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STATION

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Revegetation of Beach-Maple Areas in the Douglas Lake, (Cheboygan Co.)
Michigan, Region¹

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[1928]

¹
The work was done at the Biological Station of the University of Michigan
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The Douglas Lake region, Cheboygan Co., Michigan, lies in a transition zone between the northeastern coniferous forests and the central deciduous forests. In this region whenever these two types of forest meet, there is a struggle for supremacy, and the southern type tends to replace the northern. Since glacial times this transition zone has retreated northward three hundred or four hundred miles.

There are many well drained ridges or moraines in the Douglas Lake region that are or have recently been covered by a virgin beech-maple forest.¹

¹Glenson, H.A. The structure of the Maple-Beech Association in Northern Michigan. Papers Mich. Acad. Sci. Arts. & Letters, 4:295-298, 1924.

A typical beech-maple forest prefers a well drained, deep, rich soil. The trees are numerous and therefore the forest floor is well shaded in summer and fall. Typical climax trees are: Acer saccharum, Betula lutea, Fagus grandifolia, Ostrya virginiana, Tilia americana, and Ulmus americana. Where trees have fallen, opportunity is given to the many seedlings which fill these open places to replace the old trees. There are but few shrubs in a beech-maple forest which are Sambucus racemosa, Ribes cynosbati, and Lonicera canadensis. There are three seasonal cycles in the ground plants. The first cycle is vernal, composed of winter annuals such as Galium aparine and bulbous plants or plants from rootstocks such as Viola canadensis, Allium tricoccum, Biscutella canadensis, Biscutella cucullaria, Erythronium albidum, Trillium grandiflorum, Polygonatum

biflorum, Saxifraga racemosa, and Hepatica acutiloba. This vernal display is by far the most dense of any for there is little shade in the forest when these flowers bloom. They generally die down after blooming and a few weeks later no trace of them can be seen above ground. The second cycle is one composed chiefly of summer annuals many of which are broad-thin leaved shade plants. Here are found Aralia nudicaulis, Geranium robertianum, Geum rivale, and Ranunculus abortivus. The third cycle is composed of fall flora many members of which are composites such as species of Aster and Solidago.

Only one or two virgin forests now remain because of burning or lumbering. However many of the destroyed areas are now being reforested.

Following a list of typical beech-maple species is a description of two virgin beech-maple forests followed by descriptions of areas studied in which reforestation is taking place.

Typical Beech-Maple Species

Trees

Acer saccharum

Betula lutea

Fagus grandifolia

Fraxinus americana

Ostrya virginiana

Prunus serotina

Tilia americana

Tsuga canadensis

Ulmus americana

Shrubs

Acer pennsylvanicum

Ribes cynosbati

Lonicera canadensis

Sambucus racemosa

Liana

Celastrus scandens

Herbs

Actaea alba

Adiantum pedatum

Agrimonia gryposepala

Allium tricoccum

Aralia nudicaulis

Arisaema triphyllum

Aspidium cristatum

Aspidium spinulosum

Bicuculla canadensis

Bicuculla cucullaria

Botrychium virginianum

Carex albursina

Carex arctata

Chenopodium capitatum

Erythronium albidum

Galium circaeans
Galium triflorum
Geranium robertianum
Hepatica acutiloba
Lapula deflexa
Lycopodium lucidulum
Medeola virginiana
Melica striata
Milium effusum
Mitella nuda
Mitchella repens
Monotropa uniflora
Osmorhiza claytoni
Osmorhiza longistylis
Polygonatum biflorum *
Pyrola elliptica
Smilacina racemosa
Streptopus roseus
Tiarella cordifolia
Tridentalis americana
Trillium grandiflorum
Uvularia grandiflora
Viburnum acerifolium
Viola canadensis
Viola eriocarpa
Viola papilionacea

Area A. Virgin Beech-Maple Forest West of Pellston

This virgin beech-maple forest is on a clay morainic ridge 4 km. west of Pellston. This was a part of the original virgin forest when white men first entered the country. That this tract is still uncut is explained by the fact that the white pine holding was cut first because it was considered more valuable and now tracts further from a lumber mill are being cut while this tract is held in reserve until other more distant holdings are cut over.

The situation here is one of a very old virgin beech-maple forest. There is a great difference in the age of the trees for seedlings are constantly taking the place of fallen trees. Because of fallen trees there is quite a lot of sunlight in certain places, and the result is a great variety of ground plants and shrubs. There are several hemlock knolls where vegetation is denser in the area. Because of its proximity to Maple River there are several lower places. The chief trees are Acer saccharum, Fagus grandifolia and Ulmus americana. Some Fraxinus americana, Prunus serotina and Ostrya virginiana are noticeable. Taxus canadensis is quite dense on certain knolls and in lower spots Fraxinus nigra is found. Shrubs here are Lonicera canadensis and Lonicera oblongifolia, Corylus rostrata, Cornus circinata, Amenanchier spicata, and Rhus glabra borealis. Taxus canadensis is in lower parts. Most of the ground plants to be found in the beech-maple forest were in here along with some more lowland species.

Area B. Virgin Beech-Maple Forest near Mud Lake

This area is near Areas 5, 6, and 7. The trees observed were Acer saccharum, Acer pennsylvanicum, Acer rubrum, Acer spicatum, Betula lutea, Fagus grandifolia, Fraxinus americana, Fraxinus nigra, Ostrya virginiana, Prunus virginiana, Tilia americana, Tsuga canadensis, Ulmus americana. These trees are many of them very large and well spaced out. Consequently, the ground plants are more numerous and so are the seedlings. The soil is very rich and the humus-leaf cover is about 20 cm. in depth. Parts of this area are low, and here more lowland forms are found. Abundance of seedlings insures indefinite repetition of the forest unless man interferes.

Various areas which were once beech-maple forests (locally called hardwoods) and have been disturbed by fire, lumbering, or cutting were examined to determine the nature of the reforestation.

Area 1, Bryant's Hardwoods

About 0.8 km. west of Bryant's Hotel on a slope is a beech-maple forest known as Bryant's Hardwoods. The soil is very good sandy loam with excellent drainage. Before 1912 this area was covered with a well developed virgin beech-maple forest with many large Tsugas. This was lumbered in the winter of 1911-1912, and in 1914 it was covered with Epilobium angustifolium. From 1917 until 1920 every indication showed that this region would be typically aspen. However by 1921 small beech and maple began to become dominant, due to seedlings and stump sprouting and the aspen association was nipped in the bud although many ground plants are still ^{characteristic of the} aspen association.

Now the trees are almost entirely Fagus grandifolia, Acer saccharum, and Acer rubrum. These trees are less than ten years of age and show every indication of vigorous growth and spread.

The trees of the aspen association which threatened to establish themselves are now (1926) much fewer in number than records show they were in 1923.

Populus grandidentata and Populus tremuloidea are producing no seedlings and in many places the older trees are dying out. Betula papyrifera, one of the most shade tolerant trees of the aspen association is thriving, but it is not abundant and seedlings are few. This area is quite exposed and most of the ground plants are sun loving pioneers on open soil. Most of these are aspen ground plants.

This place is now carefully protected from cutting and burning, and from all indications a beech-maple forest will be re-established.

Area 2, North Fishtail Hardwoods

About 0.2 km. from Douglas Lake at North Fishtail Bay is an area known as the North Fishtail Hardwoods. This is located on a slope toward the lake. Because of this slope the drainage is excellent. The soil is quite rich, and in the less disturbed area there is a thick layer of humus.

In 1915 it was a fine beech-maple forest. Since then, part of it has been burnt over twice, the second burning being in 1919. These fires did not reach the slope. Consequently, back of this territory there is an excellent beech-maple area which has not been disturbed for some time.

In the territory burnt over in 1919, the beech and maple, although small are more numerous than the aspens. Even though this area is very exposed, some Beech-maple ground plants such as Trillium grandiflorum are found. The upper part of the area which is on the slope is quite shady. The dominant trees are Fagus grandifolia, Acer saccharum, Tilia americana, and Ostrya virginiana. The ground plants are typically beech-maple except in a few exposed parts where Rubus strigosus has entered.

Every indication points to the fact that the Beech-maple will remain here unless disturbed by fire. As this is now University property, lumbering and destruction by fire is minimized.

Area 3, North of North Fishtail

In an area about 1.6 km. north of Sedge Point there was a beech-maple climax forest, but in 1912-1915 it was lumbered. In the three years following, coppicing began. In 1919 a forest fire swept all of this area.

All of this area is now being used as a pasture for cattle. Because of this, a peculiar situation has developed and the vegetation is of two types, (1) that within the clumps of Acer saccharum and about the few beech trees, (2) that of the open land between clumps of Acer saccharum.

There are many clumps of Acer saccharum containing ten to twelve young trees reproduced by coppicing, and practically unmolested by the cattle. Within these clumps, a miniature forest can be seen. Shade is dense, soil good, and here the maple seedlings are in abundance and such typical beech-maple plants as Aralia nudicaulis, Trillium grandiflorum, Smilacina stellata and Aster

the trees or due to their destruction by storms. In those open spaces pioneer
twenty years in age remain. There are many open spaces due to the cutting of
This area was partially timbered in 1919-1920 but many large trees over
2.5 - 10 cm. in depth over most of the ground.

drainage is good and so is the soil. There is a leaf-litter cover varying from
North of Area 3 is the remnant of a second growth beech-maple forest. The

Area 4, North of North Mitchell

It could readily return to its former state as a second growth climax forest.
cattle and reproduction will cease. However, if this area would be unimpeded
arrangement disappears the ground plants and seedlings will be removed by the
be used as a pasture. If it is, in all probabilities as soon as the stump
The future of this area depends upon whether or not it will continue to
Its presence may keep the cattle from destroying the maples.

is very much in evidence both in and near the stumps and in the open places.
such as Liriodendron and Pteris aquilina are also found. Sparganium angustifolium
theraps, and grasses such as Poa pratensis and Poa annua. Aspen species
such as Rumex acetosella, Salix spp., Geranium viscaria, Verbascum
largely of pasture plants and aspen species. Here are found many common weeds
open ground pasturing and exposure have caused the vegetation to be composed
Lonicera canadensis and Celastrus scandens are present occasionally. In the
Only a very few beech seedlings are to be found but beech-maple shrubs such as
were probably seedlings at the time of lumbering and were killed by the fire.
Microphyllum are found. The few beech trees are about twelve years old and

plants abound. The successional tendency seems to be (1) pioneer ground plants such as Asclepias syriaca, Antennaria canadensis and Solidago canadensis, (2) pioneer shrubs such as Rubus strigosus, (3) pioneer trees as Populus tremuloides.

Where the trees have been undisturbed, the dominant tree is Acer saccharum. There are a few individuals of Fagus grandifolia and Ostrya virginiana. Acer saccharum is reproducing abundantly. In the quadrats taken, Acer saccharum seedlings under a meter in height had a frequency index of 80. Other tree seedlings are noticeable for their absence. No Fagus grandifolia seedlings could be found in all this area, and only one Ostrya seedling that was not particularly healthy. However, there are two seedlings less than a meter in height whose presence is most interesting. One of these is an Abies balsamea and another is a Tsuga canadensis. No larger trees of these species could be found any place in the area, and unless there were some which were cut out, the presence of these seedlings can not readily be accounted for. This habitat is an unusual one for Abies balsamea, which generally prefers a low wet place.

Although this is not being pastured this year, it has been used as a pasture in previous years. This fact may account for the scarcity of certain shrubs and ground plants. Ground plants are few, not so much in different species but in actual individuals. Typical beech-maple plants here are Trillium grandiflorum, Viola pubescens, Osmorhiza claytoni, Botrychium virginianum, Smilacina racemosa, and Smilacina stellata.

In both open spaces and woodland, in addition to the species expected in natural succession, many introduced plants such as Poa compressa, Cerastium vulgatum, and Poa pratensis abound.

If this area is left undisturbed as it is now, the present production of maple will tend to bring it back to its former state.

Areas 5, 6, 7, Mud Lake Hardwoods

About 1.5 km. southwest of Mud Lake is an area which was once entirely covered by a virgin beech-maple forest. The soil is good and the topography rolling. There is a tendency in parts to be wet especially in that part nearest Wolff's Bog. Part of this area is still covered by a virgin forest which is discussed in another place. The rest of the forest has been cleared. Part of it is now being used for farm land or pasture but part has been allowed to revert to forest. It is in the latter place where quadrats were taken.

Three sets of quadrats were taken and while the results differed slightly, all brought out the following conclusions: (1) Acer saccharum is reproducing by coppicing and is by far the dominant tree of the area, (2) in most places this coppice is reaching such density that certain weaker trees are being crowded out, (3) due to this density there are very few ground plants or shrubs, and seedlings are very spindling, (4) in open places where trees have fallen, however, these seedlings are growing rapidly and ground plants abundant, (5) part of this is being used for pasturing and in openings such introduced species as Poa pratensis, Synaglossum officinale, Verbascum thapsus, Alnus media, Cernatium vulgatum, Taraxacum officinale and Rumex elongatus are found. However, this pasturing is so restricted that it will not influence the growth of the forest very much, and (6) while Acer saccharum is now by far the dominant tree in the coppice area there are a few beech, yellow birch and American

elm, relics of the former virgin forest. When the coppice thins out, as it must when it becomes larger, these trees will be given a better opportunity to reproduce and the forest will become a typical second growth beech-maple forest.

Area 8, Clem's Woods

About 2.5 km. northeast of Riggsville is an area covered by a second growth beech-maple forest. This is evidently a remnant of a larger forest but the territory surrounding it has been cleared and is now being farmed. The soil and drainage are excellent and the topography is rather rolling.

No definite history of this territory is known, but indications show that there has been a slight ground fire in one corner recently but not a serious one, and that some few trees have been cut out. The presence of Poa pratensis and other introduced species indicate pasturing at some time. Most of the trees are about 35 years old and are dominated by Acer saccharum, Ulmus americana, and Tilia americana. Seedlings of these trees are beginning to get a start in a few open spots, but as a whole the shade is too dense for growth. A large variety of beech-maple ground plants are present, principally Osmorhiza claytoni, Trillium grandiflorum, Viola canadensis and Hepatica acutiloba.

If this area is left undisturbed, it will become a typical beech-maple forest.

Area 9, Biggsville Hardwoods

At Biggsville Corners there is a second growth hardwood area with good soil and drainage. The history of this area is not known beyond the fact that it has been pastured a little. It apparently was left undisturbed at the time the surrounding land was cleared, but has been disturbed slightly by fire.

Here, the trees are of approximately 30 to 35 years old, and are not dense, allowing a fair amount of light to penetrate, and ground plants to exist. Of the trees, Touga canadensis, Tilia americana, and Betula lutea are well represented but do not seem to be reproducing by seedlings. Seedlings of Acer saccharum, Fagus grandifolia, and Ulmus americana are present but not very numerous. Shrubs are practically absent. A great abundance of Geranium robertianum is found near the edge of the area where plenty of light is present. Throughout the area, Osmorhiza claytoni and Polygonatum biflorum are persistent. A few introduced species such as Taraxacum officinale, Cirsium arvense and Cerastium vulgatum; aspen species represented by Maianthemum canadense and Lactuca canadensis; and beech-maple species such as Hepatica acutiloba, Arisaema triphyllum and Trillium grandiflorum are found.

If the area is again pastured, reproduction will not continue, and all the ground plants will be killed off. There will be no young trees to take the place of the older. However if it is left entirely unmolested, it will slowly lose its disturbed characteristics, and become typical beech-maple forest.

Area 10, Bogardus Point Hardwoods

Back of North Woods Camp near Bogardus Point is a second growth beach-maple forest. This has been undisturbed by fire or cutting for at least twenty-five years, but conditions are scarcely natural because of the people who go through parts of it so often, forming paths and often destroying rarer species by

logging.

The situation is a well drained one but it is somewhat lower and more

moist than any of the former areas studied. Consequently, even in very shaded

places there is an increase in ground plants. The tree species include not

only the typical beach-maple trees as *Acer saccharum*, *Acer pennsylvanicum*,

Acer spicatum, *Fagus grandifolia*, *Ostrya virginiana*, *Pinus strobus*, but

Acer rubrum and a great deal of *Taxus canadensis*. Some young *Pinus strobus*

seedlings were observed but these seem to be having rather a hard time of it.

There are several shrubs as *Lonicera canadensis*, *Sambucus racemosa*, *Viburnum*

acerifolium and *Ribes cynosbati*. The abundance of the ground plants has already

been mentioned. They include such typical beach-maple plants as *Trillium*

grandiflorum, *Fritillaria americana*, *Osmorhiza claytoni*, and *Arnica nudicaulis*.

Also, there are some suggestive of the inland, such as *Geotheca procumbens*

and *Chimaphila umbellata*, and in the open spaces where trees have fallen or

were taken out are *Rattus norvegicus* and *Pteris aquilina*.

Area 11, Big Stone Bay Hardwoods

In addition to the studies made near Douglas Lake, an area about nine miles southwest of Mackinaw City in the State Game Refuge in Emmet County was observed. This area is small, only about 100 by 650 meters in extent. It is on sandy soil at the base of an old dune and is completely surrounded by a coniferous forest. Before the early lumbering this was composed almost altogether of pines with an occasional beech or maple. When the white pine was cut out in this particular area, the beech and maple were given ample opportunity to become dominant and now a beech-maple association dominates with a few individuals of Tsuga canadensis and Abies balsamea, relics of the pineland which can withstand the shade. Charred logs and the presence of Betula papyrifera and Populus tremuloides tell that there has been fire in here at some time but the beech-maple is taking the place of these birches and aspens as they die out. The ground plants are a mixture of beech-maple plants and pineland plants which have entered from surrounding areas.

The future development of this little area is promising for it is ⁱⁿ a region that is protected from fire. The probabilities are that the beech-maple will spread into the upland pine area on adjoining ridges gradually. Or, if the state ever allows the cutting of pines the beech-maple will get a start there. However, the area will never supplant the lowland Tsuga forest on one side of the ridge because of the poor drainage and wet conditions there.

Methods

The frequency indices of species were determined from twenty-five to one hundred quadrats depending upon the size and variability of the region. After quadrats were taken, all vascular plants outside the quadrats were listed. The quadrats were taken at intervals of three paces in a Z shaped course, covering the whole area. A tree count was taken of all trees within a meter's distance on each side of the quadrat course.

In the following table a comparison is made between the tree composition of the virgin beech-maple forests of the region, and that of the reforesting areas studied. The great ascendancy of Acer saccharum is very patent.

Tree Composition of the Beech-Maple Forest

	% in typical beech-maple forest	% in reforesting areas studied
Normal Species		
<i>Acer rubrum</i>	3.7	1.7
<i>Acer saccharum</i>	35.9	67.3
<i>Betula lutea</i>	4.1	.9
<i>Fagus grandifolia</i>	21.2	6.8
<i>Fraxinus americana</i>	.8	x ²
<i>Ostrya virginiana</i>	1.4	.9
<i>Tilia americana</i>	2.1	.8
<i>Thuja americana</i>	14.6	2.7
<i>Ulmus americana</i>	<u>2.9</u>	<u>1.5</u>
	86.7	83.4
Prominent Relics		
<i>Betula papyrifera</i>	1.4	4.0
<i>Pinus strobus</i>	1.5	0
<i>Quercus borealis</i>	<u>0.7</u>	<u>x²</u>
	90.3	86.4
Trees not in the Mature Beech-Maple Forest		
<i>Abies balsamea</i>	0	2.4
<i>Populus grandidentata</i>	0	2.8
<i>Populus tremuloides</i>	0	1.0
<i>Prunus pennsylvanica</i>	0	<u>1.6</u>
		94.2

1. Tree count from 18,000 trees. Data from F.C. Gates

2. Found out of quadrat line, so not figuring in the calculation.

In the following table, the ground plants found in the reforestation areas are grouped together according to their average frequency index, and type of vegetation. Some plants had a very high frequency index in one area and practically none in the other areas, while others were about equal in each area.

Ground plants in Reforestation Areas

Average Frequency Index above 10

(Species typical of beech-maple forests are starred)

*Acer saccharum (seedling)

Rubus strigosus

*Trillium grandiflorum

Helianthus canadensis

*Aralia nudicaulis

*Osmorhiza claytoni

*Tilia americana

Poa pratensis

Average Frequency Index between 5-10

Seedlings of Trees

*Acer pennsylvanicum

Acer rubrum

*Fagus grandifolia

Shrubs

Desmodium illinoense

*Sambucus racemosa

Herbs

Fragaria virginiana

Lactuca canadensis

***Mitchella repens**

***Pea compressa**

***Polygonatum biflorum**

***Smilacina racemosa**

Teraxacum officinale

***Viola canadensis**

***Viola papilionacea**

Average Frequency Index between 1-5

Seedlings of trees

Abies balsamea

Betula papyrifera

Populus balsamifera

Populus tremuloides

Prunus pennsylvanica

Thuja canadensis

***Ulmus americana**

Shrubs

Acer spicatum

***Lonicera canadensis**

***Prunus virginiana**

Rhus glabra borealis

Rubus allegheniensis

Rubus triflorus

Taxus canadensis

Herbs or creeping plants

**Actaea alba*

Antennaria canadensis

**Arisaema triphyllum*

**Aspidium cristatum*

**Aspidium spinulosum*

Aster laevis

**Botrychium virginianum* *m*

Carex umbellata

Cerastium vulgatum

Chimaphila umbellata

Clintonia borealis

**Galium triflorum*

Gaultheria procumbens

**Geranium robertianum*

**Hepatica acutiloba*

Lycopodium annotinum

**Lycopodium lucidulum*

**Osmorhiza longistylis*

Rumex acetosella

Saxifraga stellata

Solidago canadensis

Verbascum thapsus

Reforestation in Disturbed Areas Studied

A. Fire. Many of the reforesting areas studied have been burnt over. There are two types of fires, (1) ground fires which damage only part of the trees and are local, and (2) fires sweeping everything and killing all the trees and ground plants and destroying accumulated humus.

The succession the first few years after a fire is very similar in all areas. Pioneer ground plants, often lichens like Cladonia rangiferina, or if low ground, liverworts like Marchantia polymorpha. Epilobium angustifolium often follows this lichen or liverwort stage and is followed by aspens and associated ground plants. This association is characterized by quickly growing, short-lived, sun-loving trees, and sun-loving ground plants, many of which have rootstocks.

From this point the succession goes one of two ways. (1) The aspen stage may become completely developed and from that go to pineland and then beech-maple, or directly to beech-maple, depending on the soil and surrounding trees; or (2) if the fire is not too severe as the aspens start to develop, stump sprouting from the burned maples begins and the aspen stage is nipped in the bud and the area reverts to beech-maple.

B. Lumbering. Conditions are radically different where the areas have been lumbered. If the lumbering has been complete, the first year or so afterwards finds some aspen species entering the area and the beech-maple ground plants, seedlings and shrubs dying out from exposure to the sun. Then the stumps of Acer saccharum begin to sprout. These coppices soon become very thick. As

the shoots grow larger they shade out aspens, and provide sufficient shade for beech-maple ground plants. Then as they grow taller and more dense the shade increases until very few ground plants and seedlings are found. As the trees grow they crowd out the weaker species. This thinning out process continues and more shade plants and beech and other seedlings enter and become a typical beech-maple forest.

C. Pasturing. Many of the areas have been or are being pastured. Pasturing does not destroy the forest immediately, of course, but changes the character of the undergrowth and destroys a large percentage of young seedlings, so the future of the forest is endangered. Maples however are somewhat distasteful and so are not readily eaten by cattle. Areas 1, 2, 3, 4, were all burned over about the same time and now Acer saccharum has a frequency index of 39.9 in Area 1 and 33.6 in Area 2. Neither of these have been pastured, and have a variety of other trees. Areas 3 and 4 however have been pastured and Acer saccharum has a frequency index of 90 in Area 3 and 87.8 in Area 4. The presence of certain species not natural in a beech-maple forest always indicates pasturing. Some of these species are Poa pratensis, Poa compressa, Phleum pratense, and Trifolium repens. If an area which has been pastured is left undisturbed for a few years, the normal ground plants return, and seedlings of beech and maple again are found.

Summary

1. Douglas Lake region, Cheboygan County, Michigan, lies in the transition zone between the northeastern coniferous forests and the central deciduous forests. Many well-drained ridges are occupied by virgin beech-maple forests unless this forest has been destroyed by fire or lumbering.

2. A typical beech-maple forest is dominated by Acer saccharum, Fagus grandifolia, Betula lutea, Tilia americana, Acer rubrum, Ulmus americana, and Ostrya virginiana. Shrubs are few and there are about 35 typical ground plants almost always present in beech-maple forests together with some ground plants found in several habitats. Many individuals in this ground cover are seedlings.

3. The reforestation of beech-maple forests in 11 areas was studied during 1926 by the quadrat method.

4. Where the area had been lumbered, a dense coppice of Acer saccharum alone has developed, and for a time the ground plants are very few. As the coppice grows older and becomes less dense, seedlings of other species become established and gradually a second growth beech-maple forest develops.

5. Where the fire has been severe, the reforestation process is very slow for the area is first covered with pioneer ground plants, then pioneer shrubs and then the aspen association. From the aspen association the area reverts to beech-maple. However, if the fire is not too severe, the beech-maple forest comes back by means of stump sprouting without going through the aspen stage.

6. Where the area has been or is being pastured, the destruction is gradual instead of sudden and damage is done not so much by destruction of trees already in existence as by the elimination of seedlings. The character of the ground plants is radically changed and some typically beech-maple plants are destroyed while introduced species such as Poa pratensis, Phleum pratense and Trifolium repens take their place.

7. If any of these areas are cultivated for a time after clearing and are then abandoned, the succession is quite long and involved, including a weed stage, a meadow stage and then stages of native ground plants, shrubs and trees to the climax beech-maple forest.

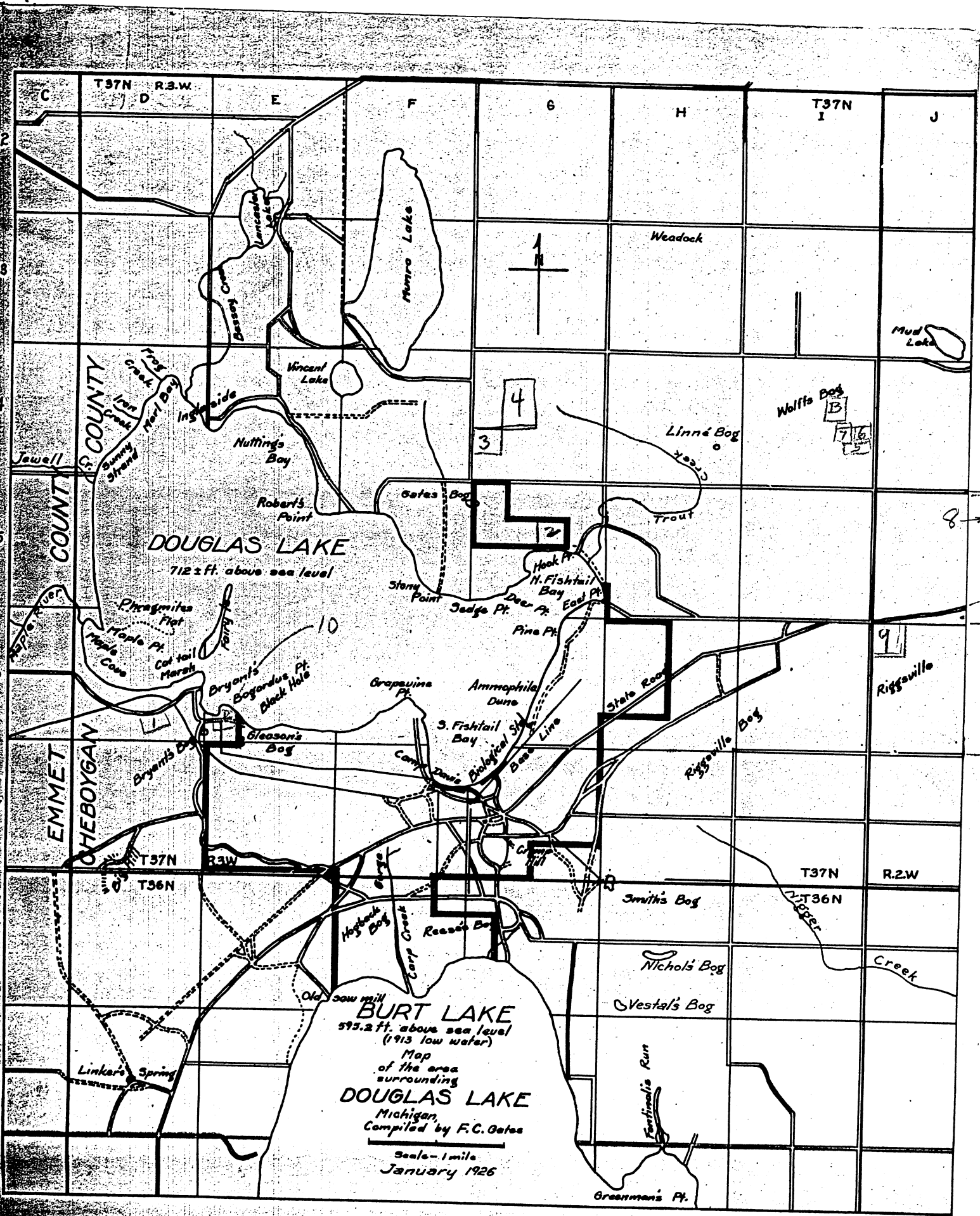
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Legend to Map

Accompanying Woollett and Sigler, Revegetation of Beech-Maple

Map showing location of areas studied. Area "A" is about 7.25 kilometers west of the southwest corner of the map and area "B" is about 16 kilometers northwest of the northwest corner. On both map and insets the squares represent square miles. (Base used is a part of a map of the area surrounding Douglas lake, showing the approximate distribution of principal types of vegetation previous to era of lumbering. (F. C. Gates, Bot. Gaz. 82:172. 1926) Horizontal lining indicates bogs and boggy areas; vertical lining, the Spruce-Balsam forests; diagonals downward towards the right, pine; and diagonal downward towards the left, the beech-maple forest.)



DOUGLAS LAKE
712 ft. above sea level

BURT LAKE
595.2 ft. above sea level
(1913 low water)

Map
of the area
surrounding
DOUGLAS LAKE
Michigan,
Compiled by F.C. Gates

Scale - 1 mile
January 1926

T37N R.3W
T37N I
C D E F G H I J

EMMET COUNTY
CHEBOYGAN COUNTY
Jawell

T37N R.3W
T36N R.3W
T37N R.2W
T36N R.2W

4
3

7
6
5

9

Linker's Spring

Greenmans Pt.