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FLORISTIC STUDY OF A PRISTINE WETLAND IN THE ISANTI COUNTY WAYSIDE PRAIRIE PARK, 2001-2003

Isanti County Environmental Coalition

In cooperation with:

Isanti County Parks and Recreation
Anoka Ramsey Community College, Cambridge Campus
Minnesota Department of Natural Resources

SUMMARY: The vegetation in the Isanti County Wayside Prairie Park is composed of a complex of upland native plant communities (prairie, oak forest), and an excellent example of a fen wetland, grading from marginal rich fen to a central poor fen. The goal of this project is to increase public awareness and interest in caring for, preserving and managing this unusual resource. The Isanti County Environmental Coalition conducted a survey of the 15-acre fen to assess the composition and integrity of its vegetation. Water and soil analyses were carried out within each plant community and correlated with vegetation data. Representative plant samples were collected and incorporated as the core collection for a new herbarium at the Anoka Ramsey Community College (Cambridge Campus.) A pamphlet featuring the park, its plant communities and trails was developed and printed for public distribution. A presentation was prepared which could be adapted to all age levels and types of community groups, describing the importance of wetlands, particularly the poor fen.

RESUMEN: La vegetación del Wayside Prairie Park del Condado de Isanti está compuesta por un complejo de comunidades vegetales nativas (pradera, robledal) y un excelente ejemplo de humedal de turbera, que va de una turbera rica marginal a otra central pobre. la finalidad de este proyecto es incrementar la consciencia e interés públicos en el cuidado, preservación y manejo de este inusual recurso. La Coalición Ambiental del Condado de Isanti condujo un estudio de los 15 acres de turbera para evaluar la composición e integridad de su vegetación. Se llevaron a cabo análisis de agua y suelo dentro de cada comunidad vegetal y se correlacionaron con los datos de vegetación. Muestras representativas de plantas fueron colectadas e incorporadas como colección base para un nuevo herbario en el Instituto de la Comunidad Anoka Ramsey (Campus de Cambridge). Se preparó un panfleto mostrando el parque, sus comunidades vegetales y sus senderos y se imprimió para distribución pública. Se preparó una presentación que puede ser adaptada a grupos de cualquier edad y comunidad, describiendo la importancia de los humedales, particularmente la turbera pobre.

INTRODUCTION

In the fall of 2001 the Isanti County Environmental Coalition (ICEC) began a floristic study of an unusual type of wetland found in the Isanti County Wayside Prairie Park, a portion of which is designated by the MN Department of Natural Resources as a unique "poor fen". The purpose of the study was threefold: 1) for the members of the ICEC to learn more about this important natural resource 2) to communicate what was learned to the general public, and finally 3) to communicate the results and conclusions to various county and state agencies in a form which could be used in management decisions. The study commenced in October 2001 with delineation of methods and establishment of sampling transects. Fieldwork was carried out primarily by volunteers, throughout the summer and fall of 2002. Data compilation and analysis was completed in the winter and spring of 2002-2003. In this paper methods and results are summarized and analyzed, and

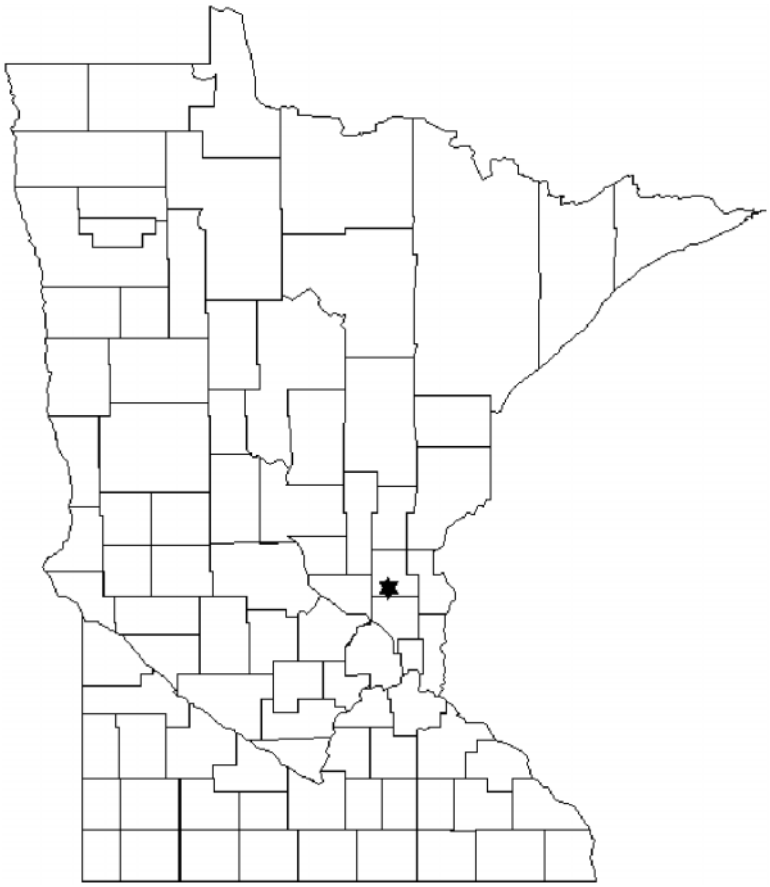

Fig. 1. The State of Minnesota, showing the study area

suggestions are provided concerning future management considerations and research priorities.

STUDY AREA

The Isanti County Wayside Prairie Park is located at 35N, 24W, S33, Bradford Township (see map, Appendix #1). This is part of the geographic ecotope designated as the Anoka Sand Plains. Two 200 meter transects were established in the western portion of the poor fen peatland, bisecting each other, one running north – south to the edge of a small lake (the NS transect), and the other running west to east (the WE transect). One-meter square quadrats (study plots) were established at 10 meter intervals along each transect, where vegetation data were gathered over the summer of 2002. (See Appendix #2).

"Rich fen" is a peatland that receives nutrients from runoff from the surrounding uplands, so is fairly mineral rich (*minerotrophic*). A "poor fen" is a peatland that is fairly mineral-poor (weakly minerotrophic), receiving relatively few of its nutrients from runoff from the

surrounding terrain. This is in contrast to a "bog", which is very mineral poor (an *ombrotrophic* peatland) that receives most of its nutrients from rainwater. A fen, therefore, is usually more mineral rich (minerotrophic) than a bog, especially near its edges, but may gradate towards more bog-like conditions towards its center, where the influence of runoff from the surrounding terrain is less.

The summer climate in this area is often warm and humid. Temperature data are reported from the weather station in Cedar, Anoka County, 11 miles (17.6 km) southeast of the study site. (This was the nearest weather station collecting and reporting temperature data). The mean monthly temperatures during the 2002 field season were 44.7, 53.3, 68.8, 73.6, 68.2, 62.7, 41.1 and 31.3 degrees Fahrenheit for April through November, respectively. Mean daily maximum temperatures were 7.2 to 11.7 degrees above these. The frost-free (>32 degrees F) period in 2002 was 225 days (April 4 – November 14).

The nearest weather station collecting precipitation data is located in Bradford Township, Isanti County, four miles (6.4 km) to the north of the study site. Monthly precipitation totals averaged 3.33, 2.31, 7.94, 7.03, 5.49, 6.76, 7.32, and 0.25 inches respectively for April through November, 2002.

TIME FRAME

(See Appendix #3 for detailed time line)

Brief time line of project activity:

Fall 2000 – March 2001: Planning, applying for support from local, regional and state sources.

July 2001: Received $10,000 matching Environmental Partnerships Grant from Minnesota Department of Natural Resources.

Fall 2001: Planned layout of study site, laid out two 200 m transects in the west end of the fen, one bisecting the other, with rebar stakes placed every 10 m along each transect to indicate location of one-meter square permanent plots.

Winter 2001 – 2002: Project planning continued. Established a wetland addition to the herbarium at the Anoka Ramsey Community College, Cambridge Campus.

Spring 2002: Project planning completed. Training seminars were held for volunteers. Mosses and liverworts of the fen were identified. Environmental data were collected.

May 2002 – September 2002: Collected vascular plant data and additional data on environmental parameters. Maintained photo history of project. Requested and received monetary support ($2500) from the Initiative Foundation.

October 2002: An herbarium committee, a pamphlet committee, a presentation committee, and a data analysis/report committee were formed.

March 2003: The herbarium committee finished its work. One member of the data analysis/report committee participated in a three-day seminar on multivariate statistics (using the PC-ORD statistical package) at the University of MN, St. Paul campus.

April 2003: The presentation committee made their first presentation, to the members of the Isanti County Environmental Coalition at their monthly meeting.

May 2003: The pamphlet committee produced a brochure delineating the Isanti County

Wayside Prairie Park and its trails, and postcards of representative plants of the poor fen. The presentation committee participated in a field day for sixth graders at the Springvale County Park.

June 2003: The herbarium collection of plants of poor fen was completed and made available for public use. A presentation was made to Isanti County Parks Board. The final written report was submitted to all interested parties.

METHODS

A. Field Work

Volunteer members of the ICEC laid out a 200 m north-south transect across the west fen, and a 190 m west-east transect, which bisected the first. One-meter square quadrats (plots) were established every 10 meters along each transect, each marked by a 3 m rebar stake. Vegetation parameters were measured and recorded twice during the growing season of 2002 within each quadrat by four three-member teams. Data collected included plant identification, percent cover (abundance), height classes (plant structure), and sociability (growth habits.) (See Appendixes 4, 5 and 6)

Each of the four teams was responsible for sampling the quadrats of one half of a transect (about 10 quadrats) on two different dates, once towards the beginning of the growing season and once in the fall. Each team sampled a different transect segment on their two sampling dates, in order to randomize the effects of individual biases in methods of collecting data.

Joannes Janssens, bryophyte (moss and liverwort) expert, was contracted to identify the mosses and liverworts of the fen and classify the cover types. He recognized five vegetation ecotopes (plant communities) within the fen and measured environmental parameters including water pH, water absorbency, and water conductivity within the five ecotopes. The environmental data were later incorporated into the PC-ORD analysis of the vegetation data collected in the quadrats along the two transects.

Mike Mueller, area hydrologist with the MN DNR, met with ICEC members at the fen once during the fall and once during the early winter of 2002, taking soil cores in the different vegetation ecotopes down to a maximum depth of 6 meters. He described how the history of the fen could be interpreted from what was seen in the cores.

B. Laboratory Work

1. Vascular Plant Identification

Dr. Martha Phillips (College of St. Catherine) and Hannah Dunevitz (MN DNR) assisted the members of the Isanti County Environmental Coalition in plant identification. Initially they participated in two field trips to the study site at the beginning of the growing season in order to direct the members of the ICEC in identifying plants in the field.

Kriste Ericsson collected, pressed and dried representative plant specimens from the poor fen throughout the growing season, and used the resources, equipment and facilities at Cambridge Community College to identify the specimens as accurately as possible.

Identifications were crosschecked by members of the Herbarium Committee.

Martha Phillips then came up to the Community College on November 19, 2002 to work with members of the Herbarium Committee to verify identifications of the dried and pressed plant specimens. Any specimens that still stumped us were delivered to Hannah Dunevitz, who lent her expertise in identifying the rest of the plant material.

2. Herbarium Mounting and Cataloguing

Representative dried and pressed plant specimens were processed by the Herbarium Committee under the direction of Phil Anderson, curator of the College Herbarium. These were mounted on museum-grade paper and labeled, including data on scientific and common names, date collected, habitat and locality.

Phil Anderson entered all data on each specimen on the herbarium computerized data base, and created a species list for the wetland study site.

3. Bryophyte Identification

Joannes Janssens visited the fen study site on June 17, 2002 and collected samples of mosses and liverworts along the two transects, and also water **samples within each** of the five vegetation ecotopes which he defined. See Appendix #4 for an explanation of his methods and results.

C. Methods of Data Analysis

1. Multivariate Statistical Analysis (See Appendix #7)

Raw data collected in the permanent plots along the two transects at each sampling date were entered as Excel files into a computer database. All plants were identified within the one-meter square plots and vegetation parameters were measured including percent abundance, plant height, and sociability. These data were imported into a computerized multivariate statistical package called PC-ORD for data analysis.

Kriste Ericsson participated in a three-day seminar explaining the uses and interpretation of PC-ORD from March 10-12, 2003, at the University of MN, St. Paul campus. As a result of this seminar she determined that the two statistical approaches most useful to the analysis of this project's data included Cluster Analysis, a program that can be used to delineate different community types (ecotopes), and Nonmetric Multidimensional Scaling (NMS).

Cluster Analysis was the technique used in the current study. NMS is a an ordination program also considered particularly useful for analyzing ecological community data since it 1) avoids the assumption of linear relationships among variables 2) it relieves the "zero truncation" problem (caused by the frequency of zeros in heterogeneous community raw data sets, the zeros indicating absence of a species, or values for environmental parameters related to species absence). Although not used in this study at this time, the technique is available for future data analysis.

2. Data Interpretation

The **percent abundance** data fit very well into multivariate analysis. However, in order to run the analysis, "outlier data" had to be eliminated from the imported data files in order not to skew the results. Outlier data included plant species that only occurred in three or fewer plots (rare or unusual plants) and upland plots that were not strictly characteristic of the fen (about 5 of the 40 plots.) Although these outliers could not be retained for analysis via multivariate statistics, they were considered in the final interpretation and conclusions drawn from this study (See Results.)

We have chosen not to analyze the **plant height** and **sociability** data in this report, but the data is available for future analysis.

RESULTS AND ANALYSIS

A. Plants

1. Species

The plant species within the study area graded from upland woods and prairie plants (5 quadrats), to those typical of a wetland (35 quadrats). Of those within the wetland, those at the edge were typical of a fen, receiving some nutrients from runoff from the surrounding wetlands. Typical species included cattails, arrowleaf, sedges, and grasses. Towards the center of the wetland plants appeared typical of more nutrient poor areas (bog-like): leatherleaf, bog rosemary, sundew, and cranberry. Most of the nutrients in the central part of the wetland come from precipitation. Thirty-eight species of vascular plants were identified within the fen (See Appendix # 8).

Joannes Janssens noted 14 species of mosses and two species of liverworts within the fen, with five species being new county records. (See Appendix #9). A total of 10 species of *Sphagnum* moss were recorded, three of these being included within the new records. One of the new records, *Sphagnum contortum*, showed a significant extension south for its known range.

The fen study area was bordered towards the lake and its southeast corner by plants typical of emergent marsh, with cattail, arrowhead, and bulrush common, and standing water present throughout the year. That area was difficult to traverse by foot. To the northeast a portion of the wetland (outside of the study area) could be designated wet meadow. Wet meadow is typified by sedges, grasses, willow, and is poorly drained. It may be subtended by a shallow layer of peat or mineral soil, but little sphagnum moss. Along the east border of the fen is oak forest, to its north, poplar grading to white cedar forest, and to the west open oak woodland and restored prairie.

2. Cover types (Ecotopes)

The following five types of plant communities (ecotopes) were identified by Joannes Janssens in the fen (Appendix #9):

a. *Carex lasiocarpa* (sedge) floating mat at lake edge (NS200-NS190)

b. *Carex rostrata – Chamaedaphne* (sedge-leatherleaf) hummock mosaic mixed

fen mat, partly floating, transitional (NS180-170)

c. *Chamaedaphne* (leatherleaf) poor fen, grounded mat (NS160-NS060, WE040-WE120) (See additional discussion under 3 V.)
d. Shrub –*Typha* (cattail) zone surrounding poor fen (NS050-NS030, WE030, WE130-140)
e. *Sagittaria-Typha* (arrowleaf – cattail) zone forming lagg (rich fen) between poor fen and upland (NS020, WE150-WE160**)**

3. Abundance (Percent Cover)

Cluster analysis of abundance data defined five vegetation cover types (ecotopes) in a similar fashion to Joannes Janssens' observations. These were grouped in the following manner in a dendrogram. Note that each of the five symbols in the dendrogram designates a different ecotope. (see Appendix # 10):

I. NS020, NS030, WE020, WE030, WE160

This cover type is dominated by cattail (*Typha latifolia*), arrowleaf (*Sagittaria latifolia*), tufted loosestrife (*Lysimachia thyrsiflora*), swamp candles (*Lysimachia terrestris*), and other species that thrive in the transition zone between upland and poor fen. It is similar to Janssens' shrub-cattail ecotope designation (d) and arrowleaf-cattail ecotope (e).

II. NS180, NS190, NS200, WE150

Several species of sedge (*Carex spp.*), arrowleaf, bladderwort (*Utricularia sp.*) and steeplebush (*Spiraea tomentosa*) typify this area. Plots NS180 to NS200 extend towards the lake's edge, corresponding well to Janssens' *Carex lasiocarpa* (sedge) ecotope (a). Plot WE150 is very species diverse, including *Eriophorum sp.* (cotton grass), and the *Phalaris arundinacea*, (reed canary grass), an invasive species which typically indicates a past history of cattle grazing, plowing or siltation in the vicinity of an area. This plot also contains a large number of *Carex spp* and other plants similar to NS180 – NS200, which caused them to be clumped together in the cluster analysis, but direct observations in the field would probably encourage an observer to place it in a transitional ecotope. Janssens assigns it to ecotope (e).

III. NS040, WE010, WE140

This grouping falls squarely within Janssens' shrub-cattail ecotope (d). Dominated by *Salix sp.* (willow) and cattail, these plots are typical of rich fen. Bog birch (*Betula glandulifera*), tufted loosestrife, swamp candles, and marsh fern (*Thelypteris palustris*) are also characteristic of this ecotope.

IV. NS050, WE040, WE130

Janssens would probably also place these plots in the shrub – cattail transitional ecotope (e). Characterized by bog birch and cattail, a *Sphagnum* – dominated community is becoming evident, with poor fen species such as *Chamaedaphne calyculata* (leatherleaf) and *Vaccinium macrocarpum* (cranberry) present in the plots.

V. NS060, NS070, NS080, NS090, NS100, NS110, NS120, NS130, NS140, NS150, NS160, NS170, WE050, WE060, WE070, WE080, WE090, WE100, WE110, WE120

The plots in this cluster are consistent in their species structure with a "poor fen" classification. It also fits closely with Janssens' ecotope (c). The plant communities located towards the center of the peatland are dominated by *Sphagnum* and *Polytrichum* mosses, leatherleaf, cranberry, bog rosemary (*Andromeda glaucophylla*), and frequented by other species such as bog birch and sundew (*Drosera sp.*) These are all species that thrive in the nutrient – poor conditions of a poor fen.

In contrast to Joannes Janssens' findings, our observations indicated that the center area of the poor fen is a floating peat mat, as determined by soil and water surveys. Janssens indicates that it is a "grounded mat".

B. Soil Survey (See Appendix #11)

The October 7, 2002 soil survey was made difficult because of the high water level. Another survey was made on December 12, 2002, which was much easier since the upper water layer was frozen.

Soil cores were drilled in December down to a depth of 18 feet, the furthest extension of the soil corer.

NS 185, towards south end of north-south transect (sedge area near lake edge): Towards the lake edge there was six inches of ice at the surface, then less resistance down to one foot depth, with a mat of plants and roots between three and four feet in depth. Below this there was loose unconsolidated fibrous material mixed with water down to a depth of 16 feet. Between 16.5 and 18 feet in depth muck appeared, with very little fiber and no sand.

Center of poor fen (near intersection of the two transects, dominated by leatherleaf and sphagnum): Ice to eight inches in depth. Eight inches to seven feet in depth: loose sphagnum, fibrous. Eight feet to 16 feet in depth: a lens of water. Sixteen feet to 18 feet in depth: black muck, some fibers, more decomposed.

Along west-east transect, plot WE 060 (dominated by leatherleaf and sphagnum, west of intersection): Ice to 8 inches in depth. Eight inches to two feet in depth: coarse sphagnum and cranberries. Two feet to 7 feet depth, more resistance, more fibrous. Ten to 16.5 feet in depth: loose muck and water. 16.5 to 18 feet: black finer muck, fibrous, but not peat. More decomposed.

WE 020, west end of WE transect, sedge zone: Ice to six inches in depth. 1.5 feet down to solid ground. Two feet down: black soil with some mineral content, mixed with sand, some fibers. (Peat/muck/sand mix.) Three to 4 feet down: loose black muck. An organic, fibrous chunk, sand below. 4.5 feet and below: sand.

NS 055, towards north end of N-S transect (Leatherleaf/sphagnum). Ice to six inches depth. 2.5 feet down to resistance, plant matter present. 2.5 to 4 feet in depth: black muck, lots of plant matter. Firmer than towards center of bog. 4-8 feet: coarse and fibrous muck. 8-9 feet: more mucky, sand at bottom. 9-10 feet: fibrous, little chunks of sand. 10-12 feet: mostly black, fibrous, drier towards bottom. Less sand, more elastic, like clay. 12-13 feet:

loose, fibrous, unconsolidated, black. 13-14 feet: sand with very fine organic matter.

One problem in interpreting the cores was that as the borer was shoved successively deeper into the substrate, soil fell into it from the substrate zones further up in the core. This made it difficult at times to describe the substrate at successively deeper levels.

Some observations:

The upper stratum within the fen is largely made of **peat**, formed from partially decayed plant matter. Towards the center of the wetland the peat is primarily composed of partially decomposed sphagnum, while towards the edge of the fen it is composed of decaying grasses and sedges.

It appears that the poor fen is floating on a lens of water, and is perhaps growing out over the lake. This is typical of small lakes with little wave action (Mitsch and Gosselink, 1986.) The base substrate consisted of sand.

See Appendix #11 for detailed Soil Survey notes.

C. Water Analysis

Water level: **Water level** was monitored at monthly intervals during the growing season by measuring water depth of the lake along a PVC pipe located in the lake near the shore. The year 2001 had been exceptionally dry, which made it easy to enter the wetland and lay out the transects in September and October of that year. The growing season of 2002 proved to be exceptionally wet. This did not inhibit fieldwork very much, but by the end of the growing season we were wading up to our waists along the transect lines to sample the plots. NS 200 was sampled on September 22nd from a canoe, but NS 190 could not be sampled – it was too precarious to walk to, and too much vegetation was in the way to access it by canoe.

- pH: (pH is a logarithmic measure of the alkalinity to acidity of a substance, indicating hydrogen ion concentration vs. hydroxide ion concentration of the substance. A pH of 7 indicates neutrality (hydrogen ion concentration equals hydroxide ion concentration), such as found in pure water when measured at 25 degrees C. A pH less than 7 is considered acidic (high hydrogen ion concentration); a pH higher than 7 is alkaline (high hydroxide ion concentration) (Lehninger 1979)). **pH** was higher in water samples collected along the edges of the wetland near the upland (pH 6.0 – 6.4), which is characteristic of a rich fen. It was lower towards its center (4.3 – 5.0). This is typical of a poor fen. As a fen develops into a bog the organic content of the peat increases due to the slowing decomposition rate, and the capacity of the soil to adsorb and exchange cations increases. These changes lead to domination by hydrogen ions, and the pH falls sharply. This is reflected in the types of plant species present that are tolerant to a lower pH, such as leatherleaf, bog rosemary and cranberry.

Conductivity (K^{25}_{red}): (the ability of a substance to conduct a current, in this case at 25 degrees C. A measure of the salinity of the water (i.e.: salt content)) Again, as would be expected, **conductivity** of water samples collected towards the center of the wetland (14.1 – 23.9) was less than the conductivity of samples collected towards the upland (67.5 – 92.7). In general, the conductivity of organic peat increases as decomposition rates increase. Peat composed of grasses, sedges and cattails are more permeable than sphagnum peat,

and thus break down quicker. This is reflected in the higher conductivity values of the water samples collected at the edge of the fen.

Absorbance @ 350 nm: **Absorbance** of water samples was measured with a Spectrophotometer at 350 nm. Absorbance is a measure of the capacity of a solution to absorb light at a given wavelength, and is dependent on the concentration of dissolved organic matter, as is often indicated by water color (Lehninger 1979). Typical water samples within a peatland are a dark tea – color, due to the stagnant conditions within peatlands. This was reflected in the absorbance values obtained by Janssens: .205 - .348 near the uplands, and .640 - .745 from water samples obtained towards the center of the peatland.

SUMMARY

Plant species composition, water chemistry, and soil stratification for this wetland are typical of a fen, gradating from mineral-rich at its edges towards mineral-poor at its center. Along its edges a typical rich fen is dominated by sedges and is fed by water draining from mineral-rich soil. A poor fen is characterized by peaty soil, and is more mineral poor, receiving most of its nutrients from rainwater. This designation was supported by both the water chemistry of the peat land and the structure of its plant communities. Cattails are dominant along the east, north, and west sides of the peat land, indicating higher nutrients in the soil. Next is a zone of sedges, on all four sides of the study area, including the south side adjacent to the lakeshore.

Towards the center of the study area the hummock/hollow structure of S*phagnum* moss – dominated area is evident. This raised area is dominated by ericacious plants such as leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda glaucophylla*) and cranberry (*Vaccinium spp.*). The pH, conductivity and absorbance of the water samples collected in these different zones also supported the gradation of rich fen towards poor fen at the center of the study area.

A taxonomic evaluation of the mosses and liverworts of the fen revealed some interesting findings. Joannes Janssens noted 14 species of mosses and two species of liverworts within the fen, with five species being new county records. (See Appendix #9). A total of 10 species of *Sphagnum* moss were recorded, three of these being included within the new records. One of the new records, *Sphagnum contortum*, showed a significant extension south for its known range.

Soil cores revealed that the layer of peat is in places 6 feet deep, and is subtended by a lens of water that extends as much as 10 feet more in depth. It appears that the peatland has developed from the filling in of an inlet of the lake, and is growing out over the lake's surface.

Research findings confirmed that this peat land is in unusually pristine condition and high integrity. Very few exotic plants were evident, although reed canary grass (*Phalaris arundinacea*), a plant native to Europe that was once widely planted for pasture, is invading along the east side of the study area. There is little other evidence that fertilizers (such as phosphorus) or runoff from cow pasture has had any impact on the area. Further analysis of chemical composition of the water of the fen could be made to examine this.

Mechanical impact to the fen, however, is evident. The tracks of a four-wheeler were

seen in the winter of 2001, running along the south side of the boardwalk and then across the center of the peat land, exiting at the west end. The damage was still evident at the end of the 2002 field season – and could be seen as the hummock/hollow structure of the fen was compressed where the four-wheeler had passed by.

Although the work teams collecting data for this study attempted to minimize their mechanical impact on the structure of the fen by spreading out as they walked the transect lines, by the end of the field season it was evident where we had traversed the peatland, particularly along the transect lines.

RECOMMENDATIONS

We have six recommendations regarding future activities at this wetland site. First, we would like to encourage students and the public to visit the fen. Access to the fen is excellent, since a floating boardwalk has been constructed across the entire length of the eastern section and extending a third of the way across the western section, where the present study was carried out. This provides a wonderful opportunity to observe plants, insects, and birds characteristic of this site. Many people would enjoy guided nature hikes to this area. Students can readily carry out experiments along the boardwalk without setting foot directly into this fragile ecosystem.

This leads to the second recommendation: that further direct penetration by foot off the boardwalk into the peat land be minimized. The physical structure of a peat bog readily incurs damage when a person, large animal, or vehicle moves across it. Peatlands take years to regenerate. The effects of this damage can still be seen a decade later. The tracks of a four-wheeler that were made in the fall or early winter of 2000 are still evident.

Although it would involve more direct penetration into the wetland, it would be worthwhile to consider having volunteers mechanically remove the reed canary grass (*Phalaris arundinacea*), growing in the rich fen area. It appears to be located primarily along the east border of the study area, and could be removed with time and effort. A survey along the other edges of the fen would determine the feasibility of such a project, and is highly recommended in order to prevent continued invasion by this plant in further degrading the integrity of the peatland.

It would be important to insure that pollutants entering into the peatland continue to be minimal. One way is to leave the surrounding native vegetation (forest, prairie, wet meadow) as a buffer surrounding the fen, and to minimize construction and intensive use of the area. So far there has been little disturbance, and it should be kept that way.

As a fifth recommendation: the fen at the Isanti County Wayside Prairie Park would be an excellent site to monitor for changes that might be related to succession and/or climate change. This study could be repeated every ten years. Such studies are already being carried out at the Cedar Creek Natural History Area in Anoka County, run by the University of Minnesota, and at other sites across Minnesota. The techniques used by the Isanti County Environmental Coalition could be readily adapted to tie into future studies of this type.

Finally, the existing database has the potential of being used in looking at plant structure, sociability and abundance in relation to nutrient capacity and the physical structure of the

wetland. We would like to map in detail the vegetation communities of the area, if this can be done with minimal impact to the physical integrity of the wetland. Future studies of the area could be carried out in cooperation with the students and faculty of the Anoka Ramsey Community College, Cambridge Campus. The possibilities are unlimited.

COLLABORATORS

Organizations and Donors:

- Isanti County Environmental Coalition (Susan Blom, Chair)
- Isanti County: Acting as the project's fiscal agent
- Minnesota Department of Natural Resources ($10,000 matching grant)
- Isanti County Parks and Recreation Commission (Maurice Anderson, Chairman, Steve Nelson, Parks Director, $1000 contribution in matching funds)
- Bonnie and John Schlagel (private contribution of $1000 in matching funds)
- Anoka Ramsey Community College – Cambridge Campus ($3,500 in-kind support)
- Initiative Foundation ($2500 grant)
- Peoples Bank of Commerce ($100 contribution in matching funds)

Individuals:

- Kriste Ericsson (Project Coordinator, Botanist, Isanti County Environmental Coalition)
- Joe Crocker (Project Co-coordinator, Isanti County Environmental Coalition)
- C. Philip Anderson (Professor Emeritus of biology and Herbarium Curator at Anoka-Ramsey Community College – Cambridge, Isanti County Environmental Coaliton)
- Hannah Dunevitz (Plant Ecologist, MN Dept. of Natural Resources)
- Martha Phillips (Professor of Biology at St. Catherine, Wetland Ecologist studying global warming trends at University of Minnesota's Cedar Creek Natural History Area)
- Joannes Janssens (Private contractor, Bryologist)
- Josie Arrowsmith (Student Intern, Cambridge Community College)
- —and all the other invaluable volunteers of the Isanti County Environmental Coalition, who donated time, thought, advice and sweat (and blood!) for this project (See
- #12)

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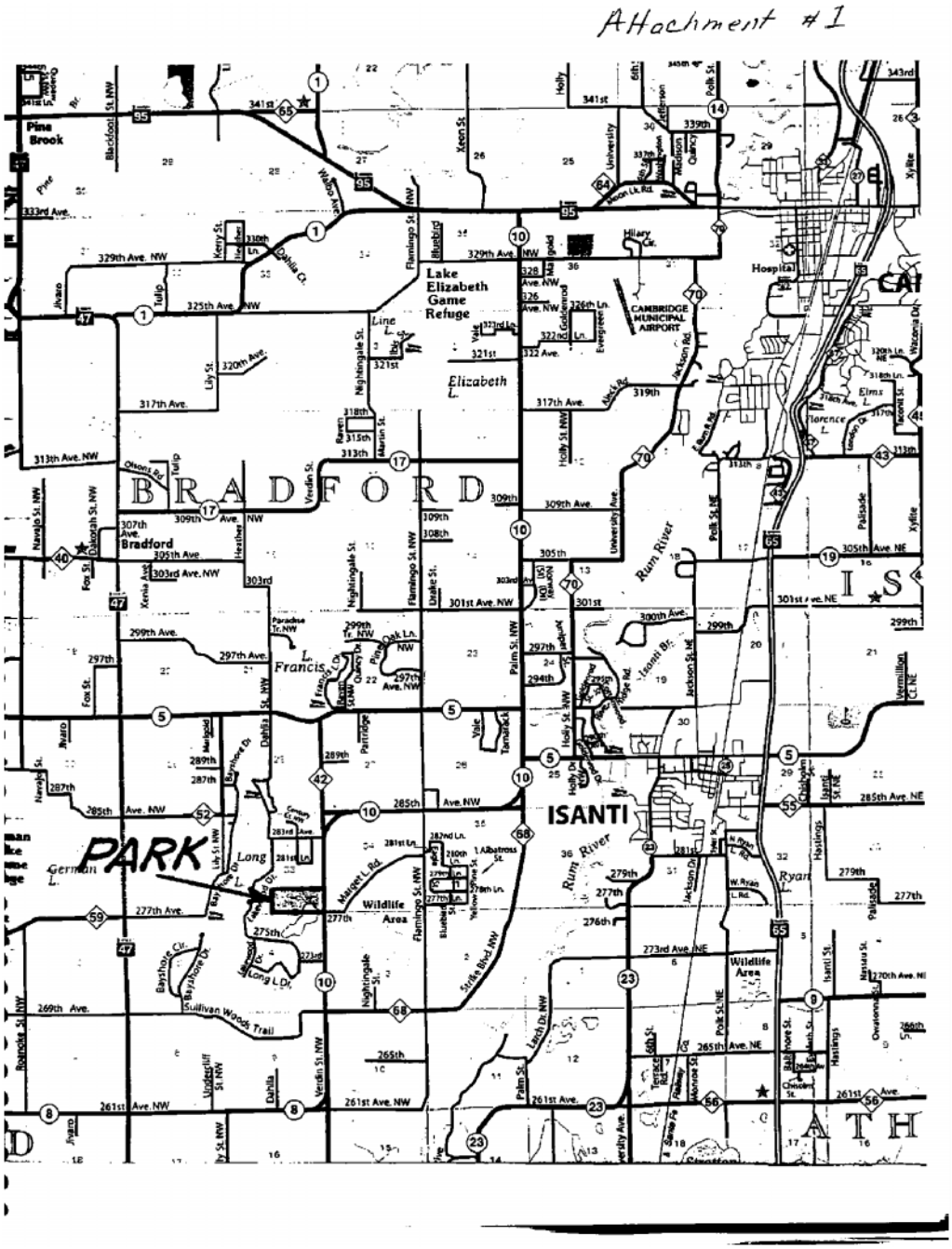
APPENDIXES

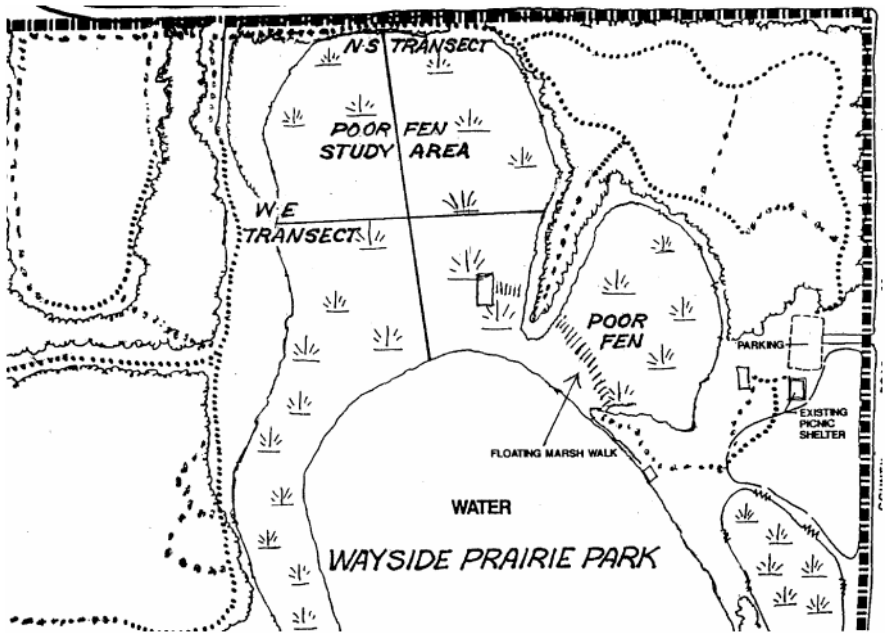
1. Map of Isanti County Wayside Prairie Park, Minnesota
2. Map of study area within the fen, Isanti County Wayside Prairie Park
3. Time Frame for the study of the fen in the Isanti County Wayside Prairie Park
4. Fieldwork codes for vegetation sampling
5. Field data sheet
6. Raw data of vegetation parameters used in multivariate statistical analyses
7. Ericsson, K.A. 2003. Analysis of plant communities using multivariate statistical techniques.
8. Plant species list of the fen peatland study site in the Isanti County Wayside Prairie Park. Isanti County Environmental Coalition, 2002
9. Janssens, J.A. 2002. Bryophytes of the Wayside Prairie Park Peatland, Site 2282, Isanti County, Minnesota. Lambda-Max Ecological Research.
10. Cluster analysis dendrogram of the plant communities of the fen in the Isanti County Wayside Prairie Park, as defined by species abundance.
11. Soil Surveys by the Isanti County Environmental Coalition with Mike Mueller in the fen of the Isanti County Wayside Prairie Park. 10-7-02 and 12-17-02.
12. Isanti County Environmental Coalition member participation
13. Photos of activities at the fen, Isanti County Wayside Prairie Park, 2003
14. Presentation Committee's general outline for presentations on the fen peatland (compiled by Susan Blom)
15. ICEC Presentation for Natural Resources Day, May 20, 2003
16. Pamphlet of the Fen Peatland and the Isanti County Wayside Prairie Park, produced by the ICEC Pamphlet Committee
17. Post cards produced by the ICEC Pamphlet Committee

APPENDIX 1

MAP OF ISANTI COUNTY WAYSIDE PRAIRIE PARK, MINNESOTA



APPENDIX 2
MAP OF STUDY AREA WITHIN THE FEN, ISANTI COUNTY WAYSIDE PRAIRIE PARK



APPENDIX 3

TIME FRAME FOR THE STUDY OF THE FEN IN THE ISANTI COUNTY WAYSIDE PRAIRIE PARK

The original timeline for the study upon receipt of the MN DNR grant was 10/01/01 to 3/31/03. An extension was allowed by the MN DNR until 6/30/03 to complete data analysis and submit the final report.

Time line of actual activity:

Fall 2000 – March 2001: Planning, applying for support from local, regional and state sources.

- Isanti County agreed to be the fiscal agent for the project
- Received $1000 financial commitment from the Isanti County Parks and Recreation
- Received $1100 in private donations towards the project
- Received $10,500 commitment of in-kind services from Anoka Ramsey Community College, Cambridge Branch
- Received commitment of in-kind services, time and technical support from members of the Isanti County Environmental Coalition
- Received commitment of in-kind services, time and technical support from various professionals
- Environmental Partnerships Grant application sent to MN DNR 3/26/01.

July 2001: Received $10,000 grant from MN DNR.

Fall 2001: Planned layout of study site, laid out two 200 m transects in the west end of the fen, one bisecting the other, with rebar stakes placed every 10 m along each transect to indicate location of one-meter square permanent plots.

Winter 2001 – 2002:

- Project planning continued
- Donation made of pressed, dried plant specimens, from Dr. Russell Johnson, professor emeritus of Bethel College, St. Paul, MN, and local Isanti County resident.
- Herbarium established at the Anoka Ramsey Community College, using Dr. Johnson's extensive collection as the foundation of the new herbarium collections. C. Phillip Anderson took on role as new herbarium's curator.

Spring 2002:

- Project planning was completed.
- C. Phillip Anderson (professor emeritus of Anoka Ramsey Community College, Cambridge Campus) led two sessions in plant identification through use of technical keys at the monthly meetings of the Isanti County Environmental Coalition.
- Hannah Dunnevitz (MN DNR) and Dr. Martha Phillips (professor at University of St. Katherine's) led training sessions at the study site in field identification of wetland plants and plant population sampling techniques, focusing on the use of one-meter square quadrat sampling frames, with members of the Isanti County Environmental Coalition and other interested parties participating.
- Dr. Joannes Janssen (bryologist, independent contractor) conducted a taxonomic study of the bryophytes (mosses and liverworts) of the poor fen, also collecting data on the water chemistry of each habitat type in the wetland.

May 2002 – September 2002:

- Collected vegetation data and data on environmental parameters.
- Started computerized data entry.
- June 2002: Submitted proposal to the Initiative Foundation requesting $2500 in support.
- September 2002: Received $2500 in support from the Initiative Foundation.
- Maintained photo history of project.

October 2002: Four committees were formed:

- An **herbarium committee**, to identify and mount plants
- A **pamphlet committee**, to produce a brochure detailing the project, the park and the fen
- A **presentation committee**, to prepare public presentations concerning the study
- A **data analysis and report committee**, dedicated to analyzing the field data and compiling the final report.

March 2003:

- The herbarium committee finished mounting all plant specimens and compiling a complete computerized inventory of the plant species present in the study site
- Kriste Ericsson participated in a three day workshop which explained the vagaries of the multivariate statistical computer package, PC-ORD, which expedited analysis of field data.

April 2003:

- The presentation committee made their first presentation, to the members of the Isanti County Environmental Coalition at their monthly meeting.

May 2003:

- The pamphlet committee produced a brochure delineating the Isanti County Wayside Prairie Park and its trails, with a description of the poor fen wetland and a plant species list of the study area. 700 copies of the brochure were printed and also 2000 postcards depicting line drawings of four plants characteristic of the poor fen.
- Members of the presentation committee participated in an environmental field day on May 20th for Isanti County sixth graders at Springvale Park, talking about the importance of wetlands, and the poor fen in particular. (Seven groups of kids, about 30 students in each group, a 20 minute presentation to each group).

June 2003:

- Herbarium collection of plants of poor fen was completed and made available for public use.
- June 23, 2003: Members of the ICEC presented the results of the study to the Isanti County Parks Board.
- A copy of this final report was submitted to the MN Department of Natural Resources, the Initiative Foundation, and Isanti County Parks and Recreation. A copy of this report was also placed in the library of the Anoka Ramsey Community College, Cambridge Campus, for access by students and the general public.

APPENDIX 4

FIELDWORK CODES FOR VEGETATION SAMPLING

Height Class	Cover Class	Sociability
5 = 5—10 m	5 = 75 -100% cover	5 = extensive mat
4 = 2—5 m	4 = 50 – 75%	4 = small colonies, broken mat
3 = 0.5 – 2 m	3 = 25 – 50%	3 = large group, many plants
2 = 0.1 – 0.5 m	2 = 5 – 24%	2 = scattered, several plants
1 = 0 – 0.1 m	1 = 1 – 5%	1 = growing singly
	+ = <1%	
	R = single (rare)	

APPENDIX 5

FIELD DATA SHEET

TRANSECT: _____ PAGE _____ OF _____

DATE: _____

OBSERVERS: _____

_____

PLOT(meter):				SPECIES DESCRIPTION
SPECIES NAME	H	C	S	

APPENDIX 6
RAW DATA OF VEGETATION PARAMETERS USED IN MULTIVARIATE STATISTICAL ANALYSES

Quadrat Analysis in the Isanti County Wayside Prairie Park 2002			Combined Data		
Plot	**Date**	**Species**	**Height Class**	**% Cover**	**Sociability**
NS000	29/06/02	Maianthemum canadense (Canada mayflower)	2	0,5	1
NS000	29/06/02	Thuja occidentalis (white cedar)	5	5	1
NS000	10/09/02	Maianthemum canadense (Canada mayflower)	1	0,5	2
NS000	10/09/02	Thuja occidentalis (white cedar)	5	5	1
NS010	29/06/02	Betula papyrifera (white birch)	4	5	2
NS010	29/06/02	Lactuca sp. (wild lettuce)	2	1	1
NS010	29/06/02	Maianthemum canadense (Canada mayflower)	2	1	2
NS010	29/06/02	Onoclea sensibilis (sensitive fern)	2	2	2
NS010	29/06/02	Polytrichum sp. (moss)	2	2	2
NS010	29/06/02	Populus tremuloides (trembling aspen, popple)	5	4	2
NS010	29/06/02	Rubus sp.	2	2	2
NS010	29/06/02	Unknown I (hairy stemmed serrated)	2	1	2
NS010	29/06/02	Unknown J (seedling, fine serrations)	2	0,1	1
NS010	29/06/02	Unknown L (sedge)	2	3	3
NS010	29/06/02	Unknown M (opposite leaves, white underneath)	2	1	1
NS010	29/06/02	Unknown N (grass, Poa?) sampled	2	0,5	1
NS010	10/09/02	Betula papyrifera (white birch)	4	4	2
NS010	10/09/02	Carex sp. Unknown C (sedge)	2	4	4
NS010	10/09/02	Corylus americana (hazelnut)	3	5	2
NS010	10/09/02	Galium sp. (Unknown G)	1	0,1	1
NS010	10/09/02	Lycopodium sp. (clubmoss)	1	2	2
NS010	10/09/02	Onoclea sensibilis (sensitive fern)	1	1	2
NS010	10/09/02	Populus tremuloides (trembling aspen, popple)	no data	no data	no data
NS010	10/09/02	Rubus sp.	2	2	2

Plot	Date	Species	Height Class	% Cover	Sociability
NS010	10/09/02	Unknown B (plum?)	2	2	2
NS010	10/09/02	Unknown D	2	1	1
NS010	10/09/02	Unknown E (fern)	2	2	2
NS010	10/09/02	Unknown F	1	1	2
NS020	29/06/02	Campanula aparinoides (marsh bellflower)	2	0,5	1
NS020	29/06/02	Galium sp. (little bedstraw)	2	0,5	1
NS020	29/06/02	Polygonum sagittatum (tear thumb)	2	1	2
NS020	29/06/02	Potentilla palustris (marsh cinquefoil)	2	1	2
NS020	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	0,1	1
NS020	29/06/02	Unknown B (round leaved)	2	1	2
NS020	29/06/02	Unknown D (sedge)	2	5	5
NS020	29/06/02	Unknown F	na	na	na
NS020	10/09/02	Polygonum sagittatum (tear thumb)	3	3	3
NS020	10/09/02	Potentilla palustris (marsh cinquefoil)	2	1	2
NS020	10/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	3	0,1	1
NS020	10/09/02	Unknown H (sedge)	3	4	3
NS030	29/06/02	Carex sp.	3	5	3
NS030	29/06/02	Hypericum sp.? (St. John's wort)	2	1	2
NS030	29/06/02	Polygonum sagittatum (tear thumb)	2	0,5	2
NS030	29/06/02	Ranunculus? Water hemlock? (sampled)	2	0,5	1
NS030	29/06/02	Sagittaria gramiNSa (grass-leaved arrowhead)	2	1	2
NS030	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	1	2
NS030	29/06/02	Typha latifolia (broadleaved cattail)	3	2	2
NS030	29/06/02	Unknown A (mint)	2	2	2
NS030	29/06/02	Unknown B (round leaved)	2	0,1	1
NS030	29/06/02	Unknown grass (sampled with seed head)	3	2	2
NS030	29/06/02	Utricularia sp. (bladderwort)	1	1	2
NS030	10/09/02	Calamagrostis canadensis (Canad. blue joint grass)	2	2	3
NS030	10/09/02	Campanula aparinoides (marsh bell flower)	3	1	2

NS030	10/09/02	Polygonum sagittatum (tear thumb)	3	1	2
NS030	10/09/02	Potentilla palustris (marsh cinquefoil)	2	1	2
NS030	10/09/02	Sagittaria graminea (grass-leaved arrowhead)	2	0,1	1
NS030	10/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	0,1	1
NS030	10/09/02	Typha latifolia (broadleaved cattail)	3	2	3
NS030	10/09/02	Unknown P	3	2	2
NS030	10/09/02	Unknown Q (sedge)	3	4	3
NS030	10/09/02	Utricularia sp. (bladderwort)	1	1	2
NS030	6/29/02	Bidens? (called mint B in NS040)	2	2	2
NS030	6/29/02	Potentilla palustris (marsh cinquefoil)	2	2	2
NS030	6/29/02	Unknown C (long leaves, opposite) sampled	2	0,1	1
NS040	29/06/02	Bidens? (called mint B in NS040)	2	2	2
NS040	29/06/02	Galium sp. (little bedstraw)	2	0,1	1
NS040	29/06/02	Lysimachia terrestris (swamp candles)	2	2	2
NS040	29/06/02	Polygonum sp. (smartweed)	2	0,5	1
NS040	29/06/02	Potentilla palustris (marsh cinquefoil)	2	2	2
NS040	29/06/02	Ranunculus? Water hemlock? (sampled)	2	0,1	2
NS040	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	2	2
NS040	29/06/02	Salix sp. (willow)	3	3	3
NS040	29/06/02	Typha latifolia (broadleaved cattail)	3	2	2
NS040	29/06/02	Unknown (not sampled)	2	0,1	1
NS040	29/06/02	Unknown A (mint) Sampled	2	2	2
NS040	29/06/02	Unknown sedge — wiregrass? Sampled	3	2	2
NS040	10/09/02	Lemna sp. (duckweed)	1	1	2
NS040	10/09/02	Potentilla palustris (marsh cinquefoil)	2	2	2
NS040	10/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	1	1
NS040	10/09/02	Salix sp. (willow)	3	3	2
NS040	10/09/02	Typha latifolia (broadleaved cattail)	3	2	2
NS040	10/09/02	Unknown I (sedge)	3	2	3
NS040	10/09/02	Unknown J (sedge)	2	1	1
NS040	10/09/02	Utricularia sp. (bladderwort)	1	1	2

Plot	Date	Species	Height Class	% Cover	Sociability
NS050	29/06/02	Betula glandulifera (bog birch)	3	3	2
NS050	29/06/02	Campanula aparinoides (marsh bellflower)	2	0,5	1
NS050	29/06/02	Chamaedaphne calyculata (leatherleaf)	2	3	3
NS050	29/06/02	Galium sp. (little bedstraw) sampled	2	0,5	1
NS050	29/06/02	Potentilla palustris (marsh cinquefoil)	2	2	2
NS050	29/06/02	Rumex? (dock) sampled	2	0,1	1
NS050	29/06/02	Sagittaria graminea (grass-leaved arrowhead)	2	1	2
NS050	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	1	2
NS050	29/06/02	Salix sp. (willow)	3	3	2
NS050	29/06/02	Typha angustifolia?	3	0,1	1
NS050	29/06/02	Unknown fern (sampled — marsh fern?)	2	0,5	1
NS050	29/06/02	Unknown grass A	2	2	2
NS050	29/06/02	Unknown mint,.1ediish stem	2	1	2
NS050	10/09/02	Betula glandulifera (bog birch)	3	2	2
NS050	10/09/02	Campanula aparinoides (marsh bell flower)	2	0,1	1
NS050	10/09/02	Chamaedaphne calyculata (leatherleaf)	2	3	3
NS050	10/09/02	Potentilla palustris (marsh cinquefoil)	2	2	2
NS050	10/09/02	Rumex? (dock) sampled	3	0,1	1
NS050	10/09/02	Sagittaria sp.	2	1	2
NS050	10/09/02	Salix sp. (willow)	3	2	2
NS050	10/09/02	Sphagnum sp.	1	4	5
NS050	10/09/02	Thelypteris palustris (marsh fern)	2	0,1	1
NS050	10/09/02	Typha angustifolia?	3	1	2
NS050	10/09/02	Unknown M (mint)	2	1	2
NS050	10/09/02	Unknown N (sedge)	2	2	2
NS060	29/06/02	Betula glandulifera (bog birch)	3	2	4
NS060	29/06/02	Chamaedaphne calyculata (leatherleaf)	3	5	5
NS060	29/06/02	Polytrichum sp. (moss)	1	miss. data	miss. data
NS060	29/06/02	Sagittaria graminea (grass-leaved arrowhead)	2	1	1

NS060	29/06/02	Sphagnum (hollow)	1	2	4,5
NS060	29/06/02	Sphagnum (hummock)	1	4	5
NS060	10/09/02	Betula glandulifera (bog birch)	3	2	2
NS060	10/09/02	Chamaedaphne calyculata (leatherleaf)	3	5	5
NS060	10/09/02	Sagittaria sp.	2	2	2
NS060	10/09/02	Sphagnum (hollow)	no data	no data	no data
NS060	10/09/02	Sphagnum (hummock)	no data	no data	no data
NS060	29/06/02	Unknown fern (sampled — marsh fern?)	2	0,5	1
NS060	29/06/02	Unknown mystery plant - like leatherleaf, softer	2	0,5	1
NS060	10/09/02	Unknown K	2	1	2
NS070	29/06/02	Betula glandulifera (bog birch)	3	2	2
NS070	29/06/02	Chamaedaphne calyculata (leatherleaf)	3	4	4
NS070	29/06/02	Drosera sp. (sundew)	1	0,5	1
NS070	29/06/02	Polytrichum sp. (moss)	1	2	3
NS070	29/06/02	Sphagnum (hollow)	1	3	3
NS070	29/06/02	Sphagnum (hummock)	1	2	3
NS070	10/09/02	Betula glandulifera (bog birch)	3	2	1
NS070	10/09/02	Chamaedaphne calyculata (leatherleaf)	3	5	5
NS070	10/09/02	Sphagnum sp.	1	5	5
NS070	10/09/02	Typha latifolia (broadleaved cattail)	3	0,1	1
NS080	29/06/02	Chamaedaphne calyculata (leatherleaf)	3	5	5
NS080	29/06/02	Drosera sp. (sundew)	1	0,5	2
NS080	29/06/02	Sphagnum (hummock)	1	5	5
NS080	10/09/02	Chamaedaphne calyculata (leatherleaf)	3	5	5
NS080	10/09/02	Polytrichum sp. (moss)	1	3	4
NS080	10/09/02	Sphagnum sp.	1	5	5
NS080	10/09/02	Unknown L	2	0,1	1
NS090	29/06/02	Betula glandulifera (bog birch)	1	0,1	1
NS090	29/06/02	Chamaedaphne calyculata (leatherleaf)	3	5	5
NS090	29/06/02	Drosera sp. (sundew)	1	0,5	2
NS090	29/06/02	Polytrichum sp. (moss)	1	2	4

Plot	Date	Species	Height Class	% Cover	Sociability
NS090	29/06/02	Sphagnum (hollow)	1	2	4
NS090	29/06/02	Sphagnum (hummock)	1	2	4
NS090	29/06/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	2
NS090	10/09/02	Chamaedaphne calyculata (leatherleaf)	3	5	5
NS090	10/09/02	Polytrichum sp. (moss)	1	3	4
NS090	10/09/02	Sphagnum sp.	1	4	4
NS090	10/09/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,1	1
NS100	22/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	3
NS100	22/09/02	Polytrichum (Christmas-tree like moss) Moss B	1	2	4
NS100	22/09/02	Sphagnum spp.	1	5	5
NS100	22/09/02	Tridenium virginium	2	0,5	1
NS100	22/09/02	Typha sp.(cattail)	2	1	1
NS100	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	0,5	1
NS100	na	na	na	na	na
NS110	26/06/02	Andromeda glaucophylla (bog.1osemary)	2	0,5	1
NS110	26/06/02	Betula glandulifera (bog birch)	1	1	2
NS110	26/06/02	Chamaedaphne calyculata (leatherleaf)	2	4	2
NS110	26/06/02	Drosera sp. (sundew)	1	0,5	missing data
NS110	26/06/02	Moss A	1	4	4
NS110	26/06/02	Moss C	1	3	4
NS110	26/06/02	Polytrichum (Christmas-tree like moss) Moss B			
NS110	26/06/02	Salix sp.	3	1	2
NS110	26/06/02	Vaccinium macrocarpum (large fruited cranberry)	2	0,5	1
NS110	22/09/02	Andromeda glaucophylla (bog.1osemary)	2	1	1
NS110	22/09/02	Betula glandulifera (bog birch)	3	3	2
NS110	22/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	3
NS110	22/09/02	Polytrichum (Christmas-tree like moss) Moss B	1	3	4
NS110	22/09/02	Salix sp.	2	1	1
NS110	22/09/02	Sphagnum spp.	1	5	5

NS110	22/09/02	Typha sp.(cattail)	2	1	1
NS110	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	1	2	2
NS120	26/06/02	Andromeda glaucophylla (bog.1osemary)	1	0,5	1
NS120	26/06/02	Betula glandulifera (bog birch)	3	2	4
NS120	26/06/02	Chamaedaphne calyculata (leatherleaf)	2	4	4
NS120	26/06/02	Drosera sp. (sundew)	1	2	4
NS120	26/06/02	Lichen	1	2	1
NS120	26/06/02	Moss A			
NS120	26/06/02	Moss C	1	3	4
NS120	26/06/02	Polytrichum (Christmas-tree like moss) Moss B	1	3	2
NS120	26/06/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	1
NS120	22/09/02	Andromeda glaucophylla (bog.1osemary)	2	1	1
NS120	22/09/02	Betula glandulifera (bog birch)	3	2	4
NS120	22/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	3
NS120	22/09/02	Polytrichum (Christmas-tree like moss) Moss B	1	3	5
NS120	22/09/02	Sphagnum spp.	1	4	5
NS120	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	1	1
NS130	26/06/02	Betula glandulifera (bog birch)	3	1	1
NS130	26/06/02	Chamaedaphne calyculata (leatherleaf)	2	3	4
NS130	26/06/02	Drosera sp. (sundew)	1	0,5	1
NS130	26/06/02	Lichen	1	0,5	1
NS130	26/06/02	Moss C	1	5	5
NS130	26/06/02	Mushroom	1	0,5	1
NS130	26/06/02	Polytrichum (Christmas-tree like moss) Moss B	1	0,5	1
NS130	26/06/02	Vaccinium macrocarpum (large fruited cranberry)	1	2	2
NS130	22/09/02	Betula glandulifera (bog birch)	2	2	1
NS130	22/09/02	Chamaedaphne calyculata (leatherleaf)	2	4	3
NS130	22/09/02	Sphagnum spp.	2	5	5
NS130	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	2	3
NS140	17/06/02	Chamaedaphne calyculata (leatherleaf)	2	3	3
NS140	17/06/02	Drosera sp. (sundew)	1	0,1	1

Plot	Date	Species	Height Class	% Cover	Sociability
NS140	17/06/02	Moss - not sphagnum	1	2	4
NS140	17/06/02	Sphagnum spp.	1	5	5
NS140	17/06/02	Vaccinium macrocarpum (large fruited cranberry)	1	2	4
NS140	22/09/02	Chamaedaphne calyculata (leatherleaf)	2	3	3
NS140	22/09/02	Polytrichum (Christmas-tree like moss) Moss B	1	2	2
NS140	22/09/02	Sphagnum spp.	1	5	5
NS140	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	2	2
NS150	26/06/02	Andromeda glaucophylla (bog.1osemary)	2	0,1	1
NS150	26/06/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
NS150	26/06/02	Drosera sp. (sundew)	1	0,1	1
NS150	26/06/02	Moss C	1	3	5
NS150	26/06/02	Polytrichum (Christmas-tree like moss) Moss B	1	3	4
NS150	26/06/02	Vaccinium macrocarpum (large fruited cranberry)	2	3	2
NS150	22/09/02	Andromeda glaucophylla (bog.1osemary)	1	0,5	1
NS150	22/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	3
NS150	22/09/02	Lichen (Devil's matchsticks)	1	1	2
NS150	22/09/02	Mushroom	1	0,5	1
NS150	22/09/02	Polytrichum (Christmas-tree like moss) Moss B	1	3	4
NS150	22/09/02	Sphagnum spp.	1	5	5
NS150	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	3	2
NS160	26/06/02	Betula glandulifera (bog birch)	2	0,1	1
NS160	26/06/02	Chamaedaphne calyculata (leatherleaf)	3	4	3
NS160	26/06/02	Drosera sp. (sundew)	1	0,1	1
NS160	26/06/02	Moss A	1	2	4
NS160	26/06/02	Moss C	1	4	4
NS160	26/06/02	Polytrichum (Christmas-tree like moss) Moss B	1	0,5	1
NS160	26/06/02	Speciment B from NS180	2	0,1	1
NS160	26/06/02	Spiraea tomentosa (steeple bush)	2	0,1	1
NS160	26/06/02	Vaccinium macrocarpum (large fruited cranberry)	2	2	2

NS160	22/09/02	Betula glandulifera (bog birch)	3	2	1
NS160	22/09/02	Carex sp. Unknown F (sedge)	3	2	2
NS160	22/09/02	Chamaedaphne calyculata (leatherleaf)	2	4	3
NS160	22/09/02	Corylus cf. americana (hazelnut)	3	na	na
NS160	22/09/02	Mushroom	1	0,5	1
NS160	22/09/02	Polytrichum (Christmas-tree like moss) Moss B	1	2	4
NS160	22/09/02	Sphagnum spp.	1	5	5
NS160	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	3	3
NS170	17/06/02	Carex cf. canescens?	2	0,5	no data
NS170	17/06/02	Carex sp.	1	0,5	no data
NS170	17/06/02	Carex.1ostrata	3	1	no data
NS170	17/06/02	Chamaedaphne calyculata (leatherleaf)	2	5	no data
NS170	17/06/02	Drosera sp. (sundew)	1	0,5	no data
NS170	17/06/02	Lysimachia thyrsiflora (tufted loosestrife) Spec. A	no data	0,5	no data
NS170	17/06/02	Moss - not sphagnum	1	0,5	no data
NS170	17/06/02	Potentilla palustris (marsh cinquefoil)	1	0,5	no data
NS170	17/06/02	Sphagnum spp.	1	5	no data
NS170	17/06/02	Spiraea tomentosa (steeple bush)	2	0,5	no data
NS170	17/06/02	Vaccinium macrocarpum (large fruited cranberry)	1	1	no data
NS170	22/09/02	Chamaedaphne calyculata (leatherleaf)	3	4	3
NS170	22/09/02	Potentilla palustris (marsh cinquefoil)	2	1	1
NS170	22/09/02	Unknown F (grass)	3	4	2
NS170	22/09/02	Unknown H (bog birch or Spiraea)	2	2	1
NS170	22/09/02	Unknown I	1	0,5	1
NS170	22/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	2	2
NS180	26/06/02	Carex.1ostrata	3	2	4
NS180	26/06/02	Lysimachia thyrsiflora (tufted loosestrife) Spec. A	3	0,5	1
NS180	26/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	0,5	1
NS180	26/06/02	Speciment B from NS180	2	0,5	1
NS180	26/06/02	Spiraea tomentosa (steeple bush)	3	3	4
NS180	22/09/02	Lycopus uniflorus (mint)	2	1	1

Plot	Date	Species	Height Class	% Cover	Sociability
NS180	22/09/02	Potentilla palustris (marsh cinquefoil)	2	2	1
NS180	22/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	1	1
NS180	22/09/02	Sphagnum spp.	1	2	4
NS180	22/09/02	Unknown F (grass)	3	4	3
NS180	22/09/02	Unknown H	3	3	2
NS180	22/09/02	Unknown I	1	0,5	1
NS180	22/09/02	Unknown K (worm plant)	3	1	1
NS190	17/06/02	Carex lasiocarpa	3	1	no data
NS190	17/06/02	Carex.1ostrata	3	3	no data
NS190	17/06/02	Spiraea tomentosa (steeple bush)	2	1	no data
NS190	17/06/02	Unknown opposite leaved forb (Bidens?)	1	0,5	no data
NS190	17/06/02	Utricularia sp. (bladderwort)	1	2	no data
NS190	22/09/02	na	na	na	na
NS200	17/06/02	(Canada bluejoint)	3	2	no data
NS200	17/06/02	Carex lasiocarpa	3	1	no data
NS200	17/06/02	Carex sf. Stricta	3	2	no data
NS200	17/06/02	Carex.1ostrata	3	2	no data
NS200	17/06/02	Galium sp. (bedstraw)	1	0,5	no data
NS200	17/06/02	Lycopus uniflorus (mint)	2	2	no data
NS200	17/06/02	Spiraea tomentosa (steeple bush)	2	1	no data
NS200	17/06/02	Thelypteris palustris (Marsh fern)	2	3	no data
NS200	22/09/02	Calamagrostis canadensis (Canad. blue joint grass)	3	4	3
NS200	22/09/02	Carex cf. lasiocarpa	3	2	3
NS200	22/09/02	Carex sp. (Unknown P)	3	1	1
NS200	22/09/02	Leersia oryzoides	3	1	1
NS200	22/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	3	1	1
NS200	22/09/02	Thelypteris palustris (Marsh fern)	3	1	1
NS200	22/09/02	Unknown F (grass)	3	3	2
NS200	22/09/02	Unknown J (sting weed)	3	2	1

NS200	22/09/02	Unknown K (worm plant)	3	1	1
WE000	29/06/02	Achillea millefolium?(yarrow)	2	1	1
WE000	29/06/02	Ambrosia sp.(ragweed)	1	0,5	1
WE000	29/06/02	Andropogon scoparius (little bluestem)	2	2	2
WE000	29/06/02	daisy fleabane	2	1	1
WE000	29/06/02	Fragaria (wild strawberry)	2	2	3
WE000	29/06/02	Galium sp. Unknown 00-T (prairie bedstraw?)	2	0,5	1
WE000	29/06/02	grass 00-1	3	2	1
WE000	29/06/02	grass 00-2	2	0,5	2
WE000	29/06/02	Moss - D	1	2	4
WE000	29/06/02	Potentilla sp. (cinquefoil, 00-2)	2	1	1
WE000	29/06/02	Quercus.1ubra (red oak)	2	1	1
WE000	29/06/02	Rudbeckia-00	2	1	1
WE000	29/06/02	Spurge? 00	2	1	1
WE000	29/06/02	Unknown 00-0	2	1	1
WE000	29/06/02	Unknown 00-P	2	1	1
WE000	29/06/02	Unknown 00-Q	2	1	1
WE000	29/06/02	Unknown 00-R	2	1	1
WE000	29/06/02	Unknown 00-S	2	0,5	1
WE000	29/06/02	Unknown 00-U	2	1	1
WE000	15/09/02	Achillea millefolium?(yarrow)	1	0,5	2
WE000	15/09/02	Ambrosia sp.(ragweed)	2	0,1	1
WE000	15/09/02	Andropogon scoparius (little bluestem)	3	2	4
WE000	15/09/02	Carex cf. lasiocarpa	3	3	3
WE000	15/09/02	Fragaria (wild strawberry)	2	3	3
WE000	15/09/02	Lespedeza sp. (bush clover)	3	0,5	2
WE000	15/09/02	Oxalis sp. (sheep sorrel)	1	0,1	1
WE000	15/09/02	Panicum sp.	2	1	1
WE000	15/09/02	Solidago sp. #1 (goldenrod, slender)	2	0,1	1

Plot	Date	Species	Height Class	% Cover	Sociability
WE000	15/09/02	Solidago sp. #2 (goldenrod, bushy)	2	2	2
WE000	15/09/02	Unknown A	1	0,1	1
WE000	15/09/02	Unknown B	3	0,5	2
WE000	15/09/02	Unknown D	1	2	2
WE000	15/09/02	Unknown E	2	0,1	1
WE010	29/06/02	grass 20-1	3	3	2
WE010	29/06/02	grass 20-2	3	2	2
WE010	29/06/02	Lysimachia thyrsiflora (tufted loosestrife) Spec. A	2	0,5	1
WE010	29/06/02	Salix sp. (willow)	3	3	1
WE010	29/06/02	sedge 10-4	3	0,5	1
WE010	29/06/02	Unknown 10-N	1	1	1
WE010	15/09/02	Polygonum cf. amphibium	2	1	2
WE010	15/09/02	Potentilla sp. (cinquefoil)	2	1	1
WE010	15/09/02	Rubus sp. (blackberry)	2	2	2
WE010	15/09/02	Salix sp. (willow)	3	3	1
WE010	15/09/02	Thelypteris palustris (Marsh fern)	2	1	1
WE010	15/09/02	Unknown H	3	3	2
WE020	29/06/02	Fern 040	2	1	1
WE020	29/06/02	Galium sp.	2	0,5	1
WE020	29/06/02	Grass 020-1	3	3	2
WE020	29/06/02	Grass 020-2	3	2	2
WE020	29/06/02	Lysimachia terrestris (swamp candles)	2	1	1
WE020	29/06/02	Lysimachia thyrsiflora (tufted loosestrife) Spec. A	3	1	1
WE020	29/06/02	Polygonum sagittatum (tear thumb)	2	1	1
WE020	29/06/02	Potentilla sp. (cinquefoil, 00-2)	2	2	1
WE020	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	2	1
WE020	29/06/02	Sedge 020-1	2	0,5	1
WE020	29/06/02	Sedge 020-2	2	0,1	1
WE020	29/06/02	Sedge 020-3	2	0,5	2

WE020	29/06/02	Unknown 020-K	2	0,5	1
WE020	29/06/02	Unknown 020-L	2	1	1
WE020	29/06/02	Unknown 020-M	2	1	1
WE020	29/06/02	Unknown 030-E	2	1	1
WE020	29/06/02	Unknown 040-F	2	0,5	1
WE020	29/06/02	Unknown 040-H	2	1	1
WE020	29/06/02	Willow? 040	3	1	1
WE020	15/09/02	Calamagrostis canadensis (Can. blue joint grass)	2	2	2
WE020	15/09/02	Carex sp. (Unknown L)	2	1	1
WE020	15/09/02	Lemna sp. (duckweed)	1	0,5	2
WE020	15/09/02	Polygonum sagittatum (tear thumb)	2	0,5	2
WE020	15/09/02	Potentilla sp. (cinquefoil)	2	1	2
WE020	15/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	1	2
WE020	15/09/02	Typha latifolia (broadleaved cattail)	3	2	2
WE020	15/09/02	Unknown J (grass) Leersia oryzoides?	2	1	2
WE020	15/09/02	Unknown K (sedge)	3	2	2
WE020	15/09/02	Utricularia sp. (bladderwort)	1	0,5	2
WE030	29/06/02	Galium sp.	2	0,5	1
WE030	29/06/02	Lysimachia thyrsiflora (tufted loosestrife) Spec. A	3	1	1
WE030	29/06/02	Potentilla sp. (cinquefoil, 00-2)	2	1	1
WE030	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	3	2	1
WE030	29/06/02	Sedge 030?	3	0,5	1
WE030	29/06/02	Spiraea tomentosa (steeple bush)	2	1	1
WE030	29/06/02	Typha latifolia (broadleaved cattail)	3	3	1
WE030	29/06/02	Unknown 040-F	2	1	1
WE030	29/06/02	Unknown 040-G	3	0,5	1
WE030	29/06/02	Unknown 040-H	2	1	1
WE030	29/06/02	Unkown 030-E	2	1	1
WE030	29/06/02	Willow? 040	3	3	1
WE030	15/09/02	Lemna sp. (duckweed)	1	0,5	2
WE030	15/09/02	Potentilla sp. (cinquefoil, 00-2)	3	2	2

Plot	Date	Species	Height Class	% Cover	Sociability
WE030	15/09/02	Salix sp. (willow)	3	2	2
WE030	15/09/02	Spiraea tomentosa (steeple bush)	3	2	2
WE030	15/09/02	Typha latifolia (broadleaved cattail)	4	3	3
WE030	15/09/02	Unknown M (grass or sedge)	3	1	2
WE040	29/06/02	Chamaedaphne calyculata (leatherleaf)	3	5	3
WE040	29/06/02	Fern 040	2	2	1
WE040	29/06/02	Moss - C	1	4	5
WE040	29/06/02	Potentilla sp. (cinquefoil, 00-2)	2	1	1
WE040	29/06/02	Typha latifolia (broadleaved cattail)	3	1	1
WE040	29/06/02	Unknown 040-C	2	1	2
WE040	29/06/02	Willow? 040	3	1	1
WE040	15/09/02	Betula glandulifera (bog birch)	3	2	2
WE040	15/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	4
WE040	15/09/02	Lysimachia thyrsiflora (tufted loosestrife)	2	0,1	1
WE040	15/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	0,1	1
WE040	15/09/02	Salix sp. (willow)	2	1	2
WE040	15/09/02	Sphagnum spp.	1	0,5	2
WE040	15/09/02	Thelypteris palustris (Marsh fern)	2	2	2
WE040	15/09/02	Unknown O (Viola?)	1	0,1	1
WE040	15/09/02	Unknown P	3	2	2
WE050	29/06/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
WE050	29/06/02	Moss - B	1	0,5	1
WE050	29/06/02	Moss - C	1	5	5
WE050	15/09/02	Betula glandulifera (bog birch)	2	1	2
WE050	15/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
WE050	15/09/02	Sphagnum spp.	1	5	5
WE060	29/06/02	Chamaedaphne calyculata (leatherleaf)	2	4	3
WE060	29/06/02	Drosera sp. (sundew)	1	1	1
WE060	29/06/02	Moss - B	1	1	1

WE060	29/06/02	Moss - C	1	4	5
WE060	29/06/02	Potentilla sp. (cinquefoil, 00-2)	2	1	1
WE060	29/06/02	Sedge 070-A	2	0,5	1
WE060	15/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
WE060	15/09/02	Sphagnum spp.	1	5	5
WE060	15/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	1	2
WE070	29/06/02	Chamaedaphne calyculata (leatherleaf)	2	4	3
WE070	29/06/02	Drosera sp. (sundew)	1	1	1
WE070	29/06/02	Moss - B	1	2	2
WE070	29/06/02	Moss - C	1	5	5
WE070	29/06/02	Sedge 070-A	2	1	2
WE070	29/06/02	Vaccinium macrocarpum (large fruited cranberry)	2	0,5	1
WE070	15/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
WE070	15/09/02	Polytrichium sp.	1	1	2
WE070	15/09/02	Sphagnum spp.	1	5	5
WE070	15/09/02	Unknown sedge	2	1	2
WE080	29/06/02	Alnus/Alder?	2	1	1
WE080	29/06/02	Andromeda glaucophylla (bog.1osemary)	2	0,5	1
WE080	29/06/02	Chamaedaphne calyculata (leatherleaf)	3	4	3
WE080	29/06/02	Drosera sp. (sundew)	1	0,5	1
WE080	29/06/02	Moss - B	1	1	2
WE080	29/06/02	Moss - C	1	5	5
WE080	29/06/02	Vaccinium macrocarpum (large fruited cranberry)	2	1	1
WE080	15/09/02	Andromeda glaucophylla (bog.1osemary)	2	0,5	2
WE080	15/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
WE080	15/09/02	Drosera sp. (sundew)	1	0,5	2
WE080	15/09/02	Sphagnum spp.	1	5	5
WE080	15/09/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	2
WE090	29/07/02	Chamaedaphne calyculata (leatherleaf)	2	4	3
WE090	29/07/02	Polytrichum sp. (moss)	1	3	3
WE090	29/07/02	Sphagnum sp.	1	5	5

Plot	Date	Species	Height Class	% Cover	Sociability
WE090	29/07/02	Unknown WE090	0,5	0,5	1
WE090	29/07/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	2
WE090	05/09/02	Chamaedaphne calyculata (leatherleaf)	2	4	4
WE090	05/09/02	Sphagnum A	1	5	5
WE090	05/09/02	Sphagnum B	1	2	4
WE090	05/09/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	2
WE100	29/07/02	Andromeda glaucophylla (bog.1osemary)	2	1	1
WE100	29/07/02	Chamaedaphne calyculata (leatherleaf)	2	5	4
WE100	29/07/02	Drosera sp. (sundew)	1	0,5	1
WE100	29/07/02	Polytrichum sp. (moss)	1	2	3
WE100	29/07/02	Sphagnum sp.	1	5	5
WE100	29/07/02	Vaccinium macrocarpum (large fruited cranberry)	1	1	2
WE100	05/09/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
WE100	05/09/02	Sphagnum A	1	5	5
WE100	05/09/02	Sphagnum B	1	1	4
WE100	05/09/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	2
WE110	29/07/02	Betula glandulifera (bog birch)	3	2	1
WE110	29/07/02	Chamaedaphne calyculata (leatherleaf)	2	5	5
WE110	29/07/02	Drosera sp. (sundew)	1	0,5	1
WE110	29/07/02	Polytrichum sp. (moss)	1	1	1
WE110	29/07/02	Sphagnum sp.	1	5	5
WE110	29/07/02	Vaccinium macrocarpum (large fruited cranberry)	1	2	2
WE110	05/09/02	Betula glandulifera (bog birch)	3	0,5	1
WE110	05/09/02	Chamaedaphne calyculata (leatherleaf)	2	4	3
WE110	05/09/02	Sphagnum A	1	5	5
WE110	05/09/02	Vaccinium macrocarpum (large fruited cranberry)	1	1	2
WE120	29/07/02	Andromeda glaucophylla (bog.1osemary)	2	2	2
WE120	29/07/02	Chamaedaphne calyculata (leatherleaf)	2	4	3
WE120	29/07/02	Polytrichum sp. (moss)	1	0,5	1

WE120	29/07/02	Potentilla palustris (marsh cinquefoil)	2	2	1
WE120	29/07/02	Sphagnum sp.	1	4	5
WE120	29/07/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	1
WE120	05/09/02	Andromeda glaucophylla (bog.1osemary)	2	0,5	2
WE120	05/09/02	Chamaedaphne calyculata (leatherleaf)	2	3	3
WE120	05/09/02	Example D	2	0,5	1
WE120	05/09/02	Potentilla palustris (marsh cinquefoil)	2	2	2
WE120	05/09/02	Salix sp.	3	0,5	2
WE120	05/09/02	Sphagnum A	1	5	5
WE120	05/09/02	Vaccinium macrocarpum (large fruited cranberry)	1	0,5	2
WE130	29/06/02	Betula glandulifera (bog birch)	3	3	na
WE130	29/06/02	Chamaedaphne calyculata (leatherleaf)	2	1	na
WE130	29/06/02	Moss - C	1	4	5
WE130	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	1	na
WE130	29/06/02	Sedge - C broad leaved	3	2	na
WE130	29/06/02	Typha latifolia (broadleaved cattail)	3	1	na
WE130	29/06/02	Unknown fern (sampled — marsh fern?)	2	1	na
WE130	29/06/02	Vaccinium macrocarpum (large fruited cranberry)	2	3	na
WE130	05/09/02	Betula glandulifera (bog birch)	3	2	2
WE130	05/09/02	Chamaedaphne calyculata (leatherleaf)	2	1	2
WE130	05/09/02	Example D	1	0,5	1
WE130	05/09/02	Moss A	1	5	5
WE130	05/09/02	Potentilla palustris (marsh cinquefoil)	2	0,5	1
WE130	05/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	3	1	2
WE130	05/09/02	Salix sp.	3	0,5	1
WE130	05/09/02	Sedge E	3	3	4
WE130	05/09/02	Spiraea alba (meadowsweet)	3	1	2
WE130	05/09/02	Typha latifolia (broadleaved cattail)	3	1	2
WE130	05/09/02	Unknown fern (sampled — marsh fern?)	2	0,5	2
WE130	05/09/02	Vaccinium macrocarpum (large fruited cranberry)	2	2	3
WE140	29/06/02	Andromeda glaucophylla (bog.1osemary)	2	0,1	1

Plot	Date	Species	Height Class	% Cover	Sociability
WE140	29/06/02	Galium sp.	2	0,5	1
WE140	29/06/02	Salix sp.	3	4	na
WE140	29/06/02	Scirpus cyperinus (wool grass)	2	0,1	1
WE140	29/06/02	Sedge - C broad leaved	3	3	na
WE140	29/06/02	Sedge - D (slender)	3	1	na
WE140	29/06/02	Typha latifolia (broadleaved cattail)	3	1	na
WE140	29/06/02	Unknown G	2	0,1	1
WE140	29/06/02	Unknown J “sweet pea”	2	0,5	1
WE140	05/09/02	Potentilla palustris (marsh cinquefoil)	2	0,5	1
WE140	05/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	1	2
WE140	05/09/02	Salix sp.	3	2	2
WE140	05/09/02	Sedge A	3	3	3
WE140	05/09/02	Sedge B	2	2	2
WE140	05/09/02	Typha latifolia (broadleaved cattail)	na	0,1	1
WE140	05/09/02	Unknown B	1	1	1
WE150	29/06/02	Carex sp. (Sedge - B)	3	0,5	1
WE150	29/06/02	Carex.1ostrata (beaked sedge)	3	0,5	1
WE150	29/06/02	Eriophorum sp. (cotton grass)	3	0,1	1
WE150	29/06/02	Galium sp.	2	0,1	1
WE150	29/06/02	Grass - C	3	2	na
WE150	29/06/02	Phalaris arundinaceae (reed canary grass)	3	3	na
WE150	29/06/02	Potentilla palustris (marsh cinquefoil)	2	2	na
WE150	29/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	2	na
WE150	29/06/02	Sedge - D (slender)	3	2	na
WE150	29/06/02	Unknown E	2	0,1	1
WE150	29/06/02	Unknown F	2	1	na
WE150	29/06/02	Unknown G	2	0,1	1
WE150	29/06/02	Unknown J “sweet pea”	2	0,1	1
WE150	05/09/02	Moss C	1	1	1

WE150	05/09/02	Potentilla palustris (marsh cinquefoil)	2	2	2
WE150	05/09/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	2	2
WE150	05/09/02	Salix sp.	2	0,1	1
WE150	05/09/02	Sedge A	3	4	5
WE150	05/09/02	Unknown A	1	0,5	2
WE160	26/06/02	blue joint grass	2	2	na
WE160	26/06/02	Carex - 1	2	1	na
WE160	26/06/02	Carex - 2	2	2	na
WE160	26/06/02	Carex - 3	2	1	na
WE160	26/06/02	Carex lasiocarpa (wire grass)	2	3	na
WE160	26/06/02	Galium sp.	2	0,5	1
WE160	26/06/02	Lycopus sp. (Water horehound)	2	2	na
WE160	26/06/02	Lysimachia terrestris (swamp candles)	2	1	na
WE160	26/06/02	Lysimachia thyrsiflora (tufted loosestrife) Spec. A	2	0,5	1
WE160	26/06/02	moss	1	3	na
WE160	26/06/02	Polygonum amphibium (water smartweed)	2	0,5	1
WE160	26/06/02	Polygonum sagittatum (tear thumb)	2	0,5	1
WE160	26/06/02	Potentilla palustris (marsh cinquefoil)	2	0,5	1
WE160	26/06/02	rooted dead grass	1	3	na
WE160	26/06/02	Sagittaria latiflolia (broad-leaved arrowhead)	2	2	na
WE160	26/06/02	Spiraea alba (meadowsweet)	3	3	na
WE160	05/09/02	Lycopus uniflorus (mint)	2	0,1	1
WE160	05/09/02	Polygonum amphibium (water smartweed)	2	0,1	1
WE160	05/09/02	Polygonum sagittatum (tear thumb)	3	0,5	2
WE160	05/09/02	Potentilla palustris (marsh cinquefoil)	2	1	2
WE160	05/09/02	Salix sp.	3	1	1
WE160	05/09/02	Sedge	3	4	3
WE160	05/09/02	Spiraea alba (meadowsweet)	3	1	2
WE160	05/09/02	Unknown B	2	0,5	1
WE170	29/07/02	Phalaris arundinaceae (reed canary grass)	3	2	2
WE170	29/07/02	Polygonum sagittatum (tear thumb)	1	1	1

Plot	Date	Species	Height Class	% Cover	Sociability
WE170	29/07/02	Pteridium aquilinum (bracken fern)	3	3	2
WE170	29/07/02	Rubus sp.	3	2	2
WE170	29/07/02	Unknown #1 (not sampled)	1	1	1
WE170	29/07/02	Unknown #2 (not sampled)	2	1	1
WE170	29/07/02	Unknown #3 (not sampled	1	1	2
WE170	29/07/02	Unknown #4 (not sampled)	1	1	1
WE170	29/07/02	Unknown A - Prunus?	4	3	1
WE170	29/07/02	Unknown B - grass	3	2	2
WE170	29/07/02	Unknown C - sedge	3	3	4
WE170	29/07/02	Unknown D - Cornus sp. (dogwood)	3	2	1
WE170	29/07/02	Unknown E - Sarsasparilla?	2	3	2
WE170	29/07/02	Unknown F - Polygonum amphibium?	2	2	2
WE170	29/07/02	Unknown G	2	1	1
WE170	29/07/02	Vitis sp. (grape)	3	1	1
WE170	05/09/02	Aralia nudicaulis (wild sarsasparilla)	2	2	2
WE170	05/09/02	Betula sp. (birch)	2	0,1	1
WE170	05/09/02	Cornus sp.(dogwood)	3	0,1	1
WE170	05/09/02	Grass A	3	0,1	1
WE170	05/09/02	Grass B	3	1	2
WE170	05/09/02	Prunus sp. (wild cherry)	1	0,5	2
WE170	05/09/02	Pteridium aquilinum (bracken fern)	3	1	2
WE170	05/09/02	Rubus sp. (raspberry)	2	2	2
WE170	05/09/02	Sedge B	3	2	4
WE170	05/09/02	Spiraea tomentosa	2	0,1	1
WE170	05/09/02	Unknown E	2	0,1	1
WE170	05/09/02	Vitis sp. (grape)	2	0,1	1
WE180	26/06/02	Aralia nudicaulis (wild sarsasparilla)	2	2	na
WE180	26/06/02	Aspen tremuloides (trembling aspen)	4	2	na

WE180	26/06/02	Cornus foemina (grey dogwood)	2	1	na
WE180	26/06/02	Galium boreale (northern bedstraw)	1	1	na
WE180	26/06/02	Lathyrus sp. (vetch)	2	1	na
WE180	26/06/02	Maianthemum canadense (Canada mayflower)	1	1	na
WE180	26/06/02	Penn's sedge	2	1	na
WE180	26/06/02	Prunus serotina (black cherry)	4	2	na
WE180	26/06/02	Pteridium aquilinum (bracken fern)	3	3	na
WE180	26/06/02	Rubus sp. (raspberry)	2	0,1	1
WE180	26/06/02	Unknown - 1 grass	2	2	na
WE180	26/06/02	Unknown - 2			
WE180	05/09/02	Calamagrostis canadensis (Canad. blue joint grass)	2	1	1
WE180	05/09/02	Galium boreale (northern bedstraw)	2	0,5	2
WE180	05/09/02	Poa pratensis (Kentucky bluegrass)	1	1	2
WE180	05/09/02	Populus tremuloides (trembling aspen)	4	0,1	1
WE180	05/09/02	Prunus serotina (black cherry)	4	0,5	1
WE180	05/09/02	Pteridium aquilinum (bracken fern)	3	2	2
WE180	05/09/02	Rubus sp. (raspberry)	2	0,5	1

APPENDIX 7

ANALYSIS OF PLANT COMMUNITIES USING MULTIVARIATE STATISTICAL TECHNIQUES

KRISTE ERICSSON

Why use statistics to analyze plant community structure? In fact, what defines a plant community?

A **plant community** is made up of a number of different species of plants, each species present in varying abundance. The absence of one species will leave an opening for the occurrence of another species, if the environmental conditions are suitable for the second species. If a plant community contains a large number of species, a verbal description of its structure and interspecies interactions can become complex. Add environmental variables to the scenario, and the description can get out of hand. Statistical analysis can help condense data and simplify how we view and interpret it.

Multivariate statistics gets its name from the fact that the statistical tools used to analyze the data are dealing with many variables. These variables can relate directly to vegetation data, such as species identity, abundance, height, biomass, or sociability. Other variables (environmental) may come in to play affecting the structure of the plant community, such as water and soil chemistry, topography, rainfall, ambient temperature, etc.. All these variables interact with each other to result in the vegetation landscape that we see.

Many multivariate statistical tools (or programs) have been developed over the years to deal with community data. These tools cross disciplinary lines, and are not limited in use to the analysis of plant communities. Any type of living community can be analyzed using multivariate statistics. The program or statistical tool that is chosen depends on the type of community that is being analyzed and its inherent characteristics. Some statistical tools work better for certain types of communities than for others.

The first step is "data reduction". This takes various forms, but has two basic parts: (1) summarizing a large number of observations into a few numbers and (2) expressing many interrelated response variables in a more compact way. (McCune and Grace, 2002).

Data reduction can be approached by categorization (or **classification**), a tool which most of us are familiar with for organizing complex systems. The statistical program used in the ICEC study that falls under this category is called "**Cluster Analysis**".

A second, less intuitive approach to data reduction is by "summarizing continuous change in a large number of variables as a synthetic continuous variable (**ordination**)" (McCune and Grace, 2002). In other words, one looks at the way that species come and go and increase and decrease in abundance in response to environmental conditions, then produce a summary that reflects these patterns of change. The ordination technique examined for use in the present study is called "**Nonmetric Multidimensional Scaling (NMS)**". It has the advantage of working very well with ecological data that includes many zeros (indicating absence of a species) in a raw data set.

As McCune and Grace (2002) put it: "(NMS) is an ordination method well suited to data that are nonnormal or are on arbitrary, discontinuous, or otherwise questionable scales." In fact, they state that "NMS is the most generally effective ordination method for ecological community data and should be the method of choice, unless a specific analytical goal demands another method."

In this study we used Cluster Analysis as our tool to summarize and analyze the data. In the future we hope to draw deductions through the use of NMS as well, but are still studying the use of that technique.

A number of computerized packages are on the market for analyzing data using multivariate statistics. The package used in this study is PC ORD, Version 4. Published by MjM Software Design in 1999 by McCune and Mefford, it incorporates state of the art multivariate statistical programs that are constantly updated. PC ORD, Version 4 includes both the Cluster Analysis and NMS statistical programs in its software.

APPENDIX 8

PLANTS OF THE POOR FEN PEATLAND IN THE ISANTI COUNTY WAYSIDE PRAIRIE PARK

Flowering in the Spring (May – June 21)

Andromeda glaucophylla Link	"Bog Rosemary"
Betula pumila L.	"Bog Birch"
Carex canescens L.	"Silvery or Hoary Sedge"
Carex echinata Murr	"Sedge"
Carex lasiocarpa Ehrh. Hirtae	"Slender Sedge/Wire Grass"
Carex rostrata J. Stokes	"Beaked Sedge"
Carex scoparia Schk.	"Sedge"
Chamaedaphne calyculata (L.)	Moench "Leatherleaf"
Eriophorum sp.	"Spike Rush"
Lysimachia thyrsiflora L.	"Tufted Loosestrife"
Phalaris arundinaceae L.	"Reed Canary Grass"(exotic)
Polygonum amphibium L.	"Water Smartweed"
Prunus serotina Ehrh.	"Wild Cherry/Black Cherry"
Salix petiolaris Sm.	"Meadow Willow"
Scirpus acutus Muhl.	"Hardstem Bulrush"
Scirpus cyperinus (L.) Kunth	"Wool Grass"
Utricularia sp.	"Bladderwort"

Flowering in the Summer (June 21 – August 31)

Campanula aparinoides Pursh.	"Marsh Bellflower"
Cicuta bulbifera L.	"Water Hemlock"
Drosera sp.	"Sundew"
Eriophorum tenellum Nutt.	"Cotton Grass"
Eupatorium perfoliatum L.	"Boneset"

Lycopodium inundatum L.	"Bog Club Moss"
Lycopus uniflorus Michx.	"Bugle Weed/ Water-Horehound"
Lysimachia terrestris (L.) BSP.	"Swamp Candles"
Polygonum sagittatum L.	"Tear Thumb"
Potentilla palustris (L.) Scop.	"Marsh Cinquefoil"
Sagittaria latifolia Willd.	"Large Leaved Arrowhead"
Scutellaria galericulata L.	"Marsh Skull Cap"
Spiraea alba Du Roi.	"Meadowsweet"
Spiraea tomentosa L.	"Steeple Bush"
Thelypteris palustris Schott	"Marsh Fern"
Triadenum Fraseri (Spach) Gl.	"Marsh St. John's Wort"
Typha latifolia L.	"Broadleaved Cattail"
Vaccinium macrocarpum Aiton	"Cranberry"

Flowering in the Fall (September 1 – October)

Bidens cernua L.	"Nodding Beggar Ticks"
Erechtites hieracifolia (L.) Raf.	"Fireweed"

Note: Many plants, including sedges, grasses and asters, are still seeding and fruiting in the Fall.

Mosses and Liverworts

Mosses

Aulacomnium palustre
Bryum pseudotriquetrum
Drepanocladus aduncus
Polytrichum strictum
Sphagnum angustifolium
Sphagnum capillifolium
Sphagnum centrale
Sphanum contotortum
Sphagnum fallax
Sphagnum fuscum
Sphagnum magellanicum
Sphagnum subsecundum s.s.
Sphagnum teres

Liverworts

Cephaloziella elachista
Lophocolea heterophylla

Many thanks to Dr. Joannes Janssens for identifying the bryophytes (mosses

and liverworts) of the poor fen. Also, many thanks to Hannah Dunevitz of the MN Dept. of Natural Resources and Dr. Martha Phillips of the College of St. Catherine for assisting the members of the Isanti County Environmental Coalition in identification of the vascular plants.

APPENDIX 9

BRYOPHYTES OF THE WAYSIDE PRAIRIE PARK PEATLAND, SITE 2282, ISANTI COUNTY, MINNESOTA UPDATE AUGUST 2002

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INTRODUCTION

Site 2282 (Fig. a) is a lake-edge peatland located at 45° 28' 25" N, 93° 19' 49" W, 280 m a.s.l., north of unnamed lake, 930 m east of Long Lake, 7 km WSW of Isanti, Isanti County, Minnesota. The site was selected for analysis of flora and vegetation by the Isanti County Environmental Coalition (ICEC), PO Box 82, Grandy, MN 55029. J.A. Janssens surveyed the site for meso-habitat differentiation (Janssens 2002) and bryophytes on June 17, 2002.

Five different ecotope or meso-habitats have been recognized (Table 1). Water-chemistry samples were collected in all five and bryophyte vouchers in four of them. The permanent plots established by ICEC are listed in the table for the ecotope in which they are located.

This report presents the results of the floristic reconnaissance of bryophytes (mosses and liverworts) at the four ecotopes B to E of site 2282. The vouchers (*Janssens 46165* to *46200*) are deposited at the herbaria of Lambda-Max Ecological Research and the Science Museum of Minnesota. The results of the water-chemistry measurements (pH, specific conductance, and absorbance @ 350 nm, Janssens 2002) are given in Table 1.

RESULTS AND CONCLUSIONS

Table 2 lists the species of bryophytes identified at ecotopes B to E of site 2282. The species are individually discussed in the Sub-appendix A.

The transitional and poor fen of the Isanti Wayside Prairie Park has a highly diverse *Sphagnum* assemblage. Several species are new records for the county (Table 2) and one of them, *S. contortum*, has a significant range extension to the south (Janssens 2000).

The site has no signs of disturbance that are immediately obvious, and the cattail fringe is only moderately developed. However, the presence of these cattail clones and of the *Drepanocladus aduncus* might signify some slight influence of past or present eutrophication from upland surface runoff. Long-term monitoring is suggested. I would still rank the poor-fen site as an A-rank EO (DNR 2001). The water chemistry of ecotope C has

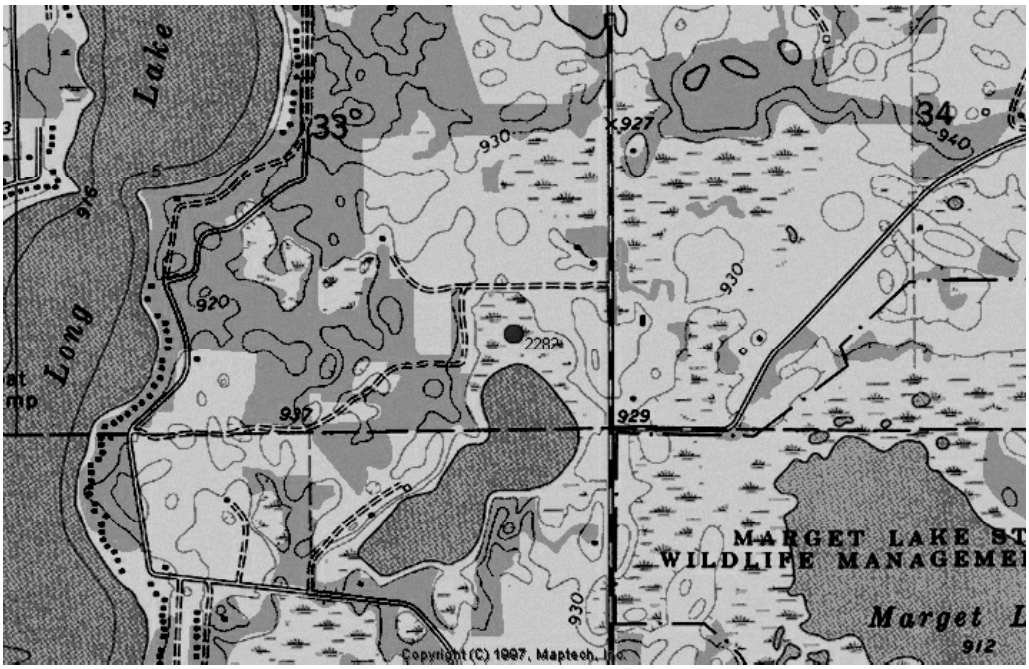

Figure a. Topographic map extract from 1:24,000 St. Francis quad with site 2282 marked at 45° 28' 25" N, 93° 19' 49" W.

anomalous high values for pH and specific conductance and will have to be checked during a future survey.

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Ecotope ID and description	Permanent Plot IDs	Bryophyte vouchers	Water-chemistry			
			sample IDs	pH	$K^{25°C}_{red}$	absorbance @ 350 nm
A: *Carex lasiocarpa* floating mat at lake edge	NS200-190	no bryophytes	2509 (S)	4.7	23.9	.745
B: *Carex rostrata-Chamaedaphne* hummock mosaic mixed fen mat, partly floating, transitional	NS180-170	*JAJ46165-175*	2510 (D)	4.3	14.1	.640
C: *Chamaedaphne* poor fen, grounded mat	NS160-060; WE040-120	*JAJ46176-183; JAJ46194-195*	2511 (D)	5.0	29.8	.740
D: shrub-*Typha* zone surrounding poor fen	NS050-030; WE030; WE130-140	*JAJ46184-190; JAJ46196-198*	2512 (S)	6.0	67.5	.205
E: *Sagittaria-Typha* zone forming lagg between poor fen and upland	NS020; WE150-160	*JAJ46191-193; JAJ46199-200*	2513 (S)	6.4	92.7	.348

Table 1. Ecotopes A to E differentiated at site 2282, the Wayside Prairie Park peatland in Isanti County. Also given are the permanent-plot IDs, the listing of bryophyte vouchers, and the water-chemistry (see Janssens 2002 for methods) measurements.

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SUB-APPENDIX A

Habitat and Distribution of Bryophyte Species

	2282 B	2282 C	2282 D	2282 E
mosses				
Aulacomnium palustre	x	x	x	x
Bryum pseudotriquetrum				x
**Drepanocladus aduncus*	x		x	x
Polytrichum strictum		x		
Sphagnum angustifolium	x	x		
**Sphagnum capillifolium*	x	x		
Sphagnum centrale	x	x	x	
**Sphagnum contortum*			x	?
Sphagnum fallax		x		
Sphagnum fimbriatum		x	x	
Sphagnum fuscum		x		
Sphagnum magellanicum	x	x		
Sphagnum subsecundum s.s.	x		x	?
**Sphagnum teres*		x	x	
liverworts				
**Cephaloziella elachista*		x	x	
Lophocolea heterophylla			x	

Table 2. Mosses and liverworts found at site 2282, poor-fen peatland at the Wayside Prairie Park, Isanti County, Minnesota. Four meso-habitats (ecotopes) have been reconnoitered: B is the partly grounded mat, with a mosaic of coarse sedge and large hummock of leatherleaf; C is the leatherleaf-*Sphagnum* lawn on the grounded mat; D is a shrub and cattail zone surrounding the poor fen and consisting of different discreet patches; and E is a wet lagg zone between the poor fen and the surrounding upland, dominated by arrowhead and cattails . The species marked by an '*" are new county records (Janssens 2000 for mosses and liverwort database). The distribution and habitat of each species is discussed in the Sub-appendix A.

Aulacomnium palustre (Hedw.) Schwaegr.
Habitat. - On moist or wet soils, in bogs and fens, on wet rocks. Only exceptionally really submerged, commonly on drier hummocks. One of the commonest species in wetlands.
Extant Distribution. - Circumboreal. Bipolar. Common in the boreal region, rare elsewhere. In North America from Alaska to Greenland, and south to Florida in the east and California in the west. Brazil, Bolivia, Patagonia. Svalbard. Northern, western, eastern and central Europe, Spain, Algeria. Asia. Australia, Tasmania and New Zealand.

Bryum pseudotriquetrum (Hedw.) Gaertn. *et al.*
Habitat. - On moist calcareous soil and in rich fens.
Extant Distribution. - Circumboreal. In North America from Alaska, Northwest Territories, Greenland, and Labrador, south to Ontario. Svalbard, throughout Europe, arctic Asia, Altai Mountains.

Drepanocladus aduncus (Hedw.) Warnst. (including the varieties *aduncus* and *polycarpus* (Bland. *ex* Voit.) Roth)

Habitat. - in fens, in seepage, beside lakes and pools in calcareous areas, sometimes brackish water. On stumps and logs in wet *Betula* forests, *Alnus* swamps and laggs, or in moderately rich fens. The species grows well in luxurious vascular-plant vegetation, often in highly shaded situations, attached to thatch and litter (var. *polycarpus*). It is commonly found in ditches and prairie potholes subject to fluctuating water levels. It is the *Drepanocladus* species most commonly associated with disturbance and eutrophication and is extremely variable in structure, with numerous intergrading modifications. The variety *D. aduncus* var. *kneiffii* (B.S.G.) Mönk., excluded from the discussion here, is a distinct taxon (or modification?) found only in rich fens and sedge meadows, often submerged.
Extant Distribution. - Circumboreal and arctic-alpine. In North America from Alaska to Greenland, south to New England, Ohio, Indiana, Illinois, Mississippi, Missouri, Oklahoma, Nebraska, Colorado, Arizona, California, and Mexico. Peru. Iceland, Europe. Algeria. Northern and central Asia, Japan. Australia, New Zealand, and Kerguelen.

Polytrichum strictum Brid. (*Polytrichum juniperinum* var. *affine* (Funck) Brid.
Habitat. - Usually growing in close association with *Sphagnum* spp. on hummocks in oligotrophic peatlands, as scattered plants or in dense tufts. Sometimes forming mats in burned-out peatlands. In the arctic in meadows with organic soil. In wet spruce forests, muskegs, *Salix* carr, sedge meadows, and *Eriophorum* bogs.
Extant Distribution. - Circumboreal and disjunct to the Southern Hemisphere. In North America from Alaska to Greenland and Labrador, and south to Georgia, Ohio, Illinois, Iowa, Colorado, Utah, and Washington. Europe, northern Africa, Svalbard, Iceland, temperate Asia, Japan. Falkland Islands and Antarctica.

Sphagnum angustifolium (Jens.) Jens.
Habitat. - Extremely common species in bogs and poor fens, forming lawns and low hummock, found as scattered plants among other hummock-forming *Sphagna.* Highly drought tolerant. Most common in shaded micro-habitats under conifer-tree canopy and also frequent in open areas. However, in the latter it is sometimes replaced by *S. fallax*.
Extant Distribution. - Part of the widespread *S. recurvum* species aggregate, this species (also considered the variety *S. recurvum* var. *tenue* Klinggr.) is most likely nearly as widely distributed, except for the more oceanic areas, where *S. fallax* (east) and *S. pacificum* (west) are more common. In North America from Greenland to Alaska, south to Oregon, Idaho, Colorado, Minnesota, Wisconsin, Michigan, West Virginia, and New York. Northern Europe. Northern Asia, Siberia, Japan, Korea.

Sphagnum centrale C. Jens. *in* Arnell & C. Jens.
Habitat. - In moist woods, *Salix* and *Alnus* carrs, and shaded, forested areas of poor and moderately poor fens.
Extant Distribution. - Circumboreal. In North America widespread throughout continental Canada south of 60° latitude and south to Pennsylvania, Illinois, and Washington.

Sphagnum contortum Schultz
Habitat. - in transitional fens, most commonly around lake edges, often submerged or partly emergent, but in wetter micro-habitats than *S. subsecundum* s.s.
Extant Distribution. - In North America in the east from Nova Scotia and Ontario in the north to Missouri, Minnesota, Illinois, Ohio, New York and New England; Alaska, British Columbia, Washington, and Alberta in the west. Northern Europe and Great Britain. Caucasus and northern Asia, Japan.

Sphagnum fallax (Klinggr.) Klinggr.
Habitat. - Commonly in open habitats, more so than the related *S. angustifolium*. In hollows and depressions in poor and moderately minerotrophic mires and in bogs. Around pools and lakes, beside streams.
Extant Distribution. - Circumboreal. In North America from Alaska to Greenland and south to the mountains of North Carolina and Georgia, Missouri, southern Canada, and Oregon. Europe. Northern Asia, China, Japan.

Sphagnum fimbriatum Wils.
Habitat. - Forming small and loose hummocks in woody micro-habitats in poor fens, often in laggs or moats surrounding small bogs, in alder swamps or along the treed fringes of open bogs. In tamarack swamps and in wet arctic tundra.
Extant Distribution. - In North America from Greenland to arctic Alaska and south to California, Colorado, Missouri, West Virginia, and Maryland. Northern and central Europe. Continental Asia, Siberia, Japan. Southern South America. New Zealand. South Africa.

Sphagnum fuscum (Schimp.) Klinggr.
Habitat. - In compact tall hummocks in oligotrophic peatlands and minerotrophic, mixed fens. Also in larger mounds in open bogs. Often a major peat-forming moss.
Extant Distribution. - Circumboreal. In North America from Alaska to Greenland and south to Maryland, West Virginia, Ohio, Michigan, Wisconsin, Colorado, and California. Northern and central Europe, northern Asia, Japan.

Sphagnum magellanicum Brid.
Habitat. - In low and expanded hummocks or as scattered plants among other *Sphagnum* spp., in oligotrophic and moderately minerotrophic peatlands, both open and forested.
Extant distribution. - Circumboreal, tropical, and austral. In North America from Alaska to Newfoundland and Labrador, south to North Carolina, Alabama, Kentucky, Indiana, Iowa, Saskatchewan, Montana, Idaho, and Washington. Mexico, West Indies, Central and South America along the mountains to Tierra del Fuego and Falkland Islands. Northern and central Europe, Iceland, northern Asia. Taiwan, Japan, Madagascar. New Zealand and Australia.

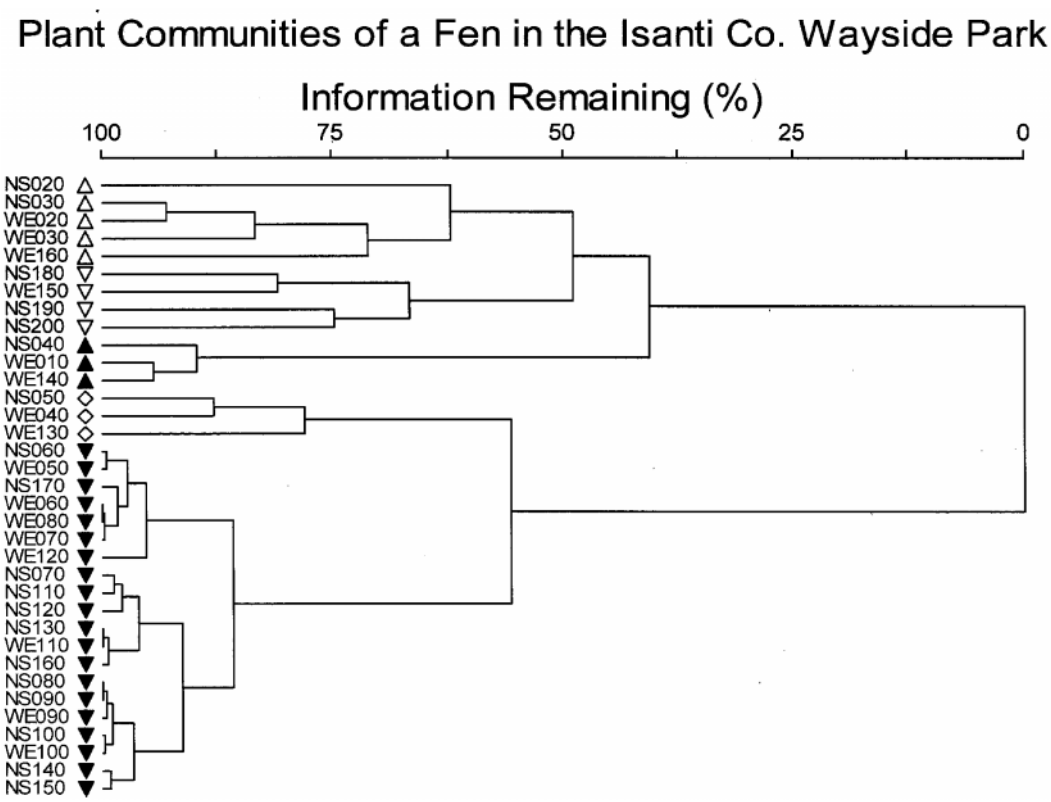
Sphagnum subsecundum s.s. Nees

Habitat. - in small cushions or loose mats in low, wet, mineral-rich, usually open, sedgy habitats, often at the pioneering edge of floating mats, in wet meadows or swales, especially along streams or drainage ditches or near ponds. Less common in shaded, swampy places such as alder thickets or bog moats. In the uplands in seepage or among rocks.
Extant Distribution. - From Greenland to Alaska, south the California in the west and in the east as far south as the mountains of North Carolina. Europe, Japan, northern Asia. Iceland, Korea, India, Thailand, and New Guinea.

Sphagnum teres (Schimp.) Ångstr.
Habitat. - A calciphile and initial colonizer in lake mats, cattail marshes, alder and willow carrs (laggs) and along streams and spring seepages, often associated with tamarack, poison sumac, and sometimes cedar. Not a woodland species.
Extant Distribution. - Circumboreal. In North America from Alaska to Greenland, and Iceland, south to New Hampshire, Pennsylvania, Ohio, Illinois, Iowa, Colorado, Idaho, and California. Northern, western, central, and eastern Europe, Pyrenees, Italy. Caucasus, central Asia. Japan.

APPENDIX 10

CLUSTER ANALYSIS DENDROGRAM OF THE PLANT COMMUNITIES OF THE FEN IN THE ISANTI COUNTY WAYSIDE PRAIRIE PARK, AS DEFINED BY SPECIES ABUNDANCE



APPENDIX 11

SOIL SURVEYS BY THE ISANTI COUNTY ENVIRONMENTAL COALITION WITH MIKE MUELLER IN THE FEN OF THE ISANTI COUNTY WAYSIDE PRAIRIE PARK. 10-7-02 AND 12-17-02.

Soil Survey Field Notes 10-7-02

MIKE MUELLER

Poor fen in Isanti County Wayside Prairie Park

Other participants:
Joe Crocker, Phil Anderson, Bill Carlson, Kriste Ericsson

Weather: Chilly, windy, above freezing.
Location: Samples taken along western-most section of board walk.
Equipment: Bucket auger

1. Location: 26 meters into fen from beginning of boardwalk.
   Description: sedge zone
   0 – 3 feet down (3 feet below water surface): partly decomposed, fibrous, black
   3 – 4 feet down: still lots of fibers, but getting more like muck.
   4 – 6 feet down: very similar to above. Leaves, stems, roots present. No mineral matter.
   6 - 6.5 feet down: getting into sand.
   6.5 – 7 feet: lots of sand mixed with lots of fibrous (organic) material. Much lighter color.
   Observations (by Mike Mueller):
   - Water level very high.
   - Soils here are very acidic. The ericaceous plants (leatherleaf, cranberry), indicate this.
   - 1930s-1950s: a much drier time in this region.
   - Peat is defined as a substance with greater than 3% organic matter, with little oxidation. Much of the fibrous "soil" in this fen may be considered peat.

2. Location: 16 meters into fen from beginning of boardwalk.
   Description: sedge/cattail zone
   0 – 1.5 feet: Water depth 50 cm.
   4 ft below water surface: black, much better decomposed, light sandy mottling
   5 feet down: almost pure sand

3. Location: 3 meters into fen from beginning of boardwalk
   Description: cattail zone
   0 – 1 feet: Water depth 32 – 36 cm.
   2 feet below water surface: sandy mixed with organic matter. Mostly a uniform dark color, but with some mottling (caused by oxidation/reduction processes).

Indicates that water has been present.
4 feet below water surface (122 cm), 3 feet from soil surface (90 cm): sandier, grayer

4. Location: Upland, about 3 meters east of beginning of boardwalk.
Description: grasses/woody shrubs, a few trees
0 – 8 inches: Root zone, black to dark brown
8– 10 inches: brown sand with roots above, orange sand below (oxidized), indicating iron
10 – 12 inches (30 cm deep): continuation of orange sand zone, some roots
12-18 inches (43 cm deep): oxidized, lighter orange sand. Roots still present. Occasional mottling (may indicate where there were once roots, or oxidation/reduction.)
18 – 21 inches (52 cm deep): Still with roots. Lighter sand with bright orange mottling.
21 - 24 inches (60 cm deep): Wetter, no roots, fairly grey sand. Water table comes
across at about 60 cm depth.
24 - 30 inches (76 cm): Slurped.. saturated sand, no roots. Orange mottling.

Soil Survey Field Notes 12-17-02

Mike Mueller

Poor fen in Isanti County Wayside Prairie Park

Other participants:

Joe Crocker, Phil Anderson, Gregg Gillett, Josie Arrowsmith, Kriste Ericsson

Weather: Overcast, 20 – 30 degrees F.

1. Location: Between NS 120 and WE 080 (about WE 075) (near intersection of transects)
Description: Dominated by leatherleaf and sphagnum hummocks
0 - 8 inches down: ice
8 inches to 7 feet: loose sphagnum, fibrous
8 feet to 16 feet: water
16 feet to 18 feet: black muck, some fibers, more decomposed
(18 feet was the furthest extension possible with our equipment)

2. Location: WE 060
Description: Dominated by leatherleaf and sphagnum. Halfway from transect intersection to WE 000.
0 – 8 inches down: ice
8 inches to 2 feet: coarse sphagnum and cranberries. Beginning of resistance at 2 ft.
2 feet - 7 feet: more fibrous
10 – 16.5 feet: loose muck and water

16.5 – 18 feet: black finer muck, fibrous – but not peat. More decomposed.

3. Location: WE 035
   Description: Cattail zone.
   0 – 6 inches down: ice
   6 inches to 3 feet: roots, black muck and sand, cattail stems
   3 ft – 5 ft: finer back muck, sand, fibrous
   5 ft – 6 ft: very firm
   6 ft: Sand, with mottling. Black organic streaks.
   Observations: Perhaps these were floating bog islands at one time (Mike Mueller).

4. Location: about WE 020
   Description: sedge zone
   0-6 inches down: ice
   1.5 feet down to solid
   2 feet down: black soil with some mineral content, mixed with sand, some fibers. Peat/ muck/sand mix.
   3 – 4 feet down: loose black muck. An organic, fibrous chunk, sand below.
   4.5 feet: Sand.
   Consider: How much impact from previous farming?

5. Location: NS 055
   Description: Leatherleaf/sphagnum (near alder zone, outside of immediate study area to the Northeast. Jan Janssens has laid 3 transects in the alder zone to study moss populations.)
   0 – 6 inches down: ice
   2.5 feet down to resistance. Plant matter present.
   2.5 - 4 feet down: black muck with lots of plant matter and a white plastic disk. Firmer than at the center of the bog.
   4 - 6 feet down: Still very fibrous muck.
   6 – 8 feet: coarse and fibrous.
   8 – 9 feet: more mucky, sand at bottom.
   9 – 10 feet: fibrous, little chunks of sand.
   10 – 12 feet: mostly black, fibrous, drier towards bottom. Less sand, more elastic, like clay.
   12 – 13 feet: loose, fibrous, unconsolidated, black.
   13 – 14 feet: sand with very fine organic matter.

6. Location: NS 185
   Description: Sedge area near lake
   0-6 inches: ice
   1 feet down to resistance
   3 feet down to plant mat
   3 – 4 feet down: plants and roots
   6 – 9 feet down: loose unconsolidated fibrous material

13.5 feet down: very loose material
13.5 - 16 feet down: thicker fibrous material. Muck appearing lower down with very little fiber.
16 – 18 feet down: Still pretty soft. 1.5 feet of muck. Some fiber. No sand.

Observations:

§ One problem in interpreting the cores was that as the borer was shoved successively deeper into the substrate, soil fell into it from substrate zones further up in the core sequence. This made it difficult at times to describe the substrate at successively deeper levels.

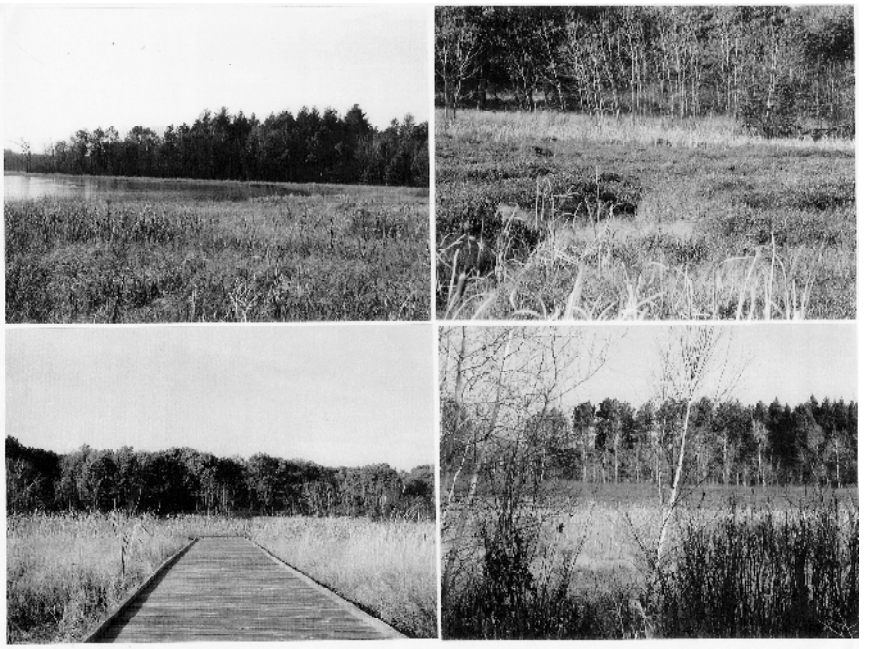
§ It appears that the poor fen is floating on a lens of water, perhaps growing out over the lake.

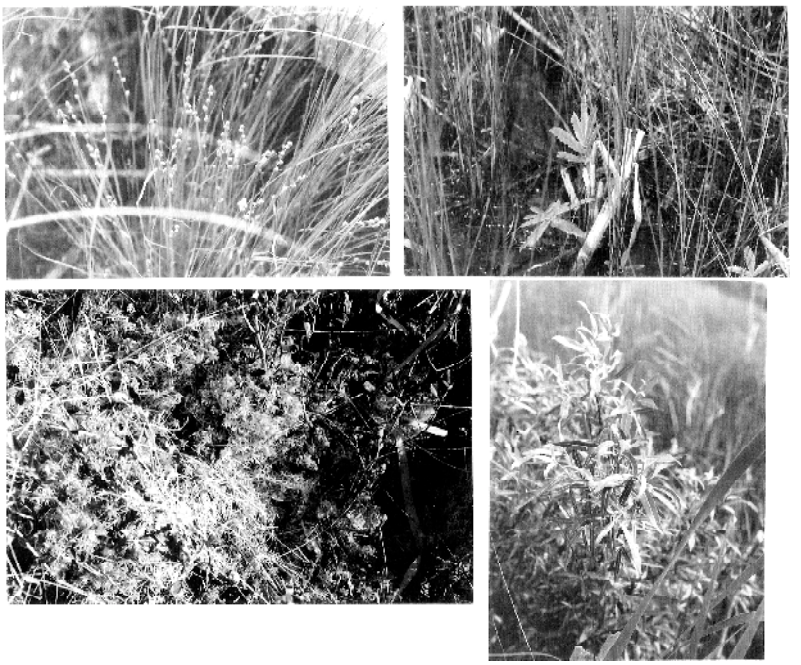
APPENDIX 12

ISANTI COUNTY ENVIRONMENTAL COALITION MEMBER PARTICIPATION

Kriste Ericsson - project coordinator, biologist
Joe Crocker - project co-coordinator, weather station
C. Philip Anderson - biologist, training, plant ID, transect layout, transect survey, herbarium committee
Susan Blom - transect survey, presentation committee, photography
Rob Lininger - transect survey, presentation committee
Dan Moran - transect labels, transect layout, transect survey, herbarium committee
Myrl Moran - transect labels, transect layout, transect survey, herbarium committee
Nancy Conger - transect survey, presentation committee
Tom Anderson - transect survey, presentation committee
Carolyn Bornhauser - transect survey
Chris Bornhauser - transect survey
Ron McGriff - transect layout, transect survey, herbarium committee
Jean Crocker - transect layout, pamphlet committee, presentation committee
Gary Moss - photography, pamphlet committee
Jamie Gillett - presentation committee
Gregg Gillett - presentation committee
Ken Reine - water level gage, transect survey
Bill Carlson - transect layout, transect survey
Anne Wakeford - report committee
Jerome Peterson - transect quadrants
Marilyn McGriff - presentation committee
Amy Sabrina - pamphlet committee
Carol Clark - equipment storage

APPENDIX 13
PHOTOS OF ACTIVITIES AT THE FEN, ISANTI COUNTY WAYSIDE PRAIRIE PARK, 2003





APPENDIX 14

OUTLINE OF PRESENTATION ON WAYSIDE PRAIRIE PARK WETLAND AND STUDY

compiled by
SUSAN BLOM

I. INTRODUCTION

A. Introduce people present as members of Isanti County Environmental Coalition
B. Purpose of ICEC is to promote environmental stewardship of our local natural resources
C. Our 20 (to 40) minute presentation will describe:
    1. Particular wetland in our county called a "poor fen"
    2. Wetlands and peatlands, their function and formation
    3. Place of this wetland within surrounding ecosystem
    4. Description of study of fen funded by DNR

II. OUR FEN

A. Definition of a poor fen (not poor Fin)
    1. Fen is a type of shallow wetland (*show poster #1-Fen)*
        a. covered by mosses, grasses, not dominated by cattails
        b. plants grow on peat *(pass peat)* not soil or water (will describe peatlands further in a few minutes)
    2. Poor fen means poor in nutrients (phosphorus, potassium, nitrogen), only certain plants grow—often have been buffered from farmland runoff
        a. continuous mat of spaghnum moss *(pass moss),* and plants grow on top (will describe further later)
        b. occurs in depressions, little runoff and little oxygen carried to plants, therefore plants do not completely decay and fen becomes acidic and poor in nutrients
        c. often sandy soil around—soil low in mineral and organic content
B. Basic description of our fen *(show poster #2-Park)*
    1. Located off Cty 10, 4 miles southwest of city of Isanti in Bradford
    2. 15 acres, off end of boardwalk, lake to south
    3. Plants in fen *(refer to poster #3-Plant Photos)*
        a. On edge of fen are sedges, grasses, and cattails
        b. In center is floating mat of peat and spaghnum, 6 ft. deep
        c. Under mat in center is 8 ft. of water
        d. On top of mat grow leatherleaf and cranberry
        e. Scattered throughout are ferns, birch, sundew, willows
        f. Cranberry
        g. Leatherleaf

h. Marsh Bell Flower
i. Three-way sedge
j. Wool-grass

III. WETLANDS

A. Functions as one of "cogs and wheels" of ecosystem (Leopold)
1. Stores water—collects and holds water following rain or snow melt in spring, gradually releases through evaporation and soaking into surrounding environment *(do wetland demo, p.9 in Appendix)*
2. Filters water—acts like natural "kidneys" to absorb nutrients (nitrogen and phosphorus from farmland), soil runoff, and pollutants, keeps groundwater and surface water cleaner

B. Peatlands are type of wetland *(refer to peat again)*
1. Made up of :
   a. Rich fens—sedge and grass covered, lack spaghnum, have more nutrients than poor fens, wider variety of plants, gets nutrients more from runoff
   b. Poor fens—as previously described
   c. Bogs—even less nutrients than poor fens, only source of water is precipitation, more acidic than poor fens.
2. What peat is and how it forms *(peat/fen demo, p.10 Appendix)*
   a. Peat in non-mineral soil made up of partially decomposed remains of dead plants accumulated on top of each other in waterlogged places for thousands of years—90% water and 10% solid material
   b. Demonstration of how peat is formed
   c. Peat used for fuel for thousands of years, for gardens to help hold moisture in soil and increase effectiveness of fertilizers, acidifies soil and lightens heavy soil, used for insulation, absorbing oil spills, and to dye tweed, peat+time=coal
3. Peatlands are acidic
   a. Low in oxygen due to little fresh water inflow
   b. Plants do not decay completely and release acid, which colors water—called absorbance, darker in center of fen *(tea leaves in water jar)*
   c. Acidic water can preserve organic matter, ph in center of fen is 4.3—5.0 (range of 0—14, with 7 as neutral) *(show pickle jar)*—have found animals and people mummified *(tell Tollund man story, p. 11 in* Appendix*)*
4. Bogs and poor fens covered with spaghnum moss *(refer to moss)*
   a. Over 300 species, 8 species found in our poor fen
   b. Spaghnum grows in layers and as dies, forms peat as shown in demo
   c. Able to regulate temperature like a blanket—keeps area warmer in winter and cooler in summer

d. Can hold 10-25 times its weight in water like sponge in demo, in dry seasons, can seem dry on outside, special cells called hyaline cells make up spaghnum, when water scarce, these cells become white, increasing light reflected and decreasing evaporation, has been used as diapers
e. Is sterile and was used as dressing for wounds in war

IV. WETLANDS AS PART OF THE WHOLE

A.Transition between dry land and open water
1. "When we try to pick out something by itself, we find it hitched to everything in the universe" (John Muir, 1911)
2. Our poor fen is linked to lake and uplands surrounding it *(refer to poster #2—Park again)*
3. Keeps lake water clean, filters runoff from land, stores water during wet year like last year
4. Provides habitat for frogs, birds, turtles, fish larvae, dragonflies, and occasionally mosquitoes

B. Rum River Watershed *(show poster #4—Watershed)*
1. Our fen is part of Long Lake Watershed (purple line)
2. Long Lake part of the Rum River Watershed, which flows into Mississippi Watershed which flows of course into the Gulf

V. RESULTS OF ENVIRONMENTAL PARTNERSHIP STUDY

A. Description of study
1. Purpose—funded by DNR, goal was to increase public awareness of poor fen and interest in caring for and preserving this unusual resource
2. Time frame—October 2001—June 2003
3. Activities—*(show poster #5-People)*
   a. Observed in fen *(show poster #2, pointing out transects)* and recorded species of plants, % cover, height sociability *(show quadrat)*
   b. Outside experts took water, soil, and moss data
   c. Collected sample plants for herbarium at CCC, *(show 10 mounted plants and sundew)*
   d. Prepared these presentations
4. For further information, refer to scientific report and herbarium at CCC media center
5. Wish to thank DNR, CCC, Initiative Foundation, Isanti County Parks & Recreation Commission, Martha Phillips from St. Catherine's, Hannah Dunevitz from DNR, Bonnie and John Schlagel, Josie Arrowsmith from CCC, Warner Nature Center

VI. PASS OUT PICKLES, POSTCARDS, AND PAMPHLETS

SUB-APPENDIX A

For demonstrations

- Photos, Pictures and Props
- Wetland Demo
- Peat/Fen Demo
- Tollund Man

PHOTOS, PICTURES, AND PROPS

Poster # 1: Photos of Wetland and Park
Poster #2: Typo map of Park
Poster #3: Photos of Plants
Poster #4: Typo map of Watershed area
Poster #5: People at Poor Fen Working and Training

Painting of sundew

Quadrat

2 bowls of peat
2 bowls of spaghnum moss
tea
pickles

Props for Wetland Demo—2 trays, sponge, block of wood, 2 watering cans, 2 quarts of water
Props for Peat/Fen Demo—bowl, 2 quarts of water, 10 handfuls of compost, spaghnum, little plants
2 pictures of Tollund Man

WETLAND DEMO

Fen collects and holds water following a rain or snow melt in Spring
Only releases water gradually through evaporation and soaking into the surrounding environment
We can demonstrate water holding capacity of fen with these two plates
One holds a sponge to represent spaghnum moss and the other a block of wood to represent buildings such as Wall Mart and surrounding parking lot
Have two containers of water in equal amounts and will pour into watering can
Pour one container worth of water on top of sponge and on top of wood to see what happens
Notice how the water in the plate with the sponge is almost completely absorbed whereas water in the other plate remains as it was when poured
You can see how water following a heavy rain will be absorbed by the fen and the rain

falling on buildings and parking lots especially will run off into gutters and sewers, and eventually creeks and rivers

This ability to absorb water helps prevent flooding, erosion of soil, and washing of debris into our surface and groundwater

The nature of the fen, its plant life including spaghnum moss and collection of decaying plant fiber acts as a natural sponge holding large quantities of water

PEAT/FEN DEMO

To give an idea of how peat forms, we have a clear plastic bowl, a jug full of water, a garbage bag of dried leaves, dead plants, and plastic plants (Have two volunteers from the audience or have presenters hold the bowl, pour the water, etc.)

Imagine this bowl is a lake formed many many years ago. First we will pour water into it.

As time goes by aquatic plants began to grow along the edges (place plastic plants around edge).

Drainage was poor. No streams flowed in or out of the lake to wash away leaves and flowers that fell into the lake in the autumn so they began to accumulate. The plants growing on the edge also died and accumulated.

No streams flowed in to deliver oxygen to support bacteria needed to break down the dead plants into nutrients. The plants did not decay or wash away but instead remained on the bottom of the lake, releasing acid into the water.

Over the years dead plants began to form deep layers of peat. This process took a very long time. (Ask them to guess how long)

To show you how long we need 10 volunteers. Each volunteer will grab a handful of composted leaves and place them in the bowl of water. With each handful, a thousand years is counted out by the group.

Spaghnum moss began to grow on the peat (add moss) and when it died added more peat to the pile and each year the moss spread farther across the water soaking it up like a sponge.

Slowly a mat of spaghnum moss supporting shrubs and trees began to encircle and eventually cover the area and the fen was born

TOLLUND MAN

The Tollund man lived about 2000 years ago and was buried in a peat bog on the Jutland Peninsula in Denmark. He is remarkable for the fact that his body was so well preserved. He seemed to have recently died.

On May 8, 1950 brothers Emil and Viggo were cutting peat for their tile stove and the kitchen range in the Tollund peat bog, 10 km west of Silkeborg, Denmark. As the two brothers worked, they suddenly saw in the peat layer a face so fresh that they could only suppose that they had stumbled on a recent murder. They immediately notified the police at Silkeborg.

The Tollund Man lay 50 meters away from firm ground and had been covered by about 2 meters of peat, now removed. He wore a pointed skin cap on his head fastened

securely under his chin by a hide thong. There was a smooth hide belt around his waist. Otherwise he was naked. He was almost clean-shaven but there was very short stubble on his chin and upper lip. There was a rope made of two leather thongs twisted together under a small lump of peat beside his head. It was drawn tight around his neck and throat and then coiled like a snake over his shoulder and down his back.

Underneath the body was a thin layer of moss. Scientists know that this moss was formed in Danish peat bogs in the early Iron Age about the time when Christ was born. The body must therefore have been put in the hole in the past roughly 2000 years ago. The acid in the peat had prevented the body from decaying, along with the lack of oxygen underneath the surface. It looked as if he had been recently buried.

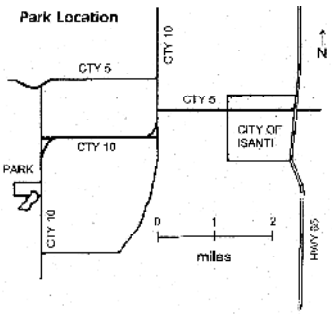
Examinations and X-rays showed that the man's head was undamaged and his heart, lungs, and liver were well preserved. He was not an old man, though he must have been over 20 years old because his wisdom teeth had grown in. He had probably been killed by the rope around his neck. The noose left clear marks on the skin under his chin and at the side of his neck but there was no mark at the back of the neck where the knot was. It was impossible to tell if the neck had been broken because the bones were very crumbly.

The stomach and intestines were examined and tests were carried out on their contents. The scientists discovered that the man's last meal had been a kind of soup made from vegetables and seeds, some cultivated seeds and some wild; barley, linseed, "gold of pleasure," knot weed, bristle grass, and chamomile.

APPENDIX 15
ICEC PRESENTATION FOR NATURAL RESOURCES DAY
Tuesday, May 20, 2003

1. Purpose of presentation is to describe what is called a <u>poor fen</u> *(show poster#1-Fen)*
   *fen is type of wetland covered with spaghnum moss *(show moss)*
   *moss is on top of peat *(show peat)*, fen is a type of <u>peatland</u>
   *poor fen means poor in nutrients so only certain plants grow like cranberries
   *this poor fen is in an Isanti County park called Wayside Prairie Park off Cty 10
2. Poor fen and wetlands are important to us because they store and filter water— We will show you how: *(wetland demo)*
3. Poor fens and peatlands were formed over thousands of years probably in the following way: *(peat/fen demo)*
4. Poor fens and peatlands are so acidic that they can preserve things, an example being the Tollund Man *(tell Tollund Man story and show picture)*
5. Poor fens are as acidic as pickle juice is which preserves and pickles the cucumber *(pass out pickles)*

APPENDIX 16
PAMPHLET OF THE FEN PEATLAND AND THE ISANTI COUNTY WAYSIDE PRAIRIE PARK, PRODUCED BY THE ICEC PAMPHLET COMMITTEE



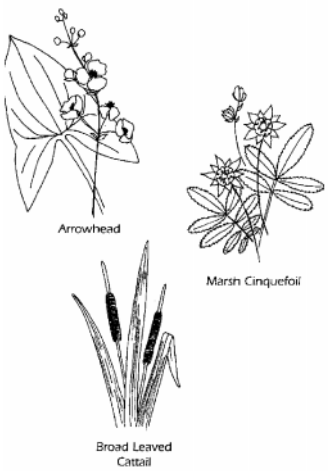
For additional information on Isanti County parks, contact:
Isanti County Parks and Recreation
Isanti County Government Center
555 18th Ave SW
Cambridge, MN 55008
763-689-8220

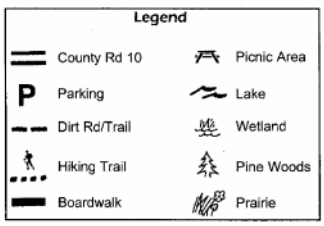
Isanti County Environmental Coalition (ICEC) completed a two year study of this poor fen wetland in June, 2003.

Presentation and/or field trips are available for your club, school group or civic organization. Programs tailored to fit your needs. Contact:
Susan Blom 763-689-5765
Joe Gruber 763-689-8726

Complete report on the ICEC study available at:
Cambridge Campus Library
Anoka Ramsey Community College
300 Polk St S Cambridge, MN 55008
763-689-7311 (Library)
763-689-7300

Herbarium containing samples of all plants collected from the wetland available to see and study at





Isanti County Wayside Prairie Park

Visit the marvel

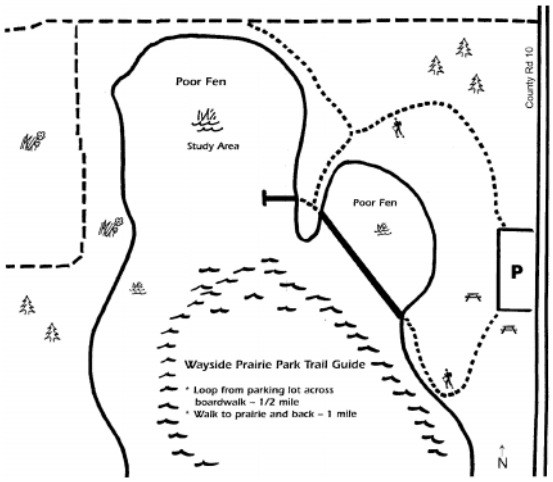

Swamp candle

Three miles southwest of the City of Isanti, just off of County Rd 10, you will come upon the Isanti County Wayside Prairie Park. Jump out of your car, walk through the picnic grounds, and you will find a dirt path cutting west through the woods. Follow it along the lakeshore, and within 300 feet you will arrive at a marvel. A floating boardwalk leads across one of Isanti County's little known wonders, a special type of wetland floating on ten feet of water, which has been designated by the Minnesota Department of Natural Resources as a "poor fen."

Never heard of it? This rare and fragile 15-acre peat land acts as a huge, springy, mossy sponge filtering the water, which runs into the lake and eventually into the Rum River. This fen harbors all types of wonderful plants, small animals, and insects. Come at the right time of the year and you will see cotton grass waving in the wind. Look into the bright yellow flowers of a carnivorous plant the bladderwort. See inside this brochure for a seasonal list of other plants found in the fen.

Study the map and you will discover that marked trails wander through all types of habitat. The hardwoods bordering the lake hide populations of the Clintonia Lily, flowering in the spring. A pine forest borders an old dirt road. A restored prairie west of the wetlands affords the discovery of native grasses and blooming plants. Each type of area harbors its own population of birds and animals. Come any season of the year, bring your binoculars and take your time. This is nature at its best in Isanti County.

Please take pictures but pick no flowers!



APPENDIX 17
POST CARDS PRODUCED BY THE ICEC PAMPHLET COMMITTEE