THE BOG SITUATION IN NORTHERN MICHIGAN

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July, 1947

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INTRODUCTION

The study of bogs was carried out by the class in Plant Ecology under the direction of Dr. F. C. Gates at the University of Michigan Biological Station, Douglas Lake, Cheboygan County, Michigan, during the summer of 1947.

In the area near Douglas Lake in northern Michigan, six bog areas were studied as to their formation, depth, drainage, present and former types of vegetation, and possible future developments.

LOCATION AND HISTORY OF AREAS

All of the bogs studied are in Cheboygan County. Bryant's Bog is very near the south shore of Douglas Lake, about three miles west of the Biological Station camp. Livingston's and Nichol's Bogs are close together and not far from a highway running east from the north end of Burt Lake. Smith's Bog is about a mile and a half southeast of the Station camp. Mud Lake and Bog are about two and a half miles north of Riggsville corners and about six miles from the camp. The "Larix" area is along the southeast side of the Cheboygan-Levering Road, north of Mud Lake. The map, Figure 1, shows these areas.

The glaciation of earlier geological times accounts for the formation of most of these bogs. The vegetation in and around them is quite varied as this region is in a transition belt between the northeastern coniferous and central deciduous ecological provinces.

About 30% of the Douglas Lake region was originally bog area and about 14% was covered with water. There has been little change in the total acreage of these two areas, although in small part the water area has been reduced by the encroachment of bog vegetation and in some places the effect of fire has been to change bog vegetation to that typical of somewhat drier areas.

CLIMATE

Various climatic factors of the Cheboygan area were outlined in a previous paper on the Aspen Association in the Douglas Lake region. Table 1 in the appendix to this paper is a summary of Meteorological data for Cheboygan, compiled by the United States Weather Bureau.

Freezing and thawing in this temperate climate have some noticeable effect on the development of some bog areas. Occasionally a very wet season or a very dry, hot season will affect the bogs, causing such changes as fluctuations in mat level or the depth of the false bottom below the surface of the water.

SPECIAL FACTORS

The basic material underlying most of the bog areas is sand. Sometimes, as in Bryant's Bog, other layers of this material are to be found at higher levels. These are doubtless due to erosion of nearby sandy hills.

Some of the bogs [illegible] clay, [illegible]

Some of the bogs are also underlain with a layer of blue clay, often found with shells of the Pleistocene period imbedded. This seems to be associated with the pH factor of the water, which in turn may influence the development of a false bottom of colloidal mud. Lakes with a blue clay bottom are always alkaline and always have some colloidal mud.

The depressions forming the bog areas are mainly of glacial origin, some of them being "kettle holes" with a typical marginal fosse formed by the alternate freezing and thawing of the glacial ice as it gradually disappeared.

Fire has affected most of these bog areas to some extent. In some cases it has destroyed most of the mat as in the 1916 fire in Smith's Bog. In Reese's Bog fire was responsible for the former presence of the Aspen Association as a step in the vegetative succession.

GENERAL CONSIDERATION OF REGION

A partial description of the region around Douglas Lake was given in the paper on the Aspen Association. It is quite hilly and has many bogs and lakes. Some of the bogs are connected with other bogs or lakes by small streams. In some cases the drainage, if any, seems to be subterranean.

Most of the bog areas are partly covered with tree growth, although Nichol's Bog has none. There is quite a dense growth in Livingston's, Bryant's and Reese's Bogs and parts of Mud Lake Bog.

METHODS

The methods used in the bog studies were similar to those used in the Aspen work. (See paper on "The Sandy Upland Aspen Association in the Douglas Lake Region.) Tree counts, line-interception and list quadrats were used to obtain most of the data. For one area count quadrats were taken. This method consists in listing all the species of plants found in one-square-meter areas together with the total number of each species found in the quadrats.

FIELD WORK

Smith's Bog

In the Carex lasiocarpa Association of Smith's Bog, culms of the Carex were counted in two strips each 10 meters long and 0.1 meter wide and 25 list quadrats were taken. The diameter of Carex lasiocarpa stems at water level was measured by four groups, two working in almost pure Carex and two working where other invasions have taken place. Each group measured 200 or more culms. The number of stems was also counted by two groups in areas 10.7 meters x 0.1 meter and 10 meters x 0.1 meter, respectively. These two areas were those where Chamaedaphne and Salix pedicellaris have established themselves.

Bryant's Bog

The line-interception method was used in five lines, each five meters or less in length, in the Nemopanthus consocies of the high bog shrub association in Bryant's Bog. All interceptions for one centimeter of width along this line were measured one centimeter above the ground. Interceptions were also measur-

ed at low shrub, Chamaedaphne, high shrub and tree levels. Observations were made on other vegetation of the area.

Livingston's Bog

Line-interceptions were measured in the Chamaedaphne near the lake in Livingston's Bog, three five-meter lines along the lake margin and two five-meter lines in an area about 100 feet away from the lake.

Peat samples were taken here and at Mud Lake. Two types of peat samplers were used to determine the thickness of the mat. One of these samplers would take either very wet or firm samples, but the Davis type would take only firm samples. The Davis sampler, however, proved very useful in determining the depths of the lowest peat layers. The samples taken were for a student who was not a member of the class, so they were not studied in detail.

"Larix" Area and Reese's Bog

The vegetation in the Larix association was studied along five five-meter lines at right angles to the Levering- Cheboygan Road.

In the western part of Reese's Bog, in an Abies-Picea association, a tree count was taken in five two-meter strips 31.6 meters long, and count quadrats were taken by five groups for five quadrats each at five-meter intervals.

DESCRIPTION OF SUBAREAS

Smith's Bog

Description

This bog is an open area which was in earlier times surrounded by beech-maple forest with Thuja next to the water. In 1911 there was high water filling all the now-open part. In 1916 a student engineer from a nearby camp set fire to the woods and burned not only the woods but also the Sphagnum ring encircling the bog lake. As this Sphagnum ring had been holding up the water and has not redeveloped, the water level dropped considerably at the time of the fire and has been receding ever since. There is now only a small strip of open water remaining.

Following the first fire the lake margin was revegetated with the Carex lasiocarpa association, the beginning of the mat. This was again partly destroyed by another fire in 1921. This association is now being further restricted by the invasion of shrubs such as Chamaedaphne calyculata on the lower level and the Salix pedicellaris consocies of the high bog shrub association on a higher level.

At one place out in the bog about 100 feet from the south east edge, a small area vegetated mainly by Calamagrostis sp., Andromeda glaucophylla, and Chamaedaphne calyculata was examined. It was learned that this "island" of the Chamaedaphne association in the mat of the Carex association was formed by the pushing out of a large log, carrying a variety of plants, onto the ice one winter. (See diagram, Figure 2.)

This bog area has rather slow drainage in two directions, to the east thru Riggsville Bog to Nigger Creek and thence to Mullett Lake and to the south underground via Fontinalis Run to Burt Lake.

At the lower end of the bog, where the water goes underground, there is a small area of lowland forest. Formerly the water came well into these woods and here are to be found several black ash, Fraxinus nigra, with the large swollen bases that are typical of trees growing in water. Ulmus americana is another common species in this lowland forest.

Associations

1. Carex lasiocarpa Association

Smith's Bog has the best example of this association to be found in this region. Figure 3 shows a similar Carex mat at another bog. The dominant species is the Carex lasiocarpa, which at a distance appears to cover the ground but on closer inspection is seen to form only a very thin cover at ground level.

Other characteristic plants are Carex stricta, with broader leaves than C. lasiocarpa, Dulicheum arundinaceum, Hypericum virginicum and Lysimachia terrestris. Salix pedicellaris is invading this association, as is shown by the data in Table 2 of the Appendix.

2. Salix pedicellaris Consocies of the High Bog Shrub Association

In this consocies the Salix pedicellaris, a willow common in wet places in northern Michigan, is dominant. Chamaedaphne calyculata is common at the low shrub level and Carex lasiocarpa is the common ground plant. As is shown by Table 2, the Carex is being modified and gradually replaced by the Salix.

Bryant's Bog

Description

This bog is a rather small area of the "kettle hole" type, showing a marginal fosse in some parts. This fosse is a depression around the outer edge of the mat which has become partly filled with soil.

The level of the small lake in the middle of this bog, Figure 4, is always above the water level of Douglas Lake due to the Sphagnum ring which surrounds it. A study of the bottom of the lake with a Davis peat sampler has shown that its greatest depth is 67 feet. This depth is exceeded by only one place in Douglas Lake and only one place in Burt Lake.

Along the west side of the bottom, five layers of sand alternating with the peat have been found. Also some logs four feet in diameter have been found buried under the accumulation of organic materials. These would seem to indicate that some very powerful forces had influenced this bog and its vegetation in past ages.

The top layers of peat in Bryant's Bog show the presence of pollen from hardwood trees while the lower layers contain conifer pollen only. This indicates that some time ago, possibly 800 to 1000 years, the vegetation was almost entirely coniferous.

Tests of the open water of this lake show that it has a pH of about 7, which is alkaline.

Recent History

Bryant's Bog has a false bottom, an accumulation of organic materials which is built up quite rapidly in hot, dry years. In 1916 and 1921 there was a good deal of filling going on. At about that time it was predicted that the lake would fill up in approximately 15 years. However, the anthropeic factor has intervened, collectors breaking down the Carex mat around the edge and leaving a border of Chamaedaphne, which works more slowly. The diagram, Figure 5, shows the changes in shore line from 1911 to 1936 and indicates the slowing down of mat development in recent years.

There is now much Sphagnum from the margin of the lake back to the Nemopanthus and tree areas, which are slowly moving in toward the lake margin. It was observed that the Picea mariana of the tree association here is being destroyed by a parasitic plant, Arceuthobium pusillum, which causes the branches of the trees to form "witch's brooms" and eventually kills the whole tree. It was also noted that the Carex lasiocarpa, which formerly formed the edge of the mat, has entirely diasppeared.

Associations

At least three different plant societies are evident in Bryant's Bog, the Chamaedaphne association, the Nemopanthus consocies of the high bog shrub association, and the Abies-Picea association. Special study was made of the Nemopanthus consocies only. (See diagram, Figure 5.)

Nemopanthus Consocies of High Bog Shrub Association

This consocies is dominated by Nemopanthus mucronata, a shrub six to ten feet high, preferring wet places; This shrub covers about 89% of the area studied. The consocies can be further characterized by stating that there are shrubs at two other levels, but the ground cover consists almost entirely of mosses.

Chamaedaphne calyculata and Gaylussacia baccata are fairly common shrubs with Vaccinium pennsylvanicum and V. canadense below them. There is much Sphagnum and other mosses are plentiful, but very few forbs are to be found. It is highly probable that the dense shade produced by the shrubs at three levels accounts for this situation, which is shown by the data in Table 3, Appendix.

Livingston's Bog

Description

In general appearance this bog resembles Bryant's Bog quite a bit. There is a small lake surrounded by the Chamaedaphne association into which the typical bog trees are coming. This bog area is a narrow strip with hardwoods on either side. It seems to be part of the same depression that forms Nichol's Bog, but the two parts are separated by a sandy ridge.

The bottom of Livingston's Bog has not been studied as extensively as has that of Bryant's Bog. The deepest part measured shows a depth of about 40 feet down to sand. The false bottom is fairly well developed.

Peat samples were taken in an area near the lake where the depth of the mat was found to be about 15 feet. Another measurement was taken about 100 feet back from the lake in the direction of Nichol's Bog. (See Map, Figure 1) Here the mat is $12\frac{1}{2}$ feet deep. There is sand beneath the peat.

Associations

At Livingston's Bog the Chamaedaphne association was studied in particular. In this association the Chamaedaphne calyculata is the dominant species, showing 442 occurrences in 25 meters of line-interception at ground level, and a total of 24,130 mm. cover at the higher level reached by these shrubs. Chamaedaphne calyculata is shrubby with leathery leaves and is common in most of the low, wet areas of northern Michigan. Its stems grow quite close together and a fairly dense shade is produced by the leaves. This shrub will grow right out to the edge of the mat or back in the firmer parts of the bog.

Two other shrubs frequently found with Chamadaphne but in fewer numbers are Andromeda glaucophylla, a slender shrub about the height of Chamaedaphne bearing bluish green leaves that are light underneath, and Kalmia polifolia, whose leaves are thinner and more yellow-green than either of the others. Ledum groenlandicum, with its brown wooly undersurface of the leaves, is also found with these shrubs, although it appears to be more characteristic of the tree associations in bogs.

At a lower level Vaccinium pennsylvanicum is characteristic. Sphagnum sp. covers much of the ground. Table 4 gives the data obtained in the study of this association.

Nichol's Bog

This is a small bog area which is part of the depression forming Livingston's Bog. Because this bog is part of a field which has been cultivated or pastured for many years, it does not show the normal development expected in a bog. Algae and water lilies grow in the open water, which is weakly acid. (pH- 5) Around the pond are some Carex, some Scirpus atrocinctus and a few Chamaedaphne shrubs, but no high shrubs nor trees.

Mud Lake Bog

Description

Mud Lake with Blanchard and Carp Lakes form a series made by the widening of a small stream, which ultimately flows into Lake Michigan. The false bottom is well developed in Mud Lake, sometimes being five or six feet below the surface, but in warm, dry years coming to the surface over a large part of the lake. (See Figure 6) It will be noted that this false bottom in dry years will support many of the birds, who run about on it, and will support many plants for growth. The blue-green algae contribute much toward the formation of the false bottom. Nymphea odorata is quite common in the open water of the lake.

The pH of the water here is 7, although tests have shown that this varies quite a bit, particularly along the lake margin where the various mateplants exert their influence. In the Sphagnum, for example, the pH is usually 3.

Some of the shore of this lake is being built up while other parts are broken off by ice action and drift to the opposite shore where they help to build it up. Along the southeastern part of the lake, the shore is in the process of building up. The mat there has a good deal of Carex lasiocarpa with masses of Chamaedaphne calyculata scattered thru it.

Much of the rest of the shore is bordered by Chamaedaphne, although there are some places where the tree associations come practically to the water's edge. Figure 7 shows some of this border as well as the portion of the margin that is being rapidly built up.

East of Mud Lake is quite a large open area, covered with Sphagnum and some shrubs, and dotted with what appear to be small islands covered with Picea mariana. In reality these are each a depression in the middle of which is, or was, a large Picea mariana, whose lower branches have reproduced by layering. Some of the smaller trees thus formed have in turn produced what resembles a third generation of small Picea mariana trees. Some of the original trees in these clumps, Figure 8, have been destroyed by the same parasite observed at Bryant's Bog, the Arceuthobium pusillum. This parasite has sticky seeds which may possibly facilitate their spread by birds.

In this more or less open area there are some places where the mat seems lower and wetter than the rest. These low spots have Nymphea odorata in a modified form growing in them. Other typical plants growing in the Sphagnum are Calopogon pulchellum, Drosera rotundifolia, D. longifolia, Sarracenia purpurea, and Vaccinium oxycoccus. Some shrubs other than the Chamaedaphne are Alnus incana and Viburnum cassinoides.

Figure 9 shows a peat sampler being used to measure the depth of the mat not far from the lake in this open area. For several years in the 1920's this depth was stabilized at 10.5 feet. Then high water caused the mat to rise, since which time the depth has fluctuated between 10.5 feet and 12.7 feet. The measurement for this year is 11.1 feet. A layer of blue clay with fossil shells underlies the peat.

Surrounding the lake, at some places near its margin, at others back of the Sphagnum and Chamaedaphne areas, is a border of trees. The Picea association is most common, with some invasion of Thuja occidentalis occurring.

"Larix" Area

In an area southeast of the Cheboygan-Levering Road, (Map, Figure 1, Area L) a study of the Larix association was made. Here Larix laricina, the dominant tree species, covers about 83% of the area at tree level. This species prefers low, wet areas and is the only native conifer of Michigan to shed its leaves every year.

The data obtained (Table 5) indicates that considerable undergrowth characterizes this association, but it will be noted that no young Larix trees were found.

At the high shrub level, Cornus stolonifera shows most frequent occurrence. There are also some Betula glandulifera, Lonicera oblongifolia and Salix discolor at this level. Osmunda regalis and Rhamnus alnifolia are characteristic at the low shrub level. Here the Chamaedaphne, Andromeda and Ledum in small numbers together with an occasional Vaccinium oxycoccus at ground level, appear as relics of the Chamaedaphne association preceding the Larix.

Among the ground plants Carex trisperma is the characteristic sedge, Osmunda regalis the characteristic fern, while Rubus triflorus, Maianthemum canadense, Mitella nuda, Pyrola chlorantha, P. secunda, Habenaria hyperborea, Galiums, Asters and others make a fairly complete ground cover. Mosses are common but there is little Sphagnum. Table 5 gives a summary of occurrences and millimeters of line-interception of all species found in this association.

Reese's Bog-- Young's Growth Plots

This area is located at the north end of Burt Lake and has been established as an area in which tree growth is being studied. (Map, Figure 1, Area Y)

When white men first came to the head of Burt Lake they found the area covered with Thuja forest. This was lumbered off and much of the area burned. Replacement with forests has been rapid, the present trees being no more than 70 years old but providing quite a dense forest cover.

The soil in these growth plots is Rifle peat underlain with sand at a depth of one to 1.8 meters. Because of the constant water supply, rooting is shallow in this bog.

The vegetation in Reese's Bog illustrates an intermediate stage between the Picea- Abies and Thuja associations. The dominant species now is the invader, Thuja occidentalis, which makes up 54 % of the trees counted. Abies balsamea, comprising 31%, and Picea mariana, 6% of the trees, are being crowded out by the Thuja. Young of all three of these species are well represented in the ground vegetation.

As the characteristic deep shade of a Thuja association has not yet fully developed, a great number and variety of ground plants were found in the count quadrats taken. Table 6 gives a summary of tree and quadrat counts.

Taxus canadensis, a low evergreen shrub, is common. Among other ground plants Gaultheria procumbens, Aralia nudicaulis, Aster macrophyllus, Clintonia borealis, Coptis trifolia, Smilacina trifolia, Mitella nuda, Polygala paucifolia, Trientalis americana, and Pyrola secunda are characteristic. Several sedges are to be found, among them Carex leptalea and C. trisperma. Equisetum scirpoides is also frequent.

Among the Sphagnum and other mosses growing here are two small vines, Chiogenes hispidula, found in all the quadrats counted, and Linnea borealis, found in 80% of the quadrats. These small plants seem to prefer low, wet places where there is a moderate amount of light.

DISCUSSION AND CONCLUSIONS

The study of the various bog areas near Douglas Lake in northern Michigan shows several factors influencing the development of plant associations in bogs.

Primarily a bog is typified by the presence of a mat, which may also be accompanied by a false bottom in the bog lake or pond. The mat may be formed by any one of several types of plants or by various combinations of these. Often

the earlier stages of mat formation are brought about by a Carex lasiocarpa association, such as that studied in Smith's Bog. On the other hand, a Carex mat is easily destroyed by anthropeic factors, such as breaking up by collectors, or by climatic factors such as ice action. Other plant associations then take over mat formation.

The Chamaedaphne association is a common plant society around the margins of bog lakes. It may develop after the Carex association has been destroyed or it may invade the Carex and crowd it out. Chamaedaphne, Andromeda, Kalmia, Ledum and the many species of Sphagnum play a large part in mat building, the result being a deposit of peat in which other plant associations may become established and in which well-preserved remains of previous vegetation may be found and studied.

Among the many possible variations of the High Bog Shrub association, the Salix pedicellaris consocies in Smith's Bog illustrates the way in which this association may invade the Carex mat when it becomes firm enough for the shrubs to grow upon. The Carex mat may thus be broken, modified or destroyed by the high shrubs.

The Nemopanthus consocies of Bryant's Bog illustrates another plant society which may replace either the Carex or the Chamaedaphne association in the mat. Sphagnum and other mosses still thrive under this situation, although most other ground plants cannot survive in the dense shade.

Chamaedaphne or High Bog Shrub associations may in turn be replaced by trees as the building up of the mat continues. In some of the drier, more shallow places the Aspen association may be the first of the tree societies , as was the case in the western part of Reese's Bog following a fire. More commonly, however, the Larix association invades the shrub associations.

The natural sequence is for the Aspen or Larix associations to be invaded and replaced by the Picea-Abies association if the ground remains wet, or by the Pine association if the area becomes somewhat higher and drier. In general, however, in areas which remain true bogs, the Larix is followed by Picea-Abies and then by the Thuja association.

Although the various possible steps in a bog succession are well illustrated in the other bog areas studied, the most advanced stage is to be found in the Young Growth Plots in the western part of Reese's Bog, where the vegetation is approaching the climax of this succession. This area furnishes indications of having gone thru a typical bog succession in these ways: (1) In earlier days a fosse could be clearly seen at the north edge of the area indicating the glacial origin of the bog. (2) A mat developed along the edge of the lake; some remnants of a Carex association have been found.(3) A great variety of bog vegetation has developed here. (4) A few characteristic plants of the Aspen association and a number of those found in a Larix association are still to be found here. (5) The Picea- Abies association is still very evident with its characteristic species. (6) The ascendancy of the Thuja association means that the end of the bog succession, its climax, is not far off.

While this succession of plant associations has been going on in the bogs, the area of open water in the lake or pond has been reduced by the extension of the mat, the development of the false bottom and filling. Thus the tendency is toward the extinction of the lake.

When the filling and covering has been completed and the vegetation has reached a climax, the bog assumes a stable aspect. Due to the poor drainage which originally caused the bog, there is likely to be an ample supply of moisture, so the vegetation thrives and continues to produce organic deposits.

Although bog areas have sometimes been artificially drained and put under cultivation, it would seem that their greatest value, at least in the northern Michigan region studied, might be derived by maintaining them as bogs in the normal, natural state. They form good game cover and act as reservoirs for reserve water supplies. As the greatest hazards to bog areas are fire and other disturbances by man, it would be good policy to protect them from fire and other anthropeic factors which tend to disrupt their normal function and development.

SUMMARY

1. The work described in this paper was done as class work in Plant Ecology at the University of Michigan Biological Station at Douglas Lake, Cheboygan County, Michigan, in July, 1947.

2. Bogs are formed in depressed areas where the drainage is so poor that lakes are formed and then slowly filled up and covered over by the growth of vegetation in a mat.

3. The climate of northern Michigan favors the growth of trees, which are important in the normal development of bog vegetation.

4. Many plant associations may contribute toward the extinction of a bog lake. Among them are Carex lasiocarpa, Chamaedaphne, High Bog Shrubs (manifested in various consocies), Larix, Picea-Abies, and Thuja associations.

5. The Carex lasiocarpa association is an effective mat former, but is easily destroyed. The Chamaedaphne association is important in peat formation.

6. A normal succession in bog vegetation may begin with the Carex association, be followed by the Chamaedaphne association, any one of the consocies of the High Bog Shrub association, the Larix association and the Picea-Abies association, to come to a climax in the Thuja Association. Several other sequences are possible.

7. Ultimately the bog lake is extinguished by the action of the mat vegetation and by filling. Stability comes with the vegetative climax.

8. Bog areas should be protected from fire and other anthropeic factors to allow them normal development as natural reservoirs and game areas.

A-

ANNOTATED SPECIES LIST
(Exclusive of species listed in Aspen association.)

Agrostis capillaris	Grass of bog areas.
Andromeda glaucophylla	Frequent with Chamaedaphne.
Arceuthobium pusillum	Parasitic on Picea.
Aster hirsuticaulis	Common in bogs.
lindleyanus	Bogs and hardwoods.
macrophyllus	Bog and aspen, common.
novaeangliae	Frequent in moist places.
Betula glandulifera	Dominant in some bogs.
Botrichium virginianum	Hardwoods and bogs, frequent.
Calopogon pulchellum	Characteristic Sphagnum bog.
Caltha palustris	Common wet places.
Carex lasiocarpa	Dominant in bogs.
leptalea	Typical of bogs.
stricta	Bogs, with C. lasiocarpa.
trisperma	Frequent in bogs with moss.
Chamaedaphne calyculata	Dominant in bogs.
Coptis trifolia	Common in rich, wet woods.
Cornus alternifolia	Hardwoods or bog.
Drosera rotundifolia	Frequent in Sphagnum bogs.
longifolia	Less common than preceding.
Dryopteris thelypteris	Common in marshes and bogs.
Dulicheum arundinaceum	Wet places, frequent.
Equisetum scirpoides	Moist places, common.
Eriophorum viridicarinatum	Characteristic bog plant.
Galium circaezans	Characteristic of moist woods.
trifidum	Bogs and wet woods.
Gaylussacia baccata	Common locally, moist woods.
Habenaria hyperborea	Exclusive in wet woods and bogs.
obtusata	Typical of bogs.
Hypericum virginicum	Common in open marshes, bogs.
Kalmia polifolia	Common with Chamaedaphne.
Lactuca spicata	Common in low places.
Larix laricina	Dominant in Bog areas.
Ledum groenlandicum	Bog, common with Chamaedaphne.
Lysimachia terrestris	Frequent in low ground.
Mitella nuda	Common in moist woods.
Nemopanthus mucronata	Dominant in bogs.
Nymphea odorata	Shallow lakes and ponds preferred.
Osmunda regalis	Common in bogs.
Prunella vulgaris	Ubiquitous.
Pyrola chlorantha	Common in woods.
Rubus triflorus	Common, bogs and wet woods.
Salix pedicellaris	Dominant in open bogs.
Sarracenia purpurea	Common with Sphagnum.
Smilacina trifolia	Common in bogs.
Sphagnum sp.	Characteristic ground cover in bogs.
Streptopus amplexicaulis	Prefers cold, moist woods.
Taxus canadensis	Typical of evergreen woods.
Thalictrum dasycarpum	Hardwoods, bogs.
Vaccinium oxycoccus	Characteristic Sphagnum bogs.
Viburnum cassinoides	Open, wet situations.
Viola pallens	Common in wet woods.

VICINITY OF

UNIVERSITY OF MICHIGAN BIOLOGICAL STATION

AND DEMONSTRATION FOREST

CHEBOYGAN AND EMMET COUNTIES, MICH.

LEGEND

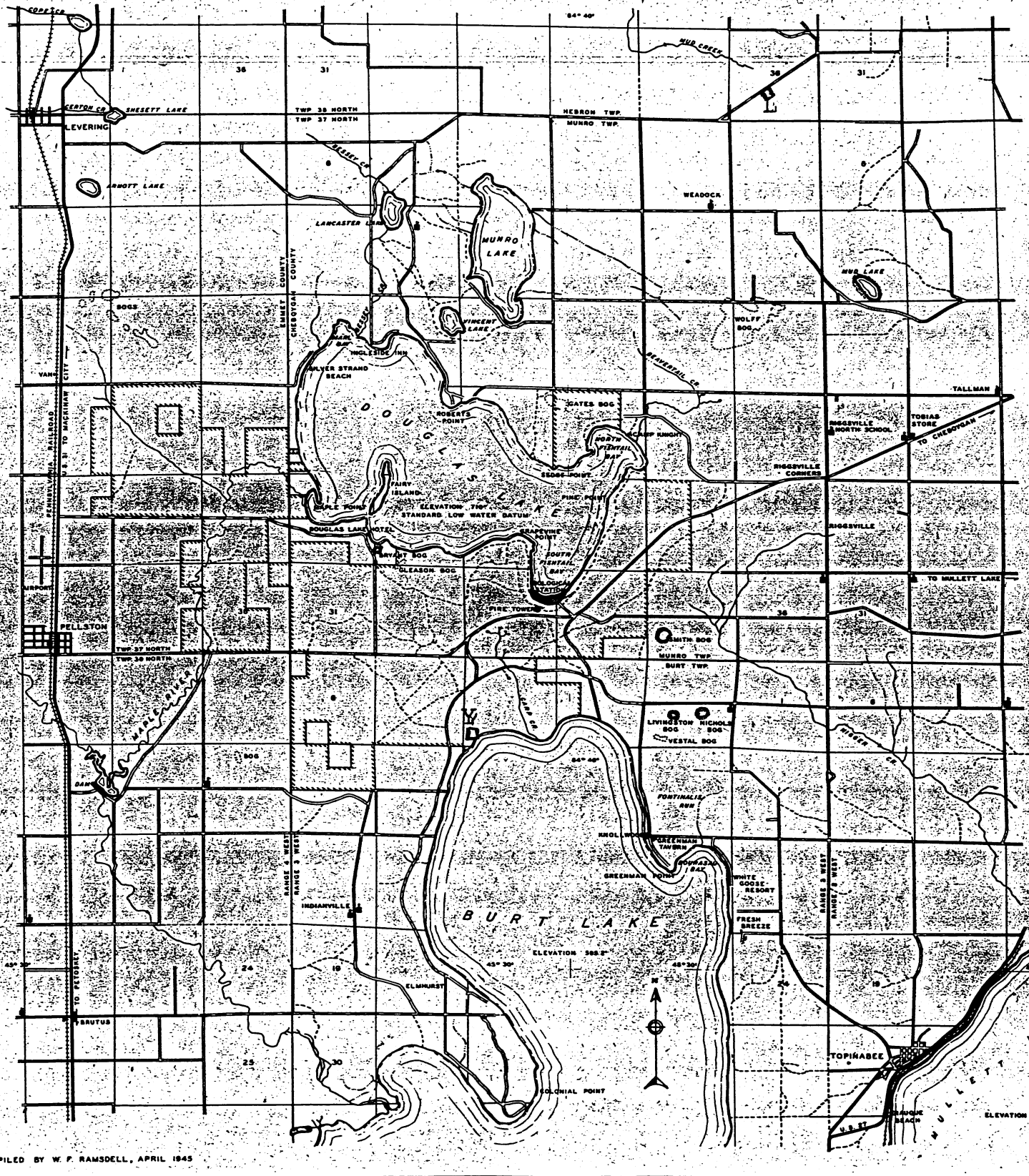
CHURCH
SCHOOLHOUSE
BOUNDARY OF UNIV. LANDS
RAILROAD

SCALE

0 1/2 MILES
0 1/2 KMS.

LEGEND

PAVED HIGHWAY
GRAVELLED ROAD
GRADED ROAD
UNIMPROVED ROAD
TRUCK TRAIL



COMPILED BY W. F. RAMSDELL, APRIL 1945

B.J.G.

Figure 2-- Diagram of Smith's Bog. The pond has since been reduced in size.

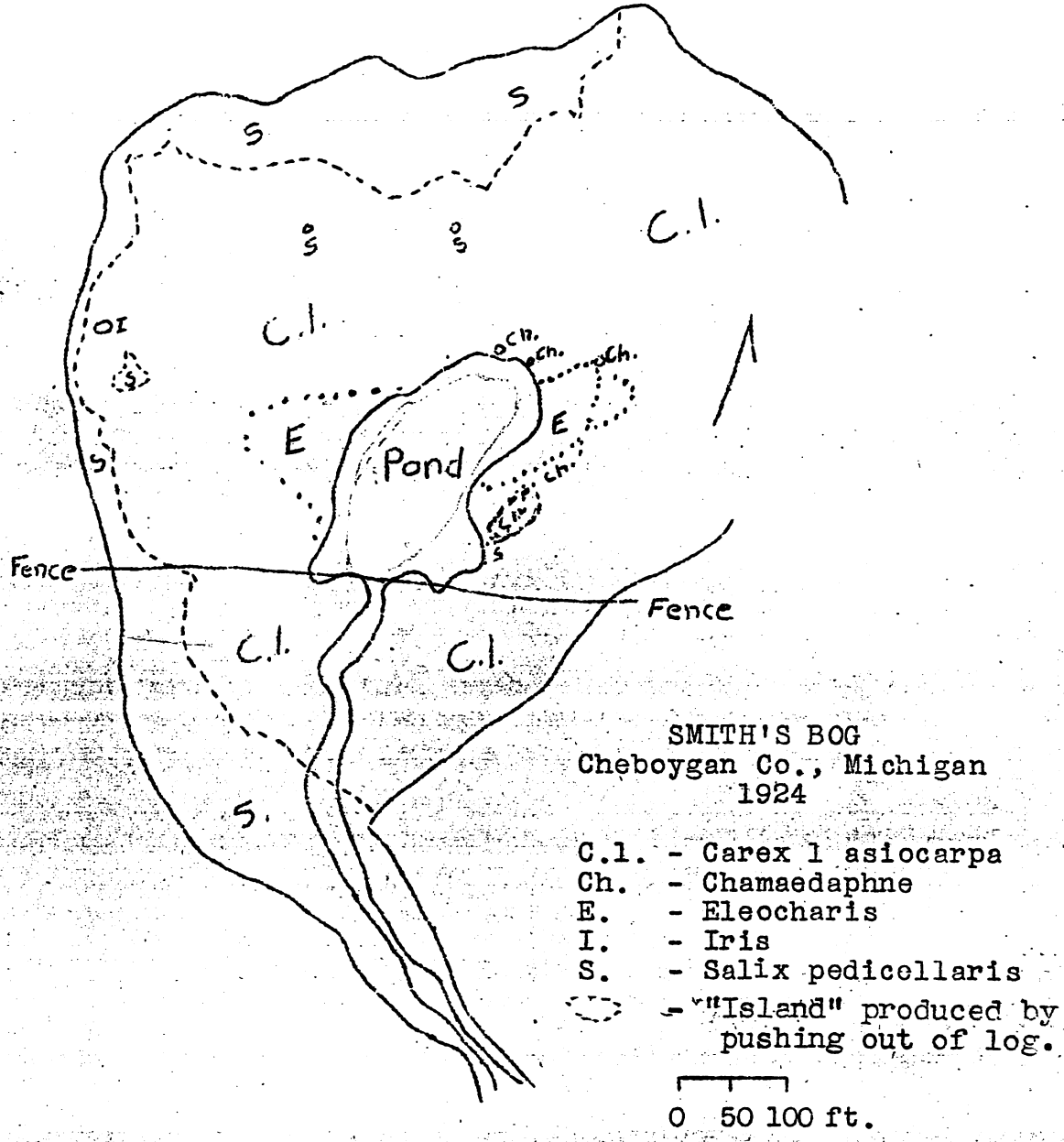
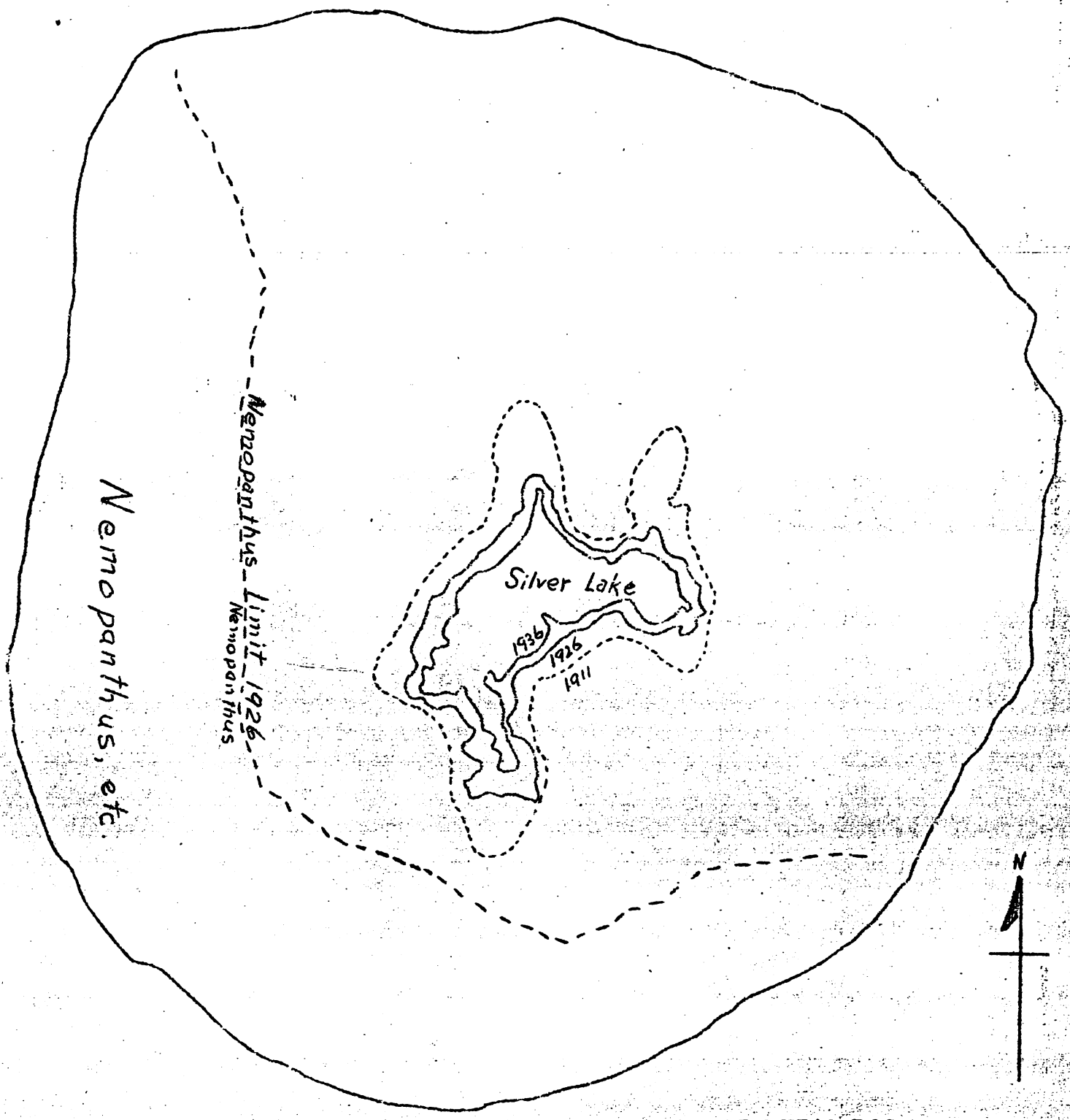


Figure 3- Carex Mat at Little Lake 16.
Photograph by C.H. Blair
1940

Figure 4 - Bryant's Bog, General Aspect

Photograph by C.H. Blair, 1940

Figure 5 -- Bryant's Bog Showing Mat Development from 1911 to 1936.



BRYANT'S BOG

Cheboygan County, Michigan

1926

Scale of 50 feet

Figure 6 - False Bottom at Mud Lake, 1940
Photograph by C.H. Blair

Figure 7 - Mud Lake. Class stands at high water line of 1918.
Photograph by C.H. Blair, 1940.

Figure 8 - Picea Layering at Mud Lake.
Photograph by C.H. Blair, 1945

Figure 9 - Peat Sampling at Mud Lake
Photograph by C. H. Blair, 1940

APPENDIX

Table 1

METEOROLOGICAL SUMMARY CHEBOYGAN MICHIGAN
(U. S. Weather Bureau Figures)

TEMPERATURE. °F	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec
Absolute Maximum	59	51	72	86	89	95	101	95	95	89	73	59
Mean	19	16	25	39	50	61	66	65	60	48	35	23
Absolute Minimum	-20	-38	-22	-2	17	28	33	35	25	15	-6	-18
Growing Season					May 20	Jun. 15			Sep. 10	Sep. 25		
Wind	NW	NW	NW	NW	NW	NW	NW	NW	SW	SW	NW	SW
Precipitation (inches)	1.70	1.38	1.90	1.79	3.10	1.85	3.10	2.97	2.92	2.50	2.49	1.93
											Total	28.57
Number of days with precipitation	9	7	6	7	8	7	8	9	8	8	9	9
											Total	95
Snowfall (Inches)	15.6	13.6	9.0	2.3	0.7	-	-	-	T	0.7	6.6	12.5
											Total	62.0

(6/27/34)

Table 2- Data for Carex lasiocarpa Association and Salix pedicellaris Consocies at Smith's Bog

Number of culms (stems) in area 10 x 0.1 meters (1 sq. meter)
South group -- 312 stems/m^2. Carex stricta 64, Lysimachia terrestris 1 Bearing N 127°
East group-- 377 stems/m^2 Bearing N 90°.
Diameter of Carex lasiocarpa stems at water level.
Group 1 - 200 stems 400 mm. 2.0 mm in diameter
Group 2 - 205 stems ? 1.2 mm diameter
Group 3 - 102 " in shade of Chamaedaphne 2.1 mm diameter
103 " " " "Salix pedicellaris 2.1 mm diameter
Group 4 - 200 " in Salix consocies between shrubs 2.9 mm dia.
25 list quadrats in Carex lasiocarpa eastward from other work.

Carex lasiocarpa	100 F.I.		
Carex stricta	37	Proserpinaca palustris	4 F.I.
Chamaedaphne calyculata	16	Salix pedicellaris	28
Dulicheum arundinaceum	24	Sphagnum sp.	8
Hypericum mutilum	12		
Hypericum virginicum	44	Tree (shrubs)	
Lysimachia terrestris	32	Salix pedicellaris	1 clump

------ Salix pedicellaris consocies of the High Bog Shrubs--
No. of stems in area.

Group 3 10.7 x 0.1 m		Group 4 10 x 0.1 m	
Carex lasiocarpa	363		322
Chamaedaphne calyculata	41		7
Salix pedicellaris	5		10
Shade on above area.			
Chamaedaphne calyculata	0.46 m		2 m
Salix pedicellaris	3.1 m		1.85 m

Table 3.

- - - - - - Nemopanthus consocies of the High Bog Shrub Association in Bryant Bog July 8

Line interception occurances (mm)					
Bearing & distance	230° 5m	145° 5 m	155° 5 m	55° 4.85 m	23° 5 m
TREE LEVEL					
Larix laricina	1 (240)				
HIGH SHRUB LEVEL					
Nemopanthus mucronata	(4200)	(4500)	(5000)	(4850)	(3540)
CHAMAEDAPHNE LEVEL					
Chamaedaphne calyculata	6(686)	(20)			(415)
Gaylussacia baccata	4(686)			(100)	(760)
LOW SHRUB LEVEL					
Vaccinium canadense	11(674)		(1775)	(450)	(460)
" pennsylvanicum	17(1431)	(2475)		(50)	(2990)
Larix laricina			(370)		
Amelanchier canadensis					(70)
Gaylussacia baccata					(510)
GROUND LEVEL					
Chamaedaphne calyculata	1(4)	(12)			(9)
Debris	38(3250	(3585)	(3452)	(3110)	(4170)
Dicot seedling	2(2)				
Gaylussacia baccata				(5)	
Lichen				(200)	
moss	20(738)	(800)	(15)	(40)	
Nemopanthus mucronata	2(7)	(16)		(120)	(89)
Sphagnum sp	172(1124)	150(750)	222(1417)	(570)	(530)
Trientalis americana					(2)
Vaccinium canadense	8(59)	(18)	5(11)	(28)	
" pennsylvanicum	5(15)			(14)	
				(430)	
Bare ground.					

Table 4.

C H A M A E D A P H N E Association in Livingston Bog July 11, 1947. Ecology Class.

Occurences (mm) Line-Interception					
Length of line	5000mm	5000	5000	5000	5000
TREE LEVEL					
Chamaedaphne level					
Chamaedaphne calyculata	(4651)	(4550)	(5000-)	(4949)	(5000mm)
Andromeda glaucophylla	10(369)				
Kalmia polifolia			(300)		
Ledum groelandicum			(1000)		
WATER or GROUND LEVEL					
Andromeda glaucophylla	3 (8.5)				
Acer rubrum			1 (1)	2 (1.5)	
Carex sp			3 (3)		
Chamaedaphne calyculata	76(351)	1(3.5)	117(578)	16(77.5)	232(1166)
Debris	59(147.5)	9(550)	(865)		(47)
Drepanocladus sp	1(6)				
Gaultheria procumbens		5(19.5)		2(3)	
Kalmia polifolia			1(3)		
Drosera rotundifolia			2(38)		
Ledum groelandicum		2(2.5)	6(21)	9(32)	
Moss		3 cl(600)	(30)		
Orchid sp			1(1)		
Sphagnum		284(1720)	175(1645)	319(3569)	282(945)
Vaccinium oxycoccus				1(5)	
" pennsylvanicum				11(27.5)	
Water			(1810)		(2842)

	eastward se cor Lake Belcher	12°	mid s shore beyond lake		mid n shore
	Bradley	Burget Hunter	James Karsten	MacLennan Murchie	Sturgeon Watson

Table 5.

Larix Association - se Cheboygan-Levering Rd. July 8, 1947
25 meters Line-Interception Occurrences (mm)

Tree Level

Larix laricina 15(14970)
Salix bebbiana 1(2000)
Thuja occidentalis 1 (1045)

High Shrub Level
Betula glandulifera 3(840)
Cornus stolonifera 18(5335)
Lonicera oblongifolia 3(403)

Low Shrub Level
Andromeda glaucophylla 1(170)
Betula glandulifera 1(30)
Chamaedaphne calyculata 2(135)
Cornus stolonifera 8(758)
Habenaria hyperborea 8(340)
Ledum groenlandicum ?(735)
Osmunda regalis ?(13540)
Rhamnus alnifolia ?(3913)
Rubus triflorus ? (1118)
Salix discolor ?(110)
Thalictrum dasycarpum ?(586)

Ground Plant Level
Aster hirstuicaulis 2(306)
Aster novaeangliae 5(63.5)
Betula glandulifera 1(4)
Andromeda glaucophylla 1(1)
Caltha palustris 3(117)
Carex trisperma 14(40.5)
Clintonia borealis 7(588)
Cornus alternifolia 1(5)
Cornus canadensis 5(9)
Cornus stolonifera 2(5)
Bare ground (1350)
Debris (4780)
Dryopteris thelypteris 1(45)
Dicot seedlings 3(39)
Habenaria hyperborea 3(18)
Galium circaezans 2(65)
Galium trifidum 2(17)
Lactuca spicata 1(50)
Ledum groenlandicum 3(7.5)
Maianthemum canadense 18(159)
Mitella nuda 14(12.5)
Moss (17791)
Osmunda regalis 21(89)
Pyrola chlorantha 11(316.5)
Pyrola secunda 10(14)
Rhamnus alnifolia 2(8)
Rubus triflorus 28(98.5)
Smilacina trifolia 1(1.5)
Thalictrum dasycarpum 1(10)
Vaccinium oxycoccus 1(0.5)
Viola pallens 5(139.5)

Table 6.

P I C E A * A B I E S being invaded by T H U J A July 18, 1947
Young's growth plots in Section 4 in Reese's Bog. Ecology Class.

TREES	0-2.5	2.5-5	5-10	10-15	15-20	20-25 cm	
Abies balsamea	110	45	27	1	1	-	3%
Acer rubrum	1						
Betula papyrifera	-	1	1				
Cornus stolonifera	2						
Fraxinus nigra	5	6					
Larix laricina	-	1					
Picea glauca	-	-	1				
Picea mariana	24	21	11	2	1		6%
Salix discolor	10						
Thuja occidentalis	181	110	27	8	2	1	54%

Trees in 5 2-meter strips 31.8 m long = 318 square meters

Large stumps of Thuja 55 and 60 cm

GROUND PLANTS in 25 quadrats (the number of quadrats not the frequency index) and the count of the plants in the quadrats.

Abies balsamea 18(99)
Acer rubrum 5(8)
Acer spicatum 3(4)
Amelanchier canadensis 5(9)
" spicata 9(24)
Agrostis capillaris 3(12clumps)
Anaphalis margaritacea 1(3)
Aralia nudicaulis 20(62)
Aster hirsuticaulis 2(6)
" laevis 2(6)
" lindbayanus 6(37)
" macrophyylus 18(64)
Aspidium thelypteris 1(2)
Betula papyrifera 1(2)
Botrychium virginianum 2(5)
Carex leptalea 11(295)
" rosea + 7(94)
" trisperma 10(165)
" sp. 12(250)
Chiogenes hisnidula 25(1230)
Clintonia borealis 15(274)
Coptis trifolia 18(460)
Cornus canadensis 4(14)
Cornus stolonifera 2(2)
Diervilla lonicera 5(9)
Drosera rotundifolia 12(106)
Epigaea repens 14(150)
Epilobium angustifolium 1(1)
Equisetum scirpoides 18(490)
Eriophorum viridicarinatum 4(20)
Fragaria virginiana 6(10)
Galium triflorum 3(6)
Gaultheria procumbens 21(638)
Habenaria obtusata 3(12)
Linnaea borealis 20(359)
Lonicera canadensis 2(3)
" oblongifolia 2(7)
Maianthemum canadense 9(76)
Mitella nuda 15(214)
Mosses 25(23,720 sq.cm)
Petasites palmata 3(130)
Phegopteris dryopteris 1(4)
Polygala paucifolia 13(82)
Picea mariana 6(21)
Pinus strobus 1(1)
Populus tremuloides 1(1)
Prunella vulgaris 5(25)
Pteris aquilina 4(12)
Pyrola secunda 13(136)
Quercus borealis 1(1)
Rhus toxicodendron 1(3)
Rubus triflorus 12(49)
Salix canadida 1(1)
" discolor 6(11)
" lucida 1(2)
Sanicula marilandica 1(3)
Smilacina trifolia 11(593)
Streptopus amplexicaulis 3(5)
Taxus canadensis 17(67)
Thuja occidentalis 13(63)
Trientalis americana 14(59)
Vaccinium canadense 5(22)
" pennsylvanicum 6(27)
Viola pallens 3(17)
Sphagnum 22(95,000 cm^2)

Branches and logs 15(19,750 sq.cm)
Abies needle cover 2 reported (850)
Water holes 2 (800)

A Picea-Abies plot, which has past completely thru the Aspen and Larix stages and is now being invaded by Thuja. Soil is Rifle Peat.

Belcher Bradley
Burget Hunter
James Karsten
MacLennan Murchie
Sturgeon Watson