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Hepatics in Brown County, Wisconsin, with an Emphasis on the Corticolous Species

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HEPATICS IN BROWN COUNTY, WISCONSIN
WITH AN EMPHASIS ON THE CORTICOLOUS SPECIES

By

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B. S., Wisconsin State University, Platteville

A Thesis

Submitted in Partial Fulfillment of the

Requirement for the Degree of

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This thesis is recommended for approval by the student's thesis committee.

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(date)

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Hepatics in Brown County, Wisconsin, With an Emphasis on the Corticolous Species

Thesis directed by Dr. Maynard C. Bowers

A sampling of 579 trees at 55 wood lots in Brown County, Wisconsin, the first sample of hepatics taken in the northeastern part of the state, yielded eleven species of hepatics (Cololejeunea biddlecomiae (Aust.) Evans, Frullania brittoniae Evans, F. eboracensis Gottsche, F. inflata Gottsche, F. oakesiana Aust., F. riparia Hampe, Lophocollea heterophylla (Schrad.) Dumort., Porella platyphylla (L.) Lindb., P. platyphylloidea (Schwein.) Lindb., Ptilidium pulcherrimum (Web.) Hampe, and Radula complanata (L.) Dumort.), plus seven additional species (Bazzania trilobata (L.) Gray, Cephalozia connivans (Dicks.) Spruce, Cephaloziella sp. Spruce, Conocephalum conicum (L.) Dumort., Jamesoniella autumnalis (D. C.) Steph., Marchantia polymorpha L., and Riccardia pinguis (L.) Gray) found on substrates other than bark. The presence of many corticolous species was low. Nevertheless it was assumed that the highest presence of a hepatic on the five genera of trees sampled, Acer spp., Betula spp., Quercus spp., Thuja occidentalis, and Ulmus spp., indicates the hepatics preference. The vertical distribution of each species was graphed. The greatest amplitude of each species was near the tree's base.

This abstract is approved as to form and content. I recommend its publication.

Signed Maynard C. Bowers

Faculty member in charge of thesis

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Throughout the study the supervision and suggestions by Dr. Maynard C. Bowers, Department of Biology, Northern Michigan University, Marquette, Michigan 49855, were very much appreciated.

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Introduction

Between 1858, the earliest known collection on record, and 1929, 116 species of hepatics were collected in 34 of the 73 Wisconsin counties (Conklin, 1929). These counties are in the north, west, and south parts of the state, and along the Wisconsin River. Since 1929 two additional collections reported four new species from two of the 34 counties previously sampled. Hale (1952) recorded Frullania plana Sulliv. in Sawyer County, and Schuster (1952) reported Anastrophyllum hellarium (Nees) Schuster, Scapania saxicola sp. n., and Tritomaria exsectiformis (Breidl.) Schiffn. in Bayfield County. Other than these reports there have been no known collections of hepatics.

The literature pertaining to Wisconsin hepatics does not record any specimens collected in Brown County. Therefore, one purpose of the present study is to list the species of hepatics reported for the first time from Brown County. Secondly, this collection presents the opportunity to describe the substrates preferred by the corticolous species. Thirdly, the data recorded while making this collection are used for the construction of graphs to depict the vertical distribution of corticolous species.

Materials and Methods

Brown County is a level to rolling land of glacial origin. The glacial soils are three-fourths clay and one-

fourth sand (Whitebeck, 1915). The eastern half of the county is about 900 feet above sea level and the bedrock is Niagara Dolomite. The west-facing Niagara escarpment extends from the northeast corner to the southwest corner of the county (Fig. 1). The land west of the escarpment is about 700 feet above sea level, with a bedrock of Ordovician limestone, dolomite, and shale. The Fox River flows northeast over the Ordovician bedrock to Green Bay. Green Bay and Lake Michigan 30 miles to the east modify the county's climate. The mean number of days of precipitation is 168 days a year, and the average annual precipitation is 28 inches. Three-fourths of the year the prevailing winds are southwesterly but in March, April, and May are northeasterly. The mean temperature for January is 16.8 F. and July 70.5 F., and the extreme temperatures are -36 F. and 104 F.

Most of the time visability is clear with little observable air pollution. One exception is the blue-white smoke that is blown into the county from the Thilmany Pulp and Paper Co., to the southwest in Kaukauna. This smoke has a hydrogen sulfide odor.

Over 15 percent of the county is forested. Fifty-five wooded plots, ten acres or larger in size, were randomly selected from topographic maps. Twelve plots had ravines in them, with the rest of their surface flat to rolling, 16 plots had a creek passing through, five had more than two-thirds brush cover, and seven were covered with one-third to two-thirds brush. The plots were not densely forrested.

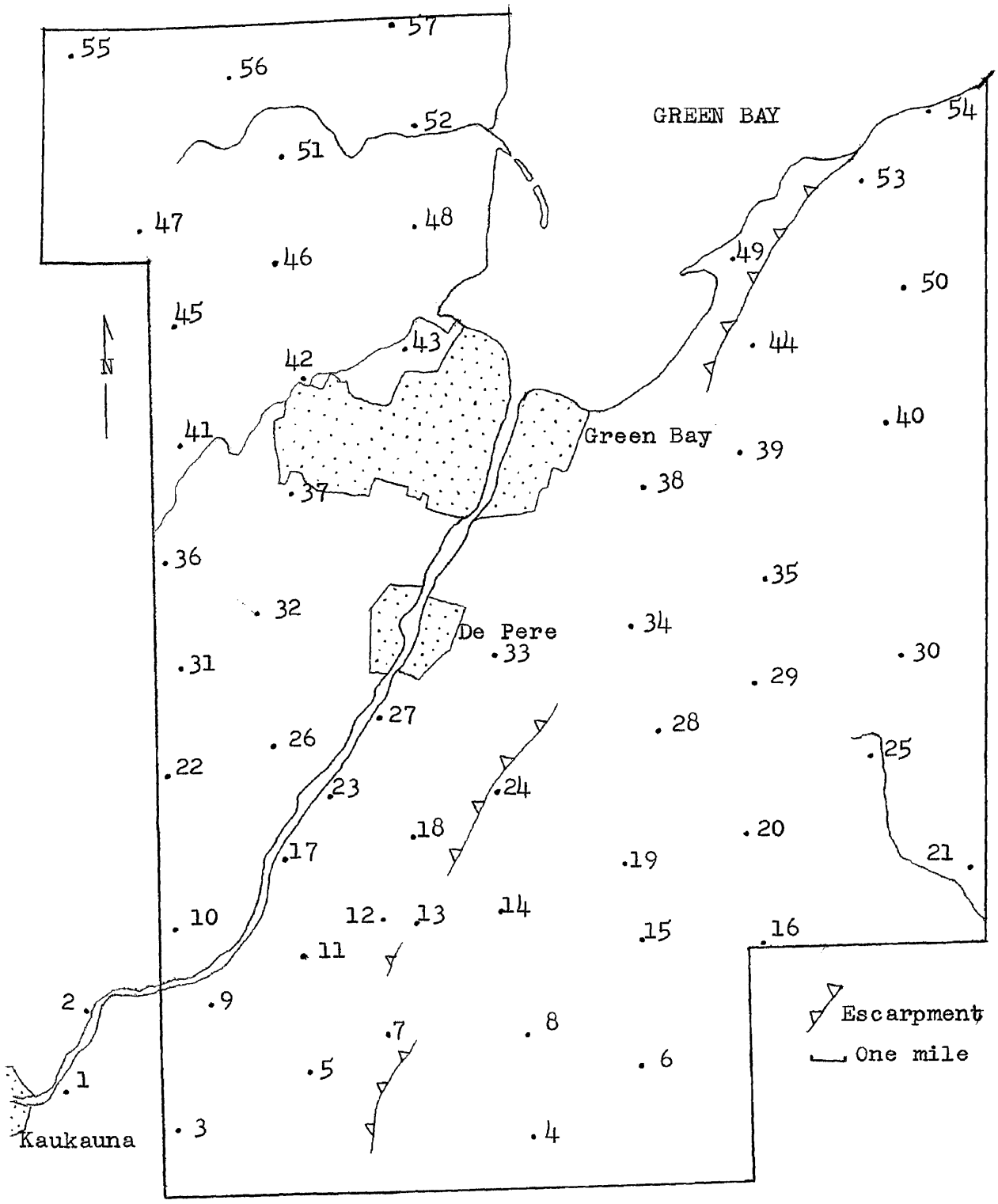


Figure 1. Brown County with numbered collection sites, and escarpment location. Numbers one and two are in Outagamie County.

The predominant trees were oak and elm, each representing about one-third of the total tree population. Collecting was done on maple (Acer spp.), birch (Betula spp.), oak (Quercus spp.), cedar (Thuja occidentalis L.), and elm (Ulmus spp.). Barkman (1958) did not record the species in most of his studies because in the Netherlands trees of the same genus, disregarding species, usually have the same surface relief. This was also found to be true in the present study.

In all plots, four trees of each genus, if present, were chosen at random. The maple, oak, and elm had diameters of eight to 24 inches at breast height. Due to the lack of larger birch a few had smaller diameters of six to eight inches. Records were kept of the hepatic's vertical range. A few specimens were taken from each tree and placed in separate paper bags. More than one species of Frullania Raddi could possibly be on a tree with but one species collected, but because a few species have similar macrosopic characteristics, this error could not be avoided. If at any time hepatics were seen growing on logs, stumps, rocks, soil, or other substrates, they were collected for possible additions to the county list.

Several keys were used in identifying the collections. Schuster (1953) was most useful because he gives an extensive list of species collected in Michigan, Minnesota, and Wisconsin. The extensive list of species in Frye and Clark (1947) made their key quite useful. Keys by Conard (1956), Steere (1940), and Arzeni (1950) were helpful in obtaining a general concept of the macroscopic characteristics.

Difficulty was encountered in classifying four species. Porella platyphylla (L.) Lindb. and P. platyphylloidea (Schwein.) Lindb. seemed to differ only slightly. Conard (1956) states that these two species are doubtfully distinguishable. For this reason records of both species are combined. A few Frullania species posed some problems, especially in the case of the sterile plants. Some of the somatic characteristics are not fully dependable for identification of species. In F. inflata Gottsche, for example, the most distinguishing characteristic is its flat lobules (ventral lobes), where as the lobules on F. eboracensis Gottsche are consistently inflated (helmet shaped) Schuster (l. c.). Therefore specimens with flat lobules (not inflated) having some of the other qualifying characteristics for F. inflata were classified as such.

Results

Eleven species of hepatics were found on the bark of the 579 trees sampled. Many of the 11 species and seven additional species were found on substrates other than bark. Below is a list of the 18 species collected in Brown County. Those collected at a site other than one shown on the map (Fig. 1) have their locations included. Locations of species collected at one or more of the sites on the map are expressed in Table 1.

The occurrence of a hepatic on a tree regardless of the level is referred to as "presence". If a species occurs

Species List

Bazzania trilobata (L.) Gray. On decaying stump, in a Thuja occidentalis L. woods on the north shore of Lily Lake. Lat. 44° 25' 45" N. and Long. 87° 51' W.

Cephalozia connivans (Dicks.) Spruce. On decaying log.

Cephaloziella sp. Spruce. On decaying log on edge of spring emptying into the East River. Lat. 44° 24' 30" N. and Long. 88° 3' W.

Cololejeunea biddlecomiae (Aust.) Evans.

Conocephalum conicum (L.) Dumort. On soil.

Frullania brittoniae Evans.

Frullania eboracensis Gottsche.

Frullania inflata Gottsche.

Frullania oakesiana Aust.

Frullania riparia Hampe.

Jamesoniella autumnalis (D. C.) Steph. On decaying log.

Lophocolea heterophylla (Schrad.) Dumort.

Marchantia polymorpha L. On soil in the valley of Baird Creek two miles east of Green Bay. Lat. 44° 30' N. and Long. 87° 55' 30" W.

Porella platyphylla (L.) Lindb.

Porella platyphylloidea (Schwein.) Lindb.

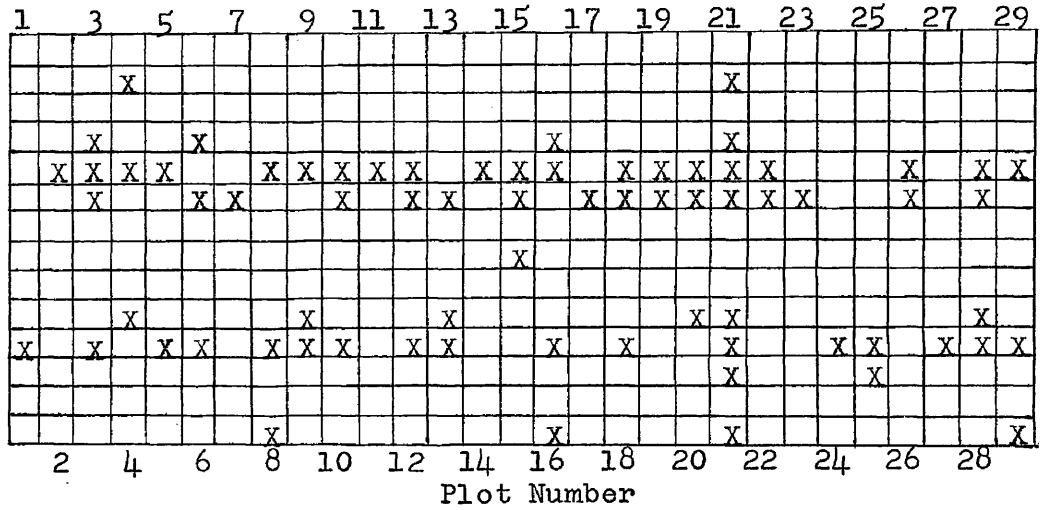
Ptilidium pulcherrimum (Web.) Hampe.

Radula complanata (L.) Dumort.

Riccardia pinquis (L.) Gray. On soil along creek edge in a Thuja occidentalis L. woods, two miles east of De Pere. Lat. 44° 28' 30" N. and Long. 88° 1' W.

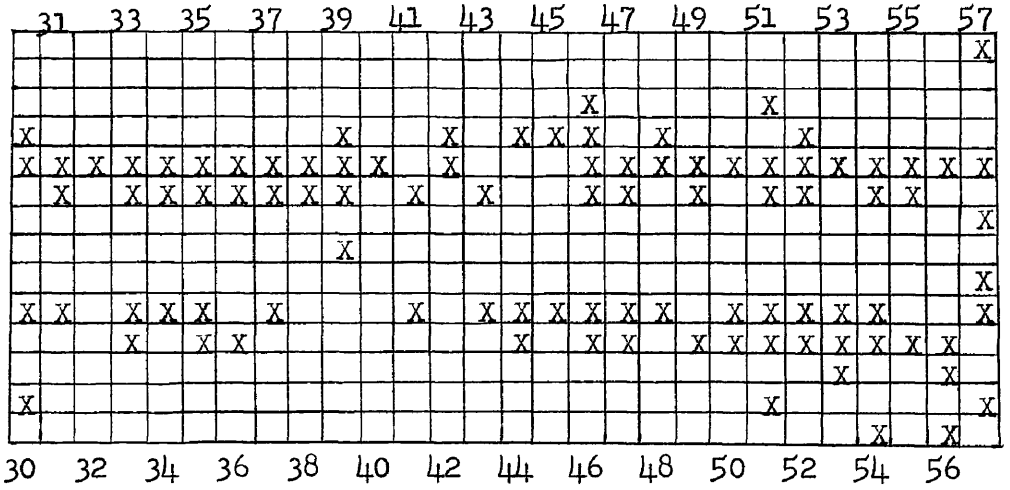
Table 1. The hepatics found on the plots sampled in Brown County, except for the plots 1, and 2, which are in Outagamie County. The location of the plots are on the map of Figure 1.

Plot Number



Cephalozia connivans
Cololejeunea biddlecomiae
Conocephalum conicum
Frullania brittoniae
Frullania eboracensis
Frullania inflata
Frullania oakesiana
Frullania riparia
Jamesoniella autumnallis
Lophocolea heterophylla
Porella platyphylla
Porella platyphylloidea
Ptilidium pulcherrimum
Radula complanata

Plot Number



Cephalozia connivans
Cololejeunea biddlecomiae
Conocephalum conicum
Frullania brittoniae
Frullania eboracensis
Frullania inflata
Frullania oakesiana
Frullania riparia
Jamesoniella autumnallis
Lophocolea heterophylla
Porella platyphylla
Porella platyphylloidea
Ptilidium pulcherrimum
Radual complanata

on 20 of 100 trees, it has a presence of 20 per cent. Lophocolea heterophylla (Schrad.) Dumort. has the greatest presence of all species collected, 32 per cent on the birch. Of the five genera of trees studied, Porella platyphylla and P. platyphylloidea have their greatest presence on the elm and oak. Their presence on these two genera of trees is about 14 per cent each. Frullania eboracensis has the highest presence on the oaks, and second highest on the elm. The presence of F. inflata is the highest on the oaks, about 23 per cent, more than twice that found on the elm. Radula complanata (L.) Dumort., found almost exclusively on cedar, has a presence of 15.2 per cent. As for the other corticolous species collected their presence values are very low.

Frullania eboracensis is the most widespread corticolous species. It is found more often on all genera of trees than any other hepatic observed in this survey. Lophocolea heterophylla, F. inflata, and species of Porella are the next most widespread species. The presence value of each corticolous species collected is expressed in Table 2.

From the vertical distribution data, graphs were constructed. Quadrats are often used when studying corticolous plants. With quadrats one can construct graphs of vertical distribution by the use of a "constant", the number of times a specific quadrat contains a species divided by the number of times the quadrat was sampled, then expressed as a per cent, but it would seem, however, that the use of the quadrat

Presence Values

Table 2. The presence is expressed in per cent. The number of trees sampled is that number below the name of the tree.

Genus of tree Number sampled	Elm	Oak	Birch	Cedar	Maple	Average
Cololejeunea biddlecomiae	.9		.8	6.0		1.5
Frullania brittoniae	3.2	2.2	1.6	6.0	3.0	3.0
Frullania eboracensis	23.4	30.5	5.6	18.1	9.0	17.5
Frullania inflata	10.0	22.8	.8	9.0	12.1	10.9
Frullania oakesiana	.5					.1
Frullania riparia	.9					.2
Lophocolea heterophylla	2.3	1.7	32.0	21.2	6.0	12.6
Porella platyphylla and P. platyphylloidea	13.6	14.2	1.6	6.0	6.0	8.2
Ptilidium pulcherrimum			1.6			.3
Radula complanata	1.8	.7	2.4	15.2		3.8

for graphing would miss subtle variations. In this study the actual vertical range has been recorded on graphs. Therefore, when constructing the graphs, the constant was determined for every inch up to the eight foot level. Only those species that have a constant of greater than eight per cent, at some level on the tree, are graphed here (Fig. 2).

Lophocolea heterophylla is limited to the very base of birches, cedar, and maples. At times they are found growing up from the soil onto the tree or often in shaded crevices. Often damp logs are also a place of inhabitation. Porella species and Radula complanata are not as limited to the very base of the trunk, but growth is restricted to the lower two feet. While the plants of Frullania eboracensis, and F. inflata have a wide vertical range they tend to grow in greater profusion below the two foot level. The species found most often higher up on the trees is F. eboracensis.

Discussion

The 18 species recorded from Brown County seems few compared to the 120 previously collected in Wisconsin. The collecting was done primarily in small wooded lots, not necessarily selected because they seemed to be ideal habitats for hepatics. Additional species could probably be located along lakes and in swamps, marshes, bogs, and large wooded lots, but such habitats are uncommon in the county. Also a greater emphasis on substrates other than bark may reveal more species.

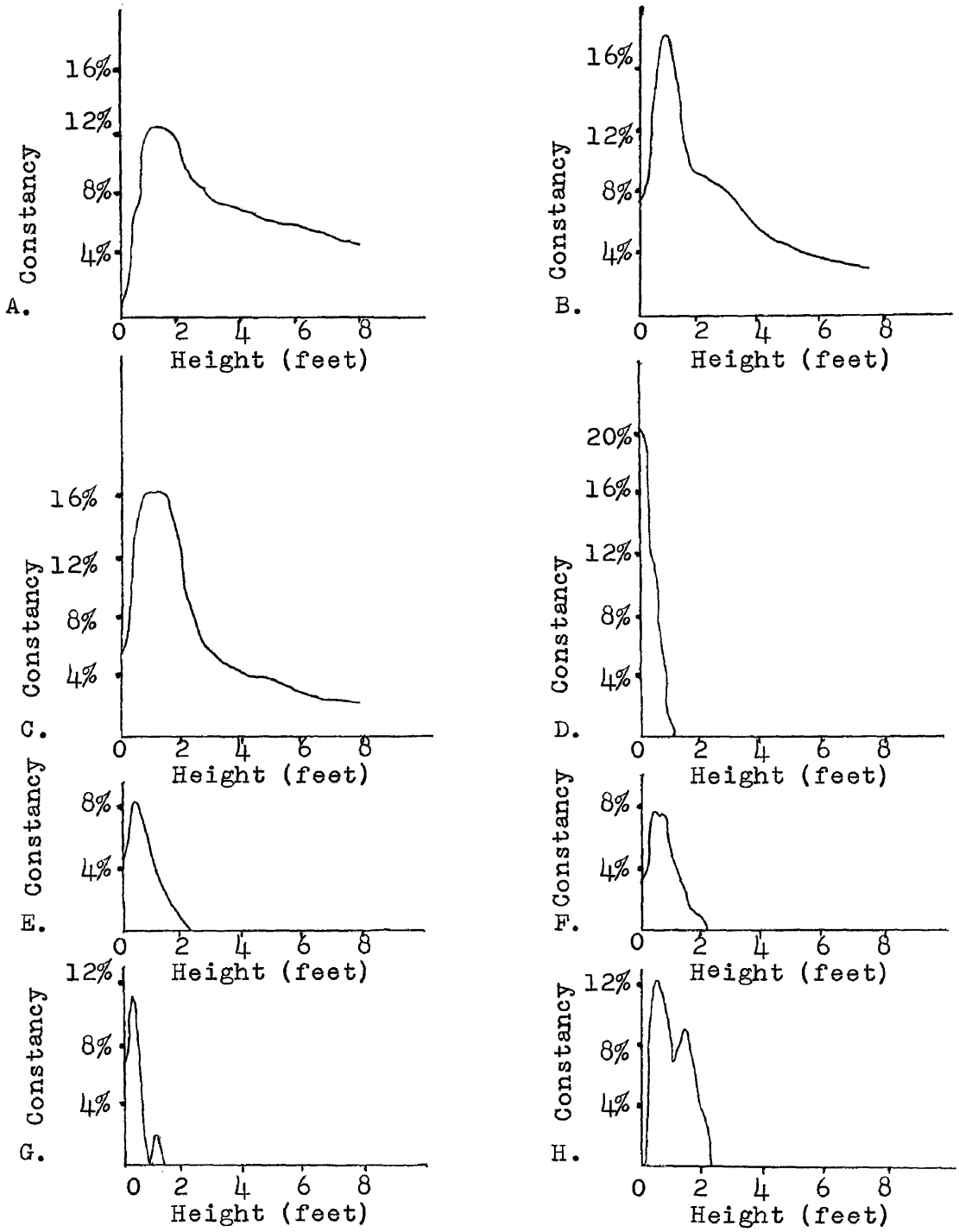


Figure 2. Graphs of the vertical distribution profile: A. Frullania eboracensis on elm, B. F. eboacensis on oak, C. F. inflata on oak, D. Lophocolea heterophylla on birch, E. Porella platyphylla and P. platyphylloidea on elm, F. are the same two species on oak, G. L. heterophylla on cedar, and H. Radula complanata on cedar.

The available moisture would also affect the variety of species. The 28 inches of precipitation could be inadequate for some species. Desiccation is accelerated by the winds blowing across open fields into the wood lots. Systems that produce toxic gases are abundant in Brown County and include industries, home furnaces, and piston-driven vehicles. These gases may inhibit the growth of hepatics. It was noted that the presence was lower, and there are fewer species found near Green Bay and Kaukauna. This is especially true on the northeastern sides of the cities, where the prevailing winds would bring noxious gases.

The presence of hepatics would also be affected by the conditions described in the above paragraph. Hale (1952) reported the presence on the trees sampled in a northern Wisconsin forest to be 70 per cent for Frullania eboracensis, 70 per cent for the two Porella species and ten per cent for Radula complanata. The presence of these three species in Brown County is much lower indicating a less ideal environment for these species.

Even though the presence values are low, they are used here as an indicator of tree preference. Lophocolea heterophylla shows the most pronounced preference for the birch and their environment, and is also common on cedar. The Porella species prefer oak and elm. Frullania eboracensis and F. inflata prefer oaks most, then elm, and cedar to a lesser extent.

Besides the hepatics having a preference for a specific bark environment, they also are found at definite levels on the trees. It is very likely that moisture, wind, and light, greatly influence the vertical distribution of the hepatics. By all indications Lophocolea heterophylla has the characteristics of an epixylic species in that it is found growing on damp logs, on soil, and in the shade at the base of trees sampled. Porella species and Radula complanata are not so restricted to the very base of the trunk as is the previous taxon, but growth is restricted to the lower two feet. Porella species probably depend on the moisture in the furrows of the bark, rain tracks, and the mosses among which they often grow. Radula complanata probably depends on the humid, shaded, environment present near the base of the smooth barked cedar. Frullania eboracensis with its consistently inflated lobules, enabling it to hold water, is the most xerophytic species collected; it was usually found growing higher up on the trees than any other hepatic.

It is interesting to note that F. eboracensis and F. inflata are more prolific at the base of oaks than at the base of elms. These two hepatics are probably intolerant to excessive amounts of moisture, and probably they require a definite amount of light. In this county elms tend to prefer lower, wetter areas than the oaks. Many elms have keel-like structures extending up onto the trunk from the horizontally growing roots. These keels protect the base from wind,

and the direct rays of the sun. The low intensity of light reaching the base probably does not support the growth of these hepatics. The vertically homogeneous oak bark probably offers a more ideal homogenous microclimate from the base up to the two-foot level. Hence, F. eboracensis and F. inflata grow from the oak's base up to a level where conditions become intolerable.

Summary

The identification of 18 species of hepatics from Brown County is an addition to information on the hepatics. Very likely additional collecting will yield other species, especially if a wide variety of habitats and substrates are sampled. In that the other northeastern counties are lightly populated, have a great deal of forested land, and a variety of habitats, a more extensive list could very likely be recorded from them than from Brown County.

Five hepatics have a definitely high presence value, each, on one or two specific tree genera. With this in mind, when one collects, he could increase the chances of finding these five species by collecting from the trees they are most often found on. Also it would seem that one would make the best use of time and effort if the search is carried out on the lower two feet of the trees. In that while making this study the greater percentage of hepatics were found inhabiting the lower two feet of the trees.

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