the Acer-Betula forest. White pine was formerly

very abundant on certain parts of the island. On the Greenstone Ridge north of Siskowit Lake (sec. 22, T. 65 N., R. 36. W.) there are many places where white pine once formed the dominant stand. One 5-acre plot has 31 white pine stubs which are from 1½ to 2½ feet in diameter. Northeast of this plot is a stand of living white pine of about the same size. A small island in Lake Harvey with an area of about 7 acres has on it 125 white pines and 12 red pines which are between 1½ and 2 feet in diameter. The ground is covered with a needle duff several inches thick, and there is a very sparse herbacous growth in this duff. The white pine logs and stubs which are very abundant along the Greenstone Ridge from opposite Hatchet Lake to Mount Franklin (sec. 12, T. 66 N., R. 34 W.) testify to the fomer range and abundance of this species. The size of the roots which sprawl over the bare rock suggest that there was much more soil at the time the seedlings started to grow than now. The charred stumps and the records of the land office surveyor indicate that fire together with a failure in seedling reproduction are largely responsible for the decrease in white pine on Isle Royale (fig. 10). Also University Party, and Ruthven (1), Holt (2), Cooper (14).

Pinus Banksiana Lamb. *Jack Pine.* A characteristic xerophytic tree occurring in rock openings as a crevice plant or in small pockets of soil usually associated with lichen mats and ericaceous shrubs. Large patches occur on the slopes of Congomlerate Bay, near Rock Harbor Lighthouse, Rock Harbor, Mount Franklin, in several places on Greenstone Ridge, and near McCargoe Cove. Occasional with *Pinus Strobus* and *Pinus resinosa* on rock ridges such as around Sumner Lake and Lane Cove. Also Foote, University Party, and Holt (2), Cooper (14), (fig. 15).

Pinus resinosa Ait. *Red* or *Norway Pine.* Dry ridges on various parts of the island in nearly pure stands, or mixed with *Pinus Strobus*, and occasionally with *P. Banksiana.* The largest stand is on a ridge near Patterson Lake, SW¼, sec. 1, T. 66 N., R. 33 W. These trees are about 2 feet in diameter and from 60 to 75 feet high. Also Ruthven (1), Holt (2), Cooper (14) (fig. 16).

Larix laricina (DuRoi) Koch. *Larch* or *Tamarack.* The land surveyor's records show that larch was a common tree not only on the filled bogs and margins of bog lakes, but that it had its best development upon the upland soils. Holt (2) reported individuals over 3 feet in diamater. Cooper stated, (14) "It is the most characteristic tree of the bog forests." All this is contrary to the observations made by the members of this survey. Larch is practically nonexistent. It is true, however, that there are scattered individuals in bogs, rock crevices, and margins of bog lakes. These individuals for the most part are small trees, usually of great age for their size. A specimen over 2 inches in diameter was seldom seen. This is attributed to the prevalence of the larch sawfly

(*Lygaeonematus erichsonii* Hart.). Many dead trees were seen around the bog lakes. Also collected by University Party, and Ruthven (1), Holt (2), Cooper (14).

Picea canadensis (Mill.) BSP. *White spruce.* Common throughout the island on a variety of habitats. Cooper (14) considered this to be "One of the three climax trees and the least abundant of them." Holt recorded, "It does not appear to be succeeding itself except along the edges of clearings and in more open parts of the forest. Since fir seedlings are common under the older trees instead of those from the present

Figure 15.—Jack pine (*Pinus Banksiana*) on the slopes of Mount Franklin. Trees are in crevices or pockets where there is an accumulation of soil.

spruces, it appears that the white spruce will be replaced by fir in the climax forest, the fir seedlings being able to endure much deeper shade." Several large spruce trees were seen in various parts of the island, evidently belonging to a generation comparable to the moderate size white pine. One tree at Duncan Bay, which had been cut a few years ago, had a diameter breast high of 14.4 inches and a count on the 29-inch stump of 155 rings. In the woods east of the outlet to Siskowit Lake, large spruce trees are common, reaching a diameter of 20.3 inches. One tree on the shore of Chickenbone Lake measured 26 inches in diameter. Also by Foote, and Ruthven (1), Holt (2), Cooper (14).

Picea mariana (Mill.) BSP. *Black Spruce.* An important constituent of the bog forest and abundant in the jack pine xerophytic forest. This species is not as abundant as the white spruce; also University Party, and Ruthven (1), Holt (2), Cooper (14).

FIGURE 16.—Norway pine (*Pinus resinosa*) on a ridge in the vicinity of Patterson Lake. Note salmon berry in foreground.

Abies balsamea (L.) Mill. *Balsam* or *Balsam Fir*. The most abundant tree of Isle Royale. It occurs in a variety of habitats such as rock crevices, heath mat, bogs, and edge of xerophytic forest. Cooper (14) considered this to be one of the three trees which make up the climax forest. It also occurs as a very minor element in the hard maple–yellow birch forest. A short-lived tree which is subject to many wood-rotting organisms. When the trunk is sufficiently rotted it will break off above the ground, probably during strong winds. The spruce budworm (*Cacoecia fumiferana* Clems.) did considerable damage to the balsam

Figure 17.—Upright growth of *Juniperus communis* var. *depressa* in sheltered locality at the head of Rock Harbor. Note lichens and bearberry in foreground.

on Isle Royale during the summer of 1930. Also collected by Foote, and Ruthven, (1), Holt (2), Cooper (14).

Thuja occidentalis L. *White Cedar*. Widely distributed in a variety of habitats, rock crevices, bogs, delta swamps, forests. Common in the hard maple–yellow birch forest, increasing in abundance as the maple decreases from the top of the ridge toward the valley on the south side of the Greenstone Ridge. Formerly abundant in the pine woods on the Greenstone Ridge. Large individuals up to 40 inches in diameter are common. Also by Ruthven (1), Holt (2), Cooper (14).

Juniperus communis (L.) var. depressa Pursh. Low Juniper. Common as a crevice plant and as a member of the heath mat; also Ruthven (1), Holt (2), Cooper (14) (fig. 17).

Juniperus horizontalis Moench. *Trailing Juniper*. Common in rock crevices and heath mat; also Holt (2), Cooper (14).

TYPHACEAE (Cat-tail Family)

TYPHA LATIFOLIA L. *Common Cat-tail.* Apparently rare, only collection was from shore of Sargent Lake. Cooper (14) reported it from the "Sedge zone of Delta Swamp Succession; shore of very sheltered coves."

SPARGANIACEAE (Bur-reed Family)

SPARGANIUM EURYCARPUM Engelm. *Broad-fruited Bur-weed.* Only by Ruthven (1), "In the margin of Washington Creek near its mouth, and about the shores of Lake Desor."

SPARGANIUM AMERICANUM Nutt. var. ANDROCLADIUM (Engelm.) Fernald & Eames. Shallow water at outlet of Chickenbone Lake. Not previously reported.

SPARGANIUM DIVERSIFOLIUM Graebner. *Bur-weed.* Aquatic in sedge mat of Hidden Lake; also Cooper (14).

SPARGANIUM DIVERSIFOLIUM Graebner var. ACAULE (Beeby) Fernald & Eames. Delta swamp at Brady Cove, sedge mat of bog near Lake Eva. The variety not previously reported.

SPARGANIUM ANGUSTIFOLIUM Michx. Along outlet of Siskowit Lake; also Foote, Foster, and Whitney (33), Beal (4), Wheeler (54), Cooper (14). Dr. Foote collected July 22, 1868, two specimens of Sparganium, one of which is labelled *S. simplex* var. ANGUSTIFOLIUM Torr. a synonym of this species; the other is labelled *S. minimum.* Both are too immature for positive identification, although the specimen labelled *S. minimum* appears to be closer to this species.

SPARGANIUM MINIMUM Fr. *Small-fruited Bur-weed.* Sedge mat of bog near Hidden Lake, sedge zone of Sargent Lake; also Cooper (14), "Aquatic, Delta Swamp Succession."

NAJADACEAE (Pondweed Family)

POTAMOGETON NATANS L. *Pondweed.* Only by Holt (2), "Fairly common on margin of Sumner Lake", and Cooper (14), "Aquatic, Delta Swamp Succession."

POTAMOGETON EPIHYDRUS Raf.[3] Lake Whittelsy, and Sargent Lake; also Cooper (14), "Pool in bog: head of Siskowit Bay."

POTAMOGETON ALPINUS Balbis. Only by Cooper (14), "Delta stream: McCargoe Cove."

POTAGMOGETON AMPLIFOLIUS Tuckerman (?). Siskowit Lake; also Cooper (14), "Delta stream; sheltered cove; bog lake."

POTAMOGETON HETEROPHYLLUS Schreb.[3] Aquatic in Siskowit Lake, Hidden Lake, Chickenbone Lake, Pickerel Cove; also Foote, and Holt (2), "Washington Creek", Cooper (14).

[3] Identification of these Potamogetons was made by H. T. Darlington.

Potamogeton heterophyllus Schreb. f. terrestris Schlecht. Only by Cooper (14), "Very wet places on sedge mat, Bog Succession; edge of sedge mat Delta Swamp Succession."

Potamogeton praelongus Wulf.[3] Submerged in 6 to 8 feet of water, Tobin Harbor; also Cooper (14), "Hay Bay."

Potamogeton perfoliatus L. Only by Foote, Holt (2), "Margin of Sumner Lake", and Cooper (14), "Commonest pondweed in sheltered bays."

Potamogeton Richardsonii (Benn.) Rydb.[3] Aquatic in Siskowit Lake, Lake Feldtmann, and Brady Cove. This species has been united with the preceding by some authors. Not previously reported if considered distinct.

Potamogeton Hillii Morong. Only by Holt (2), "Margin of Sumner Lake."

Potamogeton zosterifolius Schumacker.[3] Aquatic, McCargoe Cove, Sargent Lake; also Cooper (14).

Potamogeton obtusifolius Mertens & Koch. Only by Cooper (14), "Delta stream: McCargoe Cove."

Potamogeton Friesii Rupr.[3] Shallow water at outlet of Chickenbone Lake. Not previously reported.

Potamogeton filiformis Pers. Only by Cooper (14), "Sheltered cove: Hay Bay."

Potamogeton interior Rydb.[3] Sterile plants, McCargoe Cove. Not previously reported.

Potamogeton pectinatus L. Only by Holt (2), "Margin of Sumner Lake."

Najas flexilis (Willd.) R. & S. Aquatic in Sargent Lake, Lake Richie, Sumner Lake, and at head of Rock Harbor; also Holt (2), Cooper (14).

JUNCAGINACEAE (Arrow Grass Family)

Scheuchzeria palustris L. var. americana Fernald (25). Sedge mat of bogs, Moose Lake, Sumner Lake, bog in sec. 35 south of Conglomerate Bay; also Foote and Cooper (14), as the species. Fernald thinks American material is worthy of varietal distinction from the European species.

Triglochin maritima L. *Arrow Grass.* Sedge mat of bog Hidden Lake; also Foote, and Holt (2), and Cooper (14).

ALISMACEAE (Water-plantain Family)

Sagittaria latifolia Willd. *Arrow-head.* Aquatic on the margins of Sargent Lake and McCargoe Cove. Cooper (14) determined his material from the delta swamp of McCargoe Cove as forma *hastata* (Pursh) Robinson.

[3] Identification of these Potamogetons was made by Dr. H. T. Darlington.

SAGITTARIA ARIFOLIA Nutt. Only by Cooper (14), "Bog Aquatic", and under *S. cuneata*, "Delta Streams: McCargoe Cove." In 2 to 3 feet of water at the head of Rock Harbor a collection was made which consisted of basal rosettes of phyllodia which may belong to this species.

HYDROCHARITACEAE (Frog's Bit Family)

ELODEA "CANADENSIS" Michx. of Gray's Manual. A broad leaf form from Brady Cove, Lake Richie, Wright Island, Siskowit Bay, and a narrow leaf form from Brady Cove and McCargoe Cove. All the material collected was without flowers or fruit. Not previously reported.

VALLISNERIA SPIRALIS L. *Eel Grass.* Widely distributed in streams, lakes, and coves; also Holt (2), Cooper (14).

GRAMINEAE (Grass Family)

PANICUM DEPAUPERATUM Muhl. *Panic Grass.* Lichen mat in rock opening along trail to Lake Richie and same habitat on the north side of Rock Harbor, sec. 28, T. 66 N., R. 34 W. Not previously reported.

PANICUM XANTHOPHYSUM Gray. *Panic Grass.* Lichen mat in rock openings near Lake Benson, and along trail to Lake Richie; also Holt (2), "Dry rocky ridges, and rocks with little soil."

PHALARIS ARUNDINACEA L. *Reed Canary Grass.* Occasional along shores, Rock Harbor, McCargoe Cove; also Foote and Cooper (14).

HIEROCHLOË ODORATA (L.) Wahlenb. *Vanilla Grass.* Moist meadow, Washington Island. Not previously reported.

MILIUM EFFUSUM L. *Millet Grass.* Old burn near shore of Lake Feldtmann, and delta swamps of Tobin Harbor, McCargoe Cove. Not previously reported.

ORYZOPSIS PUNGENS (Torr.) Hitchc. *Mountain Rice.* Widespread in rock openings and occasional in rock crevices; also Cooper (14).

ORYZOPSIS ASPERIFOLIA Michx. *Rough-leaved Mountain Rice.* Same habitat as the preceding; also Cooper (14).

MUHLENBERGIA RACEMOSA (Michx.) BSP. Sedge mat of bogs, Forbes Lake, and Lake Benson; also Cooper (14).

PHLEUM PRATENSE L. *Timothy.* Widespread in clearings and rock openings; also Cooper (14).

SPOROBOLUS UNIFLORUS (Muhl.) Scribn. & Merr. *Dropseed Grass.* Margin of rock pool, Passage Island. Not previously reported.

AGROSTIS ALBA L. *Red Top.* Rocky shore, Rock Harbor; also Cooper (14), "Shingle beach near Blake Point."

AGROSTIS HYEMALIS (Walt.) BSP. *Hair Grass.* Widespread in a variety of habitats; also Foote, and Holt (2), Cooper (14).

Calamagrostis canadensis (Michx.) Beauv. *Blue-joint Grass.* Widely distributed in rock openings, margin of delta swamps, and sedge mat of bogs; also Holt (2), Cooper (14).

Calamagrostis hyperborea Lange. Frequent throughout the island in rock crevices; also Porter (43) as *C. lapponica* Trin., Wheeler (54), Cooper (14).

Calamagrostis neglecta (Ehrh.) Gaertner, Meyer & Scherbius. Only by Porter (43) as *C. stricta* Trin.

Cinna latifolia (Trev.) Griseb. *Wood Reed Grass.* Delta swamp, Brady Cove, McCargoe Cove; dry ground Sargent Lake, mixed woods near Blake Point; also Cooper (14).

Trisetum spicatum (L.) Richter. Frequent in rock shore crevices; also Foote, University Party, and Holt (2), Cooper (14).

Aria flexuosa L. *Common Hair Grass* (36). Widespread in rock ridges and rock openings; also Foote, University Party, and Cooper (14).

Aria caespitosa L. Common throughout the island in rock shore crevices; also Cooper (14).

Avena sativa L. *Common Oat.* Only by Cooper (14), "Occasional on sand beaches."

Danthonia spicata (L.) Beauv. Lichen mat Rock Harbor Lighthouse, Tobin Harbor.

Danthonia compressa Austin. *Wild Oat Grass.* Rock opening, Tobin Harbor; also Foote (?), and Cooper (14), "Forbes Lake vicinity."

Danthonia intermedia Vasey. Lichen mat on rock ridge near McCargoe Cove; also Cooper (14), "rock shore crevices; heath mat."

Beckmannia erucaeformis (L.) Host. Gravel point opposite Birch Island, McCargoe Cove. Apparently recently introduced, as only a few plants were found in a place where fishermen had beached their boats for the winter. Not previously reported for Isle Royale or Michigan.

Phragmites communis Trin. *Reed Grass.* Shore of Brady Cove; also Ruthven (1), "Along the margin of Washington Creek near its mouth, and about the shores of Lake Desor", Holt (2).

Melica Smithii (Porter) Vasey. Listed from Isle Royale by Beal (4).

Melica striata (Michx.) Hitchc. Mixed woods at head of Grace Harbor, rock openings, McCargoe Cove and Tobin Harbor; also Cooper (14).

Poa annua L. In shade on edge of marsh, Washington Island. Not previously reported.

Poa compressa L.[4] Rock openings, Rock Harbor; also Cooper (14).

[4] Determined by A. S. Hitchcock.

Poa alpina L. *Alpine Meadow Grass.* Rock shore crevices, Raspberry Island, Rock Harbor; also Foote, and C. J. Loring in Beal (4), Cooper (14).

Poa interior Rydb.[4] Rock opening, Mount Franklin, and Rock Harbor. This location is somewhat east of the published range. Not previously reported.

Poa nemoralis L. Only by Cooper (14), without any data as to habitat or locality.

Poa glauca Vahl. Only by Cooper (14), "Rock shore crevices and bare burned ridges."

Poa palustris L.[4] *Fowl Meadow Grass.* Widespread in rock openings and delta swamps; also Cooper (14).

Poa pratensis L.[4] *Kentucky Blue Grass.* Widespread in clearing and rock shore crevices; also Holt (2), Cooper (14).

Poa Canbyi (Scribn.) Piper.[4] Rock crevices of Monument Rock, Tobin Harbor, not previously reported. This species is reported from Washington to Montana, Colorado, and Nebraska; thus this forms an eastern extension of its range.

Glyceria Torreyana (Spreng.) Hitchc. *Manna Grass.* Only by Holt (2), "Margin of Siskowit cabin trail bog."

Glyceria canadensis (Michx.) Trin. *Rattlesnake Grass.* Delta swamp Brady Cove, margin of Sargent Lake, sedge mat of bogs, Hidden Lake, Moose Lake, Washington Island; also University Party, and Holt (2), Cooper (14).

Glyceria nervata (Willd.) Trin. Widespread in such habitats as delta swamps, bogs, and bog forests; also Cooper (14).

Glyceria borealis (Nash) Batchelder. Margin of delta swamps, Brady Cove and McCargoe Cove; also University Party, and Cooper (14).

Festuca occidentalis Hook. *Fescue Grass.* Heath mat or rock openings, Rock Harbor, and at Rock Harbor Lighthouse. This is another western grass which has its eastern limits in Michigan.

Festuca ovina L. *Sheep's Fescue.* Lichen mats in rock openings and rock shore crevices; also University Party, and Holt (2), Cooper (14).

Festuca ovina L. var. duriuscula (L.) Koch. Listed by Beal (4) on the authority of Henry Gillman.

Bromus ciliatus L. *Brome Grass.* Outlet of Sargent Lake at McCargoe Cove, and along stream near Patterson Lake; also Cooper (14).

Agropyron repens (L.) Beauv.[4] *Quack Grass.* Widespread in old clearings. Not previously reported.

Agropyron Smithii Rydb. Only by Cooper (14), "Burn forest: Rock Harbor."

[4] Determined by A. S. Hitchcock.

AGROPYRON TENERUM Vasey. Widespread in rock openings; also Stuntz and Allen, and Cooper (14).

AGROPYRON CANINUM (L.) Beauv. Only by Cooper (14), "Rock Harbor."

HORDEUM JUBATUM L. *Squirrel Tail Grass.* Clearings at Rock Harbor, Caribou Island, and Passage Island; also Cooper (14).

CYPERACEAE (Sedge Family)

DULICHIUM ARUNDINACEUM (L.) Britton. Sedge mat of Hidden Lake; also Foote, and Cooper (14).

ELEOCHARIS PALUSTRIS (L.) R. & S. *Common Spike Rush* (30). Aquatic in bog lakes, Hidden Lake; also University Party, and Holt (2), Cooper (14).

ELEOCHARIS PALUSTRIS (L.) R. & S. var. GLAUCESCENS (Willd.) Gray. Only by Holt (2), "Wet part of island in Tobin Harbor", Cooper (14), "Aquatic bog lakes."

ELEOCHARIS PALUSTRIS (L.) R. & S. var. VIGENS Bailey. Aquatic, Sargent Lake, Moose Lake. This variety has not been previously reported.

ELEOCHARIS ACICULARIS (L.) R. & S. Margins of bog lakes and delta swamps, Moose Lake, Lake Richie, and Brady Cove; also Cooper (14).

SCIRPUS CAESPITOSUS L. A very characteristic plant of rock pool margins, rock crevices, and sedge mat of bogs; also Holt (2), Cooper (14).

SCIRPUS HUDSONIANUS (Michx.) Fernald. *Alpine Cotton Grass.* Common in sedge mat of bogs, and as a crevice plant, Scovill Point; also Porter (43), Holt (2), Cooper (14).

SCIRPUS VALIDUS Vahl. *Common Bulrush.* Aquatic in sedge mat of bogs, Lake Eva, Hidden Lake; also Cooper (14).

SCIRPUS SUBTERMINALIS Torr. Only by Cooper (14), "Aquatic Delta Swamp Succession."

SCIRPUS RUBROTINCTUS Fernald. Only by Cooper (14), "Brook bank: Ramson Clearing."

SCIRPUS ATROVIRENS Muhl. Clearing about Washington Club, Washington Harbor. Not previously reported.

SCIRPUS CYPERINUS (L.) Kunth. *Wool Grass.* Only by Holt (2), "Low ground along the 'Island Mine' road, head of Siskowit Bay."

SCIRPUS ATROCINCTUS Fernald. Moist habitats, Pickerel Cove, Chickenbone Lake, Lake Desor Trail, McCargoe Cove, and Rock Harbor; also Cooper (14).

SCIRPUS ATROCINCTUS Fernald var. BRACHYPODUS Fernald. Moist depression on ridge above old mine McCargoe Cove, with the species. Variety not previously reported.

Eriophorum spissum Fernald. *Cotton Grass.* Sedge mat of bogs, Rock Harbor, Washington Island, and Monument Rock Trail; also Foote, and Holt (2), Cooper (14).

Eriophorum gracile Roth. Only by Holt (2), "Bog margin of Sumner Lake."

Eriophorum tenellum Nutt. *Slender Cotton Grass.* Margin of rock pools, Passage Island; also Cooper (14),

Eriophorum viridi-carinatum (Engelm.) Fernald. *Tall Cotton Grass.* Sedge mat of bogs, Hidden Lake, Sumner Lake, and Washington Island; also Cooper (14).

Rynchospora alba (L.) Vahl. *White Beak Rush.* Common in sedge mat of bogs, Sumner Lake, Hidden Lake, bog near Scovill Point; also Stuntz and Allen and Holt (2), Cooper (14).

Cladium mariscoides (Muhl.) Torr. *Twig Rush.* Only by Cooper (14), "Sedge zone of bog succession; Hidden Lake."

Carex scoparia Schk. *Pointed Broom Sedge.* Only by Holt (2), "Washington Club grounds", who credited it to the University of Michigan Museum Expedition of 1904, although it was not reported by Ruthven (1).

Carex tribuloides Wahlenb. Only by Ruthven (1), "Along Washington Creek."

Carex projecta Mackenzie.[5] Delta swamp, Tobin Harbor. This may be the same as Cooper (14) reported from Mott Island as *C. tribuloides* var.

Carex Crawfordii Fernald.[5] Sedge mat, Hidden Lake, Brady Cove, sandy beach McCargoe Cove; also Cooper (14).

Carex Crawfordii Fernald var. vigens Fernald. Only by Stuntz and Allen whose material was determined by G. P. Van Eseltine in 1920.

Carex pratensis Drejer. Only by Cooper (14,) "Smithwick Island; Rock Harbor."

Carex cristatella Britton.[5] Delta swamp, McCargoe Cove. Not previously reported.

Carex straminea Willd. Only by Stuntz and Allen. Determined by G. P. Van Eseltine in 1920.

Carex festucacea Schkuhr. Only by Cooper (14), "McCargoe Cove."

Carex festucacea Schkuhr. var. brevior (Dewey) Fernald. Only by Cooper (14), "Rock Harbor."

Carex Merritt-Fernaldii Mackenzie.[5] Rock opening and crevices, Rock Harbor, north shore of Lake LaSage. This species is the northern

[5] Determined by G. P. Van Eseltine.

representative of the above variety (which is often considered a species) and is, according to Van Eseltine, "apparently sufficiently distinct to warrant its being given a specific name." Not previously reported.

Carex Bebbii Olney. Only by Cooper (14), "Head of Siskowit Bay."

Carex foenea Willd. Listed by Beal (4), on the authority of J. H. Sandberg.

Carex exilis Dewey. Only by Cooper (14), "Sedge zone, Bog Succession: head of Siskowit Bay."

Carex aenea Fernald.[5] Open woods, Grace Harbor; also Cooper (14), "Bare grassy burn: Rock Harbor."

Carex angustior Mackenzie.[5] Sedge mat of bog, Hidden Lake. Not previously reported.

Carex stellulata Good. var. excelsior (Bailey) Fernald. Only by Cooper (14), "Sedge zone, Bog Succession."

Carex incomperta Bicknell. Shrub zone of bog, Raspberry Island, Rock Harbor. Not previously reported.

Carex interior Bailey.[5] Sedge mat of bog, Hidden Lake, bog near Scovill point, margin of rock pools Scovill point; also Cooper (14).

Carex sterilis Willd. Only by Holt (2), "Rock pools, Scovill Point, and Siskowit cabin trail bog."

Carex canescens L.[5] Widespread in sedge mats of bogs. The species not previously reported. Cooper (14) reported the variety *suboliacea* Laestad without locality or habitat, and the variety *disjuncta* Fernald from "Bog forest."

Carex brunnescens Poir.[5] Widespread with the above species and around temporary pools in the mixed woods; also Stuntz and Allen, and Holt (2), Cooper (14).

Carex tenuifolia Wahlenb. Widespread in marginal zone of bogs associated with *Carex leptalea*, *cannescens*, *brunnescens*, and *tenella;* also Cooper (14).

Carex trisperma Dewey. Widespread in bogs and often carpeting large areas; also Stuntz and Allen, and Ruthven, (1), Holt (2) Cooper (14).

Carex tenella Schkuhr. Common in the marginal zone of bogs and often associated with *Carex trisperma;* also Stuntz and Allen, and Holt (2), Cooper (14).

Carex alopecoidea Tuckerman.[5] Swamp near lake shore Rainbow Cove, and sedge mat Moose Lake. Not previously reported.

Carex diandra Schrank.[5] Floating sedge mat of delta swamp Brady Cove; also Cooper (14).

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[5] Determined by G. P. Van Eseltine.

Carex stipata Muhl.[5] Delta swamp at head of Tobin Harbor, Brady Cove, and margin of Pickerel Cove. Not previously reported.

Carex chordorrhiza L. f. Common in sedge mat of bogs and occasional in delta swamps; also Holt (2), Cooper (14).

Carex crinata Lam. Only by Holt (2), "Along road to 'Island Mine' head of Siskowit Bay."

Carex aquatilis Wahlenb.[5] Sedge zone of gravel bar in Tobin Harbor; also Cooper (14).

Carex aquatilis Wahlenb. var. elatior Bab. Listed by Cooper (14), without data concerning habitat or locality.

Carex substricta (Kük.) Mackenzie.[5] Sedge mat of bog, Hidden Lake. Not previously reported.

Carex lenticularis Michx.[5] Shore of Pickerel Cove; also Cooper (14).

Carex concolor R. Br.[5] Delta swamp Brady Cove. Not previously reported.

Carex stricta Lam. Delta swamp Brady Cove; also Cooper (14), "Sedge and sphagnum zone, Bog Succession."

Carex strictior Dewey.[5] Sedge mat Hidden Lake; Bog forest Washington Island. Not previously reported, although collected by Dr. Foote in 1868.

Carex bicolor All. Only by Cooper (14), "Margin or rock pools and gravel beaches."

Carex aurea Nutt. Clearing around Washington Club, Rock Harbor, sedge mat Rainbow Cove, Sumner Lake. Not previously reported.

Carex pauciflora Lightf. Frequent in sedge mat of bogs; also Holt (2), Cooper (14).

Carex leptalea Wahlenb. Common on marginal zone of bogs and in bog forest; also Stuntz and Allen, and Cooper (14).

Carex Halleri Gunn. Only by Foster and Whitney (33), and Cooper (14), "Sheltered rock shore crevices and margins of rock pools."

Carex atrata (L.) var. ovata (Rudge) Boott. Only by Stuntz and Allen, and Cooper (14), "Rock shore crevices and margins of rock pools."

Carex polygama Schkuhr. Sedge mat of bogs, Hidden Lake; also Cooper (14).

Carex gracillima Schwein. Only by Cooper (14), "Brook bank in Climax forest."

Carex communis Bailey. Only by Stuntz and Allen (?), and Cooper (14), "Rock Harbor."

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[5] Determined by G. P. Van Eseltine.

Carex livida (Wahlenb.) Willd. Frequent in sedge mat of bogs; also Porter (43), Cooper (14).

Carex vaginata Tausch. Only by Cooper (14), "Bog forest."

Carex paupercula Michx.[5] Sedge mat of bogs and margins of rock pools. Not previously reported.

Carex paupercula Michx. var. irrigua (Wahlenb.) Fernald. Only by Stuntz and Allen, determined by G. P. Van Eseltine in 1920.

Carex paupercula Michx. var. pallens Fernald. Only by Stuntz and Allen (?) and Cooper (14), "Margin of rock pools."

Carex limosa L. One of the important species which helps to form the sedge mat in the bog lakes, and margins of rock pools; also Foote, Stuntz and Allen, and Holt (2), Cooper (14).

Carex eburnea Boott. Only by Cooper (14), "Margin of rock pools."

Carex laxiflora Lam. var. varians Bailey. Listed by Cooper (14) without any data concerning locality or habitat.

Carex flava L. Margin of bog Rainbow Cove, shore of Chickenbone Lake, and Rock Harbor; also Stuntz and Allen, and Cooper (14).

Carex Oederi Retz. var. pumila (Cosson & Germain) Fernald. Sandy beach of Chickenbone Lake; also Foote, Stuntz and Allen, and Holt (2).

Carex castanea Wahlenb. Margin of Chickenbone Lake and bog forest; also Cooper (14).

Carex capillaris (L.) var. elongata Olney.[5] Rock shore crevices, Rock Harbor; also Cooper (14), "Margin of rock pools."

Carex arctata Boott.[5] Lake Desor trail, Birch woods Lake Benson, and along outlet of Sargent Lake in McCargoe Cove; also Holt (2), "Dry woods, Washington Harbor."

Carex arctata Boott var. Faxoni Bailey. Listed by Beal (4) on the authority of J. H. Sandberg.

Carex lasiocarpa Ehrh.[5] Sedge mat of bogs and in delta swamps. One of the dominant sedges in many of the bogs; also Holt (2), Cooper (14).

Carex lanuginosa Michx. Only by Stuntz and Allen. Determined by G. P. Van Eseltine in 1920. Not previously reported.

Carex Houghtonii Torr.[5] Depression in coniferous woods east of Siskowit Lake outlet. Collected by Dr. Foote in 1868 and Porter (43).

Carex oligosperma Michx.[5] One of the dominant species in the sedge mat of bogs, Hidden Lake, Passage Island, and bog near Scovill Point; also Cooper (14).

[5] Determined by G. P. Van Eseltine.

Carex riparia Curtis. Delta swamp at Brady Cove; also Holt (2), "Head of Rock Harbor."

Carex hystericina Muhl.[5] Margin of outlet of Lake Eva, and Pickerel Cove. Not previously reported.

Carex retorsa Schwein.[5] Outlet of Lake Eva, Chickenbone Lake, and shore of Sargent Lake; also Stuntz and Allen, and Ruthven (1), Holt (2).

Carex intumescens Rudge. Only by Ruthven (1), "Washington Creek" and Holt (2), "Associated with *C. pauciflora* margin of Siskowit cabin trail bog."

Carex intumescens Rudge var. Fernaldii Bailey.[5] Delta swamp Tobin Harbor, Lake Eva, moist depression on Lake Desor trail, shore of Lake Richie; also Cooper (14).

Carex Michauxiana Boeckl. Common in sedge mat of Hidden Lake; also Stuntz and Allen, and Cooper (14).

Carex vescaria L.[5] Wet depression on rock ridge at head of Tobin Harbor; also Stuntz and Allen, and Cooper (14).

Carex vescaria L. var. monile (Tuckerman) Fernald.[5] Swamp near Forbes Lake; also Holt (2), "wet creek margin of bog near Malone's fishing camp."

Carex vescaria (L.) var. jejuna Fernald. Only by Cooper (14), "Sand bar; Duncan Bay."

Carex rostrata Stokes.[5] Common in sedge mats of bogs and delta swamps; also Cooper (14).

Carex Tuckermani Dewey. Only by Foote and Holt (2), "Along Washington Creek."

ARACEAE (Arum Family)

Arisaema triphyllum (L.) Schott. *Jack-in-the-Pulpit.* Moist woods on the south side of Chickenbone Lake, along the outlet of Siskowit Lake. Not previously reported.

Calla palustris L. *Water Arum.* Widely distributed in delta swamps and inland lakes; also University Party, and Holt (2), Cooper (14).

Symplocarpus foetidus (L.) Nutt. *Skunk Cabbage.* Widespread in bog and delta swamp forests, and margins of lakes and coves; also Ruthven (1), Holt (2), Cooper (14).

LEMNACEAE (Duckweed Family)

Lemna trisulca L. *Ivy-leaf Duckweed.* Only by Cooper (14), "Aquatic: delta streams."

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[5] Determined by G. P. Van Eseltine.

ERIOCAULACEAE (Pipewort Family)

Eriocaulon articulatum (Huds.) Morong. *Pipewort.* Shores of Sargent Lake, Chickenbone Lake, Lake Eva, Lake Benson, and head of Rock Harbor; also Foote, University Party, and Cooper (14).

JUNCACEAE (Rush Family)

Juncus Dudleyi Wiegand. McCargoe Cove; also Cooper (14), "Tobin Harbor."

Juncus filiformis L. Only by Cooper (14), "Margin of rock pools, common."

Juncus effusus L. Margins of streams and lakes, Chickenbone Lake, Lake Eva, McCargoe Cove; also Ruthven (1) "Washington Creek", Holt (2).

Juncus brevicaudatus (Engelm.) Fernald. Sedge mat of Hidden Lake, north end of Sargent Lake, rock pools Scovill Point; also Cooper (14).

Juncus canadensis J. Gay. Marsh on shore of Sargent Lake. Not previously reported.

Juncus pelocarpus Mey. Sedge mat of bog Lake Eva, bog in section 35 south of Conglomerate Bay; also Cooper (14), "Margin of bog pond at head of Siskowit Bay."

Juncus alpinus Vill. Sandy beach Lake Richie; also Cooper (14), "Margins of rock pools."

Juncus articulatus L. Margins of Lake Eva, Lake Richie; also Wheeler (54), "Tobin Harbor."

Luzula parviflora (Ehrh.) Dewey. *Wood Rush.* Shore of Washington Harbor. Not previously reported.

Luzula campestris (L.) DC. *Wood Rush.* Only by Cooper (14), without any mention of locality or habitat.

LILIACEAE (Lily Family)

Tofieldia palustris Huds. *False Asphodel.* Margins of rock pools and rock shore crevices, Washington Harbor, Tobin Harbor, Rock Harbor, Scovill Point, and Blake Point; also Beal (4), Foster and Whitney (33), Holt (2), Cooper (14).

Tofieldia glutinosa (Michx.) Pers. Occurs in the same habitat with the preceding species; also Cooper (14).

Uvularia perfoliata L. *Bellwort.* Only by Holt (2), "Rich, moist, woods, scattered."

Uvularia grandiflora Sm. Dr. Foote collected this species on Isle Royale in June 1868, and it has not been found since. Specimen in the herbarium of the University of Michigan.

Allium Schoenoprasum (L.) var. sibiricum (L.) Hartman. *Wild Chives.* Rock crevices and margins of rock pools, Passage Island, Blake Point, and Scovill Point; also Cooper (14).

Lilium philadelphicum L. *Wood Lily.* Abundant in old burns, rock openings, and occasional as a crevice plant; also Foote, and Holt (2), Porter (43), Cooper (14).

Clintonia borealis (Ait.) Raf. Widely distributed in shady woods. One of the common forest floor plants; also Foote, and Ruthven (1), Holt (2), Cooper (14).

Smilacina trifolia (L.) Desf. *Three-leaved Solomon's Seal.* Widely distributed in margins of bogs and bog forests; also Ruthven (1), Holt (2), Cooper (14).

Smilacina racemosa (L.) Desf. *False Spikenard.* Only by Ruthven (1), "Alder thicket near the mouth of Washington River."

Maianthemum canadense Desf. *Two-leaved Solomon's Seal.* Widely distributed in bog forest and mixed woods; also University Party, and Holt (2), Cooper (14).

Streptopus amplexifolius (L.) DC. *Twisted-stalk.* Widely distributed although not common, bog forest, margin of streams and lakes; also Foote, University Party, and Ruthven (1), Holt (2), Cooper (14).

Streptopus roseus Michx. *Pink-flowered Twisted Stalk.* Bog forest and in mixed woods, Rock Harbor; also Foote, and Cooper (14).

Polygonatum biflorum (Walt.) Ell. *Small Solomon's Seal.* Hard maple woods along Lake Desor trail, also Ruthven (1) in coniferous woods near Washington Harbor.

Trillium erectum L. *Purple Trillium.* Only by Cooper (14), "Bog forest; climax forest."

Trillium grandiflorum (Michx.) Salisb. *Large White Trillium.* Only by Holt (2), "Flood plain of Washington Creek."

Trillium cernuum L. Shore of Lake Feldtmann, margin of pool in woods between Tobin Harbor and Rock Harbor, margin of stream at head of Tobin Harbor. Not previously reported, although collected by the University Party, June 27, 1868.

IRIDIACEAE (Iris Family)

Iris versicolor L. *Blue Flag.* Widespread in a variety of habitats, with a special preference for sedge mats of bogs and delta swamps; also Ruthven (1), Holt (2), Cooper (14).

Sisyrinchium angustifolium Mill. *Blue-eyed Grass.* Rock shore crevices Blake Point, clearing at Rock Harbor, Washington Harbor, and Mott Island; also Cooper (14).

CYPRIPEDIUM ARIETINUM R. Br. *Ram's-head Lady's Slipper.* Rare. In dry pine ridge on the northwest side of Sumner Lake. A remarkable change from its normal habitat in swamps and rich woods. Listed in Beal (4) for Isle Royale on the authority of Dr. A. B. Lyons. A specimen collected by Dr. Foote, July 7, 1868, is in the herbarium of the University of Michigan.

CYPRIPEDIUM PARVIFLORUM Salisb. *Smaller Yellow Lady's Slipper.* White cedar swamp near old lighthouse, Rock Harbor; also Cooper (14), "Bog forest : Sargent Lake."

CYPRIPEDIUM PARVIFLORUM Salisb. var. PUBESCENS (Willd.) Knight. *Larger Yellow Lady's Slipper.* Bog forest Rock Harbor; also Holt (2), as *C. hirsutum.*

CYPRIPEDIUM HIRSUTUM Mill. *Showy Lady's Slipper.* Rare. Bog on Mott Island by J. R. Gube; also by Holt (2), "Wet woods near Ramson Clearing and Forbes Lake."

CYPRIPEDIUM ACAULE Ait. *Stemless Lady's Slipper.* Moist ground on north side of Angleworm Lake, bog near Forbes Lake, lichen mat on rock ridge, sec. 4, T. 65 N., R. 34 W., and according to F. Warren on the north side of Lake LeSage. Also Foote, University Party. Darlington (17) reported this species for Isle Royale from a specimen collected by Foote.

ORCHIS ROTUNDIFOLIA Banks ex. Pursh. *Round-leaved Orchis.* Only by Holt (2), "Rare. Tamarack Forest."

HABENARIA BRACTEATA (Willd.) R. Br. Moist shady depression on rock openings, Rock Harbor; also Cooper (14), "Wet places in climax forest: Duncan Bay."

HABENARIA HYPERBOREA (L.) R. Br. *Rein Orchis.* Sedge zone of bogs and in other moist habitats; also Foote, and Holt (2), Porter (43), Cooper (14).

HABENARIA DILATATA (Pursh) Gray. *White Rein Orchis.* Sedge zone of bogs, Moose Lake, Forbes Lake; also Foote, University Party, and Porter (43), Holt (2), Cooper (14).

HABENARIA DILATATA var. MEDIA (Rydb.) Ames. Widely distributed on sedge mat of bogs, apparently more abundant than the species. Determined by Fuller.

HABENARIA CLAVELLATA (Michx.) Spreng. *Small Green Wood Orchis.* Rock Pool margin, Scovill Point; also Foote, University Party, and Cooper (14), "Sedge zone of bog succession: Forbes Lake."

HABENARIA OBTUSATA (Pursh) Richards. *Small Northern Bog Orchis.* Bog forest and mixed woods. The commonest orchis on Isle Royale; also Foote, Sandberg, and Beal (4), Holt (2), Cooper (14).

Habenaria Hookeri Torr. *Hooker's Orchis.* Dry pine ridge northwest of Sumner Lake; also Cooper (14), "Heath mat in rock opening in climax forest; ridge northwest of Tobin Harbor: one plant only."

Habenaria orbiculata (Pursh) Torr. *Large Round-leaved Orchis.* Rare. Bog forest and mixed woods, north slope of Mount Franklin, Brady Cove, and Mrs. S. B. Langworthy, Rock Harbor; also University Party, and Holt (2), Cooper (14).

Habenaria leucophaea (Nutt.) Gray. Reported by Beal (4) based on collection by Dr. Foote. This collection is in the herbarium of the University of Michigan. Not found by subsequent collectors.

Habenaria psycodes (L.) Sw. *Purple Fringed Orchis.* Sedge zone of bogs, Moose Lake, Forbes Lake, Sumner Lake, delta swamp Brady Cove; also Foote, University Party, and Porter (60), Holt (2), Cooper (14).

Pogonia ophioglossoides (L.) Ker. *Pogonia.* Sedge mat of Forbes Lake; also Holt (2), from same locality and Sumner Lake, Cooper (14).

Arethusa bulbosa L. *Arethusa.* Sedge mat of bog Hidden Lake; also Foote, University Party, and Holt (2), Cooper (14).

Sprianthes gracilis (Bigel.) Beck. *Slender Lady's Tresses.* Lichen mat in rock openings, Mount Franklin, McCargoe Cove, along trail between Rock Harbor and Lake Richie. Not previously reported.

Spiranthes Romanzoffiana Cham. *Lady's Tresses* (fig. 18). Widespread in sedge mat of bogs, Moose Lake, Sumner Lake, Forbes Lake, Hidden Lake, rock crevices Blake Point, lichen mat Rock Harbor, Mount Franklin, McCargoe Cove; also Foote, and Beal (4) based on collection by Porter from Caribou Islet, Holt (2), Cooper (14). House (7) considered *Idium strictum* (Rydb.) House, which is often given as a synonym of this species, as distinct from *S. romanzoffiana* which according to him is an Alaskan plant. Two specimens from Alaska in the herbarium of the University of Michigan are not specifically distinct from the Isle Royale collections.

Epipactis repens (L.) Crantz. var. ophioides (Fernald.) Eaton. *Rattlesnake Plantain.* In bog forests and mixed woods, Rock Harbor, Lake Eva; also Foote, and Holt (2), Cooper (14).

Epipactis tesselata (Lodd.) Eaton. Same habitat as the preceding. Rock Harbor; also University Party, and Cooper (14).

Epipactis decipiens (Hook) Ames. Same habitat as the preceding, Monument Rock trail, Tobin Harbor, Lake Harvey; also Foote and Beal (4), Holt (2), Cooper (14).

Epipactis pubescens (Willd.) Eaton. *Downy Rattlesnake Plantain.* Coniferous woods Tonkin Bay, also Ruthven (1), Holt (2).

Listeria cordata (L.) R. Br. *Twayblade.* Widely distributed in shrub zone of bogs and bog forests; also Douglas Houghton 1840 (the oldest known collection from Isle Royale), Foote, University Party, and Holt (2), Cooper (14).

FIGURE 18.—Lady's tresses (*Spiranthes Romanzoffiana*) growing in rock opening. This species is more commonly found in bogs. Note cladonias and mosses in the foreground.

Listeria auriculata Wiegand. Bog forest, Rock Harbor, Balsam-Spruce woods Grace Harbor, Rainbow Cove and Mott Island. Darlington (17) states that Isle Royale is the only known locality in the state for this species. Also Foote, and Cooper (14). The specimen collected by Dr. Foote is on the same sheet with a specimen of the next species.

Listeria convallarioides (Sw.) Torr. Rock forest, Rock Harbor; also Foote, and Beal (4), Ruthven (1), Cooper (14).

Corallorhiza trifida Chatelain. *Early Coral Root.* Moist shady mixed woods, south shore of Tobin Harbor, Rock Harbor; also Holt (2), Cooper (14).

Corallorhiza maculata Raf. *Large Coral Root.* Mixed woods south shore of Tobin Harbor, Balsam woods at head of Rock Harbor; also University Party, and Holt (2), Cooper (14).

Corallorrhiza maculata Raf. var. flava (Peck) Bartlett (3). Lower lip white with no spots, slightly fragrant. Mixed woods on south shore of Tobin Harbor. Variety not previously reported.

Corallorrhiza striata Lindl. *Striped Coral Root.* Burn forest, Tobin Harbor, Rock Harbor, along outlet of Chickenbone Lake, McCargoe Cove. The three species of Corallorhiza are widely distributed on Isle Royale but not common. Also Cooper (14).

Microstylis monophyllos (L.) Lindl. *Adder's Mouth.* Sedge mat of Moose Lake and Sumner Lake. Not previously reported.

Microstylis unifolia (Michx.) BSP. Summit of Mount Franklin. Not previously reported. A rare plant in Michigan.

Liparis liliifolia (L.) Richard. *Twayblade.* Only by Holt (2), "Moist woods and bog margins, between Rock Harbor and Conglomerate Bay."

Liparis Loeselii (L.) Richard. Sedge mat of Sumner Lake and bog in section 35 south of Conglomerate Bay; also Holt (2), Cooper (14).

Calypso bulbosa (L.) Oakes. *Calypso.* Balsam-spruce woods Smithwick Island, mixed woods, Rock Harbor, McCargoe Cove; also Foote, University Party, and Porter (43), Holt (2), Cooper (14).

SALICACEAE (Willow Family)

Salix pentandra L.[6] *Bay-leaved Willow.* Planted on Barnum Island, Washington Harbor. The plants were secured from a nurseryman at Duluth, Minnesota. Not previously reported.

Salix fragilis L. *Crack Willow.* Planted on Barnum Island, Washington Harbor. The plants were secured from a nurseryman at Duluth, Minnesota. Not previously reported.

[6] Identifications by G. R. Ball.

Salix balsamifera Barr.[6] *Balsam Willow.* Rock ridge, Scovill Point, margin of bog Raspberry Island; also Cooper (14).

Salix pedicellaris Pursh var. hypoglauca Fernald. *Bog Willow.* Bog Raspberry Island. This variety was collected from the same place that Cooper (12 pp. 139, 204) reported the species, and his report should refer to this variety. The species has not been found west of the Adirondack Mountains.

Salix discolor Muhl.[6] *Glaucous Willow.* Margin of bog near Scovill Point; also Cooper (14) Delta Swamp Succession, rock shore crevices.

Salix humilis Marsh.[6] *Prairie Willow.* Rock crevices, Rock Harbor, Mott Island, margin of pool near Scovill Point; also Cooper (14).

Salix humilis var. Keweenawensis Farwell (?).[6] Rock crevices, Scovill Point. Ball wrote, "Leaves very small and firm, perhaps due to habitat.—I cannot place it elsewhere." Variety not previously reported.

Salix bebbiana Sargent.[6] *Bebb's Willow.* Widely distributed, rock shore crevices; also Cooper (14).

Salix bebbiana Sargent var. perrostrata (Rydb.) Schn.[6] Nearly decumbent in rock crevices, Rock Harbor. Not previously reported.

Salix pellita Anders. Only by Cooper (14), "Tobin Harbor."

Salix phylicifolia L. Only by Cooper (14), "Shrub zone, Bog Succession: head of Siskowit Bay; Gull Islands."

Populus tremuloides Michx. *Aspen.* Widespread in various habitats and associated in different proportions with white birch, balsam, and spruce; most abundant in old burns; also by Ruthven (1), Holt (2), Cooper (14).

Populus grandidentata Michx. *Large-toothed Aspen.* A few trees on the Lake Desor Trail about 4 miles from the Washington Club, 8 inches to 30 inches in diameter, with a very much corrugated bark, and about 60 feet tall. Also Ruthven (1), Holt (2).

Populus balsamifera L. *Balsam Poplar.* Scattered in rock openings and burns; also Holt (2), Cooper (14).

MYRICACEAE (Sweet Gale Family)

Myrica Gale L. Margins of bogs, delta swamps, lakes, and rock pools; also by Foote, and Holt (2), Cooper (14).

BETULACEAE (Birch Family)

Corylus rostrata Ait. *Beaked Hazelnut.* Widespread in old burns and rocky ridges; also Foote, and Ruthven (1), Holt (2), Cooper (14), "Abundant in burn forest." The records of the Ives linear survey show

[6] Identifications by G. R. Ball.

that hazelnut was one of the chief undershrubs of the dense woods. Most of the hazelnut thickets seen had been browsed by moose.

Ostrya virginiana (Mill.) Koch. *Ironwood.* Rare, on the Greenstone Ridge north of Hay Bay, sec. 10, T. 66 N., R. 37 W. Ives recorded the presence of this species in his field notes while he was running the line between sections 9 and 10 in the same locality.

Betula lenta L. *Sweet* or *Black Birch.* Only by Holt (2), as associated with the yellow birch on the Greenstone Ridge. The geographical range and lack of records for the Lake Superior district leads the writer to doubt whether this species occurs on Isle Royale.

Betula lutea Michx. f. *Yellow Birch.* Common on the Greenstone Ridge between Washington Harbor and Lake Desor, Greenstone Ridge south of Todd Harbor, high ground near Lake Feldtmann, valley and ridge to the south of the Greenstone Ridge in the vicinity of Hay Bay. Apparently formerly more abundant in the region south of the Greenstone Ridge between Lake Descr and Hatchet Lake and Siskowit Lake. A few old specimens remain in this area which is now covered by burn forest. Yellow birch frequently attains a size of 3 feet in diameter and a height of 50 to 60 feet. Most of the yellow birch has a stunted appearance and seldom will it be possible to get more than two 16-foot logs from one tree. Also by Ruthven (1), Holt (2) (fig. 19).

Betula alba L. var. papyrifera (Marsh) Spach. Paper or white birch. Widespread in a variety of habitats, principally a tree that follows fire, although Cooper considered it one of the three climax trees of Isle Royale and second in abundance. Also Foote, and Ruthven (1), Holt (2), Cooper (14).

Betula alba L. var. cordifolia (Regel) Fernald. Sparingly mixed with the preceding. Rosendahl and Butters (48) consider this and the preceding variety worthy of specific rank. Herbarium specimens are readily separated on several characters, but in the field the shape of the leaves was quite variable on the same tree, although the darker, orange color of the bark made this variety appear conspicuous. Not previously reported.

Betula pumila L. var. glandulifera Regel. Shrub zone of bog on Raspberry Island. Cooper (12, 14) reports the species from this same bog and it is probable both collections are the same.

Alnus crispa (Ait.) Pursh. *Green* or *Mountain Alder.* Margin of bays, lakes, and rock openings; also Foote, University Party, and Holt (2), Cooper (14).

Alnus incana (L.) Moench. *Speckled* or *Hoary Alder.* Common on margin of bogs and delta swamps; also Foote and Holt (2), Cooper (14).

FIGURE 19.—Yellow birch (*Betula lutea*). Tree 20 inches in diameter, on the Greenstone Ridge between Lake Desor and Washington Harbor.

FAGACEAE (Beech Family)

QUERCUS BOREALIS Michx. f. *Boreal Red Oak.* Frequent on the Greenstone Ridge from Washington Harbor northeast to Angleworm Lake (fig. 20). Gillman (35) counted 384 annual rings in an oak log lying across an Indian pit in the vicinity of McCargoe Cove. Today the nearest oaks are about 3 miles to the southwest. Apparently oaks were formerly more abundant than they are today. The oaks in the open are stunted and bushy trees with a diameter up to 10 inches D. B. H. and a height of 25 to 30 feet. In the hard maple–yellow birch forest one specimen was seen which was about 6 inches in diameter and about 50 feet high. A specimen 1½ inches in diameter on a stump 10 inches high had 63 annual rings. Thus a specimen 10 inches in diameter under the same conditions would be over 200 years old. Holt (2) stated that "a single specimen was noted along the forest road between Washington Club and Lake Desor", which he called *Quercus rubra* L., and Adams referred to it as black oak. Ives recorded black oak in the same vicinity as the ironwood. The writer believes that this is red oak.

URTICACEAE (Nettle Family)

URTICA GRACILIS Ait. *Nettle.* Delta swamp Tobin Harbor, and shore of Lake Feldtmann; also Cooper (14) clearings.

SANTALACEAE (Sandalwood Family)

COMANDRA UMBELLATA (L.) Nutt. *Bastard Toad-Flax.* Rock crevices Blake Point, rock opening at head of Tobin Harbor. Not previously reported, although collected by Foote in 1868.

COMANDRA LIVIDA Richards. Common in rock openings and mixed woods; also Holt (2), Cooper (14).

ARISTOLOCHIACEAE (Birthwort Family)

ASARUM CANADENSE L. *Wild Ginger.* Only by Holt (2), "Flood plain, Washington Creek."

POLYGONACEAE (Buckwheat Family)

RUMEX BRITANNICA L. *Great Water Dock.* Delta swamp Brady Cove; also Cooper (14).

RUMEX CRISPUS L. *Curled Dock.* Clearing on Amygdaloid Island; also Foote, University Party, and Cooper (14).

RUMEX MEXICANUS Meisn. Occurring as a weed in clearings, Wright Island, Rock Harbor, Washington Harbor. Probably a recent introduction to Isle Royale. Not previously reported.

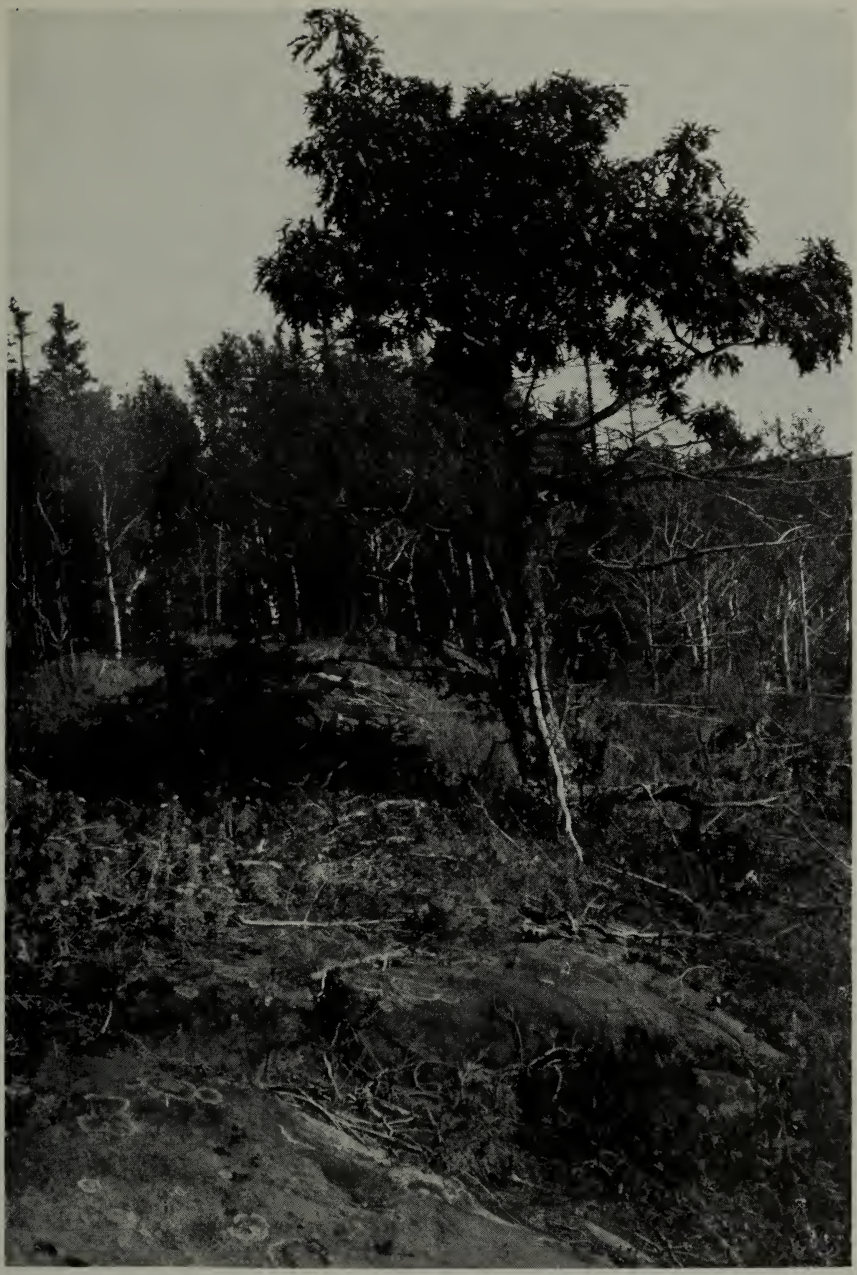

FIGURE 20.—Red oak (*Quercus borealis*) on Greenstone Ridge north of Angleworm Lake.

Rumex Acetosella L. *Sheep Sorrel.* Clearing at various parts of the island; also Foote, and Cooper (14).

Polygonum aviculare L. *Knotweed.* Clearings on Fish Island, Wright Island; also by Cooper (14).

Polygonum Douglasii Greene. Frequent in rock openings, bare ridges, and old burns; also by Cooper (14).

Polygonum viviparum L. *Alpine Buckwheat.* Widespread but not common in rock shore crevices and margins of pools; also by Foote, and Cooper (14).

Polygonum amphibium L. Shallow water, McCargoe Cove, Pickerel Cove. Not previously reported.

Polygonum amphibium (L). var. Hartwrightii (Gray) Bissell. Margin of bogs, Moose Lake, bog south of Conglomerate Bay section 35, Sumner Lake. Not previously reported.

Polygonum cilinode Michx. Rock openings Rock Harbor, old burn near Lake Feldtmann; also Cooper (14).

CHENOPODIACEAE (Goosefoot Family)

Chenopodium capitatum (L.) Asch. *Strawberry Blite.* Clearing on Amygdoloid Island; also Cooper (14).

Chenopodium album L. *Lamb's Quarters.* Clearing at old lighthouse Rock Harbor; also Cooper (14).

CARYOPHYLLACEAE (Pink Family)

Sagina nodosa (L.) Fenzl. *Pearlwort.* Rock shore crevices Scovill Point Passage Island; also Holt (2) as *S. saginoidès* (L.) Britton, Cooper (14). *S. saginoides* is described with four or five petals. Our material has five or six sepals and petals, and all are too long for *S. saginoides.*

Arenaria macrophylla Hook. Thick duff in mixed woods near shore east of the outlet of Siskowit Lake. The only locality in which this plant was found. It was first reported from Isle Royale by Fernald (27) based on a specimen in the Gray Herbarium.

Stellaria borealis Bigel. Widespread in moist shady habitats; also Foote, and Cooper (14).

Stellaria longifolia Muhl. *Long-leaved Stitchwort.* Clearings at Washington Island, Washington Club, Washington Harbor, McCargoe Cove, Brady Cove; also Foote, and Holt (2) as a "scattered ruderal."

Stellaria media (L.) Cyrill. *Common Chickweed.* Clearing around dwellings Washington Club, Wright Island. Not previously reported.

Cerastium arvense L. Clearing on Washington Island. Not previously reported.

CERASTIUM VULGATUM L. *Mouse-ear Chickweed.* Clearings Rock Harbor, Mott Island; also Cooper (14).

SILENE ANTIRRHINA L. *Sleepy Catchfly.* Frequent in rock openings and rock shore crevices; also Holt (2), Cooper (14).

SILENE NOCTILFORA L. *Night-flowering Catchfly.* Clearings near old lighthouse, and Rock Harbor Lodge; also Cooper (14).

GYPSOPHILA MURALIS L. In cultivation at Rock Harbor.

CERATOPHYLLACEAE (Hornwort Family)

CERATOPHYLLUM DEMERSUM L. *Hornwort.* Only by Cooper (14) "Delta Streams."

NYMPHAEACEAE (Water Lily Family)

NYMPHAEA AMERICANA (Provancher) Miller and Standley (44). *Cow Lily.* Formerly abundant in bog lakes, bays, and delta streams. See discussion under changes in vegetation due to mammals. Also Foote, and Holt (2), Cooper (14).

CASTALIA ODORATA (Ait.) Woodville and Wood. *Sweet-scented Water Lily.* Only by Foote, and Holt (2) "abundant in Sumner Lake", Cooper (14) "Bog lakes and delta streams."

CASTALIA TETRAGONA (Georgi.) Lawson. *Small Northern Water Lily.* Only by Cooper (14), "Delta streams: Chippewa Harbor; Duncan Bay." This species is rare in Michigan and has a very discontinuous range. "In the Misinaibe River, Ontario (R. Bell); in ponds along the Keewatin (J. M. Macoun); near Granite Station, northern Idaho (Leiberg). Also in Siberia, Japan and the Himalayas", Britton and Brown (7).

BRASENIA SCHREBERI Gmel. *Water Shield.* Rare. Aquatic in Moose Lake; also by Foote, and Holt (2).

RANUNCULACEAE (Buttercup Family)

RANUNCULUS AQUATILIS L. var. CAPILLACEUS DC. *White Water Buttercup.* Aquatic in Sargent Lake, Tobin Harbor, Amygdaloid Channel; also by Foote, and Cooper (14).

RANUNCULUS FLAMMULA L. var. REPTANS (L.) Mey. *Creeping Spearwort.* Muddy shore Sargent Lake, sandy shore Chickenbone Lake; also Cooper (14).

RANUNCULUS RHOMBOIDEUS Goldie. *Dwarf Buttercup.* Dry rock ridge south of McCargoe Cove, Greenstone Ridge near Chickenbone Lake; also Holt (2), Cooper (14), "Heath mat and bare burned ridges."

RANUNCULUS SCELERATUS L. *Cursed Crowfoot.* Delta swamp Brady Cove. Not previously reported.

Ranunculus abortivus L. *Small-flowered Buttercup.* Widespread in moist habitats, Delta swamp Brady cove, margin of pool Tobin Harbor, Washington Harbor, Passage Island; also Holt (2), Cooper (14).

Ranunculus septentrionalis Poir. *Swamp Buttercup.* Moist depression in balsam woods Lake Eva, swamp Washington Island. Not previously reported.

Ranunculus pennsylvanicus L. f. *Bristly Crowfoot.* Delta swamp McCargoe Cove, swamp Washington Island. Not previously reported.

Ranunculus Macounii Britton. *Macoun's Buttercup.* Delta swamp Brady Cove, Tobin Harbor; also Cooper (14) on "Sand beaches."

Ranunculus acris L. *Tall Buttercup.* Clearing Rock Harbor, Mott Island; also Foote and Cooper (14).

Thalictrum dasycarpum Fisch. & Lall. *Tall Meadow Rue.* Sedge mat Moose Lake, grassy shores Rock Harbor, Washington Island; also Holt (2) as *T. purpurascens L.*, Cooper (14).

Hepatica triloba Chaix. *Mayflower.* Widespread in mixed woods and in hard maple–yellow birch woods near Lake Desor. Recorded from Mount Franklin Trail, near Sumner Lake, south of Conglomerate Bay, Sargent Lake Trail, Todd Harbor, near McCargoe Cove and Angleworm Lake; also Holt (2), Cooper (14).

Anemone canadensis L. Sandy beach McCargoe Cove, clearing Washington Island; also Foote and Cooper (14).

Anemone multifida Poir. var. Hudsoniana DC. (22) *Northern Anemone.* Clearing on Mott Island, Passage Island; also Holt (2), Cooper (14).

Clematis verticillaris DC. Widespread in mixed woods and old burns; also Cooper (14).

Caltha palustris L. *Marsh Marigold.* Widespread in bog forest and delta swamps; also Ruthven (1), Holt (2), Cooper (14).

Coptis trifolia (L.) Salisb. *Goldthread.* Common in bog forest and moist mixed woods; also Ruthven (1), Holt (2), Cooper (14).

Aquilegia canadensis L. *Columbine.* Frequent in rock shore crevices and rock openings; also Foote and Holt (2), Cooper (14).

Actaea rubra (Ait.) Willd. *Red Baneberry.* Scattered in old burns, mixed woods, and rock openings; also Foote, and Holt (2), Cooper (14).

Actaea rubra (Ait.) Willd. f. neglecta (Gillman) Robinson. Associated with the preceding; also Cooper (14). This form is listed in Gray's Manual as "Not rare—worthy of further study and perhaps distinct." In Britton and Brown (7) under *A. Alba* (L.) Mill., "Races or hybrids with white berries and slender pedicels (*A. neglecta* Gillman, *A. eburnea* Rydb.), and red berries on thickened pedicels are occasionally met with."

The author wishes to add some field observations on this form which is separated from *A. rubra* by the white color of the fruit and from *A. alba* by the slender pedicel. Many specimens were observed in which there were some red berries on the raceme, some mottled red and white, and some pure white. Other specimens had unripe berries which were green in color and as they ripened turned white without any red appearing in the fruit, all with the slender pedicel characteristic of *A. rubra*.

FUMARIACEAE (Fumitory Family)

Corydalis sempervirens (L.) Pers. *Pale Corydalis.* Widespread in rock shore crevices and rock openings; also University Party, and Holt (2), Cooper (14).

Corydalis aurea Willd. *Golden Corydalis.* Only by Foote, and Porter (43), Cooper (14), "Clearings."

CRUCIFERAE (Mustard Family) (Walpole 50)

Draba arabisans Michx. Rock shore crevices, Rock Harbor, Passage Island, and interior cliffs, Mount Franklin, Monument Rock; also Foote, G. A. Marr 1868, and Cooper (14).

Draba arabisans Michx. var. orthocarpa Fernald & Knowlton. Rock crevices Passage Island; also Cooper (14), "Gull Island."

Thlaspi arvense L. *Field Penny Cress.* Barnyard, Washington Club; also Holt (2).

Lepidium virginicum L. *Wild Pepper Grass.* Tobin Harbor trail near fishing camp; also Cooper (14).

Subularia aquatica L. *Awlwort.* Very abundant in the sandy-gravel bottom at the head of Rock Harbor. Not noted elsewhere. It grows submerged at various depths up to 3 feet. The plants are all less than 1½ inches tall. The range as given in Gray's Manual (47) is "Nfd. to B. C., southw. to centr. N. E., Wyo., and Cal.; local. Aug., Sept. (Eu., Siber.)." Not previously reported for Isle Royale.

Capsella Bursa-pastoris (L.) Medic. *Shepherd's Purse.* Two collections of seeds were sent to G. H. Shull, who grew them in the greenhouse and identified them as var. *tenuis* and var. *rhomboidea.* Clearings around dwellings; also Foote, and Cooper (14).

Brassica nigra (L.) Koch. *Black Mustard.* Clearing at the Washington Club. Not previously reported.

Sisymbrium altissimum L. *Hedge Mustard.* Clearings around fishing camps Caribou Island, old lighthouse Rock Harbor; also Ruthven (1), Holt (2), Cooper (14).

Braya humilis (C. A. Mey) Robinson. Only by Wheeler (54), Gillman, by Beal (4).

Erysimum cherianthoides L. *Worm-seed Mustard.* Clearing on Passage Island; also Cooper (14).

Erysimum parviflorum Nutt. Only by Cooper (14) "Clearings."

Radicula palustris (L.) Moench. *Marsh Cress.* Wet depressions along the Lake Desor Trail. Not previously reported.

Radicula Armoracia (L.) Robinson. *Horseradish.* Introduced on Wright Island, Siskowit Bay. Not previously reported.

Barbarea vulgaris R. Br. *Winter Cress.* Along shore, Rock Harbor, Washington Harbor; also Cooper (14), "Sand beaches."

Cardamine pennsylvanica Muhl. *Bitter Cress.* Margin of pool Rainbow Cove, delta swamp and south shore of Tobin Harbor; also Cooper (14).

Arabis lyrata L. *Rock Cress.* Common in rock shore crevices; also Foote, and Cooper (14).

Arabis Drummondii Gray. Rock shore crevices and frequent in rock openings; also Cooper (14).

Arabis brachycarpa (T. & G.) Britton. Rock crevices on island in sec. 14, T. 66 N., R. 33 W.; also Holt (2), Cooper (14).

Arabis hirsuta (L). Scop. Only by Cooper (14), "Recent burn, Smithwick Island."

SARRACENIACEAE (Pitcher-plant Family)

Sarracenia purpurea L. *Pitcher-plant.* Frequent in bogs; also Foote, and Holt (2), Cooper (14).

DROSERACEAE (Sundew Family)

Drosera rotundifolia L. *Round-leaved Sundew.* Common in sedge mat of bogs and occasional on margin of rock pools; also Foote, and Holt (2), Cooper (14).

Drosera anglica Huds. Margin of rock pool Passage Island; also Cooper (14), "Sedge zone of bog succession: Raspberry Island."

Drosera longifolia L. Sedge mat of bogs, Hidden Lake, Raspberry Island, margin of pool Passage Island; also Foote, University Party, and Holt (2), Cooper (14).

Drosera linearis Goldie. Margin of bog Sumner Lake, bog in sec. 35 S. of Conglomerate Bay; also Foote, University Party, and Holt (2), Cooper (14).

CRASSULACEAE (Orpine Family)

Sedum acre L. *Mossy Stonecrop.* Rock ledge in clearing along trail to Minong mine, McCargoe Cove. Probably introduced in 1872 when miners were working this area. Associated with tansey and cultivated rose apparently at the site of an old cabin. Not previously reported.

SAXIFRAGACEAE (Saxifrage Family)

Saxifraga virginiensis Michx. *Early Saxifrage.* Rock shore crevices and rock openings; also G. A. Marr 1867, and Cooper (14).

Saxifraga nivalis L. Only by Holt (2) exposed rock shores, growing on scanty soil. Inasmuch as the plants collected by Holt have not been studied, it is impossible to tell whether his material was this species or a depauperate form of *S. virginiensis.*

Saxifraga tricuspidata Rottb. Frequent in rock shore crevices and rock ridges in the interior; also Foote, University Party, G. A. Marr, and Holt (2), Cooper (14).

Saxifraga Aizoon Jacq. Rare in rock shore crevices, Mott Island, rock ridge Lookout Louise (sec. 28, T. 67 N., R. 33 W.); also University Party, and Holt (2), Cooper (14).

Mitella nuda L. *Miterwort.* Common in moist soil of mixed woods; also University Party, and Ruthven (1), Holt (2), Cooper (14).

Parnassia parviflora DC. *Grass of Parnassus.* Only by Cooper (14), "Margins or rock pools, and sheltered crevices."

Parnassia palustris L. Sedge mat of bogs; also University Party, and Holt (2), Cooper (14).

Ribes oxyacanthoides L. *Gooseberry.* Gravel beach Grace Harbor, gravelly soil Mott Island; also Cooper (14).

Ribes setosum Lindl. *Bristly Gooseberry.* Only by Holt (2), "Shore of Siskowit Lake. Rare."

Ribes hudsonianum Richards. Cedar swamp near Pickerel Cove. Not previously reported.

Ribes lacustre (Pers.) Poir. *Swamp Black Currant.* Margin of swamp Washington Island, woods along Tobin Harbor Trail; also Foote, and Cooper (14), "Duncan Bay."

Ribes prostratum L'Her. *Skunk Currant.* Common in white cedar swamps and bog forests; also Foote, and Cooper (14), "Climax forest, Burn forest."

Ribes triste Pall. *Wild Red Currant.* Only by Cooper (14), "McCargoe Cove."

Ribes triste Pall. var. albinervium (Michx.) Fernald. Widespread in moist mixed woods; also Holt (2) as *R. rubrum* L., Cooper (14).

ROSACEAE (Rose Family)

Physocarpus opulifolius (L.) Maxim. *Nine-bark.* Widespread in rock shore crevices, and occasional in delta swamps; also Ruthven (1), Holt (2), Cooper (14).

Spiraea salicifolia L. Margin of swamp Rainbow Cove; also Ruthven (1), "This shrub was found along Washington Creek, between the alder and sedge zones, where the latter was well developed."

Pyrus malus L. *Apple.* On gravel bar, northeastern end of Grace Island. Medium size tree 4 to 6 inches in diameter. C. E. Allen has informed the writer of apple trees at Ramson Clearing, Rock Harbor, now called the Daisy Farm. Not previously reported.

Pyrus melanocarpa (Michx.) Willd. *Black Chokeberry.* In Ledum-Chamaedaphne bog at the southwestern end of Forbes Lake; also Foster and Whitney (33), Holt (2).

Pyrus americana (Marsh) DC. *Mountain Ash.* Widespread in a variety of habitats; also Ruthven (1), Holt (2), Cooper (14).

Amelanchier Bartramiana (Tausch.) Roem. Apparently common in rock crevices; also Cooper (14) as *A. oligocarpa* (T. & G.) Roem. The treatment of the genus Amelanchier in Gray's Manual and Britton and Brown has been rather unsatisfactory, and K. M. Wiegand (51, 53), has made a critical study of this genus. His results emphasize the necessity for further studies, and show the futility of attempting to use previously recorded names as synonyms. Material passing under the name of *A. canadensis* (L.) Medic. has been referred to either *A. laevis* Wiegand or *A. canadensis*, and such is the case with some of the other species. Cooper reported *A. canadensis*, *A. oblongifolia*, *A. spicata*, *A. oligocarpa*. Wiegand determined the material collected by this survey, and *A. Bartramiana* was the only species with a positive identification. Other collections were "probably *A. huronensis*" and "probably *A. huronensis* × *laevis*", which would indicate that possibly *A. laevis* occurs on Isle Royale.

Fragaria virginiana Duchesne. *Wild Strawberry.* Poplar woods on north side of the Greenstone Ridge near Mount Franklin; also Cooper (14), "Smithwick Island."

Waldsteinia fragarioides (Michx.) Trattinick. *Barren Strawberry.* Common in the vicinity of Sargent Lake, and along the Greenstone Ridge from Hatchet Lake to Mount Franklin; also Holt (2), Cooper (14).

Potentilla arguta Pursh. Rock shore crevices, Mott Island, near old lighthouse, Rock Harbor; also Holt (2), Cooper (14), " 'N. to Isle Royale,' Beal."

Potentilla monspeliensis L. Widespread in rock crevices and on sedge mat Hidden Lake, Delta swamp Brady Cove; also Holt (2), Cooper (14).

Potentilla pennsylvanica L. Frequent in rock crevices and rock openings; also Holt (2), as *P. littoralis* Rybd., Cooper (14).

Potentilla argenta L. *Silvery Cinquefoil.* Only Ruthven (1), "On the shingle beach at Siskowit Bay."

Potentilla palustris (L). Scop. *Marsh Cinquefoil.* Common in sedge mats of bogs and delta swamps; also Foote, and Holt (2) as *Comarum palustre* L., Cooper (14).

Potentilla fruticosa L. *Shrubby Cinquefoil.* Common in rock shore crevices; also Ruthven (1) as *Dasiophora fruticosa* (L.) Rybd., Holt (2), Cooper (14).

Potentilla tridentata Ait. *Three-toothed Cinquefoil.* Widespread in rock shore crevices and rock openings; also J. H. Sandberg 1889, Ruthven (1), as *Sibbaldiopsis tridentata* (Soland.) Rydb., Cooper (14).

Potentilla Anserina L. var. sericea Hayne. *Silverweed.* Rock shore crevices, Rock Harbor, Mott Island; also Cooper (14) as the species.

Potentilla canadensis L. Clearing at the head of McCargoe Cove; also Cooper (14).

Geum rivale L. *Purple Avens.* Old burn on slopes of Mount Franklin. Not previously reported.

Geum strictum Ait. Hard maple woods along Lake Desor Trail. Not previously reported.

Rubus idaeus L. var. aculeatissimus (C. A. Mey.) Regel & Tiling. *Red Raspberry.* Widespread in rock openings and old burns; also Foote, and Ruthven (1), Holt (2), Cooper (14).

Rubus parviflorus Nutt. *Salmon Berry.* Widespread as one of the undershrubs in the mixed woods, rock openings and old burns; also Foote, and Ruthven (1), Holt (2); Cooper (14).

Rubus triflorus Richards. *Dwarf Raspberry.* Common in bog forest and as a crevice plant; also Cooper (14).

Rubus arcticus L. *Arctic Raspberry.* Only by Ruthven (1), "in the bogs Grace Creek, and sec. 20, T. 64 N., R. 38 W.", Holt (2), "Sparingly distributed in moist woods and filled bog areas."

Rubus frondosus Bigel. *Blackberry.* Rocky ridge between Lake Benson and Forbes Lake. Apparently rare. Only a few specimens were found in this locality. Not previously reported.

Rosa blanda Ait.[7] Sand bar on the northeast end of Grace Island. Not previously reported.

Rosa acicularis Lindl.[7] Rock shore crevices and rock openings and ridges with the varieties; also Holt (2) Cooper (14).

Rosa acicularis Lindl. var. rotunda Erlanson.[7] Common in rock openings and rock shore crevices. Variety not previously reported.

Rosa acicularis Lindl. var. sayiana Erlanson.[7] Margin of lake, Washington Island. Variety not previously reported.

[7] Determined by E. W. Erlanson.

Rosa acicularis Lindl. var. Bourgeauiana Crepin. Only by Cooper (14), "Gull Islands; Mott Island."

Rosa virginiana × (hort. ?) A cultivated rose that has persisted apparently at the site of a miner's cabin along the trail to the Minong Mine, McCargoe Cove. It belongs in the Carolinae group. Not previously reported.

Prunus virginiana L. *Choke Cherry.* Mixed woods Washington Island, outlet of Lake Feldtmann in Rainbow Cove; also Foote, and Holt (2), Cooper (14), "Burn Forest."

Prunus pennsylvanica L. f. *Fire Cherry.* Widespread in a variety of habitats, common tree following fires; also Holt (2), Cooper (14).

LEGUMINOSAE (Pea Family)

Trifolium pratense L. *Red Clover.* Common in rock openings and clearings; also Cooper (14).

Trifolium repens L. *White Clover.* Common in rock openings and clearings; also Cooper (14).

Trifolium hybridum L. *Alsike Clover.* Clearing at Washington Club; also Cooper (14). These clovers and many other introduced species were probably brought to Isle Royale in hay which the miners fed their horses. Many of these introduced species stay in the vicinity of old clearings and mines, others, like the red and the white clover, have spread over large areas.

Melilotus officinalis (L.) Lam. *Yellow Sweet Clover.* Apparently recently introduced at a fishing camp near the old lighthouse, Rock Harbor. Not previously reported.

Vicia americana Muhl. *Vetch.* Old burn on the Greenstone Ridge between Mount Franklin and Monument Rock, and along trail to Lake Richie; also Cooper (14).

Lathyrus maritimus (L.) Bigel. *Beach Pea.* Gravel beach Grace Harbor, Rock Harbor; also Ruthven (1), Cooper (14).

Lathyrus palustris L. *Vetchling.* Delta swamps McCargoe Cove, Brady Cove; also Foote, and Cooper (14).

Lathyrus ochroleucus Hook. Rock slopes of Mount Franklin; also Cooper (14), "Sedge and grass zone of Delta Swamp Succession."

OXALIDACEAE (Wood Sorrel Family)

Oxalis Acetosella L. *Wood Sorrel.* Shade of balsam-spruce woods between Washington Harbor and Grace Creek, Washington Island; also Cooper (14), "Climax forest", Smithwick Island, and Duncan Bay.

GERANIACEAE (Geranium Family)

GERANIUM BICKNELLII Britton. Frequent in lichen mat rock openings; and old burns; also Porter 1865 (43) as *G. carolinianum* L., Cooper (14). This species was not separated from *G. carolinianum* until 1897.

POLYGALACEAE (Milkwort Family)

POLYGALA PAUCIFOLIA Willd. *Fringed Polygala.* Widespread in mixed woods although not common; also Holt (2), Cooper (14).

CALLITRICHACEAE (Water Starwort Family)

CALLITRICHE PALUSTRIS L. *Water Starwort.* Delta swamps, Tobin Harbor, Brady Cove; also Cooper (14).

EMPETRACEAE (Crowberry Family)

EMPETRUM NIGRUM L. *Crowberry.* Rock shore crevices, Scovill Point, Passage Island; also Ruthven (1), Holt (2), Cooper (14).

ANACARDIACEAE (Cashew Family)

RHUS TYPHINA L. *Sumac.* Only by Holt (2), as *Rhus hirta* (L.) Sudw., "Sparingly distributed on the higher parts of Greenstone," Cooper (14), without any data concerning location or habitat.

RHUS GLABRA var. BOREALIS Britton. Rock opening along trail up Mount Franklin, old burn near Sargent Lake and ridge south of McCargoe Cove. Foliage and twigs are pubescent but not a dense velvety-pubescence as occurs on *Rhus typhina* with which this may have been confused. This species has been severely browsed by the moose and plants less than 1 meter high are from 20 to 30 years old, and have a stem diameter of 1 inch; this dwarfing may be partly due to the rocky habitat. Not previously reported.

ACERACEAE (Maple Family)

ACER PENNSYLVANICUM L. *Striped Maple.* Only by Holt (2), "Rare on island."

ACER SPICATUM Lam. *Mountain Maple.* Widely distributed in mixed woods and rocky cliffs; also University Party, and Ruthven (1), Holt (42), Cooper (14). Ives recorded in his field notes and on the original land office map the presence of "spotted maple", which occurred in many localities in sufficient abundance to be conspicuous. Certain of these localities were visited and the only maple present was this species.

ACER SACCHARUM Marsh. *Sugar Maple.* Common on the Greenstone Ridge from Washington Harbor to northeast of Lake Desor, sections 7 and 8 south and southeast of Lake Harvey; northeast from there to

within one-half mile of Mount Franklin as a scattered tree not assuming forest proportions in this area. Common on the ridge south of the Greenstone Ridge where it is associated with yellow birch and white cedar as in the region between Washington Harbor and Lake Desor. The average diameter of the trees in the good sites is about 2 feet in diameter although occasional specimens are as large as 3 feet in diameter (fig. 21). All are short trees with not more than two merchantable 16-foot logs. Seedling reproduction of this species is very abundant. Sapling and pole stages are, however, absent in the forest, thus resulting in a forest with very few age classes. A large quantity of seed was produced in the 1930 season, although the percentage of sterility of the samaras was over 50 percent. Also University Party, Ruthven (1), Holt (2).

Acer saccharum Marsh var. *Rugelii* Rehd. On ridge about 1 mile south of Todd Harbor, and apparently occurs with the species. Variety not previously reported.

Acer rubrum L. *Red Maple.* Widespread on ridges and occasional in margins of swamps. Common on the Greenstone Ridge from south of Hatchet Lake to Mount Franklin, near Sargent Lake, and Daisy Farm, Rock Harbor; also Cooper (14) "Bare burned ridge: Sargent Lake Trail near Rock Harbor."

BALSAMINACEAE (Touch-me-not Family)

Impatiens biflora Walt. *Jewel Weed.* Clearing Amygdaloid Island, moist ground Sargent Lake; also University Party, and Cooper (14).

RHAMNACEAE (Buckthorn Family)

Rhamnus alnifolia L'Her. *Buckthorn.* Widely distributed although not common in shrub zone of bogs, and occasional in rock crevices; also Ruthven (1), Cooper (14).

Ceanothus americanus L. *New Jersey Tea.* Only Ruthven (1), "With the heaths on Menong Trap Promontory" (northwest side of Washington Harbor).

VITACEAE (Grape Family)

Psedera quinquifolia (L.) Greene. Cultivated at Belle Isle.

HYPERICACEAE (St. John's-wort Family)

Hypericum boreale (Britton) Bicknell. *Northern St. John's-wort.* Sandy beach Lake Richie. Not previously reported.

Hypericum canadense L. Rocky shore head of Rock Harbor. Not previously reported.

FIGURE 21.—Sugar Maple (*Acer saccharum*). Tree 21 inches in diameter, same locality as figure 19.

Hypericum virginicum L. *Marsh St. John's-wort.* Common in sedge mat of bogs, occasional on the margins of lakes; also Holt (2), Cooper (14).

VIOLACEAE (Violet Family) Thompson (49)

Viola septentrionalis Greene.[8] Dense balsam–white birch woods on south shore of Tobin Harbor, rock openings along trail to Lake Richie. Not previously reported.

Viola novae-angliae House. Only by Cooper (14), "Depression in climax forest: Duncan Bay."

Viola Selkirkii Pursh.[8] Mixed woods between Washington Harbor, and Grace Creek. Not previously reported.

Viola pallens (Banks) Brainerd.[8] Widely distributed in bogs, and margin of rock pool Scovill Point; also Cooper (14), "Depression in climax forest: Duncan Bay."

Viola incognita Brainerd.[8] Black ash swamp on Mount Franklin Trail, Tobin Harbor, white cedar swamp south of Brady Cove; also Cooper (14).

Viola renifolia Gray var. Brainerdii (Greene) Fernald (20).[8] Widespread in a variety of habitats, apparently the most abundant violet on Isle Royale. An important member of the hard maple–yellow birch woods. Dr. H. D. House who kindly identified the violets wrote "Typical *V. renifolia* should be more or less (chiefly more) pubescent on the upper surface of leaf blades. The prevailing form in New York (as in your Isle Royale series) has the leaf-blades glabrous or nearly so above, and is known as var. *Brainerdii* (Greene) Fernald. Intermediate forms are not rare and its status as a variety is a matter of opinion." Also collected by the University Party and Holt (2) as *V. rotundifolia* Michx. and Cooper (14) as the species.

Viola eriocarpa Schw. var. leiocarpa Fernald. Hard maple woods on the Lake Desor Trail, poplar woods on north side of the Greenstone Ridge near Mount Franklin. Not previously reported.

Viola adunca J. E. Smith.[8] Common in rock crevices and rock openings, and passing into *V. adunca* J. E. Smith var. *glabra* Brainerd [8] in the same habitats. It is evident that the material reported by Holt (2) as *V. arenaria* and that by Cooper as *V. labradorica* is *V. adunca* and its variety since Brainerd (6) considered that *V. arenaria* does not occur in the United States, and he cites a specimen collected by Cooper from Isle Royale as an example of *V. adunca* J. E. Smith var. *glabra* Brainerd.

Viola tricolor L. var. hortensis DC. *Pansy.* Persisting as an escape on Birch Island, McCargoe Cove.

[8] Determined by H. D. House.

ELAEAGNACEAE (Oleaster Family)

Shepherdia canadensis (L.) Nutt. Rock opening Rock Harbor, rocks on small island sec. 14, T. 66 N., R. 32 W.; also Cooper (14), no locality or habitat given.

ONAGRACEAE (Evening Primrose Family)

Epilobium angustifolium L. *Fireweed.* Widespread but nowhere abundant. One of the first plants to follow slight fires; also Holt (2), Cooper (14).

Epilobium densum Raf. Sedge mat of bogs, Moose Lake, bog south of Conglomerate Bay section 35; also Holt (2), as *E. lineare* Muhl.

Epilobium palustre L. *Willow herb.* Delta swamp Brady Cove; also Cooper (14), "Sedge zone of bog succession."

Epilobium adenocaulon Haussk. Moist depression on Lake Desor Trail, delta swamp Brady Cove; also Holt (2), Cooper (14), "Rock crevices: Chippewa Harbor."

Oenothera spp. *Evening Primrose.* Gravel beach Grace Harbor, clearing McCargoe Cove. Professor H. H. Bartlett, who examined this material stated, "that it represents three undescribed species which he has had growing in the Botanical Garden. The record of *Oenothera biennis* L. from Isle Royale is erroneous as this species does not occur in Michigan."

Circaea alpina L. *Enchanter's Nightshade.* Widespread in moist woods; also University Party, and Holt (2), Cooper (14).

HALORAGIDACEAE (Water Milfoil Family)

Myriophyllum alterniflorum DC. *Water Milfoil.* Only by Cooper (14) "Tobin Harbor."

Myriophyllum spicatum L. Only by Cooper (14), "Aquatic, Delta Swamp Succession."

Myriophyllum verticillatum L. var. pectinatum Wallr. Only Cooper (14), "Aquatic, Delta Swamp Succession." Sterile material of Myriophyllum spp. was collected in the delta swamps of Tobin Harbor, McCargoe Cove, Brady Cove, shores of Lake Feldtmann, Siskowit Lake, Sargent Lake, and Lake Harvey. It is impossible to determine this positively.

Myriophyllum tenellum Bigel. Aquatic, rooting in the sandy bottom of Lake Feldtmann. Not previously reported.

Hippuris vulgaris L. *Mare's-tail.* Sedge mat of delta swamp, McCargoe Cove, Brady Cove; also Holt (2), Cooper (14).

ARALIACEAE (Ginseng Family)

ARALIA RACEMOSA L. *Spikenard.* Hard maple–yellow birch woods on the Greenstone Ridge, Lake Desor Trail. Not previously reported.

ARALIA HISPIDA Vent. *Bristly Sarsaparilla.* Rock crevices Amygdaloid Island, Passage Island, old burn Blake Point; also Foote, and Holt (2), Cooper (14).

ARALIA NUDICAULIS L. *Wild Sarsaparilla.* Widespread in mixed woods and occasional in rock openings; also Foote, and Ruthven (1), Holt (2), Cooper (14).

OPLOPANAX HORRIDUM (Sm.) Miguel. *Devil's Club.* Shade of balsam-birch woods Smithwick Island, shady, moist, ravine Blake Point, and moist shady woods Passage Island; also Wheeler (54), Cooper (14), "Gull Islands, 7 km. northeast of Passage Island." On Smithwick Island the Devil's Club forms a patch approximately 100 by 30 feet. In this about 100 plants are growing. The average height was nearly 3 feet, although the tallest individual was about 8 feet high and had 16 distinct nodes on the stem. Cooper recorded 200 plants for this area.

At Blake Point the plants are larger, more abundant, and apparently spreading rapidly, now reaching within a half mile of Monument Rock or extending back from Blake Point about 2 miles.

At Passage Island the plants are most abundant, attaining proportions as an undershrub similar to those seen in the State of Washington.

This species is several hundred miles to the east of its general range—Rocky Mountains to California and southern Alaska.

UMBELLIFERAE (Parsley Family)

SANICULA MARILANDICA L. *Black Snakeroot.* Moist ground at head of Rock Harbor, delta swamp Tobin Harbor; also Cooper (14).

OSMORHIZA CLAYTONI (Michx.) Clarke. *Sweet Cicely.* Hard maple–yellow birch woods on Lake Desor Trail. Not previously reported.

OSMORHIZA OBTUSA (Coult. & Rose) Fernald. Widespread in mixed woods. The status of this species for Michigan is very uncertain. Material that K. K. McKenzie determined as *O. obtusa*, Kenoyer (39) considers as *O. divaricata*. Similar material from Isle Royale appears to be *O. obtusa*, as all have the stylopodium and style less than one half a millimeter in length. A specimen collected by Foote is listed under *O. divaricata* by Kenoyer although he discusses it under *O. obtusa*. No mention was made of the pink color of the petals of this specimen which is worthy of being considered a new color form. Also Foote, University Party; determined by Kenoyer as *O. divaricata*.

OSMORHIZA DIVARICATA Nutt. Only by Cooper (14), from "Park Place." Fernald (27) lists this species from Isle Royale.

Cicuta bulbifera L. *Water Hemlock.* Frequent in swamps and bogs; also Holt (2), Cooper (14).

Carum Carvi L. *Caraway.* Clearing at Washington Club. Not previously reported.

Sium cicutaefolium Schrank. *Water Parsnip.* Delta swamp Brady Cove. Not previously reported.

Pastinaca sativa L. *Parsnip.* Clearing at Washington Club; also Holt (2), Cooper (14).

Heracleum lanatum Michx. *Cow Parsnip.* Widespread, not only in clearings but also in the interior of the island; also Holt (2), Cooper (14).

CORNACEAE (Dogwood Family)

Cornus Canadensis L. *Bunchberry.* Widespread in mixed woods and common in rock openings; also M. W. Harrington, and Ruthven (1), Holt (2), Cooper (14).

Cornus circinata L'Her. *Round-leaved Dogwood.* Mount Franklin, top of ridge between Brady Cove and Sargent Lake; also Holt (2), Cooper (14), "climax forest, rare."

Cornus stolonifera Michx. *Red osier.* Widespread on rocky shores, margins of bogs, and delta swamps; also Ruthven (1), Holt (2), Cooper (14).

ERICACEAE (Heath Family)

Chimaphila umbellata (L.) Nutt. *Pipsissewa.* Shady rocks on slopes of Mount Franklin; also Foote, and Holt (2), "dry woods and exposed sunny places as the pine ridge near Sumner Lake", Cooper (14).

Moneses uniflora (L.) Gray. *One-flowered Pyrola.* Widespread in mixed woods; also Foote, and Holt (2), Cooper (14).

Pyrola minor L. *Small Shin Leaf.* Open mixed woods Rock Harbor, not abundant; also Holt (2), Cooper (14).

Pyrola secunda L. *Nodding Shin leaf.* Common in mixed woods; Foote, and Holt (2), Cooper (14).

Pyrola chlorantha Swartz. Mixed woods south shore of Tobin Harbor, dense coniferous woods on trail to Lake Richie; also Foote, University Party, and Holt (2), Cooper (14).

Pyrola elliptica Nutt. Old burn slopes of Mount Franklin, Balsam-Spruce woods Grace Harbor; also Foote, and Cooper (14), "Sedge zone, bog succession near Tobin Harbor."

Pyrola asarifolia Michx. Frequent in open mixed woods Rock Harbor, balsam-spruce woods Grace Harbor; also Foote, and Holt (2), as the "most common of the island pyrolas. Woods"; Cooper (14). The

specimen collected by Foote has been determined by Kenoyer (40) as *P. uliginosa* (equals *P. asarifolia* var. *incarnata*). It appears to the writer to be the species *P. asarifolia* rather than the variety.

Pyrola asarifolia Michx. var. *incarnata* (Fisch.) Fernald. Only by Cooper (14), without data as to locality or habitat.

Monotropa uniflora L. *Indian Pipe*. Widespread in mixed woods; also Foote, and Ruthven (1), Holt (2), Cooper (14).

Monotropa Hypopitys L. *Pinesap*. Not common, mixed woods Chicken-bone Lake, top of Greenstone Ridge between Lake Livermore and Lake LeSage, white birch woods Mount Franklin; also Holt (2), Cooper (14).

Ledum groenlandicum Oeder. *Labrador Tea*. Widespread in shrub zone of bogs; also Ruthven (1), Holt (2), Cooper (14).

Kalmia polifolia Wang. *Pale Laurel*. Widespread in shrub zone of bogs; also Foote, and Holt (2), Cooper (14).

Andromeda glaucophylla Link. *Bog Rosemary*. Abundant in shrub zone of bogs; also Foote, and Holt (2), Cooper (14).

Chamaedaphne calyculata (L.) Moench. *Leather Leaf*. Very common in bogs throughout the island; also Foote, and Ruthven (1), Holt (2), Cooper (14).

Gaultheria procumbens L. *Wintergreen*. Locally abundant in poplar grove northwest of Hay Bay, rare in heath pockets on slopes of Mount Franklin, rocky slope on north side of Angleworm Lake, pine ridge near Sumner Lake according to Mrs. Gertrude Cram. First reported by Kenoyer (40) based on a specimen collected by Mr. J. H. Ely in 1892.

Arctostaphylos Uva-ursi (L.) Spreng. *Bearberry*. Widespread in rock shore crevices, heath mat of rock openings and in the xerophytic forest; also Ruthven (1), Holt (2), Cooper (14).

Chiogenes hispidula (L.) T. G. *Creeping Snowberry*. Widespread in bogs and bog forests; also Ruthven (1), Holt (2), Cooper (14). All the specimens examined had oblong-cylindrical fruits. Gray's Manual gives the fruits as globular.

Vaccinium pennsylvanicum Lam. *Early Blueberry* or *Huckleberry*. Widespread in rock crevices, heath mats and rock openings; also Foote, and Ruthven (1), Holt (2), Cooper (14).

Vaccinium canadense Kalm. *Velvet-leaf Blueberry*. Same hahitat as the last; also Foote, and Cooper (14).

Vaccinium vacillans Kalm. var. crinatum Fernald. Lichen-heath mat rock openings, Rock Harbor and Scovill Point. Not previously reported.

Vaccinium uliginosum L. *Bog Bilberry*. Common in rock crevices, margin or rock pools and occasional in rock openings; also Holt (2), Cooper (14).

Vaccinium Vitis-Idaea L. var. minus Lodd. Only by A. E. Foote in 1868 and has not been collected since. Specimen in the herbarium of the University of Michigan. The report of Kenoyer (40) is based on this specimen.

Vaccinium Oxycoccos L. *Small Cranberry*. Widespread in bogs; also Foote, and Holt (2), Cooper (14).

Vaccinium Oxycoccos L. var. intermedium Gray. Only by Cooper (14), no data concerning habitat or locality.

Vaccinium macrocarpon Ait. *Large Cranberry*. Widespread in bogs; also Cooper (14).

PRIMULACEAE (Primrose Family)

Primula mistassinica Michx. *Mistassini Primrose*. Widespread in rock shore crevices and margins of rock pools; also Foote, University Party, and Holt (2), Cooper (14). Fernald (29) has monographed the Farinosae section of the American primulas. His citation of specimens shows that two species have been collected on Isle Royale. *P. mistassinica*, Aug. 2, 1865, A. H. and C. E. Smith, Cooper No. 55. *P. intercedens* Aug. 2, 1865, A. H. and C. E. Smith, July 1889 J. H. Sandberg. His separation of these is as follows: *P. intercedens* Fernald, "Seeds strongly angulate and truncated, prominently rugose or reticulated: leaves often farinose beneath"; *P. mistassinica* Michx., "Seeds rounded-obovoid, nearly smooth or obscurely linear-reticulated. Leaves green, very rarely farinose."

Considerable difficulty was experienced in determining the material in the field because of the variation in the farinose condition. Plants were seen in the same crevice, side by side, in which none of the leaves was farinose, some with only one leaf or part of a leaf farinose, and others all farinose. This farinose condition is also very variable on certain of the cultivated primulas, and the use of it as a critical character is somewhat hazardous. The mealiness is due to a wax or resinous excretion soluble in alcohol, and after the dissolving of the wax, capitate glands and minute stellate hairs are revealed. These have not been previously mentioned in descriptions.

An examination of the seeds under the low power of a microscope revealed that the seeds from one capsule were highly irregular in shape and varied from triangular, oblong, square, rectangular, rhomboid, to nearly globose in shape. Herbarium material was even more irregular and with conspicuous recticulations which the fresh material did not show. The sunken appearance of the seeds led the writer to soak seeds from herbarium specimens and the Isle Royale collections. The seeds from the herbarium specimens lost their angularity and reticulations,

became plump and resembled those of the Isle Royale collections, especially in the slight reticulated condition of the seed coat.

The variation of the farinose condition of the leaves, the fact that the mealy condition is an excretion which would vary with any slight physiologic condition of the plant, the variation in shape and reticulations of the seeds in one capsule, which will be lost after soaking in water for a short time, leads the writer to consider that *Primula intercedens* Fernald is not specifically distinct from *P. mistassinica* Michx.

Lysimachia terrestris (L.) BSP. *Loosestrife*. Sedge mat of bogs and delta swamps; also Foote, and Holt (2), Cooper (14).

Lysimachia thyrsiflora L. *Tufted Loosestrife*. Margin of bog lakes and bays; also University Party, and Holt (2), Cooper (14).

Trientalis americana (Pers.) Pursh. *Star Flower*. Widespread in bog forest and mixed woods; also Foote, University Party, and Holt (2), Cooper (14).

OLEACEAE (Olive Family)

Fraxinus americana L. *White Ash*. Only by Cooper (14), "Very old burn west of Sumner Lake; bog forest; Lake Eva. Rare."

Fraxinus nigra Marsh. *Black Ash*. Common in swamp on Mount Franklin trail where it forms nearly a pure stand of trees 6 to 8 inches in diameter and with straight clear trunks about 40 feet high. Widespread in moist habitats and in places forming trees with a diameter of 30 to 36 inches; also Ruthven (1), Cooper (14).

Syringa vulgaris L. *Common Lilac*. Cultivated at Belle Isle and Tobin Harbor.

GENTIANACEAE (Gentian Family)

Gentiana linearis Froel. var. latifolia Gray. *Bottle Gentian*. Widespread but not common, margins of bogs, shores of bays, rock crevices. In addition to the normal blue flowers, white and pink color forms were collected. Also Cooper (14).

Gentiana Andrewsii Griseb. Only by Holt (2), "A few specimens from the Siskowit Cabin trail bog. Rare."

Halenia deflexa (Sm.) Griseb. *Spurred Gentian*. Common in moist habitats; also University Party, and Holt (2), as *Tetragonanthus deflexus* (Sm.) Kuntze, Cooper (14).

Menyanthes trifoliata L. *Buckbean*. An important aquatic in the formation of the sedge mat of bogs and delta swamps, widely distributed; also Foote, University Party, and Holt (2), Cooper (14).

APOCYNACEAE (Dogbane Family)

Apocynum androsaemifolium L. *Spreading Dogbane*. Frequent on rock ridges especially near McCargoe Cove, Mount Objibway to Mount Franklin; also Foote, and Holt (2), Cooper (14).

ASCLEPIDACEAE (Milkweed Family)

Asclepias incarnata L. *Swamp Milkweed.* Only by Ruthven (1), "Occasional in the grass and sedge zone along Washington Creek near its mouth."

CONVOLVULACEAE (Convolvulus Family)

Convolvulus spithamaeus L. *Erect Bindweed.* Old burn near Sargent Lake; also Foote, and Cooper (14).

Convolvulus sepium L. var. pubescens (Gray) Fernald. Only by Holt (2), "Nearly bare sides of the Greenstone along the McCargoe Cove trail."

HYDROPHYLLACEAE (Waterleaf Family)

Phacelia Franklinii (R. Br.) Gray. Rock openings Rock Harbor, Pickerel Cove; also Foote, and Beal (4), Holt (2), Cooper (14).

BORAGINACEAE (Borage Family)

Cynoglossum boreale Fernald. *Hound's Tongue.* Old burn on Greenstone Ridge near Mount Franklin, pine ridge near Sumner Lake, along moose trail into Lake Harvey. Not previously reported.

Myosotis laxa Lehm. *Forget-me-not.* Clearing near old lighthouse Rock Harbor. Not previously reported. Not common. Introduced recently.

Myosotis arvensis (L.) Hill. Cultivated at Washington Island. Not previously reported. This species is beginning to spread and may in time become widely scattered.

Mertensia paniculata (Ait.) Don. Margin of beach in Grace Harbor. Not previously reported.

LABIATAE (Mint Family)

Scutellaria lateriflora L. *Mad-dog Skull Cap.* Wet habitats along outlets of Siskowit Lake, Sumner Lake, Chickenbone Lake, Lake Eva, and margin of Sargent Lake; also Holt (2).

Scutellaria galericulata L. *Skull Cap.* Sedge zone of bogs; also Foote, and Holt (2), Cooper (14).

Nepeta hederacea (L.) Trevisan. *Ground Ivy.* Only by Cooper (14), "Clearings."

Dracocephalum parviflorum Nutt. *Dragon Head.* Rock opening Rock Harbor, slopes of Mount Franklin, and top of ridge near McCargoe Cove. Not previously reported.

Prunella vulgaris L. *Self-heal.* Clearings Washington Harbor, Mott Island, Rock Harbor; also University Party, and Holt (2), Cooper (14).

Galeopsis Tetrahit L. *Hemp Nettle.* Clearing, Todd Harbor. Not previously reported.

Satureja vulgaris (L.) Fritch. *Basil.* On rocks near Monument Rock; also University Party, and Holt (2), as *Clinopodium vulgare* L. "Woods on Greenstone along McCargoe trail. Not abundant." Cooper (14).

Thymus Serpyllum L. *Thyme.* Clearing at the head of McCargoe Cove. Not previously reported. First collected by Mrs. J. K. Farley.

Lycopus uniflorus Michx. *Bungle Weed.* Muddy shore of Sargent Lake and sedge mats of bogs; also Cooper (14).

Lycopus americanus Muhl. Along trail from Brady Cove to Sargent Lake, outlet of Lake Feldtmann at Rainbow Cove; also Holt (2).

Mentha arvensis L. var. canadensis (L.) Briquet. *Wild Mint.* Along creek at head of Tobin Harbor, margin of bog Moose Lake; also Holt (2) as *M. canadensis* L., Cooper (14).

Mentha arvensis L. var. glabrata (Benth.) Fernald. Along shore Rock Harbor, Washington Island, margin of sedge mat Moose Lake; also Cooper (14).

SCROPHULARIACEAE (Figwort Family)

Verbascum Thapsus L. *Mullein.* Widely scattered in clearing and rock openings; also Foote, and Cooper (14).

Collinsia parviflora Lindl. Heath mat of rock openings Mount Franklin, trail to Lake Richie, top of ridge near Lake Linklater. Not previously reported.

Scrophularia leporella Bicknell. *Figwort.* Along trail to Lake Desor, and at Lake Desor; also Holt (2).

Chelone glabra L. *Turtlehead.* Sedge mat of bogs, and delta swamps; also University Party, and Cooper (14). The specimen collected by the University Party August 15, 1868, has been determined by F. W. Pennell as variety *linifolia* Coleman, noting that "upper leaves too wide and all leaves too jaggedly cut."

Mimulus ringens L. *Monkey Flower.* Alder thicket along stream, head of McCargoe Cove. Not previously reported.

Veronica americana Schwein. *American Brooklime.* Along trail to Lake Desor, delta swamp Tobin Harbor; also Holt (2).

Veronica officinalis L. *Common Speedwell.* Moist soil along trail to Lake Desor. Not previously reported.

Castilleja pallida (L.) Spreng. var. septentrionalis (Lindl.) Gray. *Paintbrush.* Common in rock opening and rock crevices; also J. H. Sandberg, and Holt (2), Cooper (14).

Melampyrum lineare Lam. *Cow Wheat.* Common in rock openings, burns, and mixed woods; also Holt (2), Cooper (14). This species grades into wide leaved individuals *M. lineare* Lam. var. *latifolium* (Muhl.) Pennell. Represented by collections of Foote and McFarlin on ridge south of Brady Cove.

Euphrasia disjuncta Fernald and Wiegand (31). *Eyebright.* Shady sod ground along shore, Rock Harbor. Not previously reported.

Euphrasia arctica Lange. Rock crevices Scovill Point; also Foster and Whitney (33), Cooper (14).

Euphrasia americana Wettst. Only by Wheeler (54). Specimens reported as this species may represent one of the above.

LENTIBULARIACEAE (Bladderwort Family)

Utricularia vulgaris L. var. americana Gray. *Common Bladderwort.* Only by Cooper (14), "Aquatic: Bog and Delta Swamp Successions."

Utricularia minor L. *Smaller Bladderwort.* Margin of sedge mat of bogs, Sumner Lake; also Holt (2), Cooper (14).

Utricularia intermedia Hayne. Sedge mat of bogs, Hidden Lake, Lake Eva; also University Party, and Cooper (14).

Utricularia cornuta Michx. *Horned Bladderwort.* Sedge mat of bog Hidden Lake, Angleworm Lake, near Scovill Point, and margin of beach pools Passage Island; also University Party, and Cooper (14).

Pinguicula vulgaris L. *Butterwort.* Rock shore crevices, not common; also Holt (2), Cooper (14).

PLANTAGINACEAE (Plantain Family)

Plantago major L. *Common Plantain.* Along trail to Lake Desor and clearings; also Cooper (14).

RUBIACEAE (Madder Family)

Galium Aparine L. var. Vaillantii (DC) Koch. *Lesser Cleavers.* Only by Holt (2), as *G. spurium* L. "Low ground along Washington Creek."

Galium boreale L. *Northern Bedstraw.* Clearing near Washington Club. Not previously reported.

Galium trifidum L. *Sweet-scented Bedstraw.* White cedar swamp north of Siskowit Lake, mixed woods Washington Island and delta swamp McCargoe Cove; also Holt (2), from Sumner Lake and Forbes Lake, Cooper (14).

Galium Claytoni Michx. Sedge zone of bogs, Lake Desor trail; also Cooper (14).

GALIUM ASPRELLUM Michx. *Rough Bedstraw.* Along outlet of Sargent Lake in McCargoe Cove, delta swamp Brady Cove; also Cooper (14), "Sedge zone of bog succession."

GALIUM TRIFLORUM Michx. Widespread in mixed woods, hard maple–yellow birch forest; also University Party, and Holt (2), Cooper (14).

CAPRIFOLIACEAE (Honeysuckle Family)

DIERVILLA LONICERA Mill. *Bush Honeysuckle.* Widespread and abundant in rock openings, old burns, rock shore crevices, and mixed woods; also Foote, University Party, and Ruthven (1), Holt (2), Cooper (14).

LONICERA TATARICA L. *Tartarian Honeysuckle.* Cultivated on Washington Island, and has tendency to escape. Not previously reported.

LONICERA VILLOSA (Michx.) R. & S. var. SOLONIS (Eaton) Fernald (28). Beach at Grace Harbor, swamp near Lake Feldtmann; also Cooper (14), as *L. caerulea* L. var. *villosa* (Michx.) T. & G. from "sedge zone bog succession; head of Siskowit Bay; McCargoe Cove."

LONICERA CANADENSIS Marsh. *American Fly Honeysuckle.* Mixed woods Washington Island, along Lake Desor trail; also Foote, and Ruthven (1), Holt (2), as *L. ciliata* Muhl., Cooper (14).

LONICERA OBLONGIFOLIA (Goldie) Hook. *Swamp Fly Honeysuckle.* Only by Ruthven (1) "In the Slope forest, sec. 32, T. 64 N., R. 38 W. (Macduff)."

LONICERA INVOLUCRATA (Richards) Banks. Mixed woods south shore of Tobin Harbor, Mott Island; also Foote, University Party, and Holt (2), Cooper (14).

LONICERA HIRSUTA Eaton. *Hairy Honeysuckle.* Margin of Sargent Lake, White cedar swamp McCargoe Cove, island in sec. 14, T. 66 N., R. 34 W; also Holt (2), Cooper (14).

LONICERA GLAUSCESCENS Rydb, Frequent in rock openings, and along rock shores; also Foote, University Party, and Holt (2) as *L. dioca* L. which could be very easily mistaken for this species, Cooper (14).

SYMPHORICARPOS RACEMOSUS Michx. var. PAUCIFLORUS Robbins. *Snowberry.* Common on the Greenstone Ridge from Mount Objibway to Monument Rock, Lighthouse Point, trail to Lake Richie; also Cooper (14), Ramson Clearing."

LINNAEA BOREALIS L. var. AMERICANA (Forbes) Rehder (23). *Twinflower.* Widespread in a variety of habitats, apparently absent or rare in the hard maple–yellow birch woods; also University Party, and Ruthven (1), Holt (2), Cooper (14).

VIBURNUM OPULUS L. *Highbush Cranberry.* Only by Ruthven (1), "In the tamarack and spruce woods, and about the shores of the islands in Lake Desor."

VIBURNUM PAUCIFLORUM Raf. *Squashberry.* Widespread in moist habitats; also University Party and Ruthven (1), Holt (2), Cooper (14). It is more abundant on Passage Island where it has not been browsed.

SAMBUCUS CANADENSIS L. *Common Elder.* Only by Holt (2) "Lighthouse clearing at Rock Harbor." A careful search in this localty failed to locate this species.

SAMBUCUS RACEMOSUS L. *Red-berried Elder.* Scattered in mixed woods, edge of coniferous woods Smithwick Island; also Foote, and Holt (2), "as *S. pubens* Michx". "Along Siskowit portage. Fairly common", Cooper (14).

CUCURBITACEAE (Gourd Family)

ECHINOCYSTIS LOBATA (Michx.) T. & G. *Wild Cucumber.* Only by Cooper (14), "Sandy shores and clearings."

CAMPANULACEAE (Bluebell Family)

CAMPANULA ROTUNDIFOLIA L. *Bluebell.* Abundant throughout the island in rock shore crevices, rock openings and on old burned ridges; also Foote, and Ruthven (1), Holt (2), Cooper (14).

CAMPANULA ULIGINOSA Rydb. Sedge zone of bogs and delta swamps; also Cooper (14).

CAMPANULA APARINOIDES Pursh. Only by Foote, and Holt (2), "Common in wet bog margins of Sumner Lake, and Forbes Lake."

LOBELIACEAE (Lobelia Family)

LOBELIA SPICATA Lam. *Pale Spiked Lobelia.* Only by Ruthven, (1), "In rock crevices on the Minong Trap promontory." (Sec. 30, T. 64 N., R. 39 W.)

LOBELIA KALMII L. Rock shore crevices and margins of bogs; also Foote, and Holt (2), Cooper (14).

LOBELIA DORTMANNA L. Widely distributed although not common in the lakes and bays, Siskowit Lake, Sargent Lake, Forbes Lake, head of Rock Harbor; also Foote, and Beal (4).

COMPOSITAE (Composite Family)

EUPATORIUM PURPUREUM L. *Joe-Pye Weed.* Only by Ruthven (1), "Among the sedges along Washington River", Holt (2), "upper end of Rock Harbor", and Cooper (14).

EUPATORIUM MACULATUM L. (52). Delta swamp Tobin Harbor, swamp near Rainbow Cove, shore of Chickenbone Lake; also Cooper (14) as the variety of the above. The specimens from Tobin Harbor and Chickenbone Lake approach variety *foliosum* (Fernald) Wiegand.

Solidago hispida Muhl. *Goldenrod.* Widely distributed in rock shore crevices and rock openings; also Cooper (14).

Solidago humilis Pursh. (21). *Bog Goldenrod.* Sedge mat of bogs, Passage Island, Hidden Lake, Lake Eva; also Holt (2), Cooper (14).

Solidago speciosa Nutt. Rocky ridge along trail into Lake Richie from Rock Harbor. Not previously reported.

Solidago Randii (Porter) Britton. Rock shore crevices, near old Lighthouse; also Holt (2), as *S. virgaurea* L. var., "Rock crevices, and thin soil on rocks and rock islands" same locality.

Solidago juncea Ait. *Early Goldenrod.* Rock openings, Rock Harbor, Mount Franklin trail; also Holt (2), Cooper (14).

Solidago nemoralis Ait. Rock opening near Chickenbone Lake, ridge near old mines McCargoe Cove, ridge with oak northeast of Angleworm Lake; also Cooper (14).

Solidago canadensis L. *Canada Goldenrod.* Margin of delta swamp head of McCargoe Cove; also Foote, and Cooper (14).

Solidago altissima L. Only Cooper (14), "Clearing: Duncan Bay."

Solidago graminifolia (L.) Salisb. Sandy beach on the northeastern end of Chickenbone Lake; also University Party, and Ruthven (1), as *Euthamia graminifolia* (L.) Nutt., Cooper (14).

Aster macrophyllus L. *Large-leaved Aster.* Most abundant aster on the island in a variety of habitats, chiefly old burns, mixed woods, and rock openings. Important as ground cover in the mixed woods. Also Foote, and Holt (2), Cooper (14).

Aster modestus Lindl. Rocky shore of Siskowit Lake. Not previously reported. Determined by M. L. Fernald.

Aster Lindleyanus T. & G. Very widespread in rock openings, and mixed woods, near Sargent Lake, head of McCargoe Cove, old burn Passage Island, north shore of Lake LeSage, and Rock Harbor; also Cooper (14).

Aster lateriflorus (L.) Britton. Rocky shore, Siskowit Lake. The species has not been previously reported.

Aster lateriflorus (L.) Britton var. hirsuticaulis (Lindl.) Porter. Only by Holt (2), "Woods along Washington Creek; one locality only."

Aster Tradescanti L. Old burn on top of Greenstone Ridge between Todd Cove and Siskowit Lake. Not previously reported.

Aster junceus Ait. Only by Holt (2), "On thinly soil-covered rock surfaces. Rock Harbor"; Cooper (14), "Sedge zone, Bog succession: McCargoe Cove."

Aster puniceus L. Widely distributed in moist depressions and delta swamps, McCargoe Cove, head of Rock Harbor, near Siskowit Lake; also Cooper (14).

Aster umbellatus Mill. var. pubens Gray. Widely distributed in delta swamps, sedge mat of bogs; also Cooper (14).

Aster ptarmicoides T. & G. Rock shore crevices, near Old Lighthouse; also Holt (2), Cooper (14).

Erigeron canadensis L. *Horse-weed.* Clearings and old burns; also Foote, and Cooper (14).

Erigeron acris L. var. asteroides (Andrz.) DC. Clearing on Passage Island; also Foote, University Party, and Porter (43), Wheeler (54) as *E. acris* var. *droebachensis* (Müll.) Blytt., Cooper (14).

Antennaria neodioica Greene. Rock shore crevices, rock openings, rocky ridges, clearings; Washington Harbor, Rock Harbor; also Foote, and Cooper (14).

Antennaria plantaginifolia (L.) Richards (?). Rock opening, Rock Harbor. Only basal leaves were found.

Anaphalis margaritacea (L.) B. & H. *Pearly Everlasting.* Widely distributed in rock openings, former burns, and mixed woods; also Foote, and Holt (2), Cooper (14).

Gnaphalium decurrens Ives. *Cudweed.* Scattered in rock openings near Scovill Point, top of ridge near McCargoe Cove; also in 1868, collector not given, and Cooper (14).

Ambrosia psilostachya DC. *Ragweed.* Only by Cooper (14), "Clearing: McCargoe Cove."

Rudbeckia hirta L. *Black-eyed Susan.* Widely distributed in clearings and rock openings, although not common: also Holt (2), Cooper (14).

Bidens comosa (Gray) Wiegand. *Stick-tight* (19). A very depauperate specimen growing in the sedge mat of the delta swamp, Brady Cove. Not previously reported.

Bidens Beckii Torr. *Water Marigold.* Only by Cooper (14), "Delta streams: Duncan Bay."

Achillea Millefolium L. *Yarrow.* Widely distributed in rock shore crevices and rock openings; also Cooper (14). The margins of the bracts vary from snuff brown to black, others are all black, rays are too small to be *A. borealis* Bongard. Examination of herbarium specimens shows that the more northern specimens from Michigan have darker color on the margin of the bracts.

Matricaria suaveolens (Pursh) Buchenau. Clearing in fishing camp at Amygdaloid Island, Caribou Island, Rock Harbor. Not previously reported. Previously collected in Michigan at Laurium, Houghton Co., by F. H. Hermann.

Chrysanthemum Leucanthemum L. *Daisy.* Widely distributed in clearings, rock openings, and old burns; also Cooper (14).

Tanacetum vulgare L. *Tansey.* Birch Island, McCargoe Cove, near old mine, head of McCargoe Cove; also Cooper (14).

Artemisia canadensis Michx. *Wormwood.* Rock shore crevices, Mott Island and Old Lighthouse Point, Rock Harbor; also Holt (2), Cooper (14).

Petasites palmatus (Ait.) Gray. *Sweet Coltsfoot.* Widely distributed in bog forest and shady mixed woods; also Cooper (14).

Senecio Balsamitae Muhl. *Ragwort.* Widely distributed in rock shore crevices, rock openings, and mixed woods; also University Party, and Holt (2), Cooper (14).

Senecio discoideus (Hook.) Britton. Margin of rock opening Mott Island, mixed woods Rock Harbor; also Wheeler (54).

Articum minus Bernh. Fishing camp Caribou Island, clearing near old mines, McCargoe Cove; also Cooper (14).

Cirsium discolor (Muhl.) Spreng. *Thistle.* Old burns, Lake Richie, and Lake Feldtmann. Not previously reported.

Cirsium muticum Michx. *Swamp Thistle.* Margin of brook at the base of the north slope of Mount Franklin, NE¼, sec. 12, T. 66 N., R. 34 W. Not previously reported.

Cirsium arvense (L.) Scop. *Canada Thistle.* Widely distributed in clearings and rock openings. A white-flowered form of this species was found on the clearing opposite Birch Island, McCargoe Cove; also Cooper (14).

Tragopogon pratensis L. *Goat's Beard.* Clearing at Washington Club. Not previously reported.

Taraxacum officinale Weber. *Dandelion.* Widely distributed in rock shore crevices, clearings, and rock ridges; also Cooper (14).

Sonchus arvensis L. *Cow Thistle.* Rocky beach of Siskowit Lake. Not previously reported.

Lactuca canadensis L. *Wild Lettuce.* Old burn, head of Tobin Harbor, along Lake Desor Trail, rocky slope near Lake Eva; also Cooper (14).

Lactuca puchella (Pursh) DC. Old burn Sargent Lake, Greenstone Ridge near Chickenbone Lake; also Holt (2), Cooper (14).

Lactuca villosa Jacq. Only by Cooper (14), "Clearing: Rock Harbor."

Lactuca spicata (Lam.) Hitchc. Shade, Sargent Lake. Not previously reported.

Prenanthes racemosa Michx. *Rattlesnake-root.* Along shore, Rock Harbor; also Holt (2), Cooper (14), "Rock shore crevices and margins of rock pools; sand beaches."

Prenanthes alba L. Rock shore crevices Washington Island, shade Sargent Lake; also Holt (2) as *Nabulus alba* (L.) Hook., Cooper (14).

HIERACIUM SCABRUM Michx. *Hawkweed.* Old burn near Sargent Lake; also Cooper (14).

HIERACIUM UMBELLATUM L. Only by Holt (2), "On rocks or in rock crevices, in the vicinity of Siskowit Bay", Cooper (14), "Rock shore crevices, bare burned ridges, and burn forest."

HIERACIUM CANADENSE Michx. var hirtirameum Fernald. Old burn near Sargent Lake, rock openings Rock Harbor; also Foote, and Fassett (Rhodora 28:246.1926) based upon a specimen collected by Stuntz and Allen.

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