The Vegetation of Offield Bog (Offield Family Nature Preserve, Emmet County, MI) Floristic Quality, Community Description and Management Implications

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Abstract

Offield Family Nature Preserve (OFNP), Emmet County, MI was purchased in Spring 2009 by the Little Traverse Conservancy (LTC). Located within OFNP is Offield Bog, a relatively small, acidic peatland (4800 m^2) with shallow peat depths (average < 3 m). We found 48 plant species in 23 families in the peatland. Native species consisted of 94% of the flora. Ericaceous shrubs including *Vaccinium angustifolium*, *Chamaedaphne calyculata*, and *Vaccinium myrtilloides* had the highest mean percent cover in the understory. The tree dominants were determined using a point-center quarter method by measuring the diameter at breast height of individual trees. The overstory dominants were *Picea mariana*, *Larix laricina*, and *Ilex mucronatus*. We found that the muskeg-moat contained 4.4 species per m^2 while the heath community contained 3.0 species per m^2. We compared the species richness and Floristic Quality Index (FQI) of Offield Bog to five other peatlands of Cheboygan and Emmet County, Michigan (Bryant's, Hogback, Linné, and Livingston Bogs as well as Orchis Fen). A X^2 analysis showed a significant difference in species richness among the peatlands (p-value < 0.05). This result was

due in part to the high species richness of Livingston Bog. When we removed Livingston Bog from the X^2 analysis we found that the difference in species richness was not significant (p-value > 0.05) between the remaining peatlands. The six peatlands also were not significantly different in their FQI values (p-value > 0.05). Bog vegetation usually consists of specialist species that can tolerate the anoxic, acidic, inundated, and cold physical conditions of peat substrates. Therefore it is not surprising that the vegetation of Offield Bog has so many similarities to other peatlands in northern Lower Michigan. Exotic species such as *Hieracium piloselloides*, *Hypericum perforatum*, and *Lonicera morrowi* may be of some concern for future land management. We recommend that management entail conservation of the existing hydrology of Offield Bog and that impervious surfaces near the peatland be minimized.

Introduction

Peatlands are ecosystems defined by waterlogged substrates in which anoxic conditions and cool yearly temperatures lead to a buildup of organic matter (Mitsch and Gosselink 2000). The ground layer of these wetlands is dominated by *Sphagnum,* which acidifies its environment and contributes to nutrient poor conditions and slow decomposition. These relatively severe physical and chemical stresses contribute to the development of a unique, predictable peatland flora. Conservation of peatlands has received much attention in recent decades as they provide many ecosystem services with social and economic benefits (Barbier et al. 1997). Peatlands contribute to global climate processes as a large carbon (C) sink that surpasses forests in importance (Rydin et al. 2006). Estimates state that northern temperate and cold climate peatlands store an amount of C equal to 37-51% of that in the atmosphere (IPCC 2007, Turunen et al. 2002).

The peatlands of northern lower Michigan have been greatly influenced by two major events: past glacial activity and anthropogenic development. Glacial retreat created depressions and a general physical environment conducive to peatland development (Gates 1942). Intensive anthropogenic modification of the region began with lumbering during the 1870s. Many peatlands had their trees removed and were also burned (Gates 1942). The resulting peatlands of the region are mostly classified as fens, which are peatlands receiving nutrients from ground or surface water (Crum 1988, Mitsch and Gosselink 2000). The novel plant communities and ecological importance of these habitats makes them of particular significance to conservation.

Our study site, Offield Bog, is a nutrient poor (oligotrophic) fen located in the Little Traverse Conservancy's (LTC) Offield Family Nature Preserve in Emmet County, Michigan. The LTC purchased the land in spring 2009 with the intention of opening the 158 ha (386 acre) tract to the public. The goal of our project was to describe the general vegetative characteristics of Offield Bog, conduct a floristic quality assessment, and compare some of these features to five other northern lower Michigan peatlands (Bryant's, Hogback, Linné, and Livingston Bogs as well as Orchis Fen). Hogback, Linné, and Bryant's Bog are poor fens of similar size to Offield Bog. Livingston Bog is a larger poor fen and Orchis Fen is a rich (eutrophic) fen. We hope that this vegetative assessment will aid the LTC as they develop management and conservation strategies for the Offield Family Nature Preserve.

Our hypotheses are: 1) there will be no differences in species richness and floristic quality between the heath and lagg of Offield Bog; 2) there will be no differences in species richness, floristic quality, and Sorenson's Index of Similarity between Offield Bog and five other nearby peatlands.

Methods

The Offield Family Nature Preserve is located in Emmet County in the northwestern part of Michigan's Lower Peninsula (45° 26' 22.34" N; 84° 59' 23.19" W), approximately three miles north of Little Traverse Bay, Lake Michigan. The preserve consists of large tracts of mesic hardwood forests, *Pinus resinosa* plantations, a prairie area of grasses and forbs, and a peatland.

The peatland is in a small basin in the northeastern portion of the preserve measuring approximately 4800 m^2. The peatland includes the *Sphagnum* mat (also referred to as the heath) and the moat-muskeg consisting of a *Scirpus* border on the southwest side (moat or lagg) and a forested area dominated by *Picea mariana* and *Larix laricina* in the southeast (muskeg). The peatland is fringed on the north end by a grove of *Populus tremuloides*. Surrounding the peatland is a grass and forb prairie with *Prunus avium, Acer saccharum, Malus pumila,* and *Rhus typhina*.

For the purposes of this study we divided the peatland into two distinct communities. The first was the heath (dominated by shrubs of the Ericaceae) and the second was the moat-muskeg. The *Scirpus* and muskeg were paired as they irregularly border the *Sphagnum* and shrub dominated mat.

We collected groundcover data in the heath by placing a baseline along the northwestern border of the bog, and running seven transects off the baseline through the central peat mat towards the southeast for 50 meters. We ran three transects through the diverse plant communities on the southwest portion of the moat-muskeg and one transect through the *Scirpus* community. We sampled five quadrats on each of the eleven transects for a total of 55 quadrats. We used a random number generator to obtain a number from 0-10 that was the initial distance from the beginning of the transect to the first quadrat. Subsequent quadrats were located 10 m apart. The quadrats covered an area of 1 m^2 and were located on the right hand side of each transect.

Percent cover was used to calculate the dominance of understory plants (Bonham 1989). Any overhanging plants rooted outside of the quadrat were excluded from the percent cover data. We established cover classes to allow for some margin of error and simplified data collection. The cover classes were as follows: (I) 0-1%, (II) 2-5%, (III) 6-25%, (IV) 26-50%, (V) 51-75%, and (VI) 76-100%. We used active searching to find specimens not present in the transects (Stohlgren 2007). All vascular plants found in the peatland were compiled into a species list (Appendix A).

We collected diameter at breast height (DBH) data for trees using the point quarter method (Bonham 1989). Two ground cover quadrat points along each transect were selected at random. We divided the area around the points into 4 quarters. We then used a 50 m tape to measure the distance to the closest tree species with a DBH greater than 4 cm in each of the four quarters. At every tree sample plot we used a 3 m peat probe to determine peat depth and also measured pH with a pH meter in the *Sphagnum* mat. The peat probe was not long enough for some sections of the mat. Those locations were recorded as having a depth over 3 m.

Plants were identified using Gleason and Cronquist (1991) and Voss (1972, 1985, 1996). We chose to perform a Floristic Quality Assessment (FQA) on Offield Bog, a technique used to assess plant communities in the Chicago, Ill. area (Herman et al. 2001). Their technique involves the assignment of a "coefficient of conservatism" to each native species in an area, with values ranging from 0 to10. A species with a high coefficient of conservatism (CC) is not tolerant of disturbance and is most commonly found in an area of the United States unaltered by European settlement (Herman et al. 2001). In contrast, a species that tolerates disturbance well and is not restricted to a particular habitat would receive a low score. For example, *Tanacetum huronense*, a plant characteristic of Great Lakes shorelines and dunes, has a CC of 10. Conversely, *Euphorbia maculata* receives a score of 0, as it is characteristic of more disturbed, human-impacted habitats (Herman et al. 2001). The floristic assessment assumes that having a considerable number of plants with high CCs indicates the area is floristically rich (Mushet et al. 2002). We used a Floristic Quality Assessment manual for the state of Michigan (Herman et al. 2001) to assign a score to each plant recorded in the peatland.

We calculated a "mean coefficient of conservatism" by summing the coefficients and dividing by the total number of plant species (n). We then divided the mean coefficient by the square root of n to obtain a floristic quality index (FQI). This allowed us to take species richness into account when comparing peatlands of differing n values—a site with few plants might have the same mean coefficient as a site with many plants, but not the same FQI.

We chose five northern lower Michigan peatlands to compare to Offield Bog: Bryant's Bog (Coburn et al. 1932), Hogback Bog (Sigler and Wollett 1926), Linné (Dean and Coburn 1927) , Livingston Bog (Delcourt 1974), and Orchis Fen (Falk et al. 2008). These sites were chosen because they were in close proximity regionally to Offield Bog and had species lists available. Using available literature, we compiled lists of species from each location and then used these lists to compute floristic quality indices and to compare floristic similarity between peatlands. We used Sorensen's Index (Mueller-Dombois and Ellenberg 1974) to compare the amount of the flora shared between Offield Bog and other local peatlands. For all peatlands, especially Orchis Fen, we tried to limit our list to those species that were most clearly collected within the peatland basin as opposed to other habitats that may have bordered the peatland or been within a larger area of study.

We performed t-tests to determine whether differences in species density and FQI between the moat-muskeg and heath were significant. We also performed a chi-square (X^2) test to determine if there were significant differences in species richness and FQI among the six peatlands. Sorenson's Index was used to analyze the degree of similarity in species composition of Offield Bog compared to the other peatlands. All statistical comparisons were computed using SPSS (SPSS Inc., Chicago IL) or GraphPad Prism (GraphPad Software Inc., La Jolla, CA).

Results

The peatland pH ranged from 2.66 to 3.63, with an average of 3.31. Peat depth ranged from 15 cm to over 3 m in depth. The heath was the shallowest area of peat accumulation besides the *Scirpus* mat. Depth increased from the north end of the peatland to the south end. Peat core samples showed what may be a charcoal layer within the mat.

We surveyed the peatland during late July and early August 2009. Within the peatland we found 48 species across 23 families. Of those, only three were found to be non-native: *Hieracium piloselloides*, *Hypericum perforatum,* and *Lonicera morrowii*. *Lonicera morrowii* is a species that might be of concern on the southern portion of the moat-muskeg.

Vegetation varies greatly from the northern to the southern end of the peatland. At the northern edge of the *Sphagnum* mat we found a mixed stand of *Prunus serotina, Betula papyrifera,* and *Picea mariana*. The mat is diffusely populated for approximately 40 m with *Larix laricina* and *Picea mariana* as the dominant overstory. The understory consisted of *Chamaedaphne calyculata*, *Vaccinium angustifolium*, *V. myrtilloides*, and *Sphagnum* spp. Towards the southern end of the peat mat the ground cover became thicker, with stands of *Nemopanthus mucronatus*, *Aronia floribunda*, and *Viburnum nudum*. The muskeg at the southern end was virtually impenetrable and dominated by *Picea mariana*.

Running along the western edge of the peatland was a stand of *Scirpus cyperinus* and *Pteridium aquilinum* that was approximately 700 m^2 with undulating borders. The immediate western edge of the peatland consisted of a variety of plant communities. At the northwest corner of the peat we found a patch of *Aronia floribunda* mixed with *Rubus strigosus*, *Vaccinium angustifolium*, *Hypericum perforatum*, *Geum aleppicum*, *Cornus canadensis* and *Rubus allegheniensis* running about 15 m along the border. Nearby there was a small patch of *Shepherdia canadensis* that extended for approximately 7 m. A patch of *Salix* spp. interspersed with *Lonicera morrowi*, *Larix laricina*, and *Gaylussacia baccata* dominated the next 20 m, which led into the muskeg. The muskeg was bordered on the western side by a long irregular patch of *Aronia floribunda*, *Viburnum nudum*, and *Vaccinium angustifolium*. In some areas along the peatland perimeter, *Sphagnum* moss was colonizing mineral soils outside of the peatland basin.

There were distinct differences between the southern moat community and the southeastern muskeg community. The southeastern muskeg has fairly large trees with *Picea mariana* as the primary dominant. This pattern held over the entire peatland (Figure 1). *Larix laricina* was the second most dominant followed by *Nemopanthus mucronatus*. The southern moat was dominated by *Scirpus cyperinus* and was smaller than the muskeg.

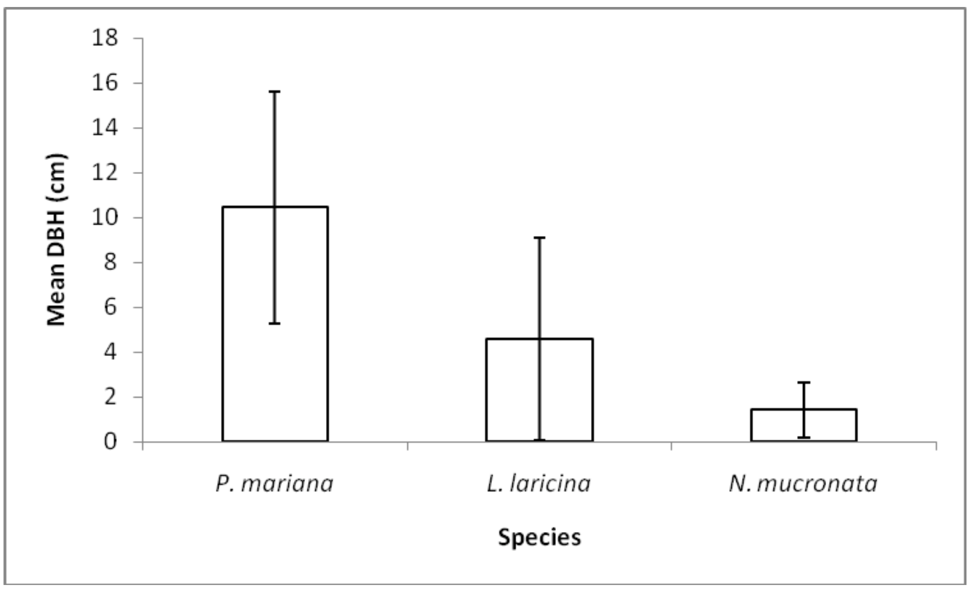

Figure 1. Mean DBH of overstory dominants at Offield Bog (*Picea mariana*, *Larix laricina* and *Nemopanthus mucronatus*). Error bars are standard error of the mean.

The understory of the peatland was dominated by three species. *Vaccinium angustifolium* had the highest mean cover followed by *Chamaedaphne calyculata* and *Vaccinium myrtilloides* (Figure 2). *V. angustifolium* was present throughout the heath and moat-muskeg. C. *calyculata* was primarily in the heath. *V. myrtiloides* was present in all localities, but especially abundant in the moat-muskeg.

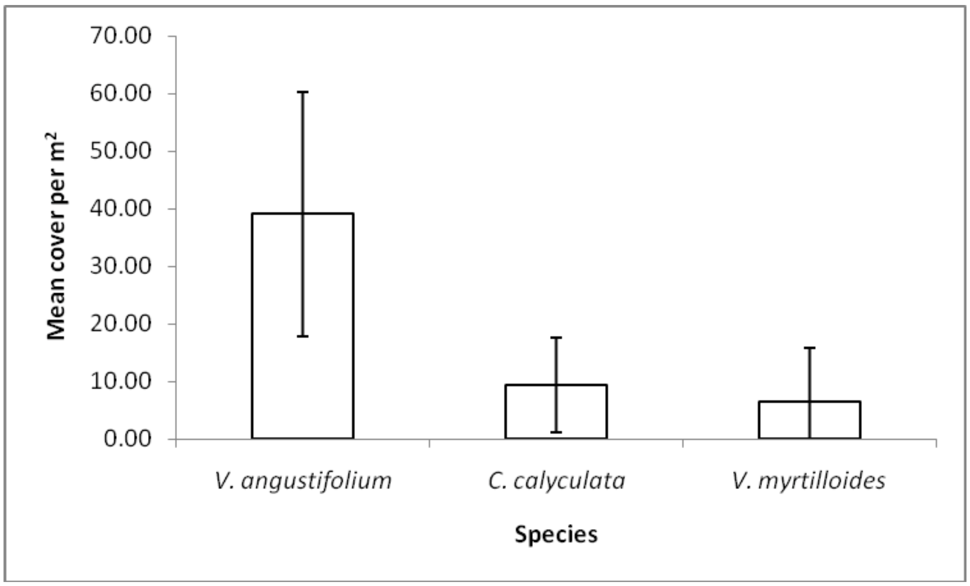

Figure 2. Mean cover comparison of understory dominants at Offield Bog (*Vaccinium angustifolium, Chamaedaphne calyculata* and *Vaccinium myrtilloides*). Error bars are standard error of the mean.

The moat-muskeg differed significantly from the heath in terms of species richness ($p = 0.02$; Figure 3). The moat-muskeg had a mean species richness of 4.4 species per m^2 while the heath had 3.0 species per m^2.

Figure 3. Species richness comparison of the two main Offield Bog communities, the moat-muskeg and heath. The two communities had significantly different species richness (p=0.02). Error bars are standard error of the mean.

Although the heath and the moat-muskeg showed differences in overall species richness (13 and 38, respectively), the floristic quality index of the two communities did not differ. The moat-muskeg had a higher mean FQI, but the difference was not statistically significant (p=0.15).

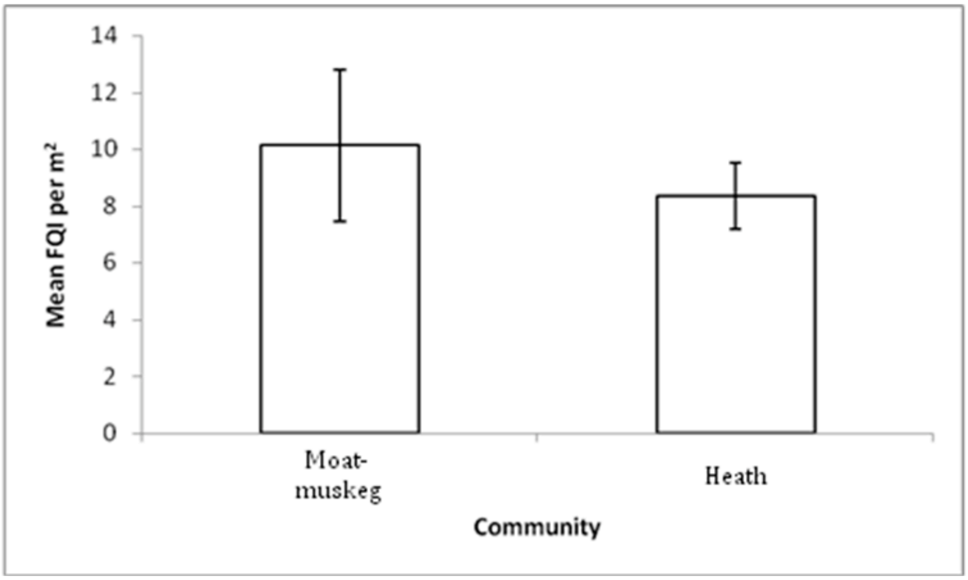

Figure 4. Floristic Quality Index comparison of the moat-muskeg and heath communities of Offield Bog. The floristic quality index showed no statistical difference between the lag and heath communities ($p = 0.15$). Error bars are standard error of the mean.

The species richness of Offield Bog also was compared to five other peatlands (Figure 5). An X^2 test indicated that there was no difference between the peatlands ($p > 0.05$), with the exception of Livingston Bog. Livingston Bog was the source of the difference between the six peatlands and had a significantly higher species richness ($p < 0.05$) than the other sites.

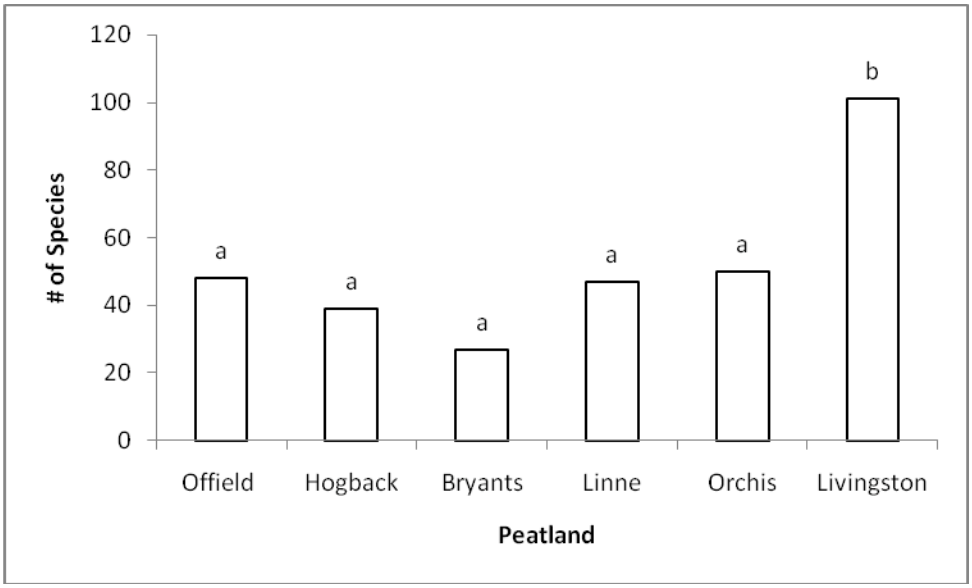

Figure 5. Regional species richness comparison of 6 northern lower Michigan peatlands. The analysis indicates that Offield, Hogback, Bryants, Linné Bogs, and Orchis Fen are similar in species richness ($p>0.05$). Livingston Bog had a higher species richness than the others ($p<0.05$).

The overall floristic quality index (FQI) value for Offield Bog was 31.1 (Figure 6). A FQI comparison was conducted with five other local peatlands (Figure 6) to better understand the flora of Offield Bog in a regional context. X^2 analysis showed that all peatlands had a similar FQI ($p > 0.05$), with the exception of Orchis Fen. Orchis Fen had a higher FQI relative to the five other peatlands ($p < 0.05$).

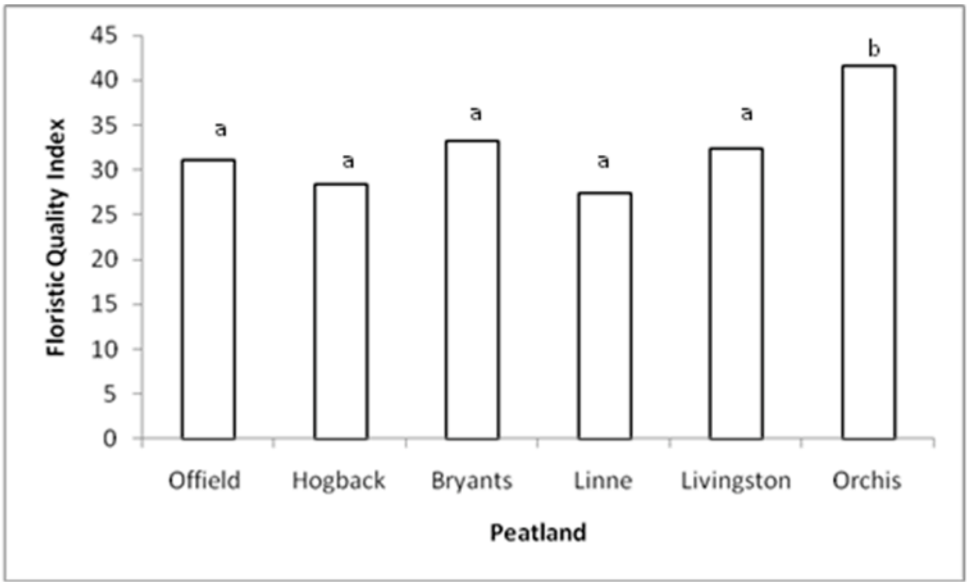

Figure 6: Regional Floristic Quality Index comparison of six northern lower Michigan peatlands. The analysis showed that all the peatlands were similar ($p>0.05$), with the exception of Orchis Fen. Orchis Fen had a significantly higher FQI relative to the others ($p<0.05$).

Sorensen's Indices (Table 1) revealed the community composition of Offield Bog was most similar to Hogback and Bryant's Bog, with scores of 0.432 and 0.400 (i.e. these peatlands shared 43% and 40% of their flora, respectively). Offield Bog was least similar to Linné Bog and Orchis Fen. However all values were within a relatively narrow range of similarity (30-43%).

Table 1. Sorensen's Index comparing the floristic similarity of six northern lower Michigan peatlands. Values represent the proportion of species shared between Offield Bog and each comparison peatland.

Peatland	Hogback	Livingston	Linné	Bryants	Orchis
Offield	0.432	0.333	0.271	0.400	0.297

Discussion

Michigan's landscape has changed dramatically since lumbering and human settlement peaked in the last half of the nineteenth century. In Cheboygan County most conifer trees in the wetlands and uplands were logged by 1900, followed by hardwoods (Jolls 1983). This left the Michigan landscape virtually barren of trees and prone to fire (Jolls 1983). Peat mining, for use as fuel or a soil conditioner, has reduced the number of wetlands in the area (Crum 1988). Studies show over one billion tons of fuel resides in northern Michigan's peatlands (Crum 1988). Peat in Cheboygan County has been mined for “brown peat,” a favored soil additive. Crops with a long growing season and an affinity for cool climates, as well as pasture grasses, can be successfully grown in drained peatlands. However, peatlands take thousands of years to form and once drained they cannot be restored within a human lifetime (Crum 1988). These characteristics create conservation concerns for Michigan peatlands. Wetlands as a whole purify water, act as storm buffers, serve as habitat for a variety of endangered species, and act as carbon and nitrogen sinks (Mitsch and Gosslink 2000). Wetlands have an integral place in the landscape.

The Offield Family Nature Preserve is surrounded by development. It is two miles away from both the Little Traverse Bay and Wequetosing Golf Courses, three miles away from the Harbor Springs Airport, and four miles from the town of Harbor Springs. The peatlands of our comparison sites (Bryant’s, Hogback, Linné, and Livingston Bogs as well as Orchis Fen) were surveyed shortly following a history of logging and fire in northern Michigan. We consider the current disturbance regime surrounding Offield Bog to be similar to what the regional peatlands have experienced in the past.

Offield Bog and its comparison peatlands were similar in terms of regional species richness and floristic quality, with the exception of Livingston Bog. Compared to the other five peatlands, Livingston Bog had a higher species richness value. The larger area of Livingston Bog could contain multiple microhabitats, which would support greater species diversity (Crum 1988). Dimensions of Livingston Bog were not available, but the lake within the bog, which comprises only a small portion of the total area, is approximately 2000 m^2 (Delcourt 1974). It is very likely that logging, fire, and human development have affected the species richness of these northern peatlands, but plant species surveys before modern development are not available.

Regarding the Floristic Quality Index, the bogs were not significantly different from one another with the exception of Orchis Fen. This is likely due to the fact that these peatlands are similar in many ways including size (except Livingston Bog), geographic proximity, and disturbance regimes. Despite the large size of Livingston Bog, it was not significantly different in terms of "quality" of species present. This could have been a result of the normalizing effect of the FQI calculation, which decreases the influence of size (Herman et al. 2001). Orchis Fen showed a higher FQI relative to the other peatlands. This is likely explained by its being a rich fen, with more nutrient rich conditions that are colonized by a different suite of wetland species, some of which are more habitat-specific than the typical flora of acid peatlands.

Sorenson's Indices showed a relatively small range of similarity scores between Offield Bog and the regional peatlands. This may also be an effect of similar geographic, physical, chemical, and historical factors. The two peatlands that were most similar to Offield Bog were Hogback and Bryant's Bog. These three peatlands have comparable peat depths, which could have contributed to the similarities in plant community composition. It could also be the peatlands are more similar in physical conditions and fire history.

The fire disturbance regimes noted in many northern Michigan peatlands may have affected the structure of the Offield Bog plant communities. Repeated fires are thought to encourage the growth of *V. angustifolium*, and suppress *C. calyculata* (Crum 1988). We found that in Offield Bog, *Vaccinium angustifolium* was by far the most abundant groundcover shrub in the heath. There was evidence of a fire history from charred tree stumps and a charcoal layer in the peat. Thus, the bog's fire history may explain the dominance of *V. angustifolium*. *Vaccinium myrtilloides* was the third most dominant groundcover species, though present mostly in the moat-muskeg. *V. myrtillioides* is more shade-tolerant than *V. angustifolium* (Moola and Mallik 1998), which would explain its general absence in the open heath.

The dominance of *Vaccinium angustifolium* may also explain the significant difference in species richness per plot between the heath and moat-muskeg communities in Offield Bog. The moat-muskeg contained 4.4 species per m^2, whereas the heath contained 2.95 species per m^2. *V. angustifolium* carpeted the heath in dense mats, and may have out-competed other species. Despite the significant difference in species richness, however, the difference in FQI between the two areas was not significantly different.

For the future of this peatland, we recommend that management consider 1) maintenance and conservation of the existing hydrology of Offield Bog; 2) minimization or mitigation of impacts to the species rich moat-muskeg; and 3) minimization of the effects of impervious surfaces on the peatland.

A large body of evidence supports the overarching importance of hydrology to wetland ecosystem and plant community assemblage and function (Farinas unpublished data, Gosselink and Turner 1978, Maltby 1986, Hunt 1999, Mitsch and Gosselink 2000). Small changes in a hydrologic regime can affect such physical and chemical properties as water level, nutrient availability, degree of substrate anoxia and salinity, and pH (Mitsch and Gosselink 2000). Hydrology therefore has great implications for plant productivity, plant community structure and composition, as well as decomposition patterns (Mitsch and Gosselink 2000). All of these factors are used in characterizing wetland ecosystems (Brinson et al. 1996, Whigham 1999). It is critical to consider factors that could impact or interrupt the hydrologic regime of Offield Bog, such as development adjacent to the reserve (e.g. land use changes on adjoining property, trail construction, vegetation clearing, etc.). Particular attention should be paid to *Lonicera morrowii* and whether it invades further into the peatland. Further encroachment could be an indication of drier conditions or altered hydrology in the peatland.

The moat-muskeg community should be of particular concern to OFNP management, as it supports a diverse assemblage of plants from both the upland and the peatland. These perimeter ecotone communities generally vary significantly between peatlands (Crum 1988). At Offield Bog, the moat-muskeg is relatively large in proportion to the peatland and has a much higher species richness.

Impervious surfaces and soil compaction is a common side effect of human development that can have large impacts on wetland hydrology (Hollis 1975, Benke 1981, Booth and Reinelt 1993). Hard substrates can lead to increased run-off into wetlands, increased sedimentation and erosion, and contribute to a general habitat decline (Booth and Reinelt 1993). The Offield Family Nature Preserve is surrounded by roads and development. We recommend monitoring of land development adjacent to the preserve and conservation of undisturbed vegetative buffers that are necessary to maintain wetland quality (Castelle et al. 1994).

Conclusions

Our study shows that Offield Bog is a small peatland with a long legacy of impacts from human development. This history is expressed in its current plant communities and its physical state. The proliferation of *Vaccinium angustifolium,* charred tree stumps, and a possible charcoal layer are the strongest evidence of a past linked to logging impacts. The evidence of paludification (*Sphagnum* colonizing over sandy, upland soils outside of the basin) also shows this is a system in flux and will likely change over time in response to environmental conditions and management.

Offield Bog showed a strong floristic similarity to other peatlands of the region. Similar geographic processes and anthropogenic impacts also have likely influenced the ecological trajectories of the peatlands compared to Offield Bog. Though relatively small in area across the landscape, these peatleads hold great ecological significance. Peatlands provide habitat for unique plant communities and other organisms, while also providing many ecological services (Mitsch and Grosselink 2000). The peatlands of northern Lower Michigan are important and unusual habitats that are critical sites for local and regional conservation efforts.

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Appendix A. Preliminary plant species list for Offield Bog, Offield Family Nature Preserve, Emmet County, MI.

ADOXACEAE
(inc. CAPRIFOLIACEAE sens. lat.)
Viburnum nudum

APIACEAE
Aralia nudicaulis

AQUIFOLIACEAE
Nemopanthus mucronatus

ASTERACEAE
Hieracium piloselloides

CAPRIFOLIACEAE
Lonicera morrowii

CLUSIACEAE
Hypericum perforatum

CYPERACEAE
Carex trisperma
Eriophorum virginicum
Scirpus cyperinus

DENNSTAEDTIACEAE
Pteridium aquilinum

DRYOPTERIDACEAE
Athyrium filix-femina

ELAEAGNACEAE
Shepherdia canadensis

ERICACEAE (inc. MONOTROPACEAE)
Chamaedaphne calyculata
Gaultheria procumbens
Gaultheria hispidula
Gaylussacia baccata
Kalmia polifolia
Monotropa uniflora
Vaccinium angustifolium
Vaccinium macrocarpon
Vaccinium myrtilloides

MYRSINACEAE
Trientalis borealis

OROBANCHACEAE
(inc. SCROPHULARIACEAE, sens. lat.)
Melampyrum lineare

OSMUNDACEAE
Osmunda cinnamomea

PINACEAE
Larix laricina
Picea mariana
Pinus resinosa
Pinus strobus

RANUNCULACEAE
Coptis trifolia

ROSACEAE
Amelanchier spp.
Aronia floribunda
Fragaria virginiana
Geum aleppicum
Potentilla simplex
Rubus allegheniensis
Rubus strigosus
Spiraea alba

RUSCACEAE
(inc. LILIACEAE sens. lat.)
Maianthemum canadense
Maianthemum trifolia (Smilacina trifolia)

SALICACEAE
Populus tremuloides
Salix exigua
Salix spp.

SAPINDACEAE
Acer rubrum

THELYPTERIDACEAE
Thelypteris palustris

VIOLACEAE
Viola sp.