Journal of the Minnesota Academy of Science

Volume 31 | Number 2 Article 5

1964

A Study of the Northern Upland Forest on the Islands of the Whitefish Lake Chain, Minnesota

Roy K. Blowers
Falls Jr. High School, International Falls

A Study of the Northern Upland Forest on the Islands of the Whitefish Lake Chain, Minnesota

ROY K. BLOWERS
Falls Jr. High School, International Falls

Introduction: During an investigation of the area of the Whitefish Lakes, it was noted that two definite types of forest communities existed, a conifer forest and a hardwood forest. It was also noted that each type appeared on different parent soil materials. The problem was actually divided into four parts as follows: How well did the vegetation and the parent material correlate? What was the plant succession in the area? How was the plant succession affected by the parent material? And, how was the resulting soil affected by the vegetation?

It was decided that a forest study of islands would give a more characteristic result than a study of the mainland areas. There are several islands in the Whitefish Lake chain and three were chosen because islands are somewhat protected from the influence of man; they are protected from fire by a natural moat; they are small enough to permit an intensive study because of their natural boundary; they were chosen for their location in the soil areas of the region, two islands being in modified till and the third is in Red drift (Winchell, 1899); finally, they included the different forest types present in the region.

The islands are located in the north central part of Crow Wing County, Minnesota, and are in the Whitefish Lake chain. They are:

Juster's Island	– T 137, R 27, NW¼, NW¼, Sec. 17 and NE¼, NE¼, Sec. 18.
O'Brian Island	– T 137, R 28, SW¼, NE¼, Sec. 15.
Arrowhead Island	– T 137, R 28, SE¼, SW¼, Sec. 9.

Juster's Island and O'Brian Island are located in modified till, while Arrowhead Island is located in Red drift (Winchell, 1899).

Vegetational Background: Potzger (1953) indicates that the forest succession subsequent to the glaciation was chiefly of conifers. He also indicates that jack pine was undoubtedly the initial pine followed by red and white pine which were followed by the spruces and fir. In the middle of the 1800's much of the area was covered with large stands of virgin red and white pine. The red pine was limited to the modified till while the white pine grew on heavier soils (Winchell, 1899). Stenlund (1955) indicates that most of these stands were eliminated by fire and axe during the period 1890-1920.

Following destruction of the forest, a new growth appeared and was aided by increased fire protection. It is in a highly variable state at this time, however, for trees with an economic importance are cut as rapidly as they reach marketable size.

Methods: The random pairs method for the selection of woodland trees was used (Cottam and Curtis, 1949). Twenty pairs of trees were measured on Juster's and Arrowhead Islands. O'Brian Island was large enough to warrant the use of 40 pairs of trees. The islands were mapped by establishing a base line and gridding them into squares 100 feet on a side. Pairs of trees were taken at every grid crossing and an additional number of points so that the total would equal 20 or 40 pairs of trees. Data were recorded on forms.

Soil samples were taken at each grid point. Only the upper layer was collected and analyzed. It has been shown that correlations between this soil layer and the vegetation are more marked than with any other soil layer, largely due to the fact that this layer is most quickly affected by the decomposition of plant remains (Partch, 1949; McIntosh, 1950). Tests for potassium, phosphate, and pH were done by the Soil Testing Laboratory of the University of Minnesota. The moisture-holding-capacity of each sample was tested.

The presence of herbs was recorded from the quadrats, 3.3 feet on a side, at each point. Seedlings were recorded from this quadrat. Saplings were taken along a belt transect between the pairs of trees.

Plant species were collected when identification was questioned and were identified, if possible, by qualified personnel.

Results and Discussion: O'Brian Island was found to contain some 7.16 acres and to have a Continuum Index (C. I.) number (Brown and Curtis, 1952) of 824.9. This indicates that it has progressed slightly toward the climax, indicated by the C. I. number of 3000. Importance values, (I. V.), (Brown and Curtis, 1952) for the tree species present are as follows: Northern-pin oak, 95.1; red pine, 68.3; jack pine, 46.7; paper birch, 33.2; large-toothed aspen, 24.45; trembling aspen, 20:5, basswood, 8.8; and red maple, 2.95. The importance values of the dominant trees correspond closely with C. I. numbers found by Brown and Curtis (1952). There are 257 trees per acre in this stand.

O'Brian Island has the following frequency of occurrence for seedlings: Northern-pin oak, 15%; trembling aspen, 5%; red maple, 5%; paper birch, 2.5%; large-toothed aspen, 2.5%. Red maple is the only seedling reaching sapling size, its frequency of occurrence is 2.5%.

Herbs occurring in this stand and not on the other two are as follows: *Antennaria* sp., *Aquilegia canadensis*, *Gaultheria procumbens*, *Linnea borealis*, *Lycopodium obscurum*, and *Solidago* sp. It was noted that the density of two herbs was in correlation with the C. I. *Carex* was dense on O'Brian Island but decreased with an increase in C. I. on the other two islands. *Araila nudicaulis*, however, was the opposite with direct correlation between its density and the C. I.

Arrowhead Island was found to contain some 3.05 acres and to have a C. I. of 1742. Importance values for the trees are as follows: Basswood, 123.8; northern-pin oak, 66.2; paper birch, 47.7; sugar maple, 18.01; ironwood, 12.8; large-toothed aspen, 12.0; white pine, 7.8; bur oak, 6.5; and butternut, 5.8. There are 257 trees per acre in this stand.

Arrowhead Island has the following seedling frequency of occurrence: Sugar maple, 50%; red maple, 5%; white oak, 5%; bur oak, 5%; and basswood, 5%. The only seedlings to reach sapling size were red maple and sugar maple, each with a frequency of occurrence of 10%.

The number of herbs found on this island was considerably smaller than the number found on the other two islands. O'Brian Island had a total of 30 species, Juster's Island had a total of 26 species, while this island had a total of 22 species of herbs. There were seven species found on this island and not on the other two. They were: *Clintonia borealis*, *Cornus canadensis*, *Diervilla Lonicera*, *Pteridium aquilinum*, *Sanquinaria canadensis*, *Smilacina racemosa*, and *Solidago flexicaulis*.

Juster's Island was found to contain some 2.02 acres and to have a C. I. of 2345. The dominant trees on this island are sugar maple and basswood. The I. V. of the species of trees on the island are as follows: Sugar maple, 127.3; basswood, 103.7; bur oak, 21.7; white pine, 18.1; ironwood, 11.9; white oak, 7.4; paper birch, 6.6; jack pine, 6.6; and northern-pin oak, 6.2. There are 218.8 trees per acre in this stand.

Juster's Island has the following seedling frequency of occurrence: Sugar maple, 65%; white oak, 5%; basswood, 5%; and American elm, 30%. The only seedlings to reach sapling size are sugar maple, the frequency of occurrence being 20%.

The herbs present on this island and not present on the other two islands are as follows: *Achillea millefolium*, *Cornus alternifolia*, *Hepatica americana*, *Smilacina stellata*, *Smilax herbacea*, and *Vaccinium pennsylvanicum*.

The average water-holding-capacities for the soil samples were as follows: O'Brian Island, 48.5%; Arrowhead Island, 52%; and Juster's Island, 53.5%. In the case of these three stands the water-holding-capacity increased with a corresponding increase in the C. I. Brown and Curtis (1952) had similar findings in Wisconsin.

The pH for the stands was as follows: O'Brian Island, 6.4; Arrowhead Island, 6.7; and Juster's Island, 6.3. This does not correlate with the C. I. Available phosphate, in pounds per acre, was as follows: O'Brian Island, 175; Arrowhead Island, 95; and Juster's Island, 175. This does not correlate to the C. I. but it does follow parent material type. Available potash, in pounds per acre, was as follows: O'Brian Island, 95; Arrowhead Island, 120; and Juster's Island, 150. This correlates directly with the C. I. Alway, Kittredge, and Methley (1933) noted a progressive increase in potash as stands progressed from conifer to hardwood.

By checking the I. V. for each tree species and comparing it to the C. I. of the stands, some generalizations of these tree species and the stands to which they belong can be made. Northern-pin oak decreases in importance as the stand goes toward the climax, as does large-toothed aspen. Red pine and trembling aspen are present in the O'Brian Island stand but not in the others indicating the pioneer stand by the pioneer tree species. Paper birch increases, as indicated by the climax adaptation number (Brown and Curtis, 1952), and then decreases to a lower value as the stands go toward climax. Bur oak per cent in both of the higher C. I. stands would increase in I.V. because of the long life making a large diameter tree, with an increase toward climax and then a disappearance in a stand with a high C. I. from lack of reproduction. White oak is present in the Juster's Island stand as one large individual which gives no indication of its place in the community. Ironwood is of almost equal importance in the two more advanced stands, Juster's Island and Arrowhead Island, as an understory tree. Jack pine is present as a dominant in the pioneer stand of O'Brian Island and is a pioneer species. It is present only on the wind swept point of Juster's Island. Butternut is present on Arrowhead Island as a few individual trees indicating the last of a few survivors of the mid-pioneer class of community. White pine is present in the Arrowhead Island, and like the butternut indicates the last of the survivors of the mid-pioneer community as a few relic trees. Red maple is a low importance tree in the pioneer stand on O'Brian Island, but, it does indicate that the stand is advancing. Basswood increases from a low importance tree in the pioneer O'Brian Island stand to a tree of high importance in the stand on Arrowhead Island and a slightly less important tree in that of Juster's Island. Sugar maple increases in importance as the stands go toward the climax.

Conclusions: With due regard for the factors affecting the stands, such as time, actual glaciation, and adjacent vegetation after denudation, the following conclusions were drawn. Vegetation did not seem to be controlled by parent material but could be aided by it; the plant succession in this area is toward a sugar maple – basswood climax; the parent material has little to do with the plant successive stages, except in the time used to complete each stage; and the vegetation changes the resulting soil to support the higher climax forest.

Literature Cited

Alway, F. J., J. Kittredge, and W. J. Methley. 1933. Composition of the Forest Floor Layers Under Different Forest Types on the Same Soil Type. *Soil Sci.* 36:387-398.

Brown, R. T., and J. T. Curtis. 1952. The Upland

Conifer-hardwood Forest of Northern Wisconsin. *Ecological Monog.* 22:217-234.

COTTAM, G., and J. T. CURTIS. 1949. A Method for Making Rapid Surveys of Woodlands by Means of Pairs of Randomly Selected Trees. *Ecology* 30:101-104.

MCINTOSH, R. P. 1950. Pine Stands in Southwestern Wisconsin. *Wis. Acad. Sci., Arts, Letters, and Trans* 40: 243-258.

PARTCH, M. L. 1949. Habitat Studies of Soil Moisture in Relation to Plants and Plant Communities. (Unpublished Ph.D. Dissertation, Univ. of Wisconsin).

POTZGER, J. E. 1953. Bogs of the Quetico-Superior Country Tells Its Forest History. *The President's Quetico-Superior Committee* Chicago, Illinois, 26 pp.

STENLUND, MILTON H. 1955. A Field Study of the Timber Wolf *(Canis lupus)* on the Superior National Forest, Minnesota. *Technical Bulletin Number* 4. Minnesota Dept. of Conservation.

WINCHELL, N. H. 1899. Geology of Minnesota, Vol. IV, the Final Report. *The Geological and Natural History of Minnesota.*

BOTANY

Sporulation of Helminthosporium dictyoides *on Filter Paper* [1]

G. A. BEAN AND ROY D. WILCOXSON
University of Minnesota, St. Paul

Helminthosporium dictyoides Drechs. and *H. sativum* Pam. King and Bakke were the fungi most commonly isolated from plants of *Poa pratensis* L. infected with leaf spot in Minnesota during 1960-1962. *H. dictyoides* has not been implicated as a pathogen of *P. pratensis* (it is pathogenic on *Festuca* spp.) and so studies on its physiology and pathogenicity seemed necessary. Such work usually requires a large quantity of spores but *H. dictyoides* sporulated sparingly on the acid potato – dextrose agar used for isolating it from the plant tissue. We decided to study methods for inducing abundant sporulation as preliminary work for the more basic studies to follow.

Methods and Results: H. dictyoides grew profusely on water agar, water agar plus sterilized plant material (1), V-8 juice agar (5), Sachs agar (6) and Czapeks agar (5) largely as submerged mycelium, but sporulation was very poor at room temperature.

Lukens (4) found that *H. vagans* Drechs. sporulated on filter paper and so this method was evaluated and found satisfactory for *H. dictyoides*. The fungus was grown aseptically in a synthetic medium (3) for several days. Then the mycelium was fragmented for 2 minutes in a blendorizer. The fragmented hyphae were filtered out of the medium and suspended in a 0.02 M phosphate buffer (pH 6.4). Two ml. of this suspension were poured over dry Whatman No. 1 filter papers in Petri dishes.

H. sativum and *H. dictyoides* sporulated abundantly on the filter papers within 2 days but H. vagans did not sporulate, even with the method developed by Lukens with this fungus. Apparently this method will not be satisfactory for every isolate of *Helminthosporium*.

When the experiment was repeated, the dishes containing the filter papers were placed at 7°, 19°, and 27°C. At intervals the filter papers were examined for spores with a dissecting microscope. *H. sativum* sporulated abundantly at all three temperatures. Sporulation by *H. dictyoides* varied with the temperature at which the cultures were incubated (Table 1). Sporulation began within 24 hours at 19° and reached a maximum after 72 hours. Sporulation began after 48 hours at 7°C and after 72 hours at 27°C. Mycelial growth of the fungus was not apparent after 24 hours at 7° and 19°C, but it was sparse at 27°C. It was sparse after 48 hours at 7° and 19°C., and abundant at 27°C.

After 72 hours the cultures at 7° and 27°C were placed at 19°C. to determine if these cultures would sporulate. Those which had been kept at 27°C, where growth was largely mycelial, did not increase sporulation. The isolates, kept initially at 7° C where growth began slowly, began to sporulate rapidly when placed at 19°C and within 48 hours appeared to sporulate as profusely as did cultures kept continuously at 19°C.

The size of the conidia of *H. dictyoides* varied with temperature. At 19°C the size of 100 conidia was as follows: range –: 45.5 – 101.5 x 14.0 – 24.5 microns, (av. 83.6 x 18.9 microns); septa: 2 – 7 (av. 5.3). At 7° C the size was as follows: range –: 91.0 – 220.5 x 14.0 – 24.4 microns, (av. 142.1 x 19.9 microns), septa: range: 4 – 12, (av. 8.3). These differences are shown in Figure 1. At 27°C so few conidia were formed that it was not possible to determine the size accurately.

Light is often reported to influence sporulation of fungi (2). Cultures were prepared on filter paper. Some of the dishes were wrapped in aluminum foil and all were placed on the laboratory table. The cultures in continuous darkness sporulated as profusely as those which were continuously illuminated (natural plus fluorescent).

One experiment also was made to determine whether

[1] Paper No. 5127, Scientific Journal Series, Agricultural Experiment Station, University of Minnesota, St. Paul 1, Minnesota.