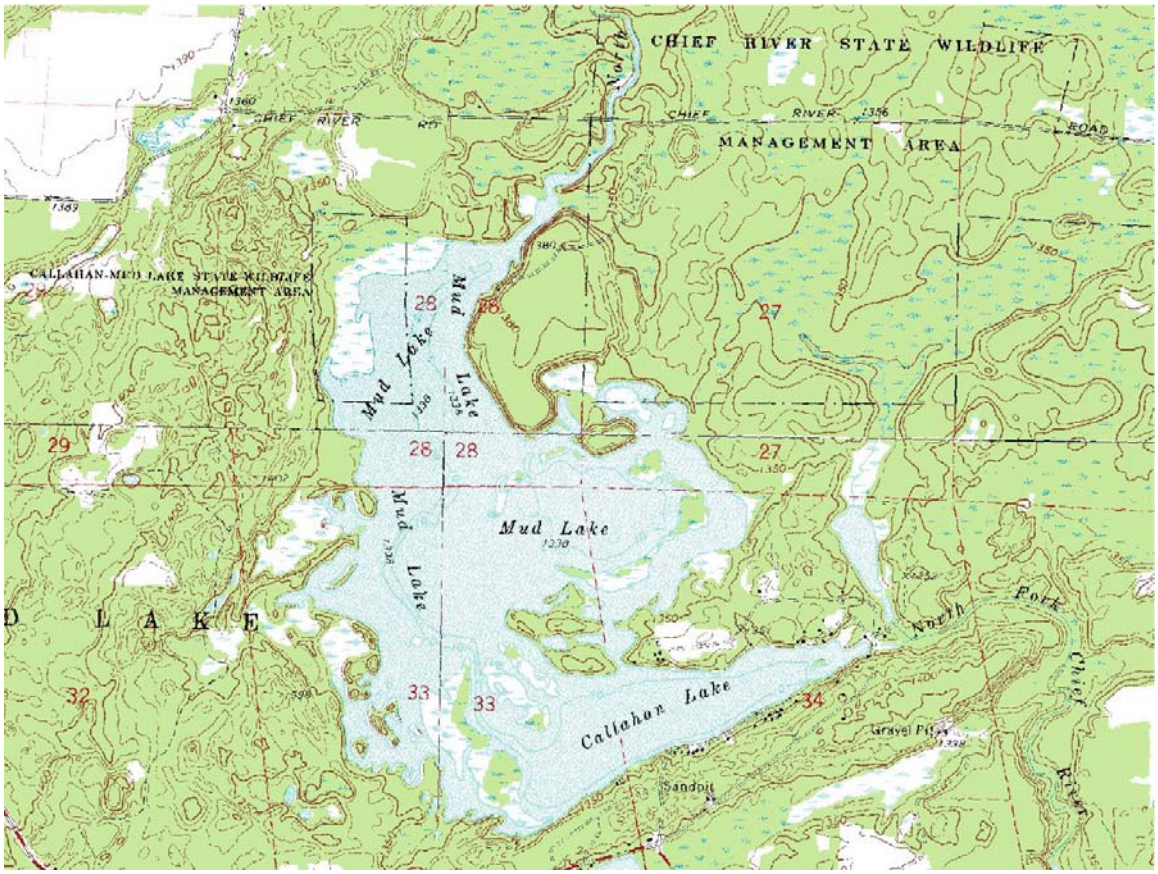
Appendix A

Aquatic Plant Survey Report

(Appendices not included)

Aquatic Macrophyte Survey for Callahan and Mud Lakes Sawyer County, Wisconsin WBIC: 2434700 and 2434800



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August 2008

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ABSTRACT

Callahan Lake (WBIC 2434700) and Mud Lake (WBIC 2434800) combine to form a 602 acre (243.6 ha) drainage system in central Sawyer County. In 2008, the Callahan Lake Association, Sawyer County Land & Water Conservation Department, and the Wisconsin Department of Natural Resources commissioned a systematic point intercept macrophyte survey as the first step in developing an aquatic plant management plan. The resulting survey found macrophytes at 306 of the 434 survey points on Callahan, and 391 of 517 survey points on Mud.

We identified a total of 24 species on Callahan, and 26 species on mud for a surprisingly low total of 28 species in the lakes. The total from both lakes produced a mean Coefficient of Conservation of 5.96 and a slightly average Floristic Index of 29.8. Robbins (fern-leaf) pondweed (*Potamogeton robbinsii*) and Common waterweed (*Elodea canadensis*) were the most common species in both lakes being found at 68.29% and 54.66% of survey points with vegetation. The lower than average mean Coefficient of Conservatism is like due to the fact that there are so many plants that can tolerate lower water quality such as Coontail (*Ceratophyllum demersum*), Common waterweed (*Elodea canadensis*), and Water smartweed (*Polyganum amphibium*) for example. However, the higher than average Floristic Index is due to the fact that there are species that only occur in certain water quality conditions, such as a low conductivity range. These plants include: Robbins (fern-leaf) pondweed (*Potamogeton robbinsii*), Floating-leaf-bur-reed (*Sparganium fluctuans*), and Robbins' spike-rush (*Eleocharis robinsii*).

Future management goals should include maintaining the lakes' native community, and assess the nutrient load coming into the system, continued education and boat monitoring through the State's "Clean Boats/Clean Water" program, and consideration to monitor Eurasian water milfoil (*Myriophyllum spicatum*) populations in transects parallel to the shore where known populations exist in order to document spread or decline.

ACKNOWLEDMENTS

I wish to thank the Wisconsin Department of Natural Resources, and the Callahan Lake Association for funding this project, Woodhaven Resort for providing a boat and gas (and hospitality), and William Daniels and Beth Bernhardt for assistance in conducting this survey.

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INTRODUCTION:

Callahan Lake (WBIC 2434700) and Mud Lake (WBIC 2434800) combine to form a 602 acre (243.6 ha) drainage lake system (Callahan 138 acres and Mud 464 acres) in central Sawyer County, Wisconsin. Callahan Lake's maximum depth is 18ft (11ft. mean depth), while Mud Lake reaches a maximum depth of 15 feet (6 ft. mean depth). The bottom substrate of both lakes is predominately muck, sand, and sandy muck.

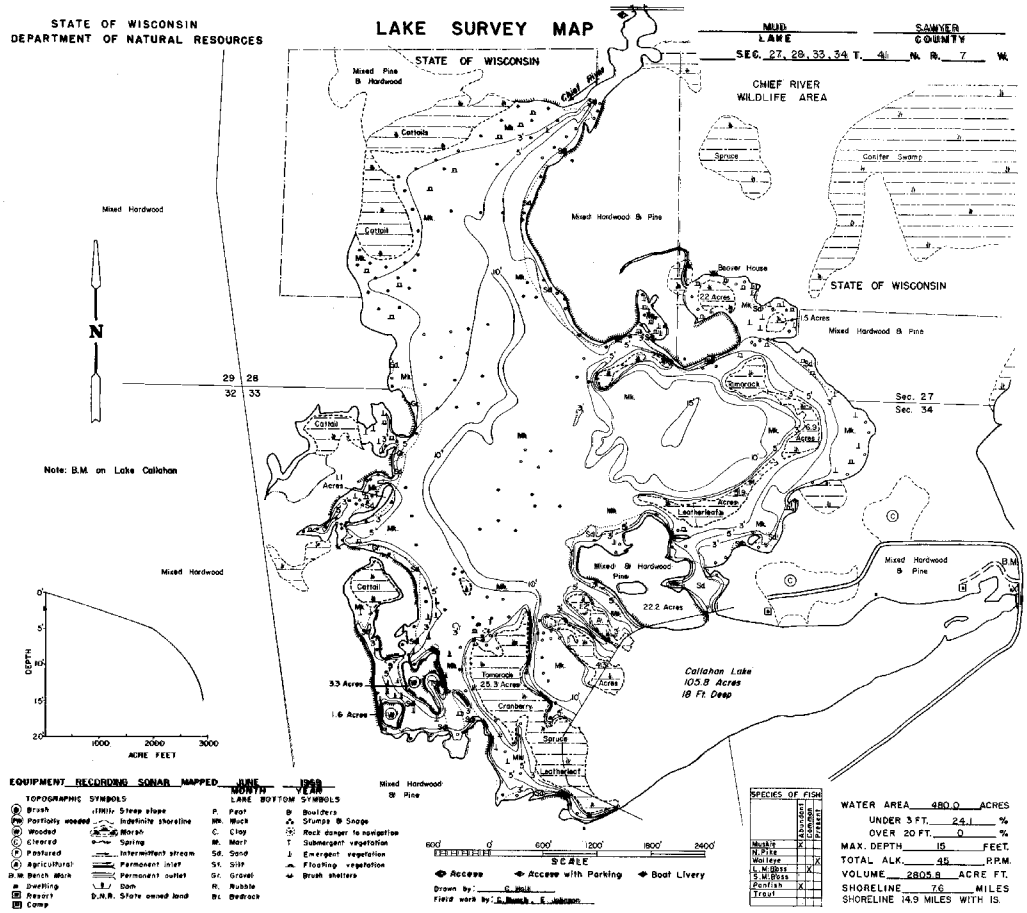


Fig. 1. Mud and Callahan Lakes

Concern over Eurasian Water Milfoil (*Myriophyllum spicatum*) infestation, has led to the desire to assess the extent of M. spicatum coverage and development of an aquatic plant management plan. Part of this assessment required a survey of aquatic macrophytes using the Wisconsin Department of Natural Resources statewide guidelines for conducting systematic point intercept macrophyte sampling.

The new guidelines ensure that all sampling in the state will be conducted using the same protocol, thus allowing data to be compared across the state over time. This report represents the summary analysis of the data collected during a survey of Callahan and Mud Lakes in August of 2008. The immediate goals of the project were to determine where M. spicatum has viable populations the

lakes, and to establish baseline data on the diversity, abundance and distribution of native aquatic plant populations. These data provide a baseline for long-term monitoring of the lakes' macrophyte community and success of an aquatic plant management program.

METHODS AND RESULTS:

Using a standard formula that takes into account the shoreline shape and distance, islands, water clarity, depth and total lake acres, the Wisconsin DNR generated a sampling grid for each lake (Appendix A).

All plants found were identified to species (except *Chara* which did not have oocytes present) (Crow and Hellquist 2006), and two vouchers were pressed and retained for herbarium specimens – one to be retained by the Callahan Lake Association, and one to be sent to the state for identification confirmation. During the point intercept survey, we located each survey point using a handheld mapping GPS unit, and each point, depth was recorded. Every point that was not bog, shallow marsh or terrestrial was sampled (bog and mash communities were characterized visually). At each of these points, we used a rake (either on a pole or a throw line depending on depth) to sample an approximately 1 meter section of the benthos. All plants on the rake, as well as any that were dislodged by the rake were identified, and assigned a rake fullness value of 1 to 3 as an estimation of abundance (Figure 2). We also recorded visual sightings of plants within six feet of the sample point. Substrate (lake-bottom) type was assigned at each site where the bottom was visible or it could be reliably determined using the rake.

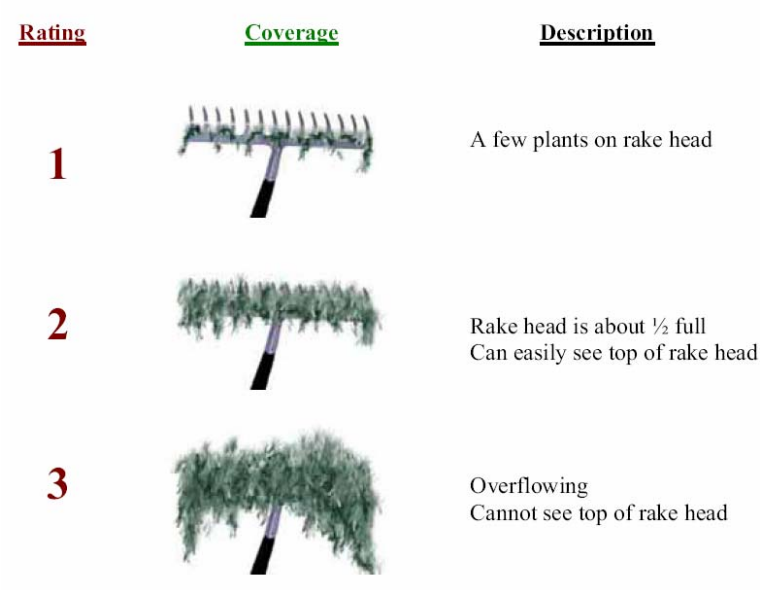


Fig. 2 Rake fullness rating (UW Extension 2007)

Data collected was entered into a spreadsheet for analysis. The following statistics were generated from the spreadsheet:

- Frequency of occurrence for all sample points in lake
- Relative frequency
- Total sample points
- Sample points with vegetation
- Simpson's diversity index
- Maximum plant depth
- Species richness
- Floristic Quality Index

The following are explanations of the various analysis values:

Frequency of occurrence for each species- Frequency of occurrence is expressed as a percentage and there are two values for this. The first is the percentage of all sample points that this plant was sampled. The second is the percentage of littoral sample points that the plant was sampled. The first value shows how often the plant would be encountered everywhere in the lake, while the second value shows if only within the depths plants potentially grow. In either case, the greater this value, the more frequent the plant is in the lake. If one wants to compare to the whole lake, we look at the frequency of all points and if one wants to focus only where plants are more probable, then one would look at frequency in the littoral zone.

Frequency of occurrence example:
Plant A sampled at 35 of 150 total points = 35/150 = 0.23 = 23%
Plant A's frequency of occurrence = 23% considering whole lake sample.
This frequency can tell us how common the plant was sampled in the entire lake.

Relative frequency-This value shows, as a percentage, the frequency of a particular plant relative to other plants. This is not dependent on the number of points sampled. The relative frequency of all plants will add to 100%. This means that if plant A had a relative frequency of 30%, it occurred 30% of the time compared to all plants sampled or makes up 30% of all plants sampled. This value allows us to see which plants are the dominant species in the lake. The higher the relative frequency the more common the plant is compared to the other plants.

Sample sites with vegetation- The number of sites where plants were actually collected. This gives a good idea of the plant coverage of the lake. If 10% of all sample points had vegetation, it implies that about 10% of the lake is covered with plants.

Relative frequency example:
Suppose we were sampling 10 points in a very small lake and got the following results:
Frequency sampled
Plant A present at 3 sites 3 of 10 sites
Plant B present at 5 sites 5 of 10 sites
Plant C present at 2 sites 2 of 10 sites
Plant D present at 6 sites 6 of 10 sites
One can see that Plant D is the most frequent sampled at all points with 60% (6/10) of the sites having plant D. However, the relative frequency allows us to see what the frequency is compared the other plants, without taking into account the number of sites. It is calculated by dividing the number of times a plant is sampled by the total of all

plants sampled. If we add all frequencies (3+5+2+6), we get a sum of 16. We can calculate the relative frequency by dividing by the individual frequency.
Plant A = 3/16 = 0.1875 or 18.75%
Plant B = 5/16 = 0.3125 or 31.25%
Plant C = 2/16 = 0.125 or 12.5%
Plant D = 6/16 = 0.375 or 37.5%
Now we can compare the plants to one another. Plant D is still the most frequent, but the relative frequency tells us that of all plants sampled at those 10 sites, 37.5% of them are Plant D. This is much lower than the frequency of occurrence (60%) because although we sampled Plant D at 6 of 10 sites, we were sampling many other plants too, thereby giving a lower frequency when compared to those other plants. This then gives a true measure of the dominant plants present.

Species	**Relative frequency**	**Frequency of Occurrence**
Myriophyllum spicatum	3.7	13.63
Filamentous algae	0.3	1.00
Brasenia schreberi	0.9	3.30
Ceratophyllum demersum	9.5	34.72
Chara	0.6	2.3
Eleocharis robbinsii	0.0	0.14
Elodea canadensis	15.0	54.66
Heteranthera dubia	0.4	1.58
Megalodonta beckii	1.6	5.74
Myriophyllum sibiricum	2.5	9.04
Najas flexilis	2.2	8.03
Nuphar variegate	0.7	2.73
Nymphaea odorata	0.9	3.30
Polygonum amphibium	Only present visually at one site	
Pontederia cordata	0.1	0.26
Potamogeton amplifolius	10.9	39.60
Potamogeton gramineus	1.1	4.16
Potamogeton natans	0.1	0.29
Potamogeton praelongis	3.3	12.05
Potamogeton pusillus	5.4	19.51
Potamogeton richardsonii	1.4	5.16
Potamogeton robbinsii	18.7	68.29
Potamogeton zosteriformis	12.7	46.20
Sparganium angustifolium	Only present visually at two sites	
Sparganium fluctuans	0.0	0.14
Spirodela polyrrhiza	0.6	2.01
Utricularia vulgaris	0.7	2.58
Vallisneria americana	6.5	23.82

Table 1: Species list and frequency values

Simpson's diversity index- Simpson's Index **(**D**)** measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species).

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Where D = Simpson's Diversity, n= the total number of organisms of a particular species, N=the total number of organisms of all species.
To measure how diverse the plant community is, Simpson's index is calculated. This value can range from 0 to 1.0. The greater the value, the more diverse the plant community is in a particular lake. In theory, the value is the chance that two species sampled are different. An index of "1" means that the two will always be different (very diverse) and a "0" would indicate that they will never be different (only one species found). The more diverse the plant community, the better the lake ecosystem.

Simpson's diversity example:
If one went into a lake and found just one plant, the Simpson's diversity would be "0." This is because if we went and sampled randomly two plants, there would be a 0% chance of them being different, since there is only one plant.
If every plant sampled were different, then the Simpson's diversity would be "1." This is because if two plants were sampled randomly, there would be a 100% chance they would be different since every plant is different.
These are extreme and theoretical scenarios, but they do make the point. The greater the Simpson's index is for a lake, the greater the diversity since it represents a greater chance of two randomly sampled plants being different.

Maximum depth of plants-This depth indicates the deepest that plants were sampled. Generally more clear lakes have a greater depth of plants while lower water clarity limits light penetration and reduces the depth at which plants are found.

Species richness-The number of different individual species found in the lake. There is a number for the species richness of plants sampled, and another number that takes into account plants viewed but not actually sampled during the survey.

Floristic Quality Index- The Floristic Quality Index is designed to evaluate the closeness of the flora in an area to that of an undisturbed condition. It can be used to identify natural areas, compare the quality of different sites or locations within a single lake, monitor long-term floristic trends, and monitor habitat restoration efforts. This is an important assessment in Wisconsin because of the demand by the Department of Natural Resources (DNR), local governments, and riparian landowners to consider the integrity of lake plant communities for planning, zoning, sensitive area designation, and aquatic plant management decisions.
It takes into account the species of aquatic plants found and their tolerance for changing water quality and habitat modification using the equation $I = \overline{C}\sqrt{N}$ (where *I* is the floristic quality, $\overline{C}$ is the average coefficient of conservation (obtainable from http://www.botany.wisc.edu/wisflora/FloristicR.asp) and $\sqrt{N}$ is the square root of the number of species). The index uses a conservatism value assigned to various plants ranging from 1 to 10. A high conservatism value indicates that a plant is intolerant of change while a lower value indicates tolerance. Those plants with higher values are

more apt to respond adversely to water quality and habitat changes. The FQI is calculated using the number of species and the average conservatism value of all species used in the index. Therefore, a higher FQI, indicates a healthier lake plant community. It should be noted that invasive species of a value of 0.

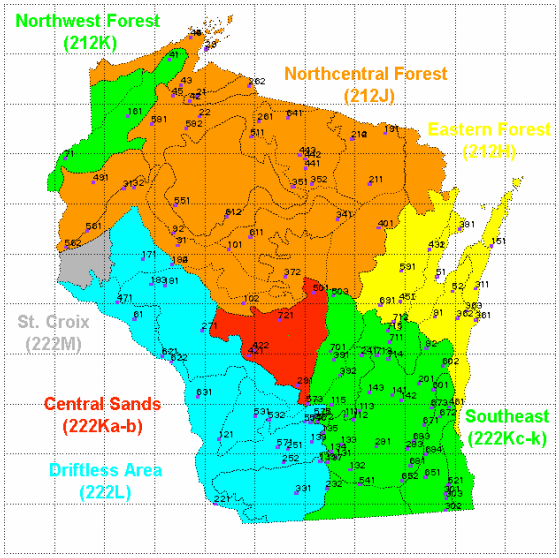


Fig. 3 Wisconsin Eco-region Map (USGS)

Summary of Northern Lakes and Forest Mean Values for Floristic Quality Index:
Mean species richness = 13
Mean average conservatism = 6.7
Mean Floristic Quality = 24.3*
*Floristic Quality has a significant correlation with area of lake (+), alkalinity(-), conductivity(-), pH(-) and Secchi depth (+). In a positive correlation, as that value rises so will FQI, while with a negative correlation, as a value rises, the FQI will decrease and vice versa.

Species observed for FQI = 27 (13)
Average conservatism = 5.96 (6.7)
Floristic Quality = 29.8 (24.3)

Table 2. Floristic Quality Data (FQI)-Value for Callahan and Mud Lakes (Northern Lakes and Forests Mean)

DISCUSSION

Mud & Callahan Lakes has an aquatic plant community that has a high aquatic macrophyte species richness compared to other lakes in the Northern Lakes and Forests Eco-region. As seen in Table ?, there were twenty-eight different species observed. The sampled species are only used in the calculating statistics such as Simpson's diversity. However, all species sampled and visually observed are used in the Floristic Quality Index. The mean species richness for lakes in this

Eco-region is thirteen. Callahan & Mud Lakes had a richness of 28 only one being and invasive species *Myriophyllum spicatum* (Eurasian water-milfoil) The most common plant sample was *Potamogeton robbinsii* (Robbins (fern-leaf) pondweed) being found at 68.29% of survey points with vegetation meaning it made up more than half of all plants sampled. *Potamogeton robbinsii* has the deepest median growth depth in the sate – it grows in water up to 4.5 meters, meaning it could have a very important impact by increasing oxygen concentrations in deeper areas of the lake. Also, *Potamogeton robbinsii* is found in a limited conductivity and alkalinity range, and therefore, has the potential to be a barometer of the lakes health.

Another indicator of diversity is the Simpson's diversity index. This index for Mud & Callahan Lakes is 0.90. Although this number has no standards for diversity indicators, 0.90 is higher compared to other lakes viewed as very diverse surveyed in Northern Lakes and Forests Eco-region. The Simpson's diversity index is a value that represents the chance of two species sampled of being different. A 0.90 means it is very likely they would be different. This high diversity could be due to hundreds of new acres of lake bed available for rooting with the flooding of Mud Lake.

Mud and Callahan Lakes appears to be a mesotrohpic. As a result the plant coverage is very high in both lakes, providing habitat and utilizing nutrients that could otherwise be used by algae. For this reason, it important to preserve the native plants that are present in Mud and Callahan Lakes and reduce the coverage of Eurasian water-milfoil that could impede native plant growth. Also, there is very abundant floating leaf and emergent stands of aquatic plants in Mud Lake and up river. These are important habitats for organisms and the preservation of these areas is paramount. The deepest plant depth was 14.5 feet, which indicates average water clarity during much of the growing season, possibly due to tannins leaching from the peat in Mud Lake.

There are a few different native plants that special mention should be made. One of the species that was fairly common was *Potamogeton amplifolius* (large leaf pondweed). This plant is a very important plant for fish habitat. Another common name for *Potamogeton amplifolius* is musky weed. As the name implies, musky use this plant extensively for foraging, cover and reproduction. For these reasons, it is important to have *Potamogeton amplifolius* present in Mud and Callahan Lakes in terms of fisheries. Additionally, *Potamogeton* species are often a fovorit food of waterfowl, shore birds, muskrats, beaver, and deer. The Finely dissected leaves of Myriophyllum sibericum often attract beneficial aquatic macroinvertebrates, which feed on epiphytic algae and provide food for young fish.

The Floristic Quality Index (FQI) for Mud and Callahan Lake is somewhat above average for the Northern Lakes and Forests Eco-region. The FQI for the lakes is

29.8, compared to a mean of 24.3. However, the average conservatism for Mud & Callahan Lakes was 5.96, compared to a mean of 6.7. The lower mean C value is likely due to the presence of several plants which are tolerant to disturbance. This is to be expected as Mud Lake is a flooded wetland. The FQI value indicates that the plant community is showing less affect of human activity (development) than the mean lake in the Eco-region (with the exception of the EWM which is not counted in an FQI). The plant community appears to be healthy, represents a healthy lake ecosystem, and is diverse. Therefore, attempts should be made to reduce the abundance and control the spread of Eurasian water-milfoil.

Mud and Callahan Lakes has a diverse plant community with extensive lake coverage. In addition, the areas of floating and/or emergent vegetation are abundant in Mud Lake and up river. For this reason, it is crucial that the native plants that are present be preserved. There were several areas within both lakes where tremendous beds of Eurasian water-milfoil occur. It is imperative that these beds be treated and the sporadic occurrence of EWM in other areas be monitored and controlled as needed. Aquatic plants are a vital part of the lake ecosystem and because Mud and Callahan Lakes are shallow and have expansive diverse communities, it is important to protect and preserve what is there, not only to protect habitat and plant diversity, but to ensure an acceptable water quality standard.

Recommendations:

- Protect and preserve the native plant community in Mud & Callahan Lakes.
- Preserve the excellent water quality Mud & Callahan Lakes has at the present time as indicated by the plant community.
- Monitor the lake for aquatic additional invasive species on a continuous basis.
- Establish an education program about the identification and danger of aquatic invasive species.
- Establish a Clean Boats Clean Waters program to stop aquatic invasive species from entering Mud & Callahan Lakes, especially at the boat landing.
- Reduce/eliminate Eurasian Water Milfoil in Mud & Callahan Lakes.

References

Borman, Susan, Robert Korth and Jo Tempte. Through the Looking Glass. University of Wisconsin-Extension. Stevens Point, Wisconsin. 1997. 248 p.

Crow, Garrett E. and C. Barre Hellquist. Aquatic and Wetland Plants of Northeastern North America. The University of Wisconsin Press. Madison, Wisconsin. Volumes 1 and 2. 2000. 880p.

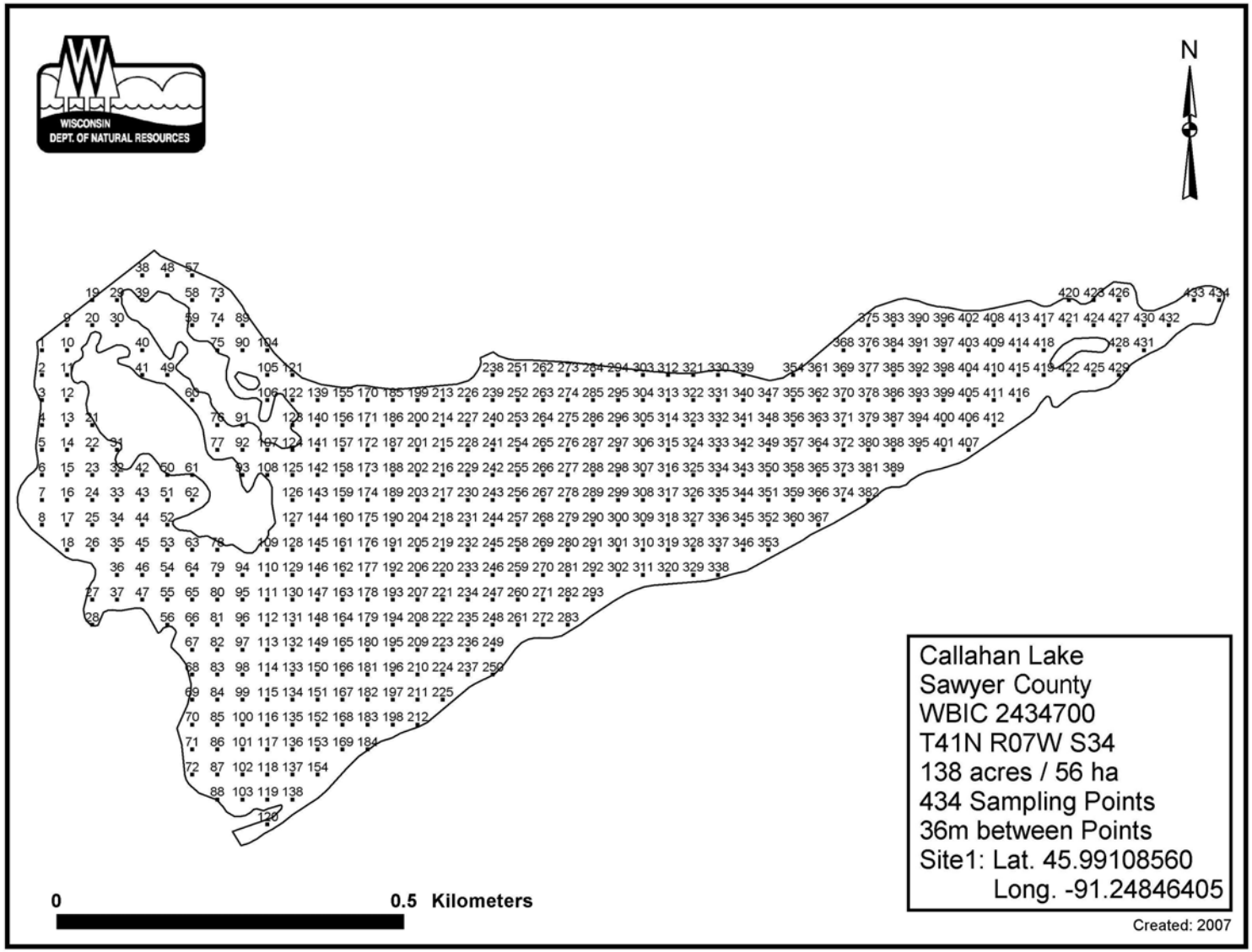
Nichols, Stanley A. Distribution and Habitat Descriptions of Wisconsin Lake Plants. Wisconsin Geological and Natural History Survey. Bulletin 96. Madison Wisconsin. 1999. 266 p.

Nichols, Stanley A. Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications. Journal of Lake and Reservoir Management 15 (2): 133-141. 1999.

University of Wisconsin-Extension. Aquatic Plant Management in Wisconsin. April 2006 Draft. 46 p.

Appendix A

Sample Points


WISCONSIN
DEPT. OF NATURAL RESOURCES
N
Callahan Lake
Sawyer County
WBIC 2434700
T41N R07W S34
138 acres / 56 ha
434 Sampling Points
36m between Points
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0.5 Kilometers
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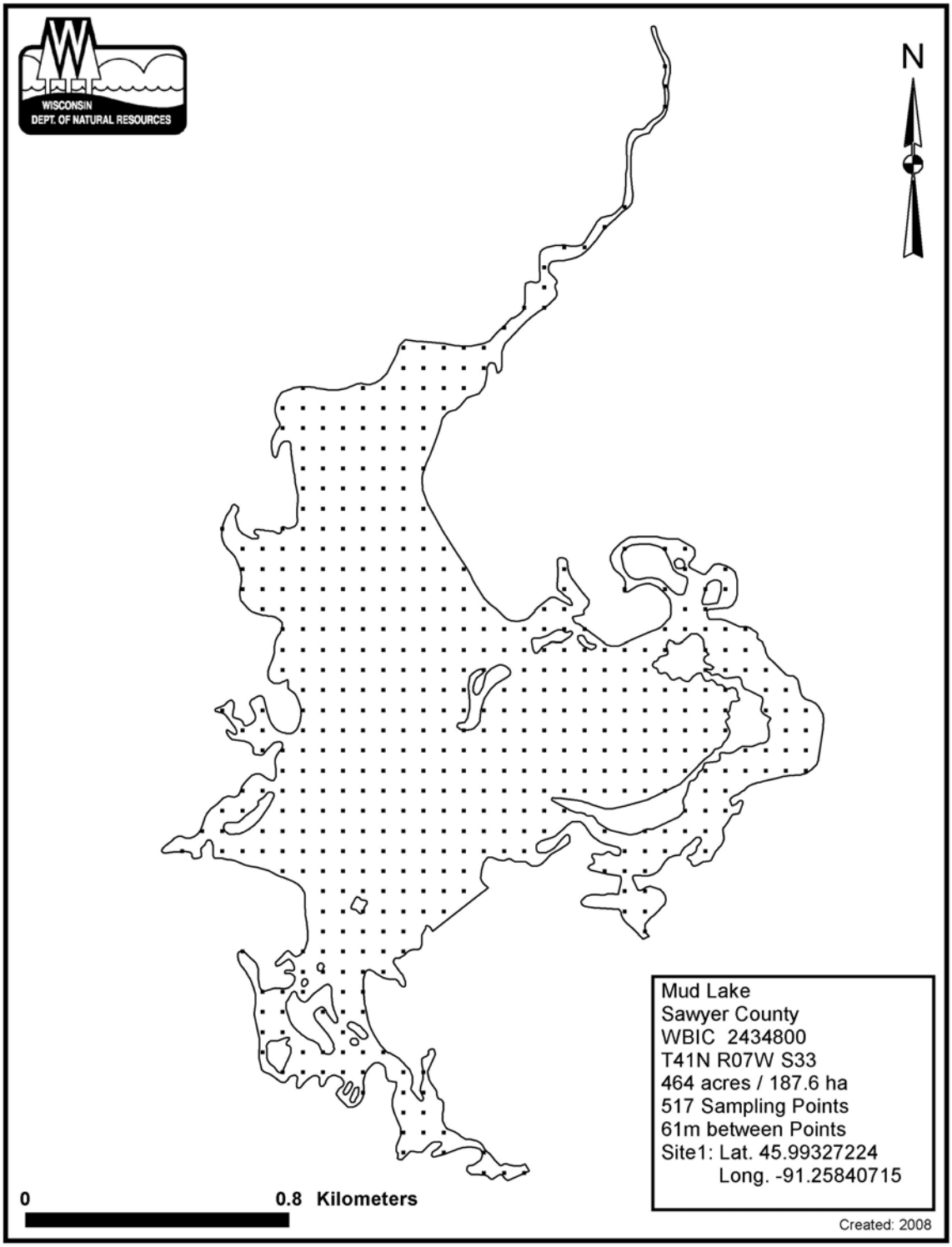
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Sawyer County
WBIC 2434800
T41N R07W S33
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61m between Points
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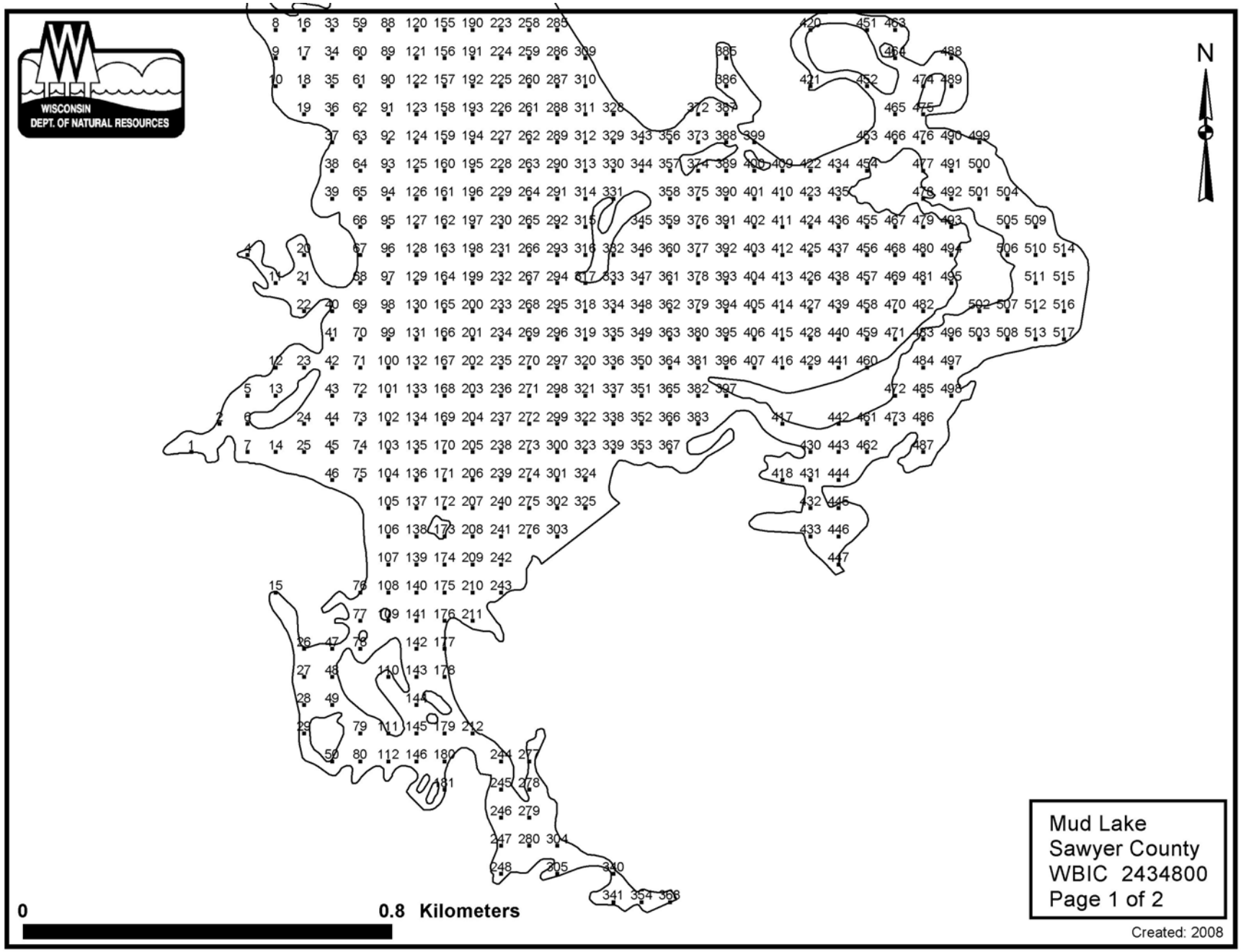
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Mud Lake
Sawyer County
WBIC 2434800
Page 1 of 2
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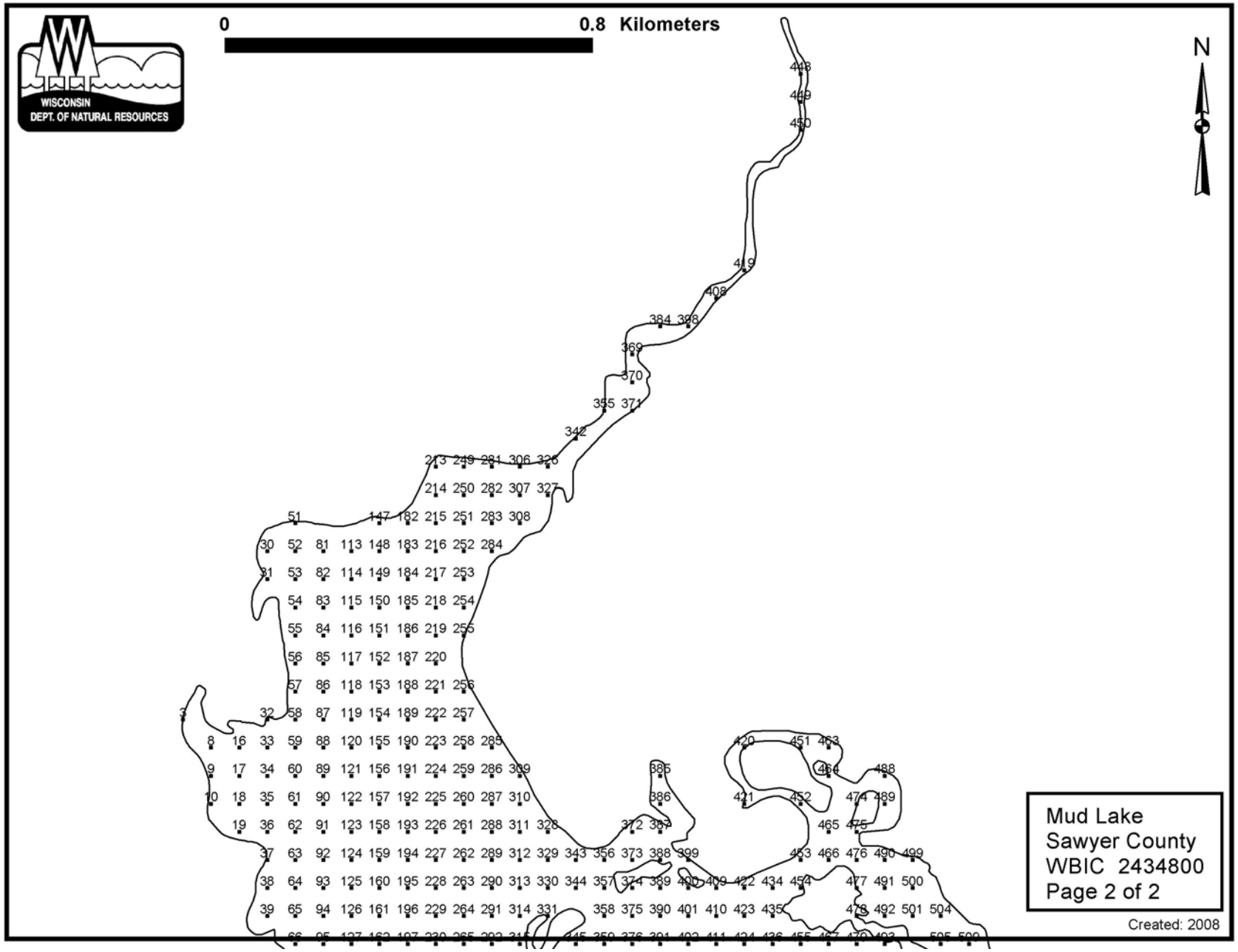
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Sawyer County
WBIC 2434800
Page 2 of 2
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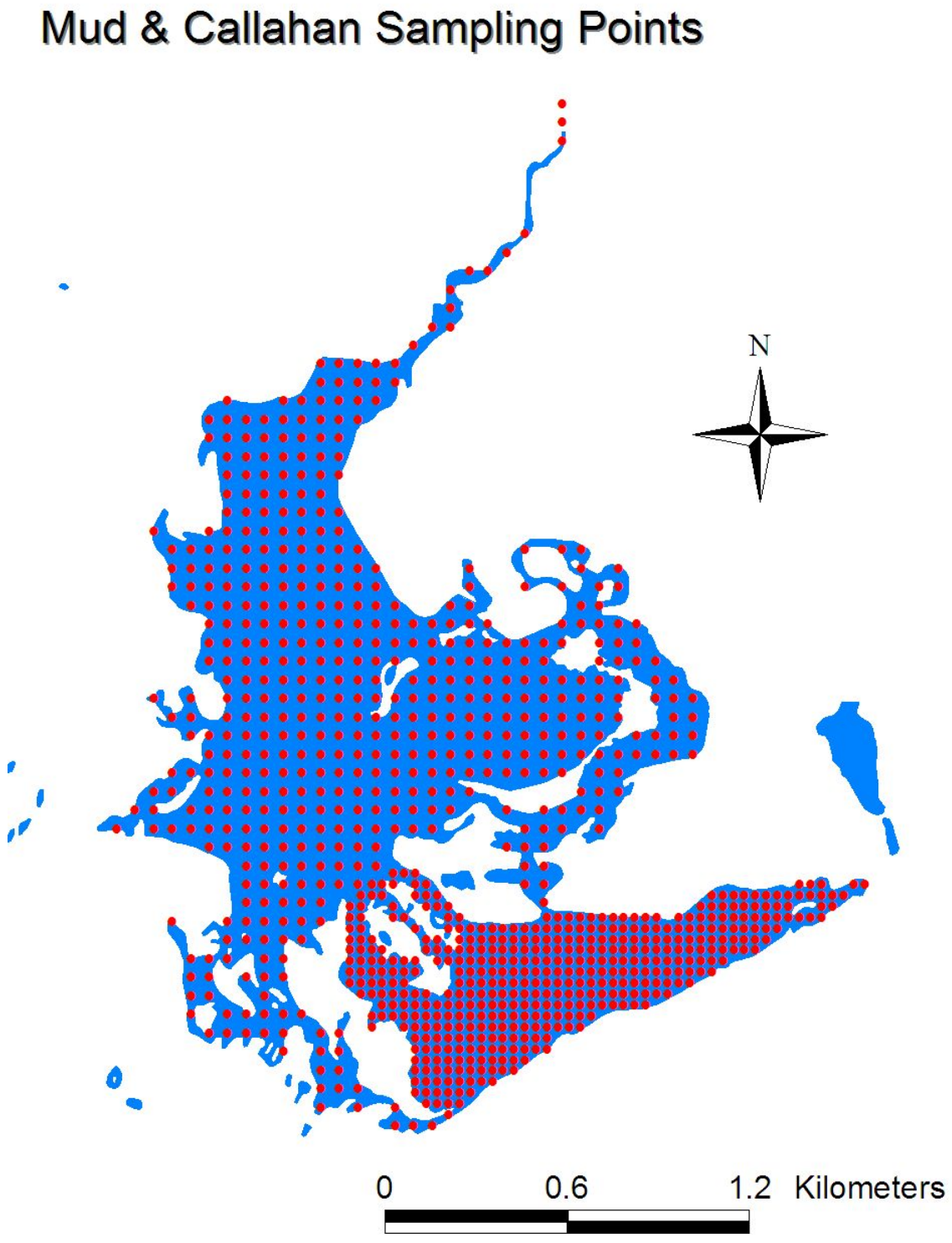
Mud & Callahan Sampling Points
N
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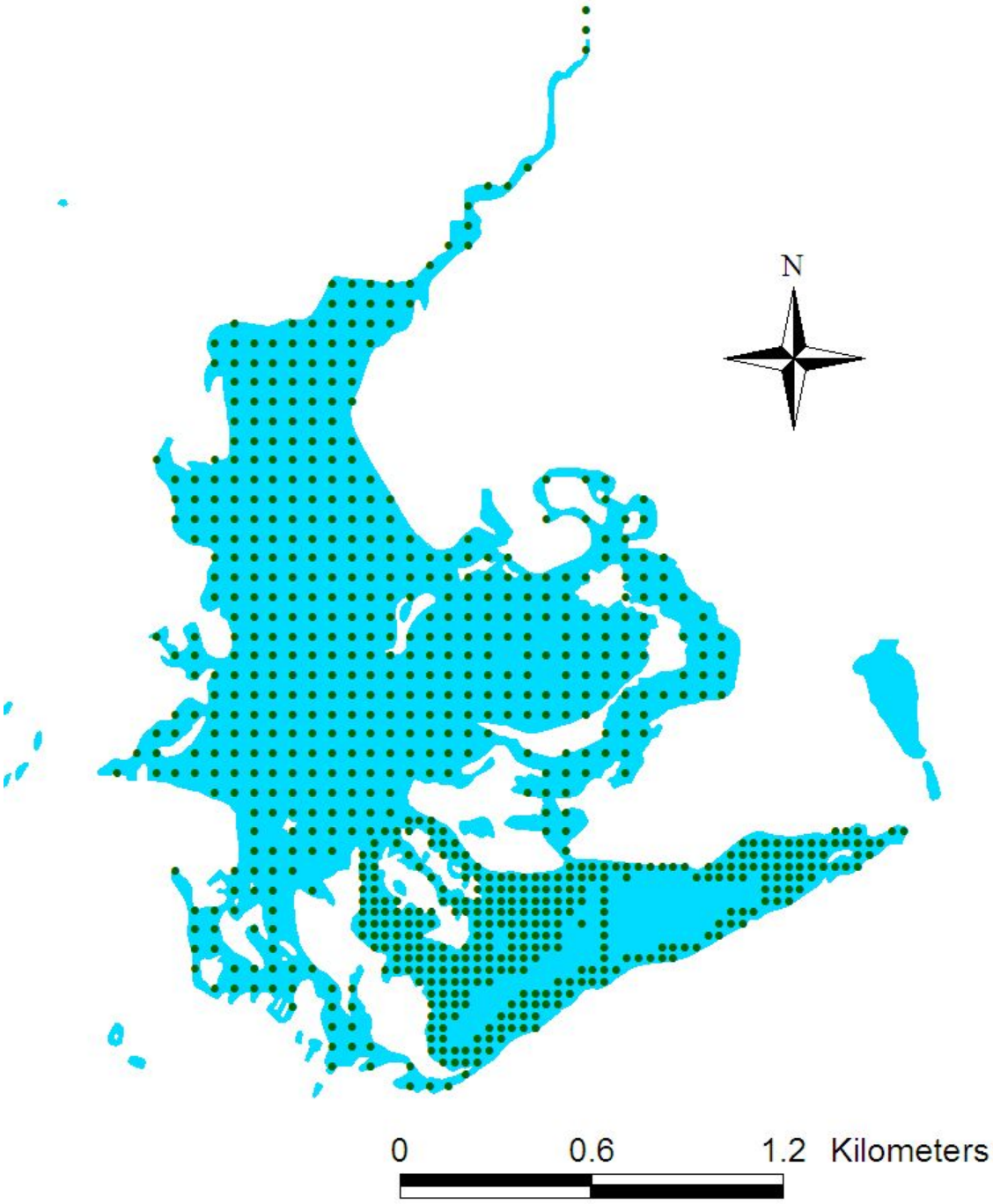
0.6
1.2 Kilometers

Appendix B

Plant Distribution

Areas in which aquatic vegetation is present

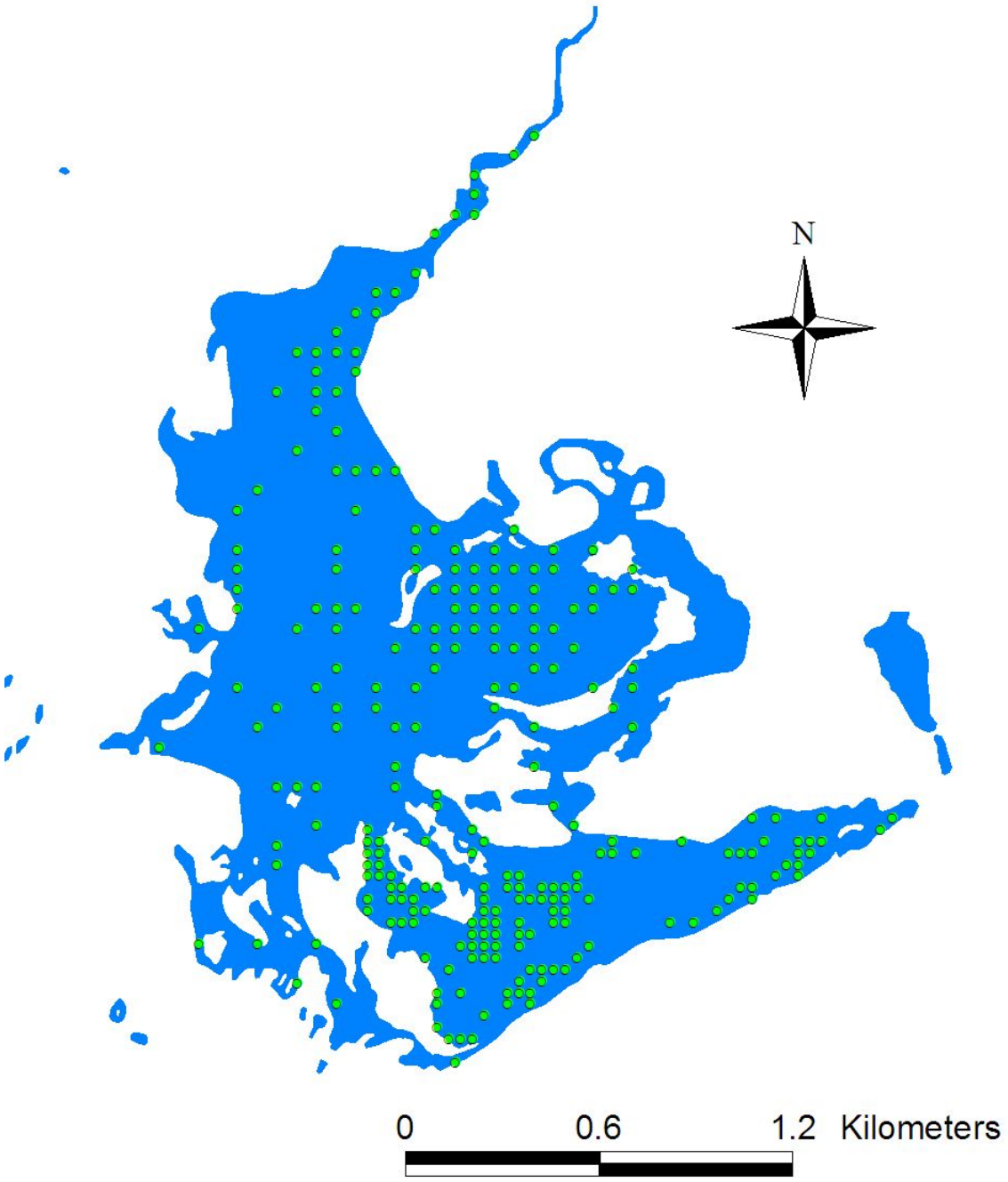


Appendix C

Species Accounts

Brasenia schreberi

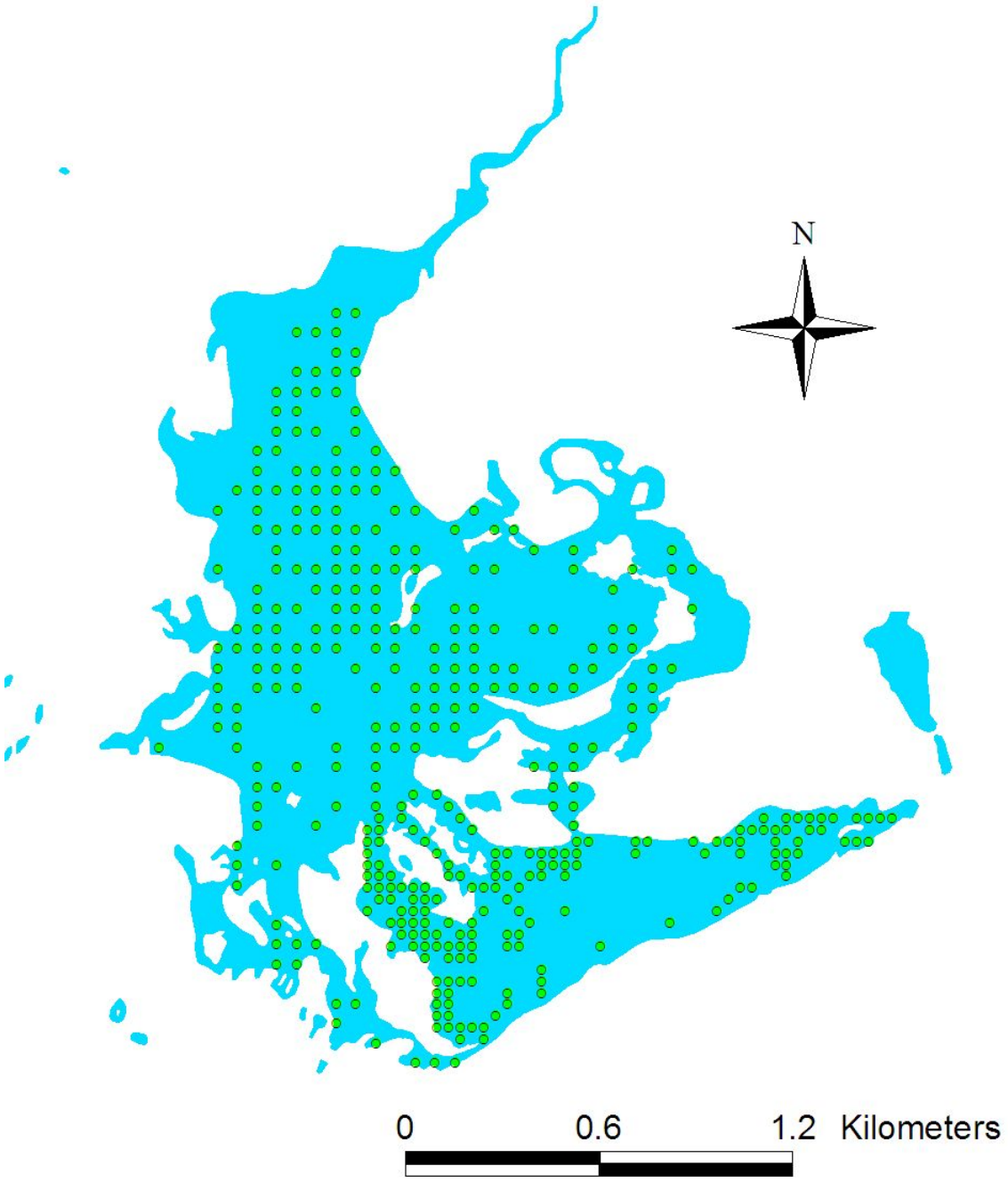
Ceratophyllum demersum




Chara
N
0
0.6
1.2 Kilometers

Eleocharis robbinsii

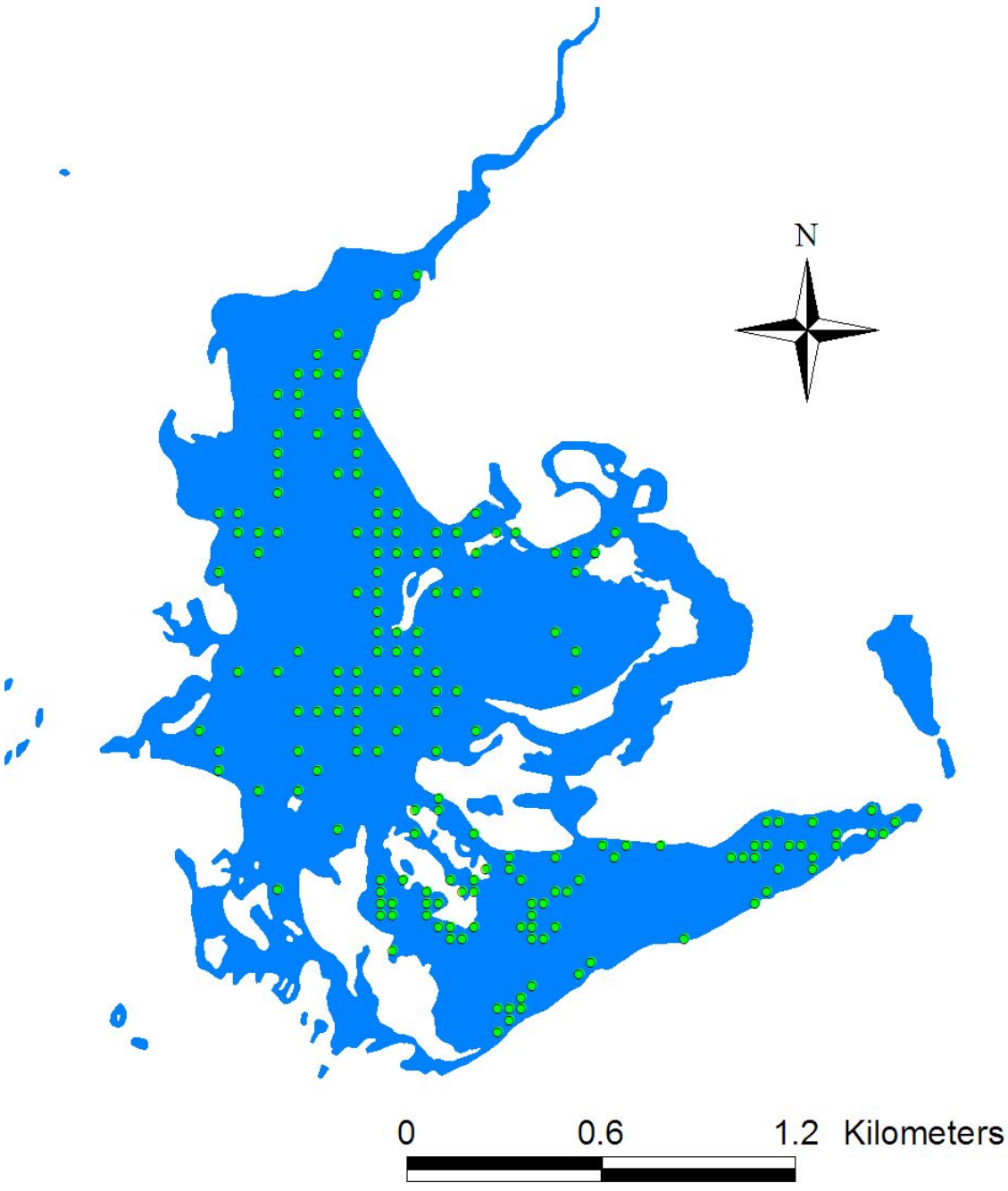
Elodea canadensis



Heteranthera dubia

Megalodonta beckii

Myriophyllum sibiricum



Myriophyllum spicatum

Najas flexilis

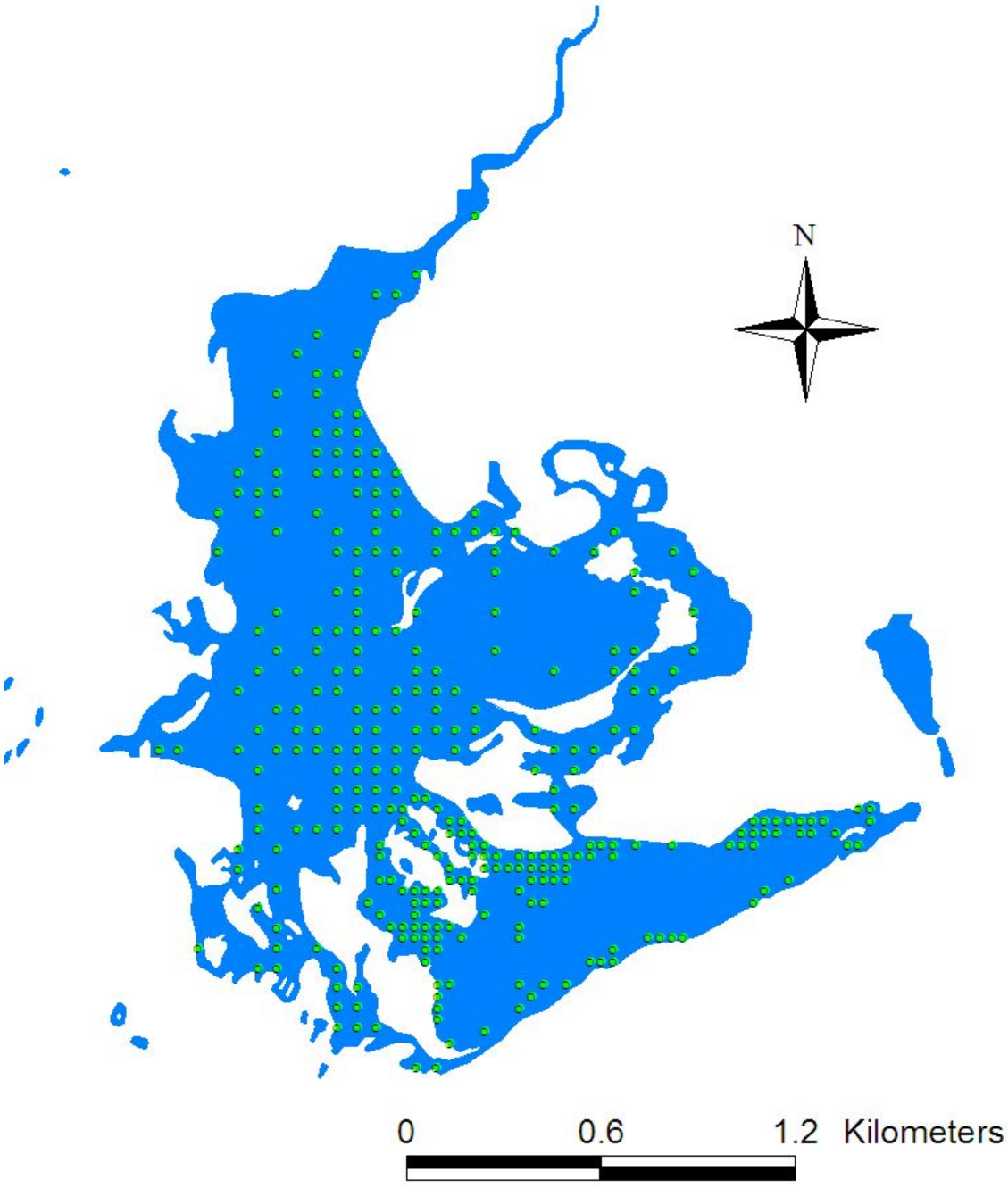
Nuphar variagata

Nymphaea odorata

Polygonum amphibium

Pontederia cordata

Potamogeton amplifolius



Potamogeton gramineus

Potamogeton natans

Potamogeton praelongis

Potamogeton pusillus

Potamogeton richardsonii

Potamogeton robbinsii

Potamogeton zosteriformis

Sparganium angustifolium

Sparganium fluctuans

Spirodela polyrhiza

Utricularia vulgaris

Vallisneria americana

Appendix D

Eurasian Water Milfoil

Information on Eurasian Water Milfoil

Eurasian water milfoil (Myriophyllum spicatum)[1]

Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, it is difficult to distinguish from Northern water milfoil, which is native to Wisconsin. Eurasian water milfoil usually has more than 12 pairs of leaflets per leaf, while Northern water milfoil typically has less than 12. Sometimes coontail is mistaken for milfoils, but does not have individual leaflets.

Eurasian water milfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lakebeds, lakes receiving nitrogen and phosphorus-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

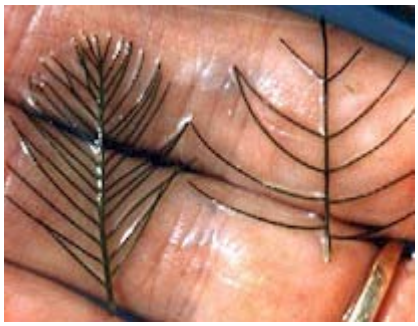


Fig. 4 Comparison of Eurasian Water Milfoil and Northern Water Milfoil-Notice the large number of leaflets on the Eurasian (Washington Department of Ecology)

Unlike many other plants, Eurasian water milfoil does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian water milfoil is adapted for rapid growth early in

spring. Dense stands of Eurasian water milfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake used on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is “infested” or “dead.” Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes.
It is very important for lake organizations to monitor their lake for Eurasian water milfoil. Prevention of the introduction of this plant is the best method to avoid infestation.

[1] Wisconsin Department of Natural Resources Invasive Species Fact sheets from www.dnr.state.wi.us

Appendix E

Spreadsheets of data collected

***see attached excel files.**

Appendix B

DNR Sub-sampling Protocol
AIS Control Grant Information
UW-Extension Information
Sawyer County Lake Contact Information

Pre and Post Treatment Evaluation of Aquatic Plant Communities
(April 2008)

Purpose

This protocol is used to determine the need for, and evaluate the results of herbicide application or any other manipulation (but from here on called a chemical application or treatment) to reduce aquatic invasive plant species. The following protocol is applicable for introducing new treatments to lakes where the treatment size is greater than 10 acres or greater than 10% of the lake littoral area and more than 150 feet from shore*. It is designed to satisfy AIS grant-funded treatment conditions where restoration is a goal or where performance results are needed (i.e. for scientific or financial accountability). This protocol is written for Eurasian water-milfoil (EWM) but can be adapted for Curly-leaf Pondweed and other AIS. This protocol may be appropriately adapted to evaluate non-herbicide controls.

This protocol assumes that the lake group has an Aquatic Plant Management (APM) Plan in place with specific goals for the native and invasive species in the lake. The first step of the pre- and post-treatment protocol is to collect data on where EWM is found and where treatment is proposed in order to secure an APM permit. The second step is to perform a point intercept (P/I) survey within the proposed treatment areas to assess the presence of all species. The third step is to return to the same P/I sampling points just before a spring treatment to assess the presence of the target species in the defined treatment areas. Following treatment, all species are again assessed using the same treatment P/I points. If another treatment (the next spring) is deemed necessary, the sponsor will repeat this process until either the treatable area falls to less than 10 acres or less than 10% of the littoral zone or the goals of the APM plan change.

We are aware that this approach necessitates several visits to the lake per year. This work is necessary to assess the overall success of chemical treatments at reducing invasive species and enhancing native species. After we learn how each lake responds to the treatment, we hope and expect that we will be able to cut back on the annual evaluations. For now, we need rigorous data collection that will help best deal with invasive aquatic plants.

***Note that whole-lake scale treatment projects (those involving ≥160 acres or ≥50% of the lake littoral area) may follow a slightly different protocol, as described in the text. For newly discovered or pioneer populations of EWM (defined as a localized bed that has been present less than 5 years and is less than 5 acres in size or less than 5% of lake area which ever is greater), consult *Response for Early Detection of Eurasian Water Milfoil Field Protocol* available from the WDNR (http://dnr.wi.gov/org/water/fhp/lakes/EarlyDetectionFieldProtocol.pdf).**

Protocol

Year 1 Season before treatment

1. *Establish baseline information about plant community*.
    a. In the season prior to a chemical treatment, perform a whole-lake summer point/intercept (P/I) survey to characterize the entire plant community if it has not been done within 5 years.
    b. Details on the protocol for conducting plant surveys can be found in *Appendix B. Protocol of Aquatic Plant Survey – Collecting, Mapping, Preserving and Data*

Entry on the UW Extension Lakes *APM in Wisconsin* website: http://www.uwsp.edu/cnr/uwexlakes/ecology/APM/Appendix-B.pdf .

2. *Identify and map proposed treatment polygons***.**
    a. During the summer or early fall growing season prior to the chemical treatment, map the proposed treatment area*s* of EWM and identify these polygons using GPS to outline the beds.
        i. The initial P/I survey is unlikely to identify every stand of EWM. Map the invasive beds using a number of strategies such as:
            1. Use a meander search (boat out from shore to the maximum rooting zone and then head back to shore, a short ways down the shore from where you started) to find beds.
            2. If clarity is good (to the depth of rooted plants) and the EWM bed is topped out, identification can be visual but must be augmented with rake tosses to verify species identification and find the edges of the bed. Under glare conditions, brown polarized sun glasses are helpful.
            3. If visibility is limited, SCUBA, underwater video and an Aqua-View Scope are all highly recommended to make a complete assessment of the beds.
            4. Look for plant fragments wind-rowed on shore as an indication that plants may be growing off shore from this point.
        ii. Note that in order to secure a chemical treatment permit, the applicant must know the acreage and location of the treatment areas.

3. *Confirm EWM identification.*
    a. Collect one EWM plant from each large (> 5 acres) treatment polygon where these exist, but collect at least 3 plants per lake.
    b. These EWM plants may be collected in the summer/fall before the treatment year or spring just before treatment, but the identification of the fresh plants must be confirmed by the DNR or appropriate university personnel before treatment takes place. The DNR may ask to see a specimen from the spring survey.

4. *Conduct Proposed Treatment Polygon Survey*.
    a. In order to assess the effect of chemical treatment on natives, there must be a survey of <u>all</u> plant species in the treatment polygons before treatment. However, since natives will be largely absent at the time of the spring pre-treatment survey, the natives must be assessed the summer before treatment. Therefore, after defining the proposed treatment polygons (2a above), perform a presence/absence and rake fullness assessment of all plants at a sub-sample of points within and near the polygons as follows (see Table 1):
        i. Sample at least 100 points per lake among the beds
        ii. Sample a minimum of 4 points (to ensure enough detail of the plant beds) but a maximum of 10 points (the maximum resolution of many GPS units) per treated acre.

iii. The points needn't be spread evenly across all treatment polygons, but it will be most informative to distribute the points among the largest polygons.
iv. Record the point locations as they will be used again the following year.

Table 1. Recommended number of points to sample in proposed treatment polygons, based on total acreage of treatments to be evaluated.

		4 pts/acre (minimum)	10 pts/acre (maximum)	
Area to be treated (acres)	Minimum points/lake	Points/lake	Points/lake	Recommended # of Points to sample
10	100	40	100	100
20	100	80	200	100
30	100	120	300	120
40	100	160	400	160
50	100	200	500	200

b. If the proposed treatment area consists of more than 50% of the lake littoral area, or whole-lake scale treatment methods are being used (i.e. liquid applications), then this step is omitted.
    i. Instead, whole-lake P/I surveys should be conducted each year following treatment for the purposes of post-treatment evaluation.
    ii. More intensive monitoring in some polygons may be warranted for evaluating treatment effectiveness or fine-tuning treatment regimes.

5. *Evaluate the treatment plan*.
    a. Once the acreage for treatment is established, be sure everyone involved agrees that a chemical treatment is the best method for solving the lake's EWM problems.
    b. Evaluate the cost of treatment to be sure everyone involved understands the cost of chemical treatment.

Year 2 First treatment

1. *Pre-treatment Survey - Spring just before treatment*
    a. Using the established proposed treatment polygons from YR 1, repeat the methods in the proposed treatment survey area sampling **only for EWM.** Adjust the delineation of the treatment area, if necessary. Plants may be small, and may be sparse this time of year. Underwater visual/video of the middle and edges of the proposed polygon is highly recommended.
    b. This step may be omitted for whole-lake scale treatments (i.e. where it is not necessary to define individual treatment polygons, e.g. when liquid herbicide is applied over large areas).

2. *Conduct Treatment.*

a. It is best to conduct the treatment as close to ice-out as possible for several reasons.
    i. Many studies have shown that the chemical herbicides are effective at temperatures normally found in lakes just after ice-off.
        1. One exception is endothall products, which are not as effective at temperatures below 50° F.
    ii. The best results are obtained when the biomass of the invasive is still low, so that there is less decomposing plant material and consequently less demand for oxygen that could rob other living organisms of oxygen.
    iii. Also, it is best to treat before the natives are growing fast, so that they are minimally affected by the chemical.
b. Therefore, treatment should occur in early spring (after ice-out), when EWM is actively growing throughout the proposed treatment areas (optimally around 6 inches tall).
c. If optimal conditions for treatment have not occurred prior to May 31, consult with the DNR to confirm if treatments may go forward. It is possible that treatments are unnecessary or would be detrimental to the native plant community if conducted too late in the season. .

3. *Post-treatment Survey*
    a. A post-treatment survey should be scheduled when native plants are well established, generally mid-July through mid-August.
    b. If treating curly-leaf pondweed (CLP), a post treatment survey needs to be completed before CLP seasonal growth ends, possibly before many natives are easily visible (i.e. mid-June). Consult with the DNR to determine the optimal time to do a post-treatment survey for CLP.
    c. For the post-treatment survey, repeat the P/I for all species in the treatment polygons, as was done the previous summer
        i. Use the results from this survey to compare with the results from the pre-treatment survey to
            1. evaluate the effectiveness on target plants,
            2. evaluate any harm or benefit to native plants
            3. identify next year's potential treatment areas for target plants.
        ii. For whole-lake scale treatments, a full lake-wide P/I survey should be conducted.
    d. To compute the significance of results from the pre- and post-treatment surveys (pre-treatment survey in summer of Year 1 and post-treatment survey in summer of Year 2) see *Appendix I. ComputePre&PostData.xls* on the UW Extension Lakes *APM in Wisconsin* website (http://www.uwsp.edu/cnr/uwexlakes/ecology/APMguide.asp) or the DNR website (http://dnr.wi.gov/org/water/fhp/lakes/ComputePrePostData.xls).

4. *Redefine proposed treatment polygons (if further treatments are planned)***.**
    a. If the polygon boundaries have shifted or new colonies have emerged, new treatment polygons must be mapped and surveyed before the end of Year 2 in preparation for treatment in Year 3.

i. Follow all instructions for Year 1 steps 2-5 above.
ii. If only targeted polygons are to be treated in years following a whole-lake scale treatment, then sub-sampling should occur in these polygons as described in Year 1 steps 2-5.

b. If the exact same polygons treated in Year 2 will be treated again in Year 3 the post-treatment survey in Year 2 can serve as the proposed treatment survey for the treatment to be done in Year 3.
    i. If a whole-lake P/I survey is conducted as part of a whole-lake scale treatment, this serves as the pre-treatment survey for Year 3.
c. Mapping of the new areas could be done immediately after the post-treatment survey or in late summer or fall, but would be separate from the post-treatment survey.
d. If, after completing the first treatment, more treatments are needed, all areas that have ever been treated must be included in subsequent pre- and post-treatment surveys. By doing this, we can assess longer-term impacts of treatments on the plant community.

5. *Measuring success or the need to change course.*
    a. Choose a percent decrease in the target plant area coverage or frequency of occurrence for an annual goal of at least 50% for restoration projects.
        i. If you have sampled 100 points for the pre- and post-treatment survey, you will be able to detect a 20% or larger change in species frequency (of both natives and the target species).
        ii. You must sample many more points (approximately 350 points) to see a 10% change in a species frequency.
    b. For an overall long term goal, a reduction to less than large scale treatment (less than 10 acres or 10% of lake littoral area) where annual spot treatments can sustain low level occurrences is reasonable. Alternatively, a goal of reducing dense beds to scattered plants using a density measurement might be appropriate.
    c. An acceptable native response is no net loss and ideally some gain. However, some loss may be purely sampling variance or inter-annual variation.

<u>Year 3 and Year 4 (if additional treatments are planned)</u>

1. *Repeat Year 2 procedure.*
    a. Be sure to resample all areas treated in all years even if treatment area declines in size over time so that an accurate record of control can be established.

<u>Year 5</u>

1. *Repeat Year 2 procedure if necessary.*

2. *Conduct a lake wide P/I survey (repeat base year) to gauge overall lake community response.*
    a. Use the P/I results to update the management plan.
    b. Consult with a DNR lake coordinator to adjust your APM plan goals.

Grants at a Glance
(Lake Grant Fact Sheet Series)

For the in-depth version, go to
http://www.uwsp.edu/cnr/uwexlakes/grants/AIS_long.pdf

Aquatic Invasive Species (AIS) Control Grants

Aquatic invasive species (AIS) or aquatic nuisance species (ANS) have been hitchhiking their way into Wisconsin for decades. By water, boat and by land - from around the planet - non-native organisms have been moving into inland waters. Aquatic invasive species can threaten the diversity and abundance of native species, alter ecosystems and affect our economy and recreational activities. In today's world, invasives can move at "the speed of flight." In response to the increasing threat to our priceless lakes and rivers, Wisconsin has increased its support of local efforts to prevent the spread of introduced aquatic invasives by creating the Aquatic Invasive Species Prevention and Control Grants.

About the grants

Aquatic Invasive Species (AIS) Control Grants are designed to assist in a state/local partnership to control aquatic invasive species. The Department of Natural Resources (DNR) was directed to establish procedures to award cost-sharing grants to public and private entities for up to 75% of the costs of projects to control invasive species. These funds are available to units of local government and others for grants to control aquatic invasive species. The grant projects are broken down into three major categories:

1) Education, Prevention and Planning
2) Early Detection and Response
3) Controlling Established Infestations

Grants are available to conduct projects on all waters of the state, including lakes, rivers, streams, wetlands and the Great Lakes.

Eligible Sponsors

Any entity that is eligible for a Wisconsin Lake or River Planning or Protection grant is also eligible for an AIS control grant. This includes units of local government, tribes, lake protection and rehabilitation districts, qualified lake associations, qualified river management organizations, nonprofit conservation organizations, and qualified school districts. Others eligible for AIS only grants are private and public colleges, universities, technical schools, state and federal natural resource or land management agencies and FERC-licensed hydroelectric corporations.

About the money

The budget for this grant program is about $4 million per year.
The state will pay up to 75% of the cost of a project, with caps of:

$50,000 and 150,000 (two categories) for Education, Prevention and Planning
$20,000 for Early Detection and Response
$200,000 for Controlling Established Infestations

The remaining 25% must be provided by the local organization in the form of cash, time, services, or "in-kind" items. Grants operate on a reimbursement basis. For Education, Prevention and Planning, and Early Detection and Response Projects, sponsors may request an advance payment of 25%.

Permit fees are considered an eligible cost, as well as the expenses required to obtain permits (retroactive up to 12 months prior to application). Watercraft inspection projects are limited to $4,000 per public boat launch facility, but can be a component of a larger project.

Eligible Projects may include:

Education, Prevention and Planning

- Educational programs and distributing information about aquatic invasive species (*Note: Projects will be reviewed for consistency with the DNR statewide education strategy and the use of existing publications and outreach materials).*
- Monitoring, mapping and reporting of data about the presence or absence of AIS to provide baseline information and monitor trends in a water body or water bodies.
- Development of plans for the prevention and control of AIS.
- Studies or assessments that will aid in the prevention and control of AIS.
- Watercraft inspection and education projects following DNR guidelines of the Clean Boats, Clean Waters program. Specifically, projects involving watercraft inspectors are required to attend a Clean Boats Clean Waters training workshop conduct inspections, collect and report data, and be present at boat launch facilities a minimum of 200 hours between May 1 and October 30).

Early Detection and Response

- Identification and removal, by approved methods, of small pioneer populations of aquatic invasive species in the early stages of colonization or re-colonization. (For rooted aquatic plants like Eurasian Watermilfoil, a pioneer infestation is defined as a localized bed that has been present less than 5 years, and is less than 5 acres in size or less than 5% of lake area, whichever is greater.)
- Control of a re-colonization following the completion of an established infestation control project.

Controlling Established Infestations

- Department approved control activities recommended in a management plan adopted by the sponsor for the control of aquatic invasive species.
- Purple Loosestrife bio-control projects (no plan approval required).

- Complimentary activities that help prevent or control AIS such as sediment control or native plant restoration.

Applications

Applications for Education, Prevention and Planning Projects and Established Infestation Control Projects are **due by February 1 and August 1 of each year**. Early Detection and Response grants are offered continuously on a first come, first serve basis and funded in order of approval.

Application forms and guidance on AIS Prevention and Control Grants can be found at: http://dnr.wi.gov/org/caer/cfa/grants/Lakes/invasivespecies.html

The DNR can provide help with applications and technical guidance. Private consultants can also assist you. A list of consultants, without endorsements, can be obtained from the University of Wisconsin-Extension (UWEX) Lakes Program at http://www.uwsp.edu/cnr/uwexlakes/lakelist/, or your DNR Region Lakes Coordinator.

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For more information

Contact your regional DNR Lake Coordinator or Environmental Grant Specialist at:

Northern Region – West	**Northern Region – East**	**Northeastern Region**
Spooner	Rhinelander	Green Bay
715-635- 2101	715-365-8900	920-492-5800
West Central Region	**South Central Region**	**Southeastern Region**
Eau Claire	Fitchburg	Milwaukee
715-839-3700	608-275-3366	414-263-8500

Or contact any of the following: UWEX-Lakes Program at 715/346-2116 or uwexlakes@uwsp.edu; Wisconsin Association of Lakes at 608/662-0923 or wal@wisconsinlakes.org; DNR Central Office at 608/261-6423.

Appendix B
Excerpts from Aquatic Plant Management in Wisconsin
UW-Extension
http://www.uwsp.edu/cnr/uwexlakes/ecology/APM/Chapter%20III.pdf

Part 2. Implementing and Evaluating Your Plan

Implementing the Plan

This section is designed to help you implement your decision. Remember to include your local DNR aquatic plant manger in deciding on your best management strategy. In the end it is the actions you take that will determine success or less for your plant management program.

All plans must address in detail how the plan will be implemented. This section, along with the rest of your plan, will help you secure a permit for the proposed manipulation.

Before You Apply for a Permit

Decide how all the management recommendations will be implemented, including

the methods

timing and schedules

operational cost estimates

a consensus on the roles and responsibilities of the persons and/or organizations involved in the management process - who does what and when?

a description of how the public will be involved.

a budget and identification of funding sources, including plans for any grant applications.

a description of the process by which the plan will be adopted, revised and coordinated, with DNR approval.

Begin the Permitting Process

Be sure that the manipulation needing the permit is proposed and recommended in the plan.

It is likely that the treatment recommendations will change after one or more years of implementation of the original plan, but this must be discussed in writing as part of the permit. If you are planning a treatment different from that recommended in your original plan, redo the sections above including:

- Analysis and Alternative Treatments (when manipulation is planned)
- Recommendations (when manipulation is planned)
  - For example, the original plan may have called for a large scale 2,4-D treatment of 30 acres or Eurasian water-milfoil. The following year, you may only need to apply for a permit for spot treatment of 2,4-D in certain locations.

Decide on the firm that will carry out your manipulation.

Have ready the name, address and other information (for example, the certification number, if chemical application is planned) of firm doing the treatment.

Identify the target levels or intensity of manipulation low (fewer than 10 acres or

less than 10% of the littoral zone in manipulation), or high levels of manipulation

needed to meet the stated use objectives, and identify these zones on a map. Verify whether the target levels coincide with the management objectives and a balanced aquatic ecosystem.

Map areas proposed for manipulation such as harvesting.

- Mapping coordinates should be recorded on a GIS map.

Treatment-Specific Requirements

Harvesting

- Identify plant offloading and disposal locations sites (using GPS coordinates or ¼¼ section of township, range and section designations).
- Identify where and how you will obtain the needed equipment (harvesters, trucks, unloading equipment, etc.)

Chemical Application

- List the dates of chemical application. Remember that early season treatment of EWM and CLP is becoming a Best Management Practice for established infestations
- List the chemicals to be used and method of application.
- Specify the planned dose and if it will be verified by a water test analysis.
- List the use restrictions that will be in effect after treatment (such as restrictions on swimming, fishing or garden use of lake water).
- List the name, address, certification number and other relevant information of firm doing the treatment
- If the treated area will be greater than 0.25 acres and/or a liquid chemical will be used, a certified applicator must apply the chemical. List the name, address, certification number and other relevant information of firm doing the treatment
- Make a public notice of the proposed application and hold a public meeting. This notice has specific requirements:
  - Notice shall be given in 2 inch x 4 inch advertising format in the newspaper which has the largest circulation in the area affected by the application
  - The notice shall state the size of the proposed treatment, the approximate treatment dates, and that the public may request within 5 days of the notice that the applicant hold a public informational meeting on the proposed application.
  - The applicant will conduct a pubic informational meeting in a location near the water body when a combination of 5 or more individuals, organizations, special units of government, or local units of government request the meeting in writing to the applicant with a copy to the DNR within 5 days after the notice is made. The person or entity requesting the meeting shall state a specific agenda of topics including problems and alternatives to be discussed.
  - The meeting shall be given a minimum of one week advance

notice, both in writing to the requestors, and advertised in the newspaper in the format described above.

- You must certify to the DNR that a copy of the permit application has been provided to any affected property owners' association, inland lake district, and, in the case of chemical applications for rooted aquatic plants, to any riparian property owners adjacent to and within the treatment area.
- After receiving a permit, the permit holder shall notify the regional DNR APM office 4 working days in advance of each anticipated treatment with the date, time, location and proposed size of treatment.
- The chemical application may be supervised by DNR personnel.
- Be aware that as new information is developed, an annual permit may change to reflect current Best Management Practices.

Drawdown: If a drawdown is proposed,

- Produce a map showing exposed lakebed and affected plant communities.

On the Day of Chemical Treatment (or other Management Action)

The lake organizations that do best at plant management are those that take a "hands on" approach during implementation of the controls. Schedule with your contractor to have a representative from the lake present during the treatment. The first hand knowledge and any documentation you make will help everyone understand the outcome and results, and help to improve the plan and actions.

Assign a person from the lake organization familiar with the plan to be present.

Assure there is a copy of the Plan and necessary permits.

Review permit and any special conditions Review what areas will be controlled, and what will be done in each area.

Agree on the locations when you arrive at them, before starting work.

Verify with the contractor that conditions are proper for the intended method - wind, water temperature, growth stage of target plants.

Verify that pesticide notice signs are posted and that they contain correct information.

Keep a log or notes of the day's actions, and note any unusual conditions that may affect the outcome, or give reason for complaints.

As the end of a chemical treatment, ask for a copy of the Treatment Record Form to have in the lake records.

Be inquisitive, ask the contractor when you have questions to learn and understand what is going on.

Have a separate boat and maybe a camera to observe and record, and do not expose your self to pesticides on the applicator boat.

Lake Information and Contacts

Current October 2009

DNR Aquatic Invasive Species Program

- Watercraft Inspection Clean Boats Clean Waters Program
  http://dnr.wi.gov/lakes/CBCW/
- Citizen Lake Monitoring
  http://dnr.wi.gov/lakes/CLMN/
- Information and Education
  http://www.uwex.edu/erc/invasives.html
  http://www.seagrant.wisc.edu/ais/
  http://dnr.wi.gov/invasives/aquatic/
- Purple Loosestrife Biological Control
  http://www.dnr.state.wi.us/org/es/science/publications/ss981_2003.htm

Wisconsin Lakes Partnership Contacts

Wisconsin Association of Lakes
4513 Vernon Blvd, Suite 101
Madison, WI 53705.
Phone:(608) 661-4313 or
Toll free (Wisconsin only) (800) 542-5253
E-mail
Technical assistance—wal @ wisconsinlakes.org
www.**wisconsinlakes**.org/

UW Extension Lakes

UWSP College of Natural Resources
800 Reserve Street
Stevens Point, WI 54481
(715) 346-2116
uwexlakes@uwsp.edu
http://www.uwsp.edu/cnr/uwexlakes/

Sawyer County Lakes Forum

http://www.sawyercountylakesforum.org/index.html

DNR Contacts

Wisconsin Lakes Contacts Sawyer County
http://www.dnr.state.wi.us/lakes/contacts/index.asp?county=Sawyer

Contact	Organization	Phone	Email	Roles
Anna Brady	Beaver Creek Reserve	715-877-2212 ext. 118		Aquatic Invasive Species - County or Tribal Coordinator
Jim Hansen	Wisconsin DNR	715-762-1343		Aquatic Invasive Species
Jim Kreitlow	Wisconsin DNR	715-365-8947		Aquatic Invasive Species Grants - Applying and Technical Assistance Aquatic Plant Monitoring - General Blue-Green Algae DNR Regional Lakes Coordinator Lake Ecology - Aquatic Plants More....
Kris Larsen	Wisconsin DNR	715-635-4072		Aquatic Invasive Species - Citizen Monitoring Aquatic Plants - Citizen Monitoring Citizen Lake Monitoring - Equipment and Training Citizen Lake Monitoring - Getting Started Water Quality- Citizen Monitoring More....
Kristy Maki	Sawyer County	715-634-6463		Aquatic Invasive Species - County or Tribal Coordinator
Jane Malischke	Wisconsin DNR	715-635-4062		Aquatic Invasive Species Grants - Financial Administration Lake Grants - Financial Administration
Craig Roesler	Wisconsin DNR	715-634-9658 x3522		Water Quality Monitoring Aquatic Plant Management
	Water Management Specialists (Sawyer Co.)			Permits, Waterway and Wetland
	Fish Biologists (Sawyer Co.)			Fishing