A BOTANICAL INVENTORY OF BEAR LAKE BOG

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ABSTRACT

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By

Phoebe Anne Hunter

Bear Lake bog, included within Michigan State University's Bear Lake Natural Area in Lansing, Michigan, is a Sphagnum bog developed in a glacial kettle-hole. The original pre-settlement vegetation has been badly disturbed by lumbering, fires, and changes in the water level. At present six vegetational zones are recognized: the Chamaedaphne-Decodon mat, mature bog forest remnants, high shrub zone, Betula-Larix zone, marginal fosse, and north fence clearing. The greatest species diversity occurs in the two most disturbed zones, the marginal fosse and north-fence clearing. A total of 168 species of vascular plants has been collected from the bog.

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A THESIS

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INTRODUCTION

A bog is a dynamic soil-water-vegetation complex which both forms under and causes conditions unfavorable to the growth of most plants. A water-filled acid or alkaline basin or a water-logged plain in a cold, wet climate favors bog formation, but once the successional stages begin, the bog, despite climatic moderation, perpetuates and may even extend the area of poor drainage. Whatever the pH of the original site, a bog creates an acid soil (Lems, 1956; Dansereau and Segadas-Vianna, 1952). Bogs occur in a variety of forms, but common to all, indeed required for their formation, is restricted water circulation and drainage. Various species of Sphagnum usually make up much of both the living ground cover and the poorly decomposed to completely rotted organic material or peat which forms the acid soil typical of peat bogs (Rigg, 1940; Moore and Bellamy, 1974; Vitt and Slack, 1975). Sphagnum creates acid conditions by secreting hydrogen ions and absorbing cations, especially those of iron, magnesium, calcium, sodium, and potassium (Bell, 1959).

Although the terms bog, swamp, and marsh are sometimes used loosely and interchangeably to mean any very wet vegetational complex, they can be more precisely defined. According to Gates (1942, p. 217):

> A bog is an area of vegetation developing in undrained or poorly drained situations, which by the development of a mat invading open water, forms a cover over a body of water.... The term bog thus includes pre-eminently a type of vegetation which controls a habitat and changes the habitat, in the course

> of its development, from an open area of water to a mat and then to a grounded mat and finally to dry land. ... in fact a bog may be defined as an area vegetated by a flora in which peat-forming types of plants (including certain herbaceous, ericaceous shrubs and coniferous trees) are particularly abundant.

In contrast, the term swamp connotes a better drained area, or at least one with more water circulation, without an invading, acidifying Sphagnum mat and with characteristic, often deciduous, trees. A marsh is similarly wet, but without trees or a Sphagnum mat.

Included in the general term bog are muskegs, hochmoors or raised bogs, and flachmoors or lowland bogs. Muskeg is generally taken to mean the more or less vast, flat expanses of peat and associated forest (usually spruce dominated) developed on low, poorly drained plains in the far north, sometimes over permafrost (Bird, 1972; Gates, 1942; Ritchie, 1956). Hochmoors are upland or raised bogs developing not in basins but within rings of Sphagnum. They are most common in northern Europe but can also be found in eastern North America, especially in New Brunswick where cool temperatures and high humidity allow their development (Baas-Becking and Nicolai, 1934; Gates, 1942). Some attempts have been made to classify raised and flat bogs as oligotrophic and eutrophic respectively, but the results of investigations have been inconclusive (Rigg, 1940). Flachmoors or lowland bogs included those developed in poorly drained basins, often glacial kettle holes, or in sheltered bays of larger lakes.

Progressing from north to south in North America, bog forms pass from muskeg and tundra to the lowland type with intermediate forms in between. Peat bogs of all types are most numerous at their appropriate latitudes in the moister regions near the coasts, becoming fewer further

inland. They are well-developed in the kettle-moraine regions left by retreating Pleistocene glaciers and in the old lake and river beds ancestral to the present Great Lakes-St. Lawrence system. The lowlands immediately surrounding Hudson and James Bays, still experiencing isostatic rebound since the retreat of the last glacial ice, show extensive peat deposits (Transeau, 1905; Rigg, 1940, 1951; Gates, 1942; Dansereau and Segades-Vianna, 1952; Gauthier, 1971; Bird, 1972; Miller, 1973; Hadden, 1975; Vitt and Slack, 1975).

Although peat bogs reach their maximum development in areas of continental glaciation, they are also found along the east coast of the United States south of the glacial boundary and in the mountains in otherwise unglaciated places; areas of Sphagnum, although not true bogs, are even found in the lowland tropics (Rigg, 1940; Dansereau and Segades-Vianna, 1952). Factors favoring peat decomposition along the east coast below the glacial limit also favor a luxuriance of vegetation not attained in northern bogs, allowing substantial peat build-up despite poor peat preservation. Further south the high temperatures, great evaporation, and varying relative humidity in the tropics cause an even higher rate of decomposition, preventing true peat bog formation and allowing only thin layers of Sphagnum to form in the lowlands. Such areas show little peat development compared to the well-preserved northern deposits which may be as much as 40 feet thick (Transeau, 1905; Rigg, 1940). The remarkable preservative powers of peat not subject to tropical conditions have been of special significance to archaeological and anthropological studies (Glob, 1969).

Formation of a lowland bog of the type found in Michigan begins in a body of water with impeded drainage and minimal wave action. Kettle holes (basins left by the late melting of huge, partially buried chunks of glacial ice) are likely sites. The bottoms of such basins are often of fine, firmly packed clays and sands, much more water-tight than the surrounding, unconsolidated glacial till, and they often have no appreciable stream drainage. Quiet backwaters of larger, otherwise well-drained lakes may also become bogs, as may the small lakes and ponds created by beaver dams.

Whatever the causative agent, such bodies of water do not automatically become peat bogs, but require the gradual invasion of certain plants. In the initial stages, bogs, marshes, and swamps may follow the same line of development. Chara and other algae at depth and Potamogeton, Nuphar, and Nymphaea in the shallow zones may be the first colonizers. The addition of Typha and Scirpus directs further development toward a marsh or swamp. Invasion by a mat-forming, floating species, often of the genus Carex, initiates bog development.

Usually the pioneer floating species in the formation of a peat bog is Carex lasiocarpa. Its floating, matted rhizomes, growing toward open water from the shore, provide an expanding substrate for colonization by other species. Early in the mat-forming stage Sphagnum, Chamaedaphne calyculata, and Decodon verticillatus appear which, with their great capacities for vegetative reproduction and clumping, tangled growth, help expand and solidify the mat. Meanwhile dead vegetation is borne underwater by the weight of new growth on the mat surface, or breaks off and falls to the bottom, gradually filling the basin and

grounding the oldest parts of the mat. Shrubs, principally ericads, appear on the firming mat and in turn are followed by various arborescent species, especially conifers which may be present in bogs well south of their usual range. The bog-grown trees are usually stunted and slow-growing compared to their upland-grown counter parts (Rigg, 1918). The final stage, in areas of otherwise deciduous forest, is invasion by this forest, signaling the end of the bog (Dansereau, 1946; Densereau and Segadas-Vianna, 1952).

Peat build-up continues throughout the successional stages, aided by the low temperatures characteristic of bogs. The settling of cold air into topographic lows is a major cause of this, but the nature of peat and bog vegetation is also a factor. After a peat bog has frozen over for the winter, the air trapped in the loose upper layers of the peat and in the dense shrubby growth at the peat surface acts as an insulative barrier and greatly retards thawing in the spring. Further, the impedence or absence of drainage precludes the warming effects of running water which assist the thawing of other bodies of water. The low, sheltered situations of bogs also lead to earlier frost in the fall. Thus the total period of warmth is reduced at both ends of the growing season.

OBJECTIVES

This study was undertaken to provide an initial checklist of the vascular plants of Bear Lake bog and to determine the vegetational zones within the bog, which is part of Michigan State University's Bear Lake Natural Area. The results of investigations of the bog's history since 1827 are presented as aids to understanding the present vegetational patterns there.

Figure 1. Oblique aerial view of Bear Lake bog from the southeast, July, 1974.

BEAR LAKE BOG

Bear Lake bog is located within the city limits in the extreme southeast corner of Lansing, Michigan, 841 feet above sea level. The bog occupies most of the northeast quarter of section 35 of Lansing Township in the northwest corner of Ingham County. Open water of the lake covers about 15 acres in the center of the bog. Although the natural limits of the bog, expressed by the extent of peat, extend north into section 26 and east into section 36, the north and east boundaries of section 35 were used as the limits for this study, as shown in Figures 4 and 9. On the north the section line is marked by a fence separating Michigan State University property from the nature study area attached to the Beekman Center, a Lansing school for the handicapped. Along the east the section line follows Interstate Highway 496, which cuts across peat and now serves as a boundary for the bog. On the south and west the transition from mineral to organic soil is clearly marked not only by the sound of the soil underfoot but also by the clearly delimited marginal fosse of which the most conspicuous components at present are dead Populus and a thick, head-high tangle of Rubus. The fosse is centered along its length by a slight depression which is water-filled in early spring, feeding into a drainage ditch at the southeast corner and into Sycamore Creek via an extensive swamp at the southwest corner.

Meteorological Factors

Lansing, located nearly equidistant from Michigan's east and west shores, is subject to a more continental climate than locations on the shores. However, a shift westward in the prevailing south-southwest winds may bring in moderating influences from Lake Michigan. Precipitation is quite evenly distributed throughout the year and cloud cover is extensive. Meteorological data for Lansing are presented in Table 1.

Although numerous bogs have persisted throughout Michigan under the present climatic regime, Lems (1956) suggests that this climate is unfavorable for the initiation of new bogs. According to his view, those now present, whatever their progress through the various stages of succession, must have had their origin during the cooler, moister period immediately following the last glacial retreat.

Geology and Soils

Lansing is located on the south wall of the Michigan basin. Directly under the glacial drift which covers Ingham County to an average depth of 100 feet lie the sandstones and shales of the Carboniferous Saginaw formation. Coal is scattered at various depths throughout the county (Leverett and Taylor, 1915; Martin, 1958). The drift covering Ingham County was laid down by the eastern limb of the Saginaw lobe of Wisconsinan glaciation, the final stage of the four recognized Pleistocene glaciations in North America. The Cary substage was responsible for the deposition of this till (Leighton, 1933; Parmelee, 1947). As described by Leighton (1960), this is included in Frye and Willman's more comprehensive Woodfordian substage, the middle of three

Table 1. Meteorological data for Lansing, Michigan. Normals for 1941-1970. (Data from U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service.)

Month	Temperature			Precipitation		Wind		% of possible sunshine	Mean Number of Days						
	Normal	Extremes							Sunrise to Sunset						
	Monthly	Record highest	Record lowest	Normal total	Snow, Ice pellets Mean total	Mean speed	Prevailing direction		Clear	Partly cloudly	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog
J	22.6	66	-17	1.91	11.0	12.3	SSW	36	3	7	21	15	3	<.5	2
F	24.0	54	-24	1.62	9.8	11.7	W	43	4	7	17	12	3	<.5	2
M	32.9	74	-12	2.36	8.9	11.5	W	48	5	8	18	14	3	1	2
A	46.5	85	2	2.90	3.7	12.0	W	52	6	8	16	13	1	3	1
M	56.8	90	19	3.32	T	10.8	S	63	7	10	14	11	0	4	1
J	67.1	96	30	3.47	0.0	9.2	S	66	8	11	11	11	0	7	1
J	70.9	99	37	2.82	0.0	8.4	S	70	9	13	9	10	0	6	1
A	69.5	100	37	2.79	0.0	8.1	S	68	11	11	9	9	0	6	2
S	61.7	97	27	2.63	T	8.8	S	59	8	10	12	10	0	4	2
O	51.6	89	15	2.31	0.5	9.7	S	53	8	10	13	8	<.5	1	3
N	38.4	75	5	2.26	5.9	11.0	S	30	3	7	20	12	2	1	2
D	27.2	65	-17	2.00	10.9	11.5	SSW	29	3	7	21	15	3	<.5	2
Year	47.5	100	-24	30.39	50.7	10.4	S	53	75	109	181	139	15	34	23

Wisconsinan substages. Although there is some disagreement about the age of the Cary, Flint (1971) places it between 14,000 and 15,000 years ago.

Two of Michigan's most well-known glacial features are within a mile of Bear Lake. As shown in Figure 2, the Lansing moraine and Mason esker lie just north and west, respectively. The Lansing moraine is the oldest of a possible series proceeding northeast toward Saginaw Bay and lying within the Charlotte moraine. The Mason esker is notable as one of the longest eskers on record, its length estimated to be 20 miles or more. It has been much disturbed by excavations for its component gravel (Leverett and Taylor, 1915; Martin, 1958).

The soils derived from the glacial drift are gray-brown podzols of the Miami-Dodge-Conover types.

> These soils occur in a nearly level to rolling landscape. They are well drained (Miami and Dodge), and imperfectly drained (Conover) soils with grayish brown, medium to slightly acid, silt loam to sandy loam surfaces. They have developed from calcareous loam to silt loam glacial till.... Humic-Gley and Organic soils occur in the associated depressions (NCR 3 Committee, 1960, p. 92-93.)

Figure 3 shows the arrangement of the various upland soils contiguous to the bog. Notable are the presence of imperfectly drained Conover to the east and northeast of the bog where there is no flowing stream and the occurrence of Miami to the south and west where Sycamore Creek provides drainage.

Topography

The topography of a *Sphagnum* bog can be considered at two levels. The growth habit of many typical bog plants--*Nemopanthus mucronatus*,

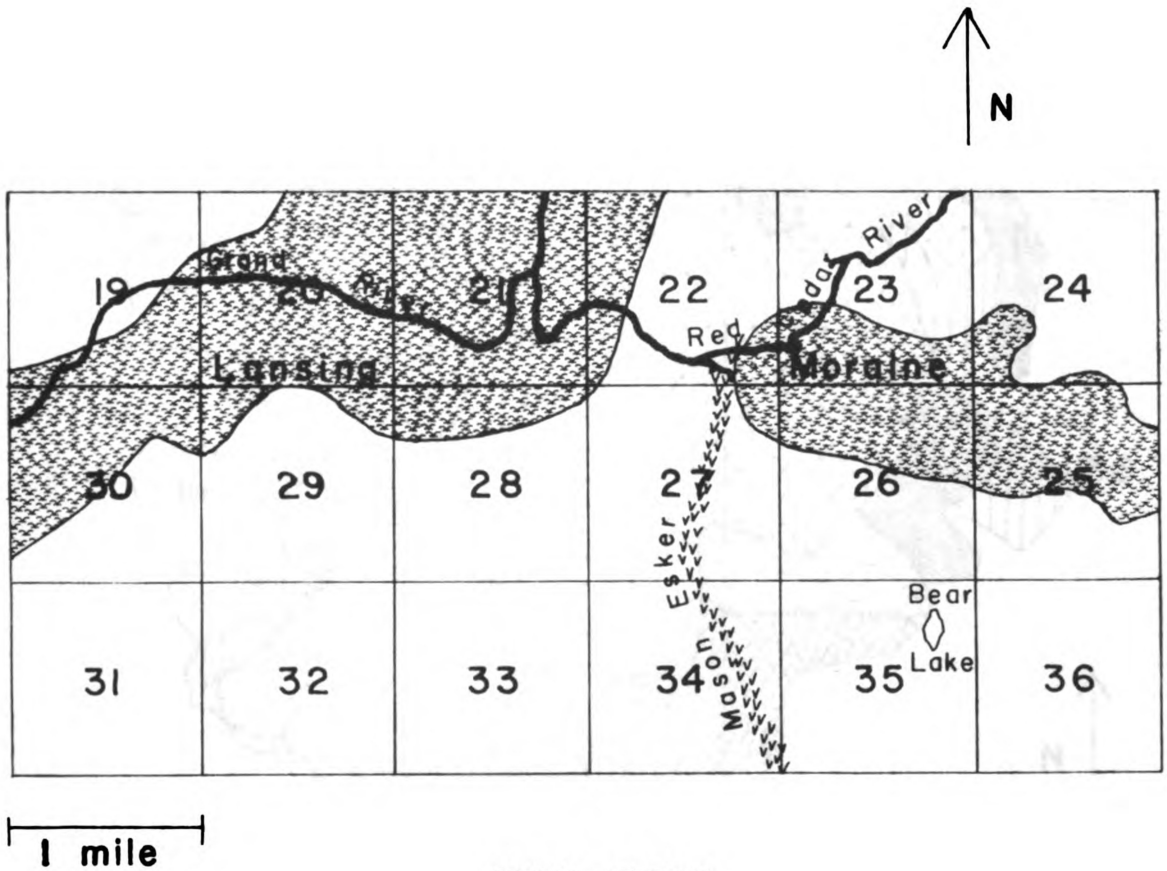


Figure 2. Glacial features in Lansing Township, Ingham County. (After Martin, 1958 and Ingham County Road Commission road map, 1963.)

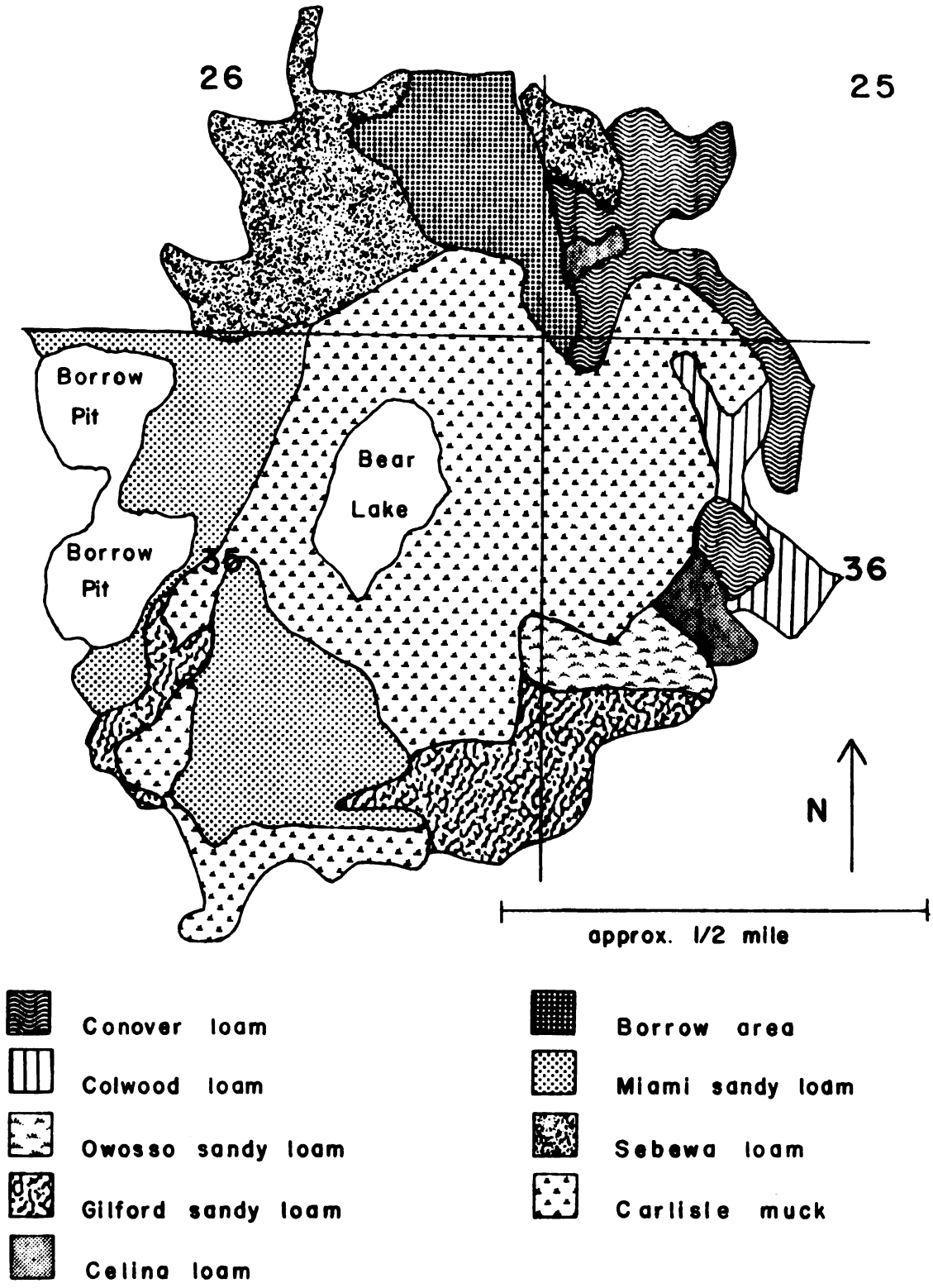


Figure 3. Upland soils contiguous to Bear Lake bog.

Vaccinium corymbosum, and Chamaedaphne calyculata, for example--produces a hummocky sort of surface with Sphagnum growing in small mounds about the bases of these shrubs. Even some arborescent species promote this pattern: Betula populifolia is noted for its clumping habit, and both Larix laricina and Picea mariana are capable of sending out adventitious roots into the Sphagnum growing around their bases, building up mounds of the moss (Hosie, 1969; Beeftink, 1951). Ice and fire action also contribute to hummock formation (Auer, 1930). This, although it produces a miniature landscape with considerable relief, is hardly sufficient to explain larger variations in elevation.

Although a peat-filled depression might be expected to have no major topographic variation, considerable relief is nevertheless possible (Auer, 1930; Simard, 1974). It will be noted, on the map shown in Figure 4, that surrounding the present lake, the bottom of which is 23.5 to 26 feet below the peat surface, is an almost complete ring of higher elevation (Parmelee, 1947). I suspect that this may have resulted from fires which have swept through the bog from time to time. (A more detailed discussion of the fires and their causes is presented in a later section.) A fire in any bog will affect least those parts nearest water. Thus any floating mat, water-logged like a giant sponge and holding water up to 30 times its dry weight, will be relatively safe from severe burning (Simard, 1974). However, grounded mat, like muck soil, is susceptible to incendiary destruction, especially during a dry season. Peat, especially well preserved, fibrous peat, has been purposely cut and dried for fuel for centuries, and it is no less flammable in situ if sufficiently dry (Darling and Boyd, 1964).

Logging operations are notorious for opening an area to fire, as seen in northern Michigan where the stands of white pine were logged off. In the same way the logging around Bear Lake, leaving a marginal fringe of forest at the lake's edge, paved the way in the cut-over, slash-covered areas for fires which burned into the peat, leaving a ridge of higher elevation where standing forest kept the water table high enough to retard burning of the supporting peat.

The formation of a depressed marginal fosse or moat has been interpreted by Gates (1942) as the result of ice action on the very young mat's shoreward edge. It has also been suggested that subsidence of the peat, caused by water uptake by nearby trees, is responsible (Parmelee, 1975). This may well explain the original formation of the south and west fosse of Bear Lake, but the effects of fires and natural drainage into Sycamore Creek must also be taken into account. The newly forming east fosse appears to be a result of drainage alterations caused by filling, as discussed in a later section.

Early Postglacial Vegetation

A detailed analysis of the postglacial vegetational history of the region of Bear Lake bog as revealed by stratigraphic pollen sequences has been presented by Parmelee (1947). At the lowest levels *Picea* and *Abies* are found, apparently survivors of a previous dominance. The decline of *Picea* and elimination of *Abies* are coincidental with a rise in *Pinus* followed by a rise in *Quereus* as the climate grew warmer and drier. These trends accord well with those reported in other glaciated areas in northeastern North America (Auer, 1930; Miller, 1973;

Hadden, 1975). The clearly defined sequences are followed by somewhat indistinct, anomalous fluctuations in the proportions of Fagus, Ulmus, and Quercus. Toward the upper levels Picea and Pinus show a second moderate rise, interpreted not as climatic reversion but as invasion of solidifying bog mat, and Tsuga enters the spectrum. The Larix and Betula now dominant never reach even a five percent representation. Due to differential preservation of pollen and the occurrence of Tsuga, now entirely absent from Bear Lake, the pollen spectrum is not accepted as an indicator of bog forest composition immediately prior to settlement. A detailed account of the postglacial migration of typical bog plants of southern Michigan has been given by Crow (1969).

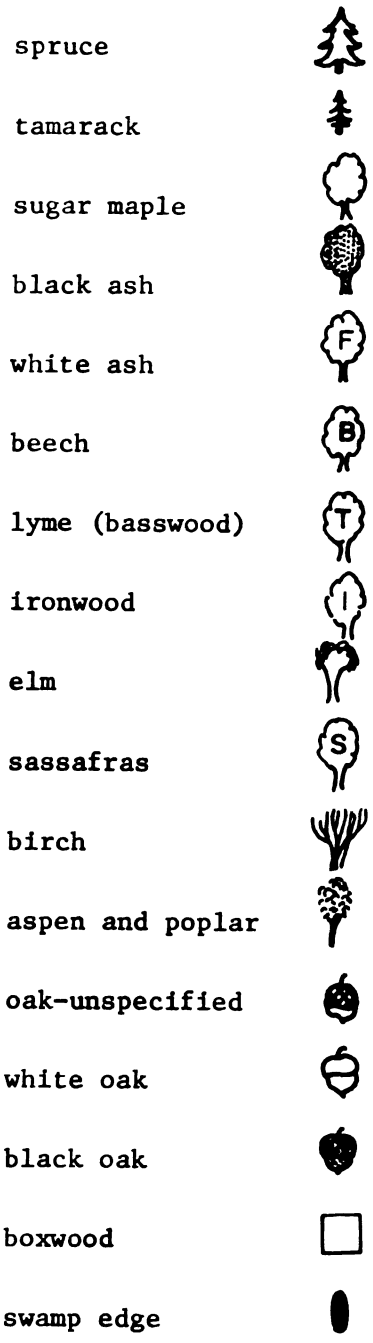
Recent History

The first recorded observations of Bear Lake bog vegetation appear to be those made in February, 1827, by deputy surveyor Musgrove Evans during the General Land Office survey which established Michigan's township, range, and section boundaries. His report is filed in the Lands Records Office, Lands Division, Department of Natural Resources in Lansing. Unfortunately for this study the section lines do not pass through the heart of the bog to the lake; indeed, it is quite likely that Evans never saw Bear Lake or any vegetational zones which may have immediately surrounded it, for the map drawn for his final report does not show the lake. However, the north and east boundaries of section 35 (the north and east boundaries of this study) do traverse the natural limits of the bog, and Evans' observations along them are pertinent to a consideration of the original vegetation.

As shown in Figure 5 the timber Evans found on the adjacent uplands was typical of what now occurs both on the mineral soils south and west of Bear Lake and in other nearby woodlots (Beaman, 1970). However, the trees he noted along the section lines which cut across organic soil suggest a bog forest quite different in aspect from the present one. Each time he encountered bog forest Evans referred to it as "very bad spruce swamp." Only once in the total two miles along the section's north and east sides did he mention tamarack and birch which now exhibit a striking dominance. The spruce stand which was impressive nearly 150 years ago is now limited to perhaps no more than 24 well-grown individuals within ten meters of the lake at its southeast and northwest corners, with an occasional seedling in the outer vegetational zones.

Understandably, land recorded in the surveyor's office, then at Detroit, as "bad spruce swamp" was not among the first parcels claimed by farming settlers, especially when surrounding land was reported to be "very good land", supporting rich beech-maple forests. According to records filed in the Ingham County Register of Deeds Office at Mason, in 1858 Samuel S. Coryell obtained the patent for the northeast quarter of section 35, which is almost entirely bog, from the United States government. Various pieces of the north half of section 35 changed hands several times until 1890 when there arose some confusion over the boundary between land owned by John Robinson and Smallwood and that owned by Zigler (Robbison and Zeigler or Ziegler as they are variously spelled in the register). In that year John McCreary, county surveyor, chained the north-south quarter section line through section

Figure 5. Timber reported in the survey of 1827.



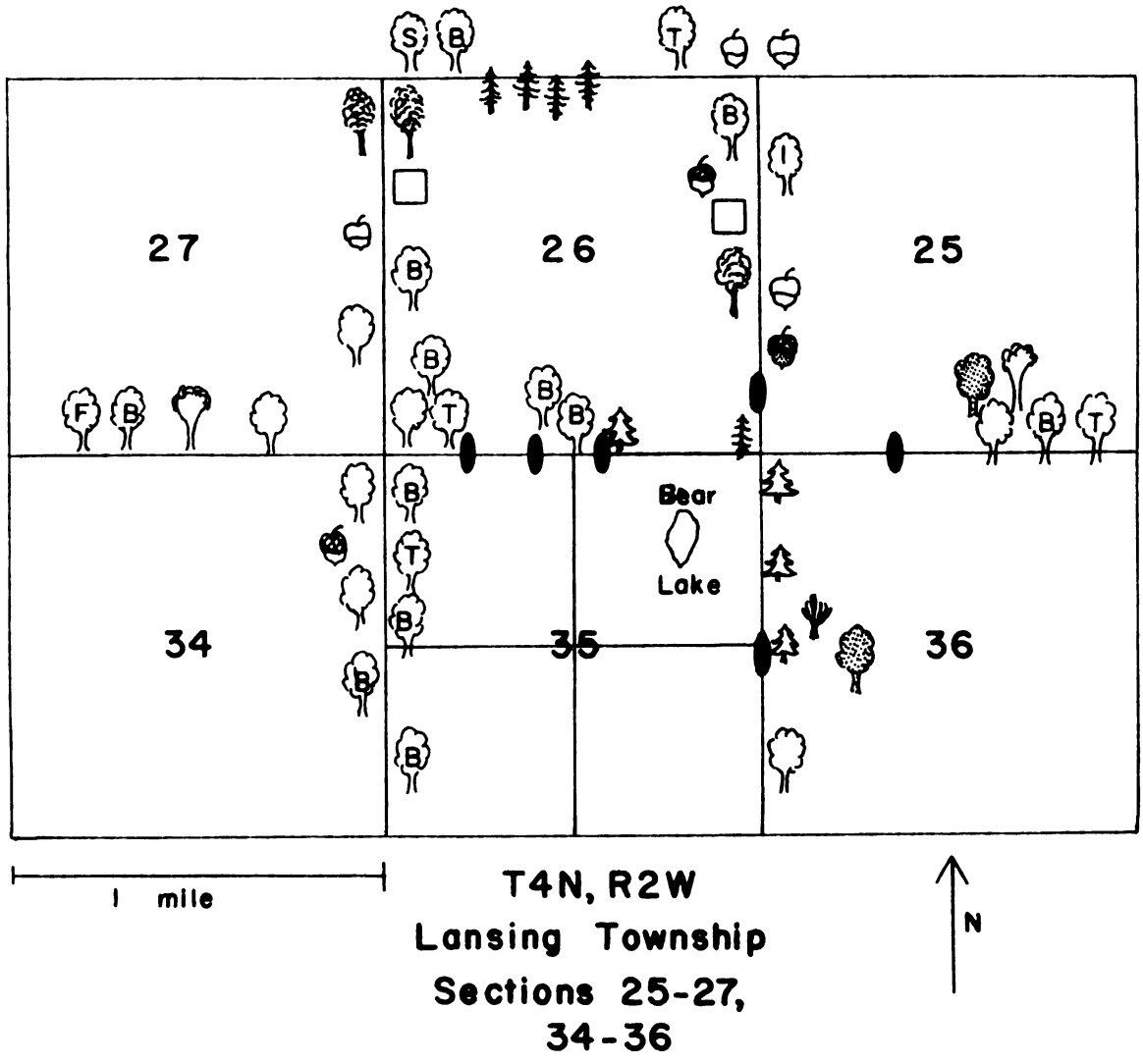

27
26
25
34
35
36
Bear
Lake
1 mile
T4N, R2W
Lansing Township
Sections 25-27,
34-36
N

Figure 5

35, to the west of Bear Lake, but was unable to chain the north-south and disputed east-west line within the northeast quarter "... on account of watter the swamp being wholey in accesable [sic]." Despite the bog's inaccessibility, the presence of a lake at its center was known by then for the map accompanying McCreary's report, now filed in the Register of Deeds office, shows Bear Lake, labeled with that name (see Figures 6-8).

Evidently the 1890 survey did not settle the boundary dispute, for in March of 1909 county surveyor R. J. Robb again surveyed the two parcels. This time, however, the east-west line was chained and line stakes set every twenty rods from the west edge of the section to the shore of the lake. This opening of the "wholey in accessable" swamp was due to fires, brought on by various drainage attempts and lumbering operations.

Fire has had a profound effect on Bear Lake bog since the 1870's. At that time drainage tiles were laid and the level of the lake was lowered about four feet at the southwest corner, perhaps in an attempt to reduce the incidence of malaria that so troubled Lansing's early residents. Within the next five years two fires swept through the bog. Just after the turn of the century clear-cutting was undertaken to supply the demand for fence posts. Abandoned, rusting rolls of fencing in the Betula-Larix zone east of the lake, now firmly anchored by the shrubs that have grown through them remain as relicts of this time. The lumbering and its resultant slash brought on more fires "... which, according to Mr. Andrews [a resident of the vicinity between about 1887 and 1947], have raged periodically for the last 40 years. [1907-1947]

Figure 6. Report of the Ingham County survey of Bear Lake bog, 1890, and accompanying map.

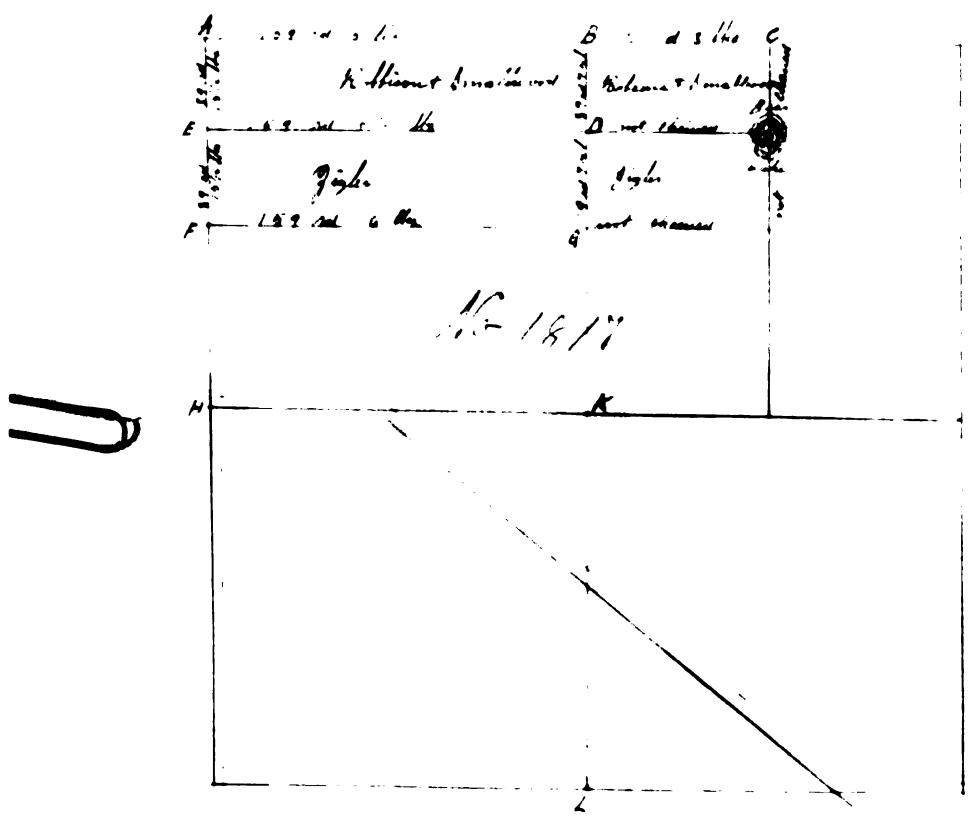


Figure 6

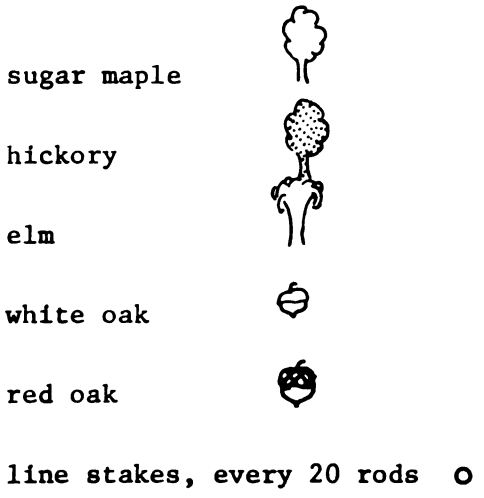
Figure 7. Marker trees cited in the survey of 1890.

Corner	Timber	Dia.	Bearing	Dist.	Corner	Timber	Dia.	Bearing	Dist.
A Stone	Elm	20	S 32° 60' W	95 3/4					
" "	Sugar	20	N 6° 10' W	232 3/4					
B Set Stone	not A tree near enough								
C Set post in swamp	no tree near								
D Post + stone	Hick	18	S 67 1/4 E	117					
E Stone + rocks	Maple	18	S 35 E	100 3/4					
" " Brick + glass	Elm	7	N 88 1/4 W	57					
F Stone + brick	Sugar	8	S 40 1/4 E	81					
" with broken tile	Bittersweet Hick	10	S 34° 60' W	125					
G Post and	Tree near								
H Stone + glass	Sugar	6	S 66 W	96 1/2					
" " "	Sugar	6	S 34 3/4 W	89					
K Post in	Sup. 8 feet high								
L Post 001 + 002	W Oak	14	S 3° W	288					
" "	Elm	9	S 34 W	245					

Figure 7

Figure 8. Timber reported in the county surveys of 1890 and 1909.

(Note: Bear Lake is shown here as it appears on the county surveyors' maps; it should be drawn more nearly in the center of the northeast quarter section.)



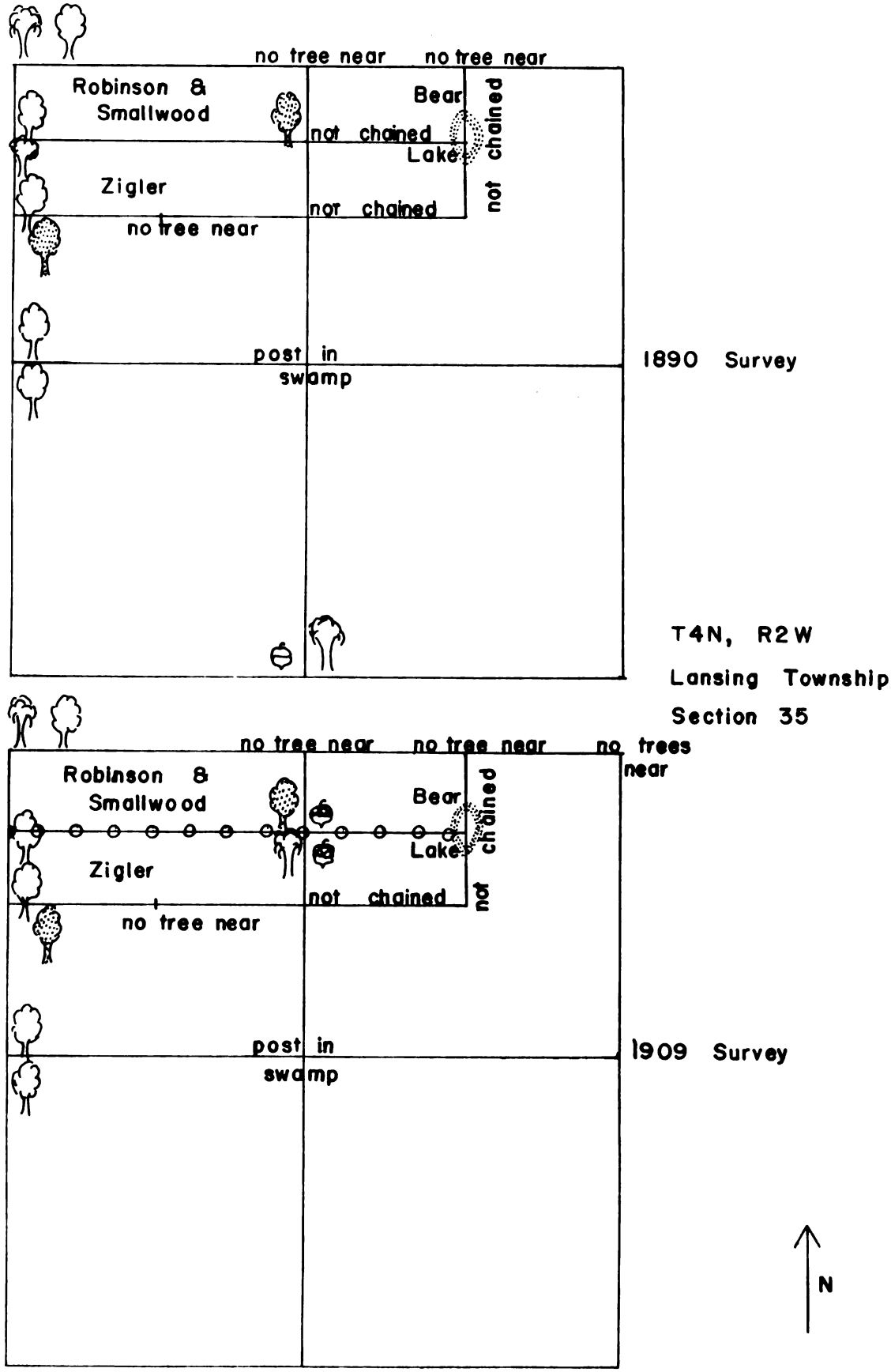

no tree near
no tree near
Robinson &
Smallwood
Bear
Lake
not chained
not chained
Zigler
not chained
no tree near
post in
swamp
1890 Survey
T4N, R2W
Lansing Township
Section 35
no tree near
no tree near
no trees
near
Robinson &
Smallwood
Bear
Lake
not chained
Zigler
not chained
no tree near
post in
swamp
1909 Survey
N

Figure 8

Especially clear in his memory are the fires of 1907 and 1908, ashes of the former conflagration having covered the lake to considerable depth and killed fish 'by the wagon load.'" (Parmelee, 1947, p. 30.) The large larches, maples, and spruces now at the lake's edge are survivors of the 1907 fire, preserved by their proximity to water. The present sweeping expanse of competition-intolerant Betula populifolia mixed with the equally shade-intolerant Larix laricina and the thick tangle of living and dead Populus tremuloides in the marginal fosse bear convincing witness to the effects of those fires (Hosie, 1969). It is interesting to note that the original forest remembered by Mr. Andrews was tamarack, not spruce. The tamarack may have achieved its dominance over spruce after the fires of the 1870's, being the more fire-resistant of the two species (Beeftink, 1951).

Fire and lumbering have not been the only forces attacking the vegetation. Alterations in the natural drainage patterns of the area have also had a hand in changing the aspect of the original spruce forest. Construction of Interstate Highway 496, which began with the Michigan State Highway Department's acquisition of access land in 1962, led to compaction of the soil north of the bog where construction equipment was stored and an access road put through. For about half a mile the highway is built on fill in an excavation through the peat substrate. The fill supports the highway as intended, but the culvert that was run under the highway for drainage empties along the east side of the bog so that a swampy marginal fosse is now forming in the low area paralleling the west edge of the highway embankment. Together this north and east fill and compaction areas separate the present bog

from about a quarter of the original catchment area. As yet the east fosse is not as extensive as that on the south and west sides, but Salix discolor, Populus tremuloides, and Typha latifolia are present and apparently thriving although continued high water is beginning to take its toll of Populus.

A century after the intentional drainage attempts in the 1870's, some unintentional drainage occurred. In 1971 part of the northeast corner of Bear Lake and land to the west was owned by Edward F. Solomon of S. D. Solomon and Sons, a Lansing road building and excavating firm. The company had been working three deep borrow pits just west of the lake and excavation proceeded so far east that seepage from the lake was noticed (Flinn, 1969). It was only after court action that fill was added which has apparently halted the drainage. The high water levels of 1971 were part of a trend of progressive inundation first noticed in 1968 which has continued to the present. Evidently road construction just south of the bog has disrupted the southwest drain installed in 1890, causing a steady rise in the water level. Measurements made at the culvert under the road show a fluctuating, but rising, water level (Parmelee, 1969, 1970, 1971).

The effects of a fluctuating water level are nowhere more immediately apparent than in the marginal fosse along the south and west sides. Here acres of dead Populus, far outnumbering living trees, stand or lie in varying stages of decay in a lush, diverse growth of aggressively weedy species.

Michigan State University's ownership of what is now known as Bear Lake Natural Area has come about by the gradual acquisition of

parcels of varying size, beginning with a 67-acre tract purchased from August Schlack in 1965. The most recent purchase was completed in December, 1974; the lake and most of the surrounding bog and uplands are now University property. Hopefully this ownership and the designation of the lake and bog as part of a natural area will protect both from further depredations. Presently the area is used by the University for teaching and research; local residents frequent it for blueberries and ice skating and a bit of illegal hunting for rabbit, squirrel, deer, and perhaps for duck, pheasant, and woodcock.

RESULTS AND DISCUSSION

Observations and plant collections were carried out at Bear Lake bog from September, 1973 through May, 1975. Measurements of pH, reported in Table 2, were taken in the field 27 April 1974, with a Beckman model G pH meter. Transects were run in late August, 1974, along the cardinal compass points from the lake shore to the boundaries of the study area. Every ten meters the species present within a one-meter-square quadrat were recorded. The results, presented in Tables 3-6, were used to assist in the delimitation of the vegetational zones shown in Figure 9.

Table 2. Bear Lake pH readings, 27 April 1974.

Location	Water Temperature	pH
Open water	17° C	6.9
Root hole (under *Acer rubrum*) in grounded mat, 2 meters from open lake water	10	5.2
Sphagnum swale on grounded mat, east of lake 15 meters, under *Larix laricina*	16	3.6
Floating *Sphagnum* mat at south end of lake	15	4.1

Vegetational Zones

At present there are six major vegetational zones in Bear Lake bog. Moving from the lake outward these are a Chamaedaphne-Decodon mat, mature bog forest remnants, high shrub zone, Betula-Larix zone, marginal fosse, and the north fence clearing. As discussed in a preceding section, disturbances have profoundly altered the original zones. Thus, although there are some similarities between the zones present in this bog and those reported by other writers, there are marked differences.

Chamaedaphne-Decodon Mat

This is one of the smallest of the zones recognized, well developed only in the southeast corner. Some minor development is also found in a small patch along the west shore and as small clumps of growth near the southwest and northwest corners. This zone is the pioneer floating mat, with a luxuriant, deep growth of Sphagnum filling in the open web formed by the intertwined roots, rhizomes, and stems of Chamaedaphne calyculata and Decodon verticillatus. Other authors (Gates, 1942; Dansereau and Segadas-Vianna, 1952; Crow, 1969) have reported that Carex lasiocarpa, Potamogeton, Nuphar, and Nymphaea are of primary importance in the establishment of a floating mat, but in Bear Lake bog these taxa now appear to be absent and the pioneer niche is filled by Decodon verticillatus. This species, with its long, arching stems, is capable of rooting at the tips when they touch water or soil. Its extensive rhizome and root systems form a tangled mat buoyed up by the plants' copious aerenchyma (Blaisdell, 1974). A thin fringe

of Decodon surrounds most of the lake, but has led to the formation of a substantial Sphagnum-covered mat only in the southeast corner of the lake.

The floating mat can be divided into two intergrading subzones. Nearest the water is an area of expansion. It tends to be little consolidated, loosely matted together, with numerous holes not yet filled in with Sphagnum, which makes walking on it risky at best and usually impossible. In the youngest sections water can still be seen between the plants. Species diversity is low--Chamaedaphne calyculata, Decodon verticillatus, and an occasional tuft of Sphagnum or Osmunda cinnamomea make up the entire list in this subzone.

The established floating mat subzone occurs just within the expansion subzone. All the species present in the expansion subzone are found here as well as some typical bog plants: Triadenum virginicum, Drosera rotundifolia, Sarracenia purpurea, Calla palustris, Eriophorum virginicum, Vaccinium macrocarpon, Toxicodendron vernix, and seedlings of Larix laricina, Acer rubrum, Betula populifolia, and B. alleghaniensis. The mat in this zone, although still floating and less than reliable underfoot when heavily saturated in the early spring, is usually quite trustworthy and will support the weight of several persons without giving way.

On the west side of the lake, where a trail comes out at the water's edge, there is a small area of established mat. A few Drosera rotundifolia and Vaccinium macrocarpon can be found in tussocks of Sphagnum growing about the bases of seedling Larix laricina and Betula

populifolia, but within three or four meters of shore the high shrub zone takes over.

Mature Bog Forest Remnants

Two thin, disjunct areas are still covered with remains of mature bog forest. A nearly complete band, about ten meters wide, surrounds all the lake except for a few gaps, the largest on the west side. At the south end of the bog, separating the fosse from the high shrub zone is another band of about the same width. The principal species present are Larix laricina, Acer rubrum, and Betula alleghaniensis. In the northwest corner near the shore the best developed Picea mariana can be found, with a few rather stunted individuals also growing with the very large Larix in the southeast corner on the landward edge of the Chamaedaphne-Decodon mat. Toward the northeast end of the lake some very large Quercus bicolor can be found. A few of the shrubs dominant in other zones are found here: relatively small specimens of Vaccinium corymbosum, Nemopanthus mucronatus, Ilex verticillata, and Aronia melanocarpa. There are herbs as well, some of which are found nowhere else in the bog: Trientalis borealis, Maianthemum canadense, Carex trispermum, C. artitecta, and especially Cypripedium acaule. This orchid deserves some special mention; it is the only member of its family collected in the bog, but appears in remarkable abundance, forming light carpets in some areas up to several meters square.

Around much of the lake this zone extends to the water's edge, forming a hard "coast line," with perhaps an occasional Decodon at the margin. The firmest shoreline is along the east and northeast sides of

the lake, which is probably a result of wind and/or wave action from the southwest.

The mature bog forest south of the lake is somewhat different in character. Here there are no spruces or Betula alleghaniensis, but growing with the Larix and Acer is a much thicker, more diverse shrub undergrowth and a higher diversity of herbs, presumably moving in from the south fosse immediately adjacent. In addition, there are some large living Betula populifolia, as well as decaying stumps up to about 15 cm in diameter.

High Shrub Zone

A dense, nearly impenetrable zone of tall shrubs surrounds Bear Lake, occurring just outside the inner mature bog forest remnants. This zone is one of low diversity--Vaccinium corymbosum, Nemopanthus mucronatus, and Aronia melanocarpa dominate, with an occasional Ilex verticillata on the east and south sides, Amelanchier arborea near the water on the west, and Betula pumila on the north. Seedlings of all the bog trees are scattered widely. The understory is principally Sphagnum, Rubus hispidus, Woodwardia virginica, with some Toxicodendron radicans and assorted Carices as well as other herbs of more limited occurrence.

On the south this zone is bordered by the mature bog forest remnant previously discussed; on the west it grades directly into the marginal fosse. To the east and along most of the north edge it is a comparatively narrow zone, with a rapid transition into the Betula-Larix zone.

Betula-Larix Zone

This zone, present only north and east of the lake, is another area of low diversity. Betula populifolia and Larix laricina dominate strikingly, growing in an almost open, park-like zone. Scattered small specimens of Vaccinium corymbosum and Aronia melanocarpa are also present, growing in a nearly continuous carpet of Rubus hispidus and Sphagnum. Scirpus cyperinus is also prominent in this zone. The bog's two known pines, one seedling each of Pinus sylvestris and P. strobus, are here as well. This zone shows the effects of the bog's disturbed history. Betula populifolia and Larix laricina are both shade intolerant and become established only after invading an open area, such as this was. Scirpus cyperinus, normally a swamp species, typically becomes established in bogs only after disturbance (Transeau, 1905).

Marginal Fosse

The outermost zone of Bear Lake bog is a marginal fosse or moat. On the south and west the fosse is the natural boundary of the bog. Dominant species are Populus tremuloides, Rubus strigosus, R. alleghaniensis, R. occidentalis, and Eupatorium perfoliatum. Diversity in this zone, in contrast to the others, is high. Not only are typical swamp plants and mesophytes present, such as Ulmus americana (stump sprouts), Fraxinus americana, Sambucus canadensis and several species of Salix and Cornus, but also weedy species typical of disturbed areas, such as Asparagus officinalis, Cirsium vulgare, Taraxacum officinale, Phytolacca americana, Cerastium vulgatum, and several species of Solidago. While Populus is one of the dominants of the zone, it is worth noting that

there are more dead trees than living, broken off at various heights or fallen, giving a particularly desolate aspect to this zone.

Along the east side the component species are similar, with the addition of Typha latifolia. In general, this younger fosse has not yet developed quite the weedy diversity of the older one.

North Fence Clearing

Along the fence separating Michigan State University property from the Beekman School a clearing about 20 feet wide was made when the boundary fence was set. This disturbance opened the area to several weedy species not found elsewhere in the bog. Epilobium angustifolium and Cichorium intybus are here, as well as the largest stands of Pteridium aquilinum. The weedy, disturbed nature of this zone makes it similar to the marginal fosse, but although it is damp in the early spring it becomes quite dry later in the season. The absence of the several species of Cornus, Salix, Rubus, and Sambucus which are present in the fosse set this zone apart from it.

Chamaedaphne Zone

As reported by Parmelee (1947) there was at that time an area just outside the mature forest remnants dominated by Chamaedaphne calyculata in pure stands. This species rebounds quickly after fires, but is eventually shaded out by taller shrubs and trees (Lems, 1956). Evidently the last 28 years have been sufficient for the elimination of these pure outer stands by natural succession, although some plants do still occur under the taller shrubs.

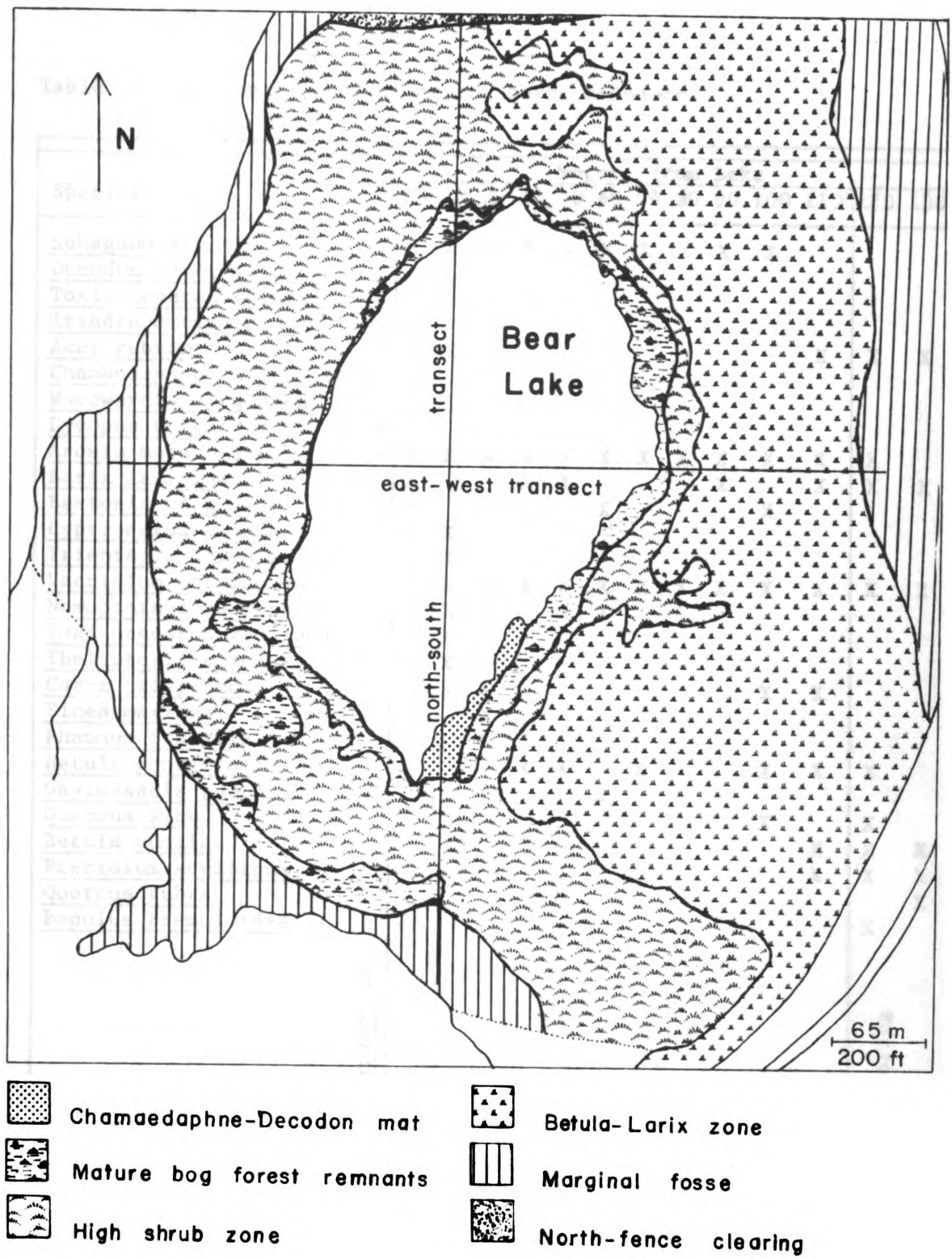


Figure 9. Vegetational zones of Bear Lake bog.

Table 3. Species present along the north transect.

Species	Meters from Lake												
	0	10	20	30	40	50	60	70	80	90	100	110	120	130
Sphagnum sp.	X	X	X	X	X	X	X	X	X	X	X			
Decodon verticillatus	X													
Toxicodendron vernix	X													
Triadenum virginicum	X													
Acer rubrum	X	X	X									X	X	X
Chamaedaphne calyculata	X													
Woodwardia virginica	X													
Lycopus uniflorus	X													
Aronia melanocarpa	X	X	X	X	X	X	X	X	X	X	X	X	X	
Larix laricina		X			X	X				X		X	X	X
Bartonia virginica		X					X				X			
Cypripedium acaule		X	X											
Trientalis borealis		X	X											
Vaccinium corymbosum		X	X	X	X	X	X	X	X	X	X	X	X	X
Nemopanthus mucronatus			X	X		X	X							
Toxicodendron radicans			X											
Thelypteris simulata			X											
Carex trispermum			X	X							X	X		
Picea mariana				X										
Rhamnus frangula				X										
Betula populifolia					X	X		X			X	X	X	
Gaylussacia baccata							X							
Quercus alba											X		X	
Betula pumila												X	X	X
Pteridium aquilinum												X	X	X
Quercus rubra														X
Populus tremuloides													X	
	Chamaedaphne-Decodon mat													
						High shrub zone								
													North-fence clearing	

Table 4. Species present along the south transect.

Species	Meters from Lake																		
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
Sphagnum sp.	X	X	X	X	X	X	X	X	X	X	X								
Osmunda cinnamomea	X					X						X							
Decodon verticillatus	X	X	X	X															
Bartonia virginica	X																		
Chamaedaphne calyculata		X	X																
Drosera rotundifolia		X																	
Larix laricina			X	X	X														
Sarracenia purpurea			X																
Woodwardia virginica				X	X		X	X	X	X									
Vaccinium corymbosum					X	X	X	X	X	X	X	X		X					
Betula alleghaniensis					X														
Nemopanthus mucronatus						X	X	X	X	X			X						
Aronia melanocarpa						X	X	X	X	X	X	X	X	X					
Carex trispermum						X													
Rubus hispidus										X	X	X	X	X			X		
Acer rubrum											X	X		X	X				
Ilex verticillata											X								
Maianthemum canadense												X							
Fraxinus americana												X	X		X	X	X		
Betula populifolia												X		X	X			X	
Prunus sp.												X							
Prunus serotina														X					
Quercus rubra												X		X					
Smilacina sp.													X	X					
Populus tremuloides													X	X	X				
Pteridium aquilinum													X	X					
Solidago rugosa													X		X	X			
Solidago sp.														X			X	X	X
Fraxinus pennsylvanica														X					
Rubus allegheniensis														X			X		

	Pioneer subzone	Established floating mat	High shrub zone	Mature bog forest remnant	Marginal fosse					
<u>Crataegus</u> sp.					X					
<u>Aralia hispida</u>						X				
<u>Phytolacca americana</u>						X				
<u>Viola sororia</u>						X	X			
<u>Vitis riparia</u>						X				
<u>Rubus strigosus</u>						X	X	X		
<u>Eupatorium perfoliatum</u>						X		X		
<u>Lactuca biennis</u>						X				
<u>Solidago graminifolia</u>							X			
<u>Fragaria virginiana</u>							X			X
<u>Toxicodendron radicans</u>							X			
<u>Impatiens biflora</u>								X		
<u>Galium</u> sp.								X		
<u>Poa</u> sp.									X	X
<u>Ranunculus recurvatus</u>									X	
<u>Cornus</u> sp.									X	
<u>Salix interior</u>									X	
<u>S. rigida</u>									X	
<u>Potentilla norvegica</u>										X
<u>Lycopus</u> sp.										X
<u>Cerastium vulgatum</u>										X
<u>Populus deltoides</u>										X
<u>Amphicarpa bracteata</u>										X

Table 5. Species present along the east transect.

Species	Meters from Lake														
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Sphagnum sp.	X	X	X	X		X	X									
Thelypteris simulata	X															
Acer rubrum	X	X	X						X		X			X		
Triadenum virginicum	X															
Decodon verticillatus	X															
Ilex verticillata	X	X														
Aronia melanocarpa	X	X	X	X	X	X	X	X	X	X	X		X			
Nemopanthus mucronatus		X	X	X					X							
Maianthemum canadense		X														
Larix laricina			X	X		X										
Vaccinium corymbosum			X	X	X	X	X	X	X		X	X	X			
Betula populifolia				X	X	X	X	X	X	X	X	X	X	X	X	X
Scirpus cyperinus					X	X	X	X		X	X	X	X	X	X	
Rubus hispidus						X	X	X	X		X		X	X	X	
Carex trispermum									X							
Pteridium aquilinum													X			
Salix discolor														X		
Populus tremuloides														X		X
Solidago graminifolia														X		
S. canadensis														X	X	X
Solidago sp.														X		
Lycopus sp.															X	
Pao pratensis															X	X
Mentha arvensis															X	
Rumex crispus																X
Agrostis perennans																X
	a	b						c							d	

[a]Mature forest remnant; [b]High shrub zone; [c]Betula-Larix zone; [d]Marginal fosse

Table 6. Species present along the west transect.

Species	Meters from Lake													
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Sphagnum sp.	X	X	X				X								
Decodon verticillatus	X														
Chamaedaphne calyculata	X														
Toxicodendron vernix	X														
Acer rubrum	X	X	X	X	X		X	X	X						
Aronia melanocarpa	X	X	X	X	X	X	X	X	X						
Thelypteris simulata	X														
Lycopus uniflorus	X														
Triadenum virginicum	X														
Vaccinium corymbosum		X	X	X	X	X	X	X	X	X					
Nemopanthus mucronatus			X			X									
Rubus hispidus			X		X	X	X	X	X	X					
Ilex verticillata			X												
Solidago rugosa			X												
Woodwardia virginica				X											
Populus tremuloides				X											
Trientalis borealis				X											
Betula populifolia					X		X	X		X					
Larix laricina							X	X							
Rhamnus frangula								X	X	X	X	X			
Toxicodendron radicans								X		X	X				
Pteridium aquilinum								X							
Galium aparine								X							
Carex sp.								X	X	X	X				
Rumex acetosella									X						
Quercus rubra										X					
Rosa sp.										X					
Quercus alba										X					
Solidago canadensis											X	X	X	X	X
Aralia hispida											X				

	Chamaedaphne-Decodon Mat	High Shrub Zone	Marginal Fosse				
Fraxinus americana			X				
Fragaria virginiana			X				
Geum canadense			X				
Rubus strigosus			X	X	X	X	
R. allegheniensis				X			
Poa pratensis				X			X
Solidago graminifolia				X			X
Sambucus canadensis				X	X	X	X
Spiraea alba				X			X
Vitis riparia					X	X	X
Eupatorium fistulosum						X	X
Viburnum lentago						X	
Eupatorium perfoliatum							X
Aster pilosus							X
Lycorus americanus							X
Salix discolor							X

VASCULAR PLANTS OF BEAR LAKE BOG

A total of 168 species of vascular plants has been collected from Bear Lake bog. Collection numbers in the following list are those of Hunter except where noted otherwise. A complete set of voucher specimens is deposited in the Beal-Darlington Herbarium of Michigan State University (MSC); a partial set is in the herbarium of the Royal Botanic Gardens, Hamilton (HAM). Nomenclature and family names, delimitation, and order of presentation used here follow Voss (1972) for the monocots and gymnosperms and Gleason and Cronquist (1963) for the pteridophytes and angiosperms. Nomenclature in the Anacardiaceae follows that of Gillis (1971); in the arboresdent Betulaceae it follows that of Hosie (1969).

Osmundaceae

Osmunda regalis L. Stevens 368. Chamaedaphne-Decodon mat.

O. cinnamomea L. 201; Stevens 367. Chamaedaphne-Decodon mat, mature bog forest.

Polypodiaceae

Pteridium aquilinum (L.) Kuhn 489. Betula-Larix zone, north-fence clearing, high shrub zone.

Woodwardia virginica (L.) Smith 319, 351, 364, 403; Bordner 110. Chamaedaphne-Decodon mat, high shrub zone.

Thelypteris simulata (Davenp.) Nieuwl. 388, 413, 441; Bordner 111. Mature bog forest, high shrub zone.

Dryopteris spinulosa (Muell.) Watt. Bordner 113. Chamaedaphne-Decodon mat.

Pinaceae

Larix laricina (DuRoi) K. Koch 198. Chamaedaphne-Decodon mat, mature bog forest, high shrub zone, Betula-Larix zone, north-fence clearing.

Pinus strobus L. Parmelee 3390. High shrub zone. Only one tree (ca. 1.5 m) known.

P. sylvestris L. 486. Betula-Larix zone. Only one tree known, a 7 dm. seedling.

Picea mariana (Miller) BSP. 160, 472. Mature bog forest, Betula-Larix zone, high shrub zone.

Typhaceae

Typha latifolia L. 488. Marginal fosse.

Graminae

Poa compressa L. 250. Marginal fosse.

P. pratensis L. 192, 258, 291, 379b, 396, 422, 468, 478. Marginal fosse.

P. palustris L. 342; G. W. Parmelee 310. Marginal fosse.

Phleum pratense L. 292. Marginal fosse.

Agrotis perennans (Walt.) Tuckerm. 379a. Marginal fosse.

A. hyemalis var. tenuis (Tuckerm.) Gleason 267; G. W. Parmelee (A. scabra Willd.) 306. High shrub zone.

Phalaris arundinacea L. 210, 253, 289, 333, 425. Marzinal fosse.

Echinochloa muricata (Beauv.) Fern. 96. Marginal fosse.

Panicum capillare L. 94. Marginal fosse.

P. dichotomum L. 265. High shrub zone-marginal fosse interface.

Cyperaceae

Carex annectens (Bickn.) Bickn. 290b. Marginal fosse.

C. vulpinoidea Michx. 244, 290a, 293. Marginal fosse.

C. trispermum Dewey 195, 221, 241, 352, 442. Mature forest remnants, high shrub zone, north-fence clearing.

Cyperaceae (cont'd)

C. bebbii (Bailey) Fern. 222, 255, 329. Marginal fosse.

C. scoparia Willd. 256, 268, 330. Marginal fosse, high shrub zone.

C. artitecta Mack. 143. High shrub zone-mature forest remnant interface. First county record.

C. crinita Lam. 246. Marginal fosse.

C. retrorsa Schw. 458. Marginal fosse.

Scirpus cyperinus (L.) Kunth 391. Betula-Larix zone, marginal fosse (east side).

Eriophorum virginicum f. album (Gray) Wieg. 475. Chamaedaphne-Decodon mat.

Araceae

Calla palustris L. 239. Chamaedaphne-Decodon mat.

Juncaceae

Juncus effusus L. 249, 269, 270. Chamaedaphne-Decodon mat, high shrub zone, marginal fosse.

J. tenuis Willd. 264. High shrub zone.

J. canadensis J. Gay G. W. Parmelee 301. Marginal fosse.

Liliaceae

Asparagus officinalis L. 220. Marginal fosse.

Trillium grandiflorum (Michx.) Salisb. 148. Mature bog forest remnant (south section).

Maianthemum canadense Desf. 203. Mature bog forest remnant.

Smilacina racemosa (L.) Desf. 227. Mature bog forest remnant, marginal fosse.

Orchidaceae

Cypripedium acaule Ait. 159, 194; Stevens 369. Mature bog forest remnant.

Salicaceae

Populus grandidentata Michx. 158, 401, 445. Betula-Larix zone, marginal fosse.

P. tremuloides Michx. 107, 122, 185, 208, 280, 407, 439. High shrub zone, marginal fosse, north-fence clearing.

P. deltoides Marsh. 461. Marginal fosse.

Salix lucida Muhl. 179. Marginal fosse.

S. interior Rowlee 180, 181, 190, 349. Marginal fosse.

S. rigida Muhl. 375. Marginal fosse.

S. discolor Muhl. 113, 114, 116, 117, 131, 381, 423. Marginal fosse. Some individuals monoecious.

S. humilis Marsh. 110, 111, 135, 155. Marginal fosse.

S. candida Flügge 112, 115, 193. Marginal fosse.

Betulaceae

Betula alleghaniensis Britt. 130, 197, 202, 238, 474; Miller 3732. Mature bog forest remnant, Chamaedaphne-Decodon mat.

B. populifolia Marsh. 102, 123, 124, 125, 163, 165, 166, 205, 207, 231, 277, 306, 310, 311, 389, 456; Miller 3060; Anderson 2260. All zones throughout the bog. Gleason and Cronquist report this species as occurring "N.S. and e. Que. to n. Del., Pa., Ont. and O.; nw. Ind." Hosie (1969) maps it from Kingston north along the St. Lawrence to Québec and in most of the Maritimes. The only other known native locality in Michigan for this species is in Oakland County.

B. pumila L. 301. High shrub zone, north-fence clearing.

B. pumila var. glabra Regel Miller 3061.

B. glandulosa Michx. 444. High shrub zone (one specimen known).

Fagaceae

Quercus alba L. 275, 313, 408b. Marginal fosse, north-fence clearing, high shrub zone.

Q. bicolor Willd. 229, 230, 233, 234, 283. Mature bog forest remnant, high shrub zone, marginal fosse.

Fagaceae (cont'd)

Q. rubra L. 226, 232, 251, 274, 276, 314, 350, 408a, 440. High shrub zone, marginal fosse, north-fence clearing.

Ulmaceae

Ulmus americana L. 175, 186, 254, 286. Marginal fosse. Found only as stump sprouts and samplings.

Urticaceae

Urtica dioica L. 419. Marginal fosse.

Polygonaceae

Rumex acetosella L. 284, 416. Marginal fosse, high shrub zone.

R. crispus L. 223. Marginal fosse.

Polygonum persicaria L. 87. Marginal fosse.

P. hydropiperoides Michx. 88. Marginal fosse.

P. scandens L. 92, 358, 427. Marginal fosse.

Phytolaccaceae

Phytolacca americana L. 356. Marginal fosse.

Caryophyllaceae

Cerastium nutans Ref. 331. Marginal fosse.

C. vulgatum L. 157, 182, 187, 236, 260. Marginal fosse, mature forest remnant.

Ranunculaceae

Ranunculus recurvatus Poir. 217. Marginal fosse.

Anemone virginiana L. 359. Marginal fosse.

Sarraceniaceae

Sarracenia purpurea L. 196. Chamaedaphne-Decodon mat.

Droseraceae

Drosera rotundifolia L. 296. Chamaedaphne-Decodon mat.

Saxifragaceae

Ribes americanum Mill. 136. Marginal fosse.

Rosaceae

Spiraea alba DuRoi 95, 399. Marginal fosse.

S. tomentosa L. 477. Chamaedaphne-Decodon mat.

Fragaria virginiana Duchesne 134, 156, 167. Marginal fosse, north-fence clearing.

Potentilla norvegica L. 324, 337. Marginal fosse.

Geum canadense Jacq. 252, 344, 417. Marginal fosse.

G. virginianum L. 259, 484. Marginal fosse.

G. laciniatum Murr. 343, 424, 459. Marginal fosse.

Rubus hispidus L. 271, 308. High shrub zone, Betula-Larix zone.

R. allegheniensis Porter 174, 211, 282. Marginal fosse.

R. occidentalis L. 206. Marginal fosse.

R. strigosus Michx. 178, 305, 402. Marginal fosse.

Rosa sp. 400. High shrub zone. Only one plant (sterile) known.

Prunus serotina Ehrh. 228, 367, 438. Marginal fosse, north-fence clearing.

Aronia melanocarpa (Michx.) Ell. 101, 103, 152, 164, 170, 273, 307; Gross 89. Mature bog forest remnant, high shrub zone, Betula-Larix zone, north-fence clearing.

Crataegus sp. 370. Marginal fosse. Only one plant (sterile) known.

Amelanchier arborea (Michx. f.) Fern. 127, 128, 138, 172; Grashoff 53. High shrub zone.

Fabaceae

Trifolium pratense L. 436. North-fence clearing.

T. hybridum L. 295. Marginal fosse.

Melilotus alba Desr. 340. Marginal fosse.

Fabaceae (cont'd)

M. altissima Thuill. 432. North-fence clearing.

Medicago lupulina L. 294. Marginal fosse.

M. sativa L. 431. North-fence clearing.

Desmodium paniculatum (L.) DC. 318, 328, 460, 470. Marginal fosse.

Amphicarpa bracteata (L.) Fern. 373. Marginal fosse.

Anacardiaceae

Toxicodendron radicans (L.) Kuntze 392. High shrub zone, mature bog forest remnent, marginal fosse.

T. vernix (L.) Kuntze 476. Chamaedaphne-Decodon mat.

Aquifoliaceae

Ilex verticillata (L.) Gray 323, 353, 390, 411, 473. High shrub zone, mature bog forest remnant.

Nemopanthus mucronatus (L.) Trel. 144, 168, 298. High shrub zone, mature bog forest remnant, Betula-Larix zone.

Aceraceae

Acer rubrum L. 108, 109, 119, 161, 173, 457. Throughout the bog, in all zones.

Balsaminaceae

Impatiens biflora Walt. 376. Marginal fosse.

Rhamnaceae

Rhampus frangula L. 209, 224, 243, 281, 321; Stevens 365. High shrub zone, marginal fosse.

Vitaceae

Vitis riparia Michx. 219, 237, 245, 288, 393, 430. Marginal fosse, mature bog forest remnant.

Hypericaceae

Triadenum virginicum (L.) Raf. 377, 447. Chamaedaphne-Decodon mat.

Violaceae

Viola sororia Willd. 137, 139, 141, 151. Marginal fosse.

V. pallens (Banks) Brainerd 150. Marginal fosse.

V. conspersa Reichenb. 118, 140. Marginal fosse.

Lythraceae

Decodon verticillatus (L.) Ell. 386, 449a. Chamaedaphne-Decodon mat.

Onagraceae

Epilobium angustifolium L. 316. North-fence clearing.

E. coloratum Biehler 427. Marginal fosse.

Araliaceae

Aralia hispida Vent. 247, 300, 309. Marginal fosse, north-fence clearing.

Umbelliferae

Torilis japonica (Houtt.) DC. 317, 341, 464. Marginal fosse.

Daucus carota L. 332, 338, 434. Marginal fosse, north-fence clearing.

Cornaceae

Cornus alternifolia L. f. 235. High shrub zone.

C. stolonifera Michx. 183. Marginal fosse.

C. racemosa Lam. 257, 287, 469. Marginal fosse.

Ericaceae

Chamaedaphne calyculata (L.) Moench 120, 121, 126, 266; Grashoff 52. Chamaedaphne-Decodon mat, high shrub zone.

Gaylussacia baccata (Wang.) K. Koch 262, 449b; Stevens 364. Chamaedaphne-Decodon mat, high shrub zone.

Vaccinium myrtilloides Michx. Parmelee 3391. High shrub zone.

V. corymbosum L. 145, 146, 147, 153, 154, 169, 171, 199, 200, 204, 215, 218, 302, 303, 304, 305, 312, 347, 348, 355, 361, 383, 414, 443. Throughout the bog, in all zones.

Ericaceae (cont'd)

V. macrocarpon Ait. 98, 240, 272; F. T. Parmelee 185; Baten. Chamaedaphne-Decodon mat.

Primulaceae

Lysimachia thyrsiflora L. 216. Chamaedaphne-Decodon mat.

Trientalis borealis Raf. 162; Stevens 371. Mature bog forest remnant.

Oleaceae

Fraxinus americana L. 177, 357, 415. Marginal fosse.

F. pennsylvanica Marsh. 455. Marginal fosse.

Gentianaceae

Gentiana andrewsii Griseb. 450. Marginal fosse.

Bartonia virginica (L.) BSP. 369, 387; Tan 30. High shrub zone, Chamaedaphne-Decodon mat.

Apocynaceae

Apocynum cannabinum L. 325, 326. Marginal fosse.

Verbenaceae

Verbena hastata L. 428. Marginal fosse.

Labiatae

Scutellaria lateriflora L. 429. Marginal fosse.

Monarda fistulosa L. 322. Marginal fosse.

Lycopus uniflorus Michx. 89, 336, 374, 384, 410, 446. Marginal fosse, Chamaedaphne-Decodon mat, mature bog forest remnant.

L. americanus Muhl. 421. Marginal fosse.

Mentha arvensis L. 380. Marginal fosse.

Solanaceae

Solanum dulcamara L. 91. Marginal fosse.

Rubiaceae

Galium aparine L. 212, 405, 463. Marginal fosse, high shrub zone.

G. trifidum L. 261, 278, 279, 297. Marginal fosse, Chamaedaphne-Decodon mat.

Caprifoliaceae

Viburnum opulus L. 176, 214, 320. Marginal fosse.

V. lentago L. 184, 213, 225, 394. Marginal fosse.

Sambucus canadensis L. 285. Marginal fosse.

S. pubens Michx. 133, 149, 242. Marginal fosse.

Lonicera morrowi Gray 360, 365, 427. Marginal fosse, north-fence clearing.

Compositae

Bidens coronata (L.) Britt. 97, 480. Chamaedaphne-Decodon mat, marginal fosse.

Ambrosia ariemisiifolia L. 90. Marginal fosse.

Achillea millefolium L. 263, 345. Marginal fosse.

Chrysanthemum leucanthemum L. 248. Marginal fosse.

Senecio aureus L. 191. Marginal fosse.

Erechtites hieracifolia (L.) Raf. 96. Marginal fosse.

Solidago rugosa Mill. 366, 368, 371, 412, 482. Marginal fosse, high shrub zone.

S. canadensis L. 385, 397, 409, 462, 466, 485. Marginal fosse.

Solidago graminifolia (L.) Salisb. 372, 382, 398. Marginal fosse.

Aster ciliolatus Lindl. 99. Marginal fosse.

A. novae-angliae L. 471. Marginal fosse.

A. puniceus L. 451. Marginal fosse.

A. umbellatus Mill. 327, 452, 467b, 479. Marginal fosse.

A. pilosus Willd. 100, 420. Marginal fosse.

Compositae (cont'd)

A. lateriflorus (L.) Britt. 453, 467a. Marginal fosse.

A. simplex Willd. 481. Marginal fosse.

Erigeron annuus (L.) Pers. 188, 189, 315, 339. Marginal fosse.

Eupatorium fistulosum Barratt 418. Marginal fosse.

E. perfoliatum L. 334, 454, 483. Marginal fosse.

Cirsium vulgare (Savi) Tenore 465. Marginal fosse.

Prenanthes altissima L. 346. Marginal fosse.

Taraxacum officinale Weber 138, 142. Marginal fosse.

Sonchus oleraceus L. 335, 433. North-fence clearing.

Lactuca biennis (Moench) Fern. 362. Marginal fosse.

Cichorium intybus L. 435. North-fence clearing.

Sight Records

Lycopodiaceae

Lycopodium obscurum L.

Liliaceae

Erythronium americanum Ker.

Orchidaceae

Cypripedium calceolus L.

Lentibulariaceae

Utricularia sp.

SELECTED NON-VASCULAR PLANTS OF BEAR LAKE BOG

Voucher specimens are deposited in the Cryptogamic Herbarium of Michigan State University. Collection numbers are those of Richard C. Harris (H) and Pamela Brant (B). The algae have been treated by Moss (1973).

Mosses

Sphagnum centrale	H 966.
S. capillaceum	H 8675; B 34.
S. fimbriatum	H 967; B 9, B 35.
S. fuscum	H 971, H 8676.
S. magellanicum	H 973.
S. palustre	H 965, H 968, H 974; B 36.
S. papillosum	H 964, H 970, H 976; B 2, B 23.
S. recurvum	H 969, H 972, H 975, H 977; B 26, B 37.
S. recurvum var. *amblyphyllum*	H 8674.
S. riparium	H 8673.
Orthotrichum ohiense	H 8667.
Plagiothecium deuticolatum	H 8677.
Tetraphis pellucida	H 8672.
Aulacomnium palustre	H 8671.
Pohlia nutans	H 8669.

Liverworts

Cephalozia conniveus	H 8668.
C. media	H 8670.

Lichens

Caloplaca holocarpa	H 8666.

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