

Aquatic Plant Management Plan

Mercer Lake

Iron County, Wisconsin

June 2012

Sponsored By

Mercer Lake Association of Iron County

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Executive Summary

This Aquatic Plant Management Plan covers the years 2012 through 2017. The plan includes data about the plant community, watershed, and water quality of the lake. This plan also reviews a history of aquatic plant management on Mercer Lake.

An aquatic plant point intercept survey was first completed for Mercer Lake in 2010. The aquatic plant surveys found that Mercer Lake has a robust and dense plant community with relatively high diversity. Native plants provide fish and wildlife habitat, stabilize bottom sediments, reduce the impact of waves against the shoreline, and prevent the spread of non-native invasive plants – all critical functions for the lake.

This Aquatic Plant Management Plan, developed with input from an advisory committee including lake property owners, will help the Mercer Lake Association (MLA) plan and carry out activities to meet plan aquatic plant management goals. The implementation plan describes the actions that will be taken toward achieving these goals.

MLA has been active in the study and managing of Mercer Lake. This has included an extensive nutrient and water budget analysis conducted by the USGS. Also, the MLA and the Town of Mercer have worked on projects to mitigate nutrient loading into the lake. This plan works in conjunction with these efforts by considering habitat, water quality and aesthetics in the plant management.

A special thank you is extended to the aquatic plant advisory committee for assistance with plan development.

Plan Goals

- 1. Stop the introduction of aquatic invasive species (AIS).***
- 2. Educate residents about the importance of maintaining native species and stopping invasive species.***
- 3. Restore developed shorelines to native vegetation.***
- 4. Preserve critical, native habitats in Mercer Lake.***
- 5. Reduce the density of native plants in areas that impede navigation and recreation use of the lake.***

Introduction

The Aquatic Plant Management Plan for Mercer Lake is sponsored by the MLA with partial funding from a Wisconsin Department of Natural Resources Lake Planning Grant.

The plan includes data about the plant community, watershed, and water quality of the lake. It also reviews a history of aquatic plant management on Mercer Lake. This plan will guide the MLA and the Wisconsin Department of Natural Resources in aquatic plant management for Mercer Lake over the next five to six years (from 2013 through 2018).

Public Input for Plan Development

The Mercer Lake Association Aquatic Plant Management (APM) Advisory Committee provided input for the development of this plan. The APM Advisory Committee met in person once and by conference call four times. At the first meeting on August 2011, the committee reviewed aquatic plant management planning requirements, plant survey results and aquatic plant management efforts to date, and discussed aquatic plant management concerns. At a second meeting on February, 2012, and a third meeting on March, 2012, the committee reviewed goals, developed objectives and updated action steps. In a final meeting on April 2012, the committee developed more actions and discussed methods extensively. The APM Advisory Committee concerns are reflected in the goals and objectives for aquatic plant management in this plan.

The APM Committee expressed a variety of concerns that are reflected in the objectives for plan development and in the goals for aquatic plant management in this plan. Management concerns ranged from water quality, protection of fish and other habitat to the density of plant growth in Mercer Lake.

The MLA board announced the availability of the draft Aquatic Plant Management Plan for review with a public notice in the weeks of July 1 and July 8, 2012. Copies of the plan were made available to the public at the Mercer Public Library. Comments were accepted through, July 22, 2012.

Staff members at the Voigt Intertribal Task Force were invited to review of draft versions of the plan and offer suggested changes or additions. No comments have been received up to the publishing of this plan. This may be due to the fact that no wild rice was found in the point intercept (PI) survey.

Resident Concerns

A 2007 community survey provides some guidance for aquatic plant management activities. About half of the respondents felt that the amount of aquatic plants had increased in recent years.

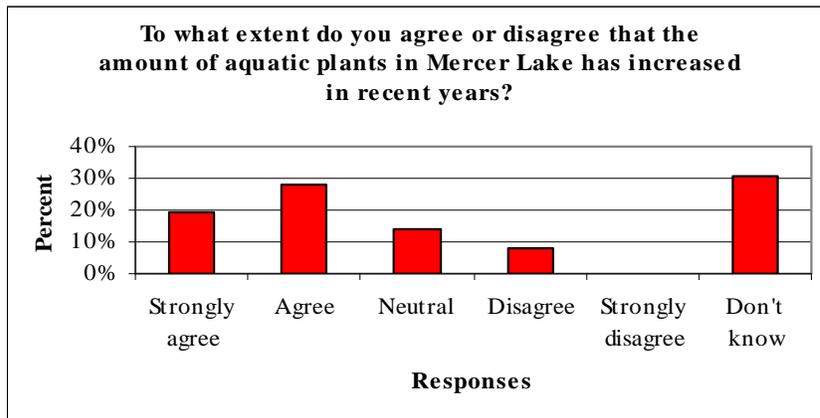


Figure 1. Survey Results: Has aquatic plant growth has increased in Mercer Lake?

Survey respondents felt that watching for and reporting exotic plants was a high priority activity for the lake association.

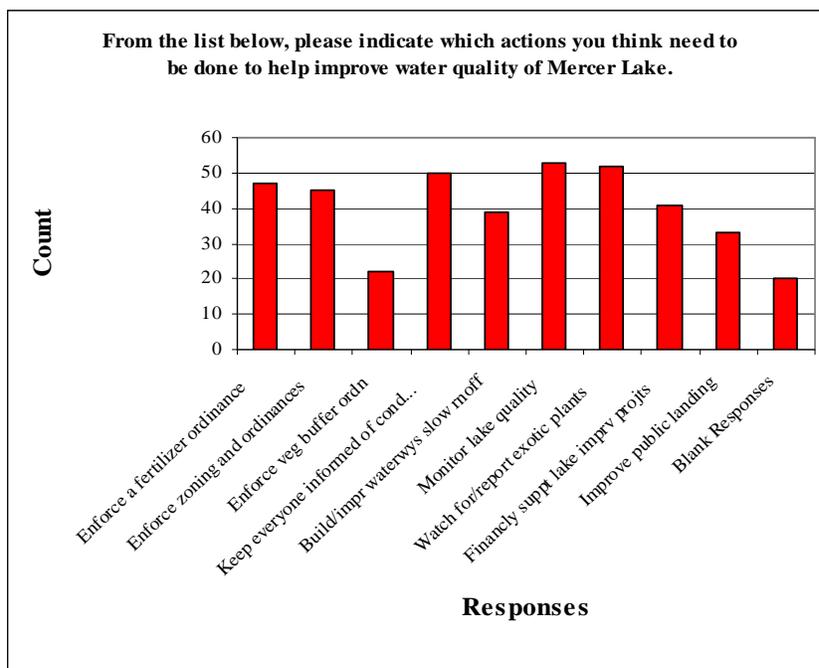


Figure 2. Survey Results - Actions to pursue to improve Mercer Lake.

Lake Information

The Lake

Mercer Lake is a 184-acre drainage lake located in Iron County in the town of Mercer (T43N, R3E, S36). Its Water Body Identification Code is 2313600. It has a maximum depth of 24 feet and a mean depth of 11 feet. The Little Turtle River is the main stream flowing into Mercer Lake from Grand Portage Lake and out of the lake to the Flambeau Flowage. A much smaller tributary flows from Lake Tahoe.

Table 1. Mercer Lake Information

Size (acres)	184
Mean depth (feet)	11
Maximum depth (feet)	24
Littoral zone depth (feet)	19.1
Average summer secchi depth (feet) 2002-2011	10.7

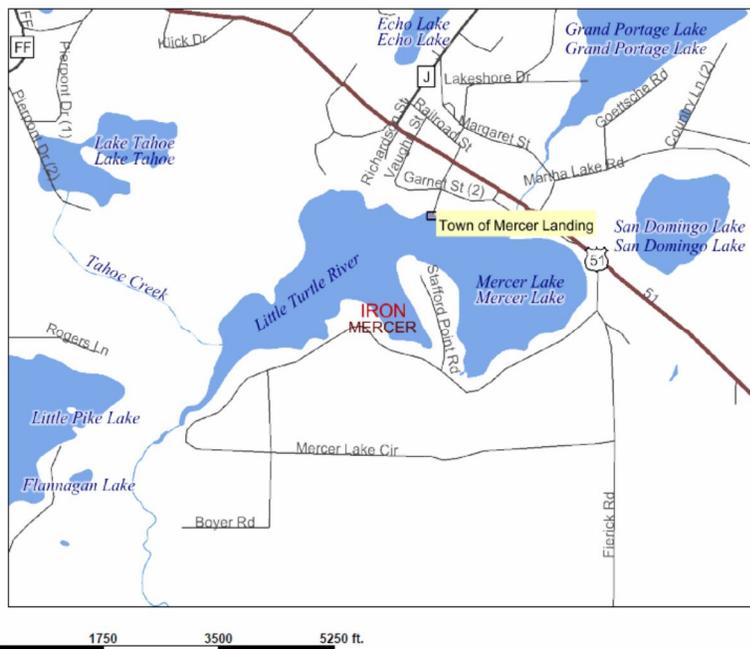


Figure 3. Map of Mercer Lake

Water Quality

The United States Geological Survey (USGS) completed a comprehensive study of Mercer Lake and its watershed beginning in 2008. The report was completed in 2012. The purposes of the study were to describe the water quality of the lake and the composition of its sediments; quantify the sources of water and phosphorus loading to the lake, and to evaluate the effects of past and future changes in phosphorus inputs on the water quality of the lake.

Based on a sediment-core analysis and in-lake monitoring data, the water quality of Mercer Lake appears to have been degraded as a result of past activities in its watershed. Water quality appears to have improved, however, after a new sewage-treatment plant was constructed in 1995 and its discharge was completely bypassed around the lake in 1995. From 1965 to 1995, the old wastewater treatment plant discharged effluent into and near the lake outflow to the Turtle River.

Since 2000, when a more consistent monitoring program began, the water quality of the lake appears to have changed very little. During the two monitoring years of the USGS study (2008–09), the summer average near-surface concentration of total phosphorus was 0.023 mg/L, indicating the lake is borderline between mesotrophic and eutrophic. The summer average chlorophyll *a* concentration was 3.3 mg/L and Secchi depth was 10.4 ft, both indicating mesotrophic conditions.

Recent citizen lake secchi monitoring in the deep hole of the lake also indicate

mesotrophic to borderline eutrophic lake nutrient conditions as shown in Figure 4. The July and August secchi depth mean was 10.7 feet from 2002 through 2011.

Lake Trophic State

Water quality is frequently reported by the trophic state or nutrient level of the lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. At the high end of the eutrophic scale blue-green algae dominate and algal scums are present sometimes throughout the summer. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.

Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes. TSI values range from 0 – 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic.

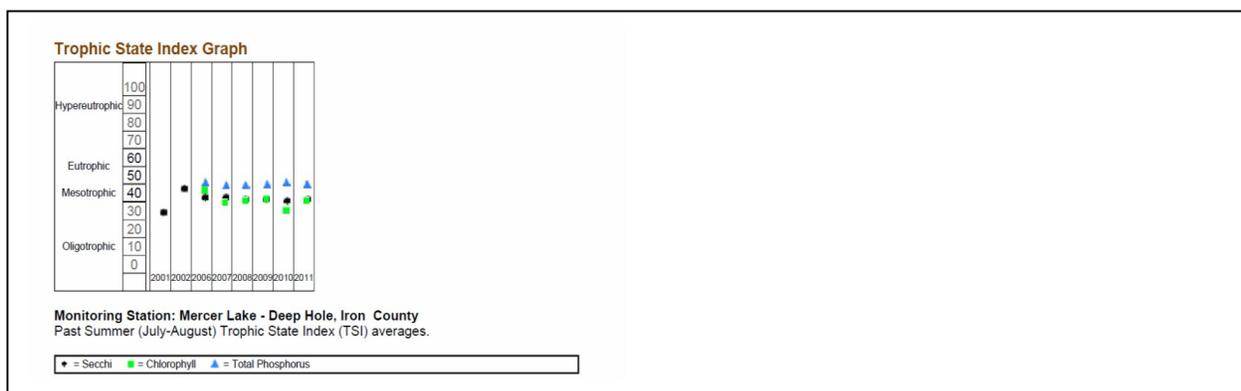


Figure 4. Citizen Lake Monitoring Data.

Algae growth in Mercer Lake is limited by phosphorus. Therefore, the lake study focused on phosphorus inputs to the lake. Phosphorus inputs in a typical year are summarized in Figure 5 below. The largest sources of phosphorus were from the Little Turtle inlet (about 45 percent) and the near-lake drainage area of urban and residential development (about 24 percent). This includes Un-gaged near-lake area, septic and storm drain inputs on the

graphs below. Phosphorus loading from lake sediments (5.5 percent) and septic systems (1.8 percent) is relatively low.

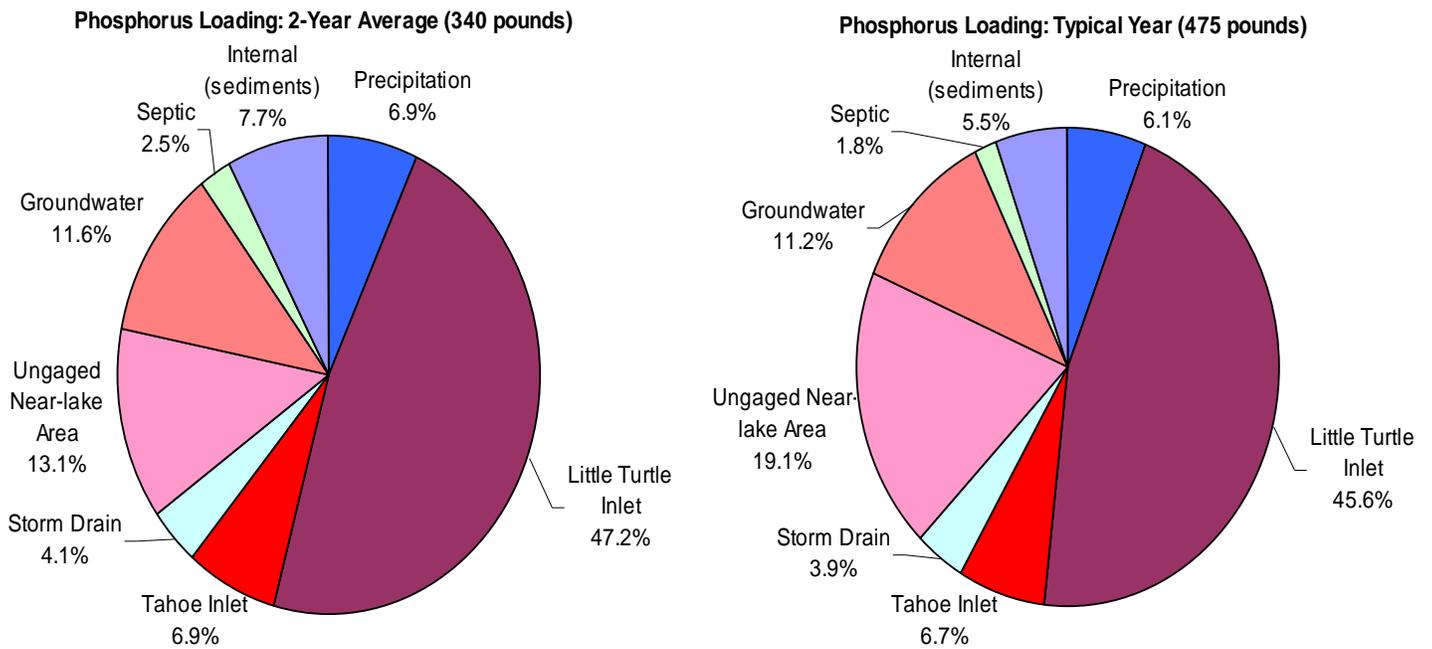


Figure 5. Annual Phosphorus Loading (from USGS 2012).

Watershed

A watershed map is included in Figure 6 below. The entire watershed is 7,625 acres with most of that (6,564 acres) draining to Mercer Lake from Grand Portage Lake through the Turtle River. Land use in the entire watershed is a mixture of forest (74.9 percent), wetlands (6.6 percent), open water (8.5 percent), low-density residential (5.9 percent), urban (2.2 percent), grassland/shrubland (1.1 percent), agriculture (0.4 percent), and golf course (0.4 percent).

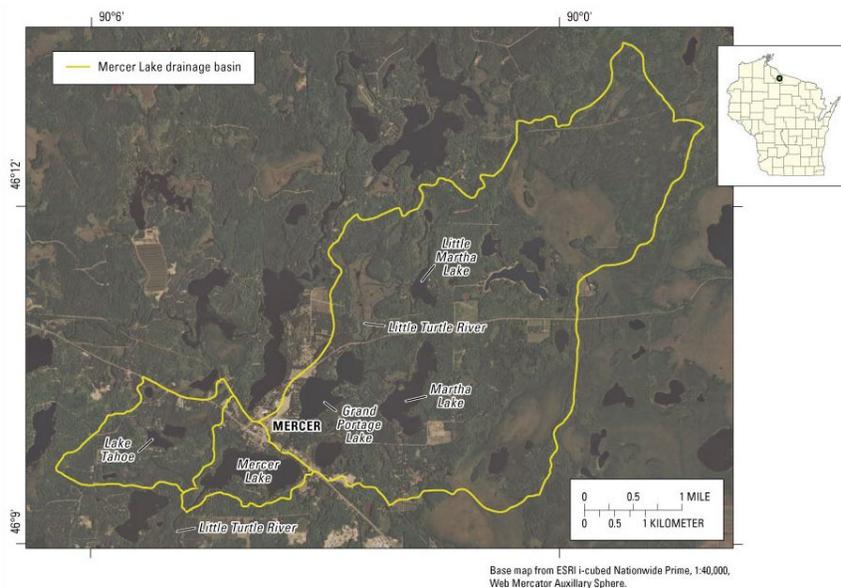


Figure 6. Mercer Lake Watershed (from USGS 2012).

Water Quality Study Conclusions

Eutrophication models were used to predict how the water quality of Mercer Lake would likely respond to changes in phosphorus loading and to estimate past water quality conditions. It is expected that reductions in watershed loading will result in less algae growth and increased water clarity. Because of the limited amount of phosphorus that is presently input into Mercer Lake, management actions to minimize future phosphorus and urban storm sewer input are likely to greatly benefit the lake's water quality. Planned highway modifications along with watershed best management practices are likely to reduce watershed phosphorus loading and lead to slight improvements in water quality.

The models also found that wastewater discharges likely negatively affected water quality in the past. Prior to 1965, when inputs from septic systems and other untreated wastewater were thought to be high, the lake was likely eutrophic, with average near-surface phosphorus concentrations near 0.035 mg/L, chlorophyll *a* concentrations about 7 µg/L, and Secchi depths about 6 ft. An analysis of a sediment core supported this conclusion. Based on sediment core analyses, the poorest water clarity and algal productivity in the lake occurred around 1965.

Wetlands make up 6.6% of the watershed and should be protected. These are important natural buffers that can help maintain higher water quality in Mercer Lake.

Aquatic Habitats

Primary Human Use Areas

A public boat landing owned by the Town of Mercer is located on the north side of the lake. The boat landing includes space for parking approximately 11 vehicles and trailers (estimated by area). A boat landing upgrade is planned for 2012.

Figure 7 below shows that much of the lakeshore development is along the south shore with Highway 51 and the town of Mercer along the northeast shoreline.

The 2007 watershed study reports that only 11 residences are not connected to the sanitary sewer system. It does not mention how many residences surround the lake. The 2007 survey results indicate that about 40 percent of residences are permanent. In 1970 there were 65 dwellings, 6 resorts, and a church located on the shoreline. Iron County has some acreage on the north shore having 0.48 mile of frontage.

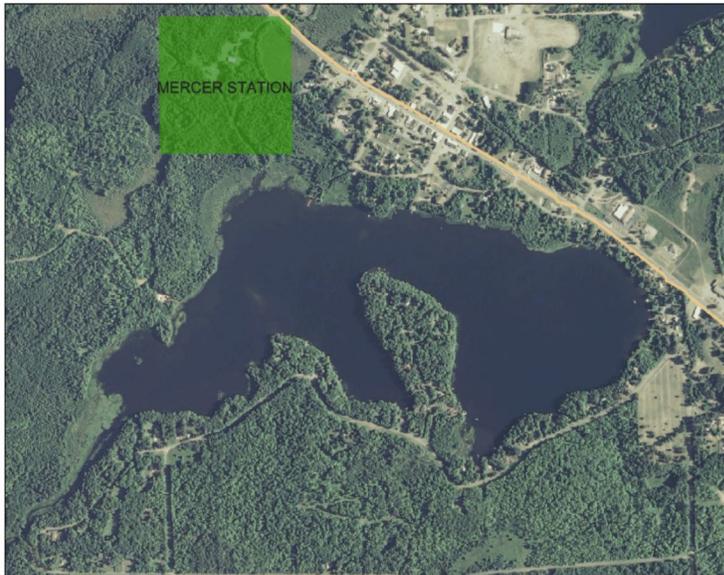


Figure 7. Mercer Lake 2008 Aerial Photo from DNR WebView.

Habitat Areas

The littoral, or plant supporting, zone of the lake provides critical habitat for fish, waterfowl, and other wildlife. The shoreline is predominantly upland (85 percent) with the balance bog-coniferous wetland. Lesser scaup, bluewinged teal, hooded merganser, and wood duck utilize this lake on their spring and fall migrations. It is probable that the lake is also utilized by nesting waterfowl, such as mallard and common loon.¹

A sensitive or critical habitat study has not been completed for the lake. A shoreline assessment was completed in 2009 and those results can be viewed in Appendix F. This assessment revealed that overall most developed areas are buffered. There are some properties that had unprotected developed areas which could be focused for improvement.

In 1970, sand was reported to be the predominant littoral material (50 percent) with rubble (25 percent), muck (20 percent), and a few boulders. In 2006 residents reported that the amount of muck had increased substantially. The 2010 aquatic plant survey found that muck was the dominant sediment (laying over sand/rock). The plant survey data collection method for bottom type is not very precise so any indication of change may not be a valid assessment, although it appears the sedimentation may have increased.

Concerns related to aquatic plant growth were expressed in a 1970 description of surface waters of Iron County. Emergent and submergent vegetation was described as moderate to dense. At that time, high nutrient effluent from the Town of Mercer sewage treatment plant was suggested a potential contributor to even greater plant nuisance growth.

A July 2003 aquatic plant survey using 21 transects across the lake found 21 plant species with plants covering an estimated 51% of the lake area. There was a mix of emergent (4), submerged (15) and floating (2) species. The plant identified as cabbage was said to be causing navigation problems, and mechanical cutting was recommended to alleviate this nuisance.

Mercer Lake Fishery

Musky, panfish, largemouth bass, northern pike, and walleye are common in the lake. Smallmouth bass and sturgeon are also present. Mercer Lake has been actively managed for musky and walleye since 1949. Annual stocking of fingerling walleye occurred most years from 1949 through 2011. Walleye stocking did not occur in only 24 years during this 62 year period. Musky were frequently stocked in years when walleye were not stocked.

The first inventory of the walleye fishery in 1970 found a lack of natural walleye reproduction. Ongoing inventories in the 1970's confirmed that result. Some walleye were assumed to be entering the lake from Grand Portage Lake. A 1983 survey recommended continued stocking and panfish thinning. The 1994 survey found no changes in panfish size structure, so additional panfish removal was recommended. Aquatic plant control was also recommended in this survey. By 2006, following the panfish removal program, some improvements in density and size structure were noted.

¹ Wisconsin DNR. 1970.

Recent management recommendations include discontinuing the stocking of walleye in even years with a new recommendation of musky stocking in alternate years. There is also a recommendation to continue aquatic plant harvesting as a means of providing “edge-effect” for increased predation.

Table 2. Fish Spawning Times and Considerations

Fish Species	Spawning Temp. (Degrees F)	Spawning Substrate / Location	Comments
Northern Pike	Upper 30s – mid 40s (right after ice-out)	Emergent vegetation 6-10 inches of water	Eggs are broadcast
Walleye	Low to upper 40s – (about one week after ice-out)	Rocky shorelines with rubble/gravel 0.5 – 3 feet of water	Eggs are broadcast
Black Crappie	Upper 50s to lower 60s	Nests are built in 1-6 feet of water.	Nest builders
Largemouth Bass Bluegills	Mid 60s to lower 70s	Nests are built in water less than 3 feet deep.	Nest builders
Muskellunge	Mid 50’s to near 60	Organic sediment, woody debris and submerged vegetation.	Eggs are broadcast

Rare, Endangered, or Protected Species Habitat

Mercer Lake is located in the town of Mercer (T43N, R03E) in section 36. Natural Heritage Inventory records are provided to the public by town and range rather than section, so there is no indication if the incidences of these species occur in and immediately surrounding Mercer Lake.²

Species listed in the Town of Mercer (T43N, R03E):

Mottled Darner	<i>Aeshna clepsydra</i>	Special Concern
Gray Wolf	<i>Canis lupis</i>	Special Concern
Trumpeter Swan	<i>Cygnus buccinator</i>	Special Concern
Spruce Grouse	<i>Falci pennis Canadensis</i>	Threatened (Federally)
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Special Concern
American Marten	<i>Martes Americana</i>	Endangered (Federally)

The proposed actions within the plan are not anticipated to affect native plants and wildlife including the natural heritage species listed above.

² Natural Heritage data for Wisconsin is found at <http://dnr.wi.gov/org/land/er/nhi>. (data current as of 11/04/11)

Functions and Values of Native Aquatic Plants

Naturally occurring native plants are extremely beneficial to the lake. They provide a diversity of habitats, help maintain water quality, sustain fish populations, and support common lakeshore wildlife such as loons and frogs.

Water Quality

Aquatic plants can improve water quality by absorbing phosphorus, nitrogen, and other nutrients from the water that could otherwise fuel nuisance algal growth. Some plants can even filter and break down pollutants. Plant roots and underground stems help to prevent re-suspension of sediments from the lake bottom. Stands of emergent plants (whose stems protrude above the water surface) and floating plants help to blunt wave action and prevent erosion of the shoreline. Poor water clarity can limit aquatic plant growth by limited light penetration.

Shallow lakes typically have two alternative stable states—phytoplankton (algae)-dominated or macrophyte (plant)-dominated (Newton and Jarrell, 1999). In moderate densities, macrophytes are beneficial in these lakes. Macrophytes keep sediment from being resuspended by the wind and, therefore, help keep the water less turbid. Macrophytes also provide a place for attached algae to grow and remove phosphorus from the water column. If the macrophytes are removed or if external phosphorus inputs increase, the lake can shift from a macrophyte-dominated state to an algal-dominated state. Once a lake is in the algal-dominated state, macrophytes have a difficult time re-establishing themselves because algae reduce the penetration of light. Of these two conditions, it is commonly believed that the macrophyte-dominated state, which is present in Mercer Lake, is more desirable for human and biological use than the algal-dominated state (Newton and Jarrell, 1999). It is believed that Mercer Lake now has more macrophytes than it once had, but macrophytes may have always been common in the lake.³

Fishing

Habitat created by aquatic plants provides food and shelter for both young and adult fish. Invertebrates living on or beneath plants are a primary food source for many species of fish. Other fish, such as bluegills, graze directly on the plants themselves. Plant beds in shallow water provide important spawning habitat for many fish species.

Waterfowl

Plants offer food, shelter, and nesting material for waterfowl. Birds eat both the invertebrates that live on plants and the plants themselves.⁴

Protection against Invasive Species

Non-native invasive aquatic species threaten native plants in Northern Wisconsin. The most common are Eurasian water milfoil (EWM) and curly leaf pondweed (CLP). These species are described as opportunistic invaders. This means that they take over openings in

³ USGS. 2012.

⁴ Above paragraphs summarized from *Through the Looking Glass*. Borman et al. 1997.

the lake bottom where native plants have been removed. Without competition from other plants, these invasive species may successfully become established and spread in the lake. This concept of opportunistic invasion can also be observed on land, in areas where bare soil is quickly taken over by weeds.

Removal of native vegetation not only diminishes the natural qualities of a lake, but it increases the risk of non-native species invasion and establishment. The presence of invasive species can change many of the natural features of a lake and often leads to expensive annual control plans. Allowing native plants to grow may not guarantee protection against invasive plants, but it can discourage their establishment. Native plants may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.⁵

⁵ *Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.*

Plant Community

Aquatic Plant Survey Results

In July 2010 a full-lake point intercept (PI) survey was completed. This survey involved the sampling of 485 predetermined points on Mercer Lake. Figure XX shows the sample point grid.

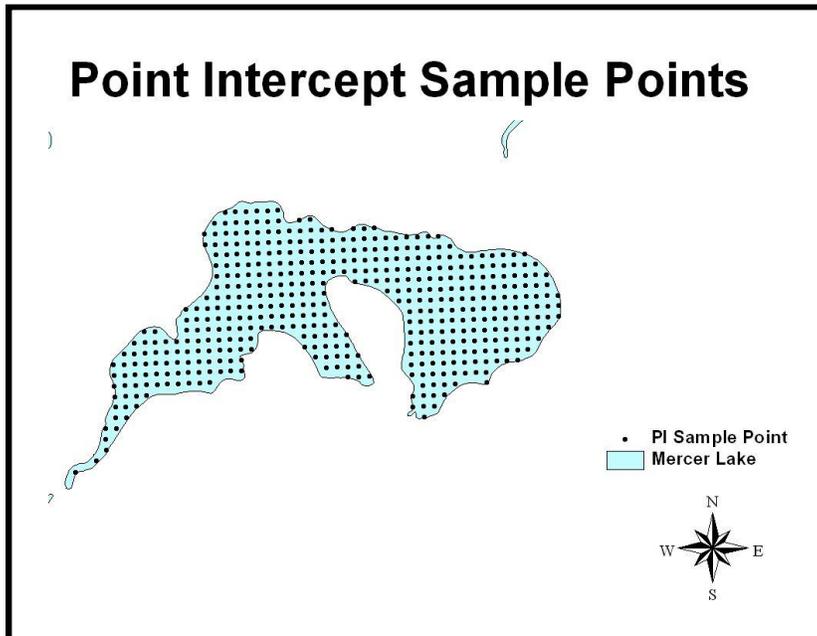


Figure 8: Sample point grid for the Mercer Lake Point Intercept aquatic plant survey.

At each sample point, a 14 tined rake was towed 1 meter and recovered. Each plant that was on the rake or fell off of the rake was identified and recorded as a density (1-3). Each sample point was also given a full rake density (due to all plants on the rake), ranging from 1-3. Figure 10 shows the rake density of plants at each sample point. The map in figure 9 shows the littoral zone, which is the area with plants in Mercer Lake. Any location with a green, yellow or red dot has plants present. The "x" represent areas where no plants were sampled.

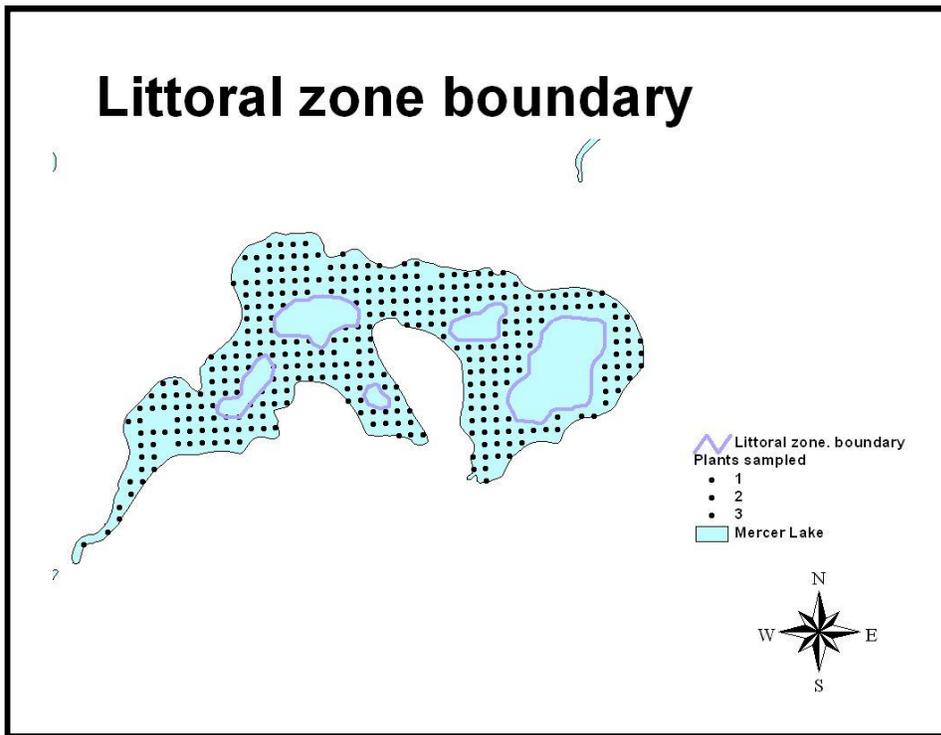


Figure 9: Littoral zone boundary of Mercer Lake from 2010 survey

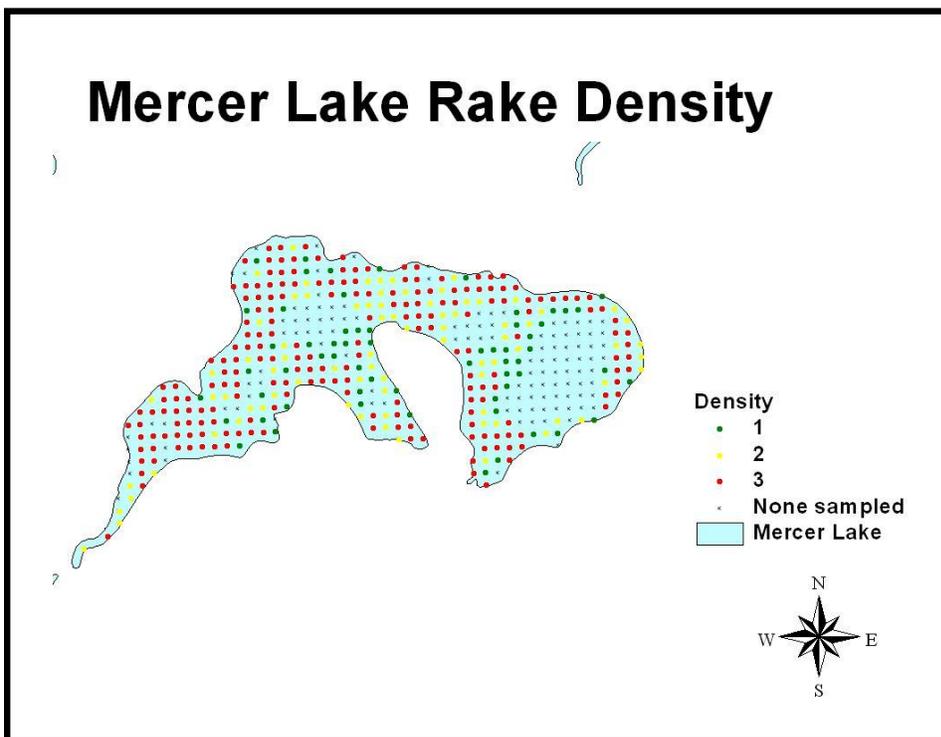


Figure 10: Rake density rating at each sample point on Mercer Lake-2010

The plant coverage of Mercer Lake is quite extensive. There were 369 sample points at or below a depth of 19.1 feet, which was the maximum depth plants were sampled, thereby defining the depth of the littoral zone. Of these sample points, 336 of them had vegetation or 91.06 % of the littoral zone. The statistic is somewhat misleading since the vast majority

of sample points over 17 feet had no growth and only one point at 19.1 feet had growth. Therefore even more than 91 % of the littoral zone had plants, which supports extensive growth. The rake density map also shows several points with a high plant density of “3.” Of the 336 sites with vegetation, 198 had a density of 3, or 58.9%. There are some areas in Mercer Lake that become dense enough to reduce navigation and recreational use.

Table 3: Summary of point intercept survey statistics-July 2010.

Total number of sample points	456
Total number of sites with vegetation	336
Total number of sites shallower than maximum depth of plants	369
Frequency of occurrence at sites shallower than maximum depth of plants	91.06
Simpson Diversity Index	0.92
Maximum depth of plants (ft)	19.1
Average number of all species per site (shallower than max depth)	3.19
Average number of all species per site (veg. sites only)	3.71
Average number of native species per site (shallower than max depth)	3.19
Average number of native species per site (veg. sites only)	3.71
Species Richness	37
Species Richness (including visuals)	43

The diversity of plants growing in Mercer Lake is also quite high. There were 37 species (35 vascular plants and 2 species of algae) actually sampled on the rake. If species richness includes plants viewed near the sample point, this richness increases to 43 species. A boat survey involves observing plants that are in under-sampled areas such as bays (where few sample points are defined). When the boat survey species are included, there were 47 species of plants observed in Mercer Lake. All species sampled were native, with two non-native species observed in the boat survey. The two non-native species were aquatic forget-me-not and reed canary grass.

The Simpson’s diversity index is a calculation that gives the probability that two species randomly sampled will be different. The Simpson’s diversity index for Mercer Lake is 0.92 (92% probability two species will differ), which is quite high and supports high diversity of the plant community in the lake. There were nearly 4 species (3.71) sample on average at each sample point.

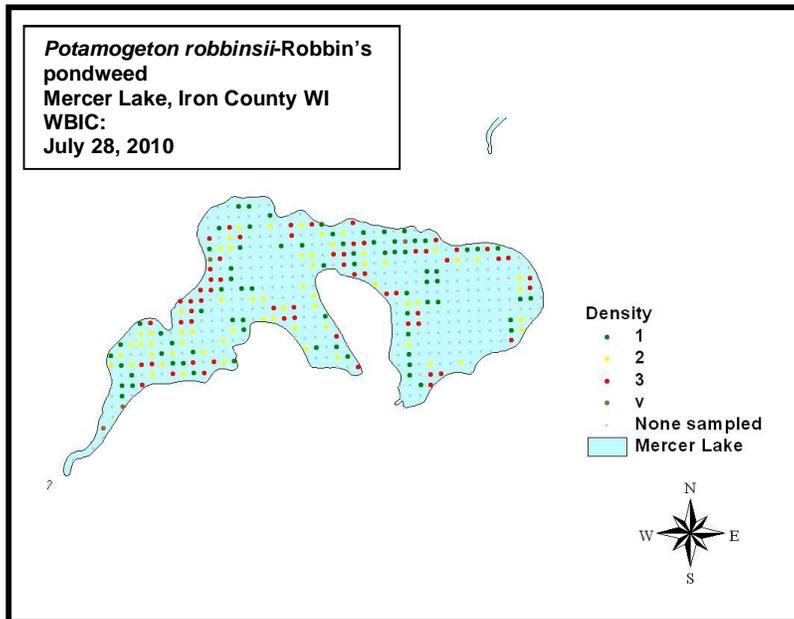


Figure 11: Distribution map of Robbin's pondweed, most abundant plant in Mercer Lake-2010.

The three most abundant plants are Robbin's pondweed (*Potamogeton robbinsii*), waterweed (*Elodea canadensis*), and large-leaf pondweed (*Potamogeton amplifolius*). All three of these plants are common native species found in Wisconsin lakes and serve important roles in the lake ecosystem. Large-leaf pondweed provides good cover for various fish species and these beds are often sought after by anglers.

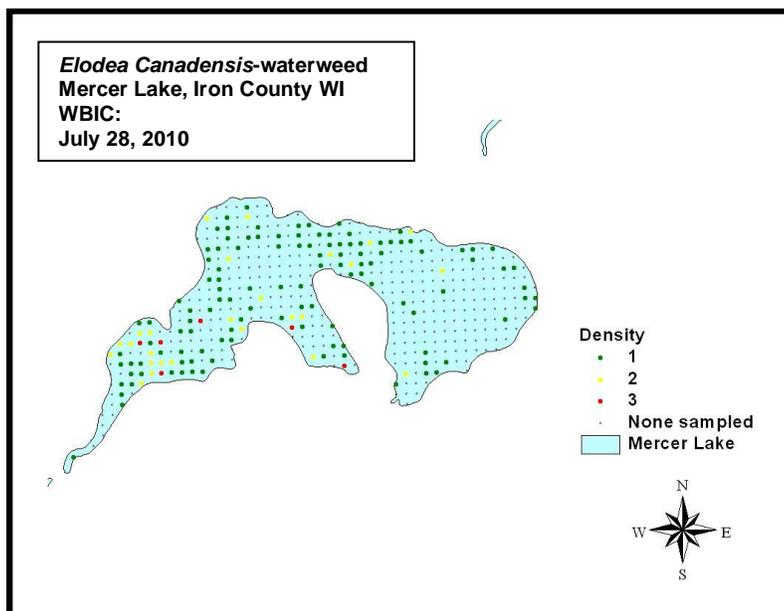


Figure 12: Distribution map of waterweed, second most common plant in Mercer Lake-2010

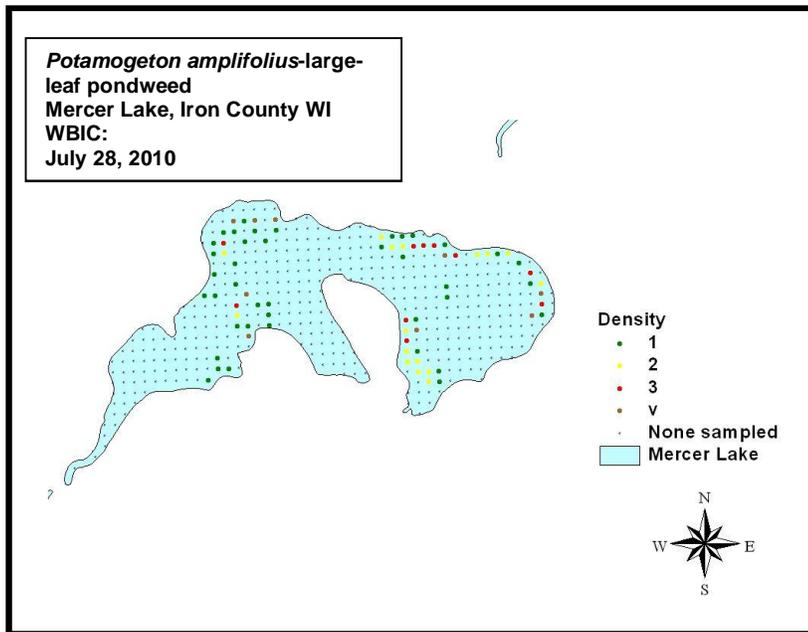


Figure 13: Distribution map of large-leaf pondweed, third most common plant in Mercer Lake-2010.

Mercer Lake holds a very diverse plant community. When the diversity per sample point is mapped, it reveals that the most diverse sample points are on the western end of the lake where the Little Turtle River flows out of the lake. This would suggest that would be a critical habitat area if such an analysis were conducted.

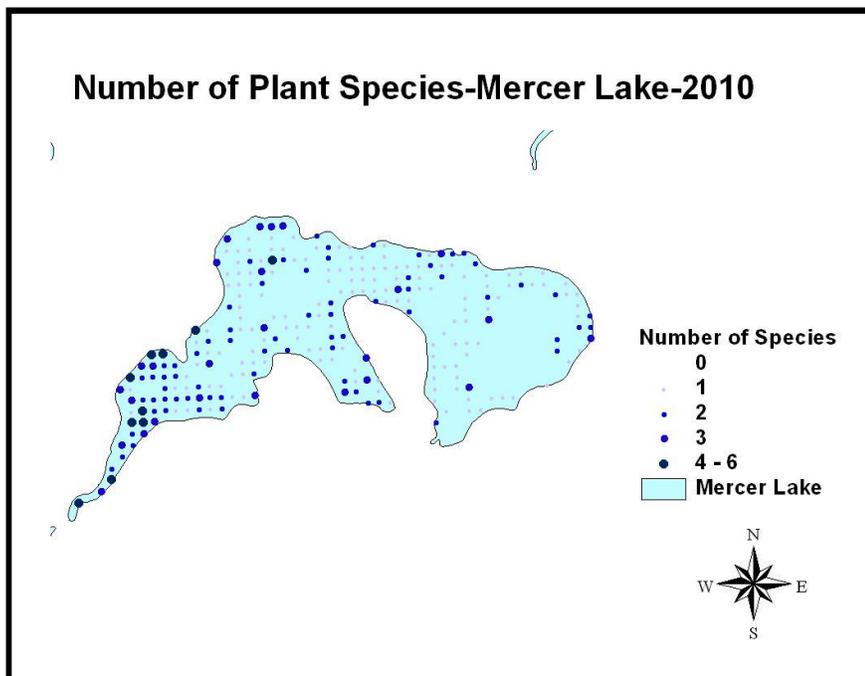


Figure 14: Species diversity at each sample point, Mercer Lake July, 2010.

<i>Species</i>	Frequency	Rel. freq	# of pts	Avg Density	# viewed
<i>Potamogeton robbinsii</i> , Fern pondweed	56.52	15.25	195	1.92	4
<i>Elodea canadensis</i> , Common waterweed	43.19	11.65	149	1.26	
<i>Potamogeton amplifolius</i> , Large-leaf pondweed	30.92	9.70	124	1.44	13
<i>Ceratophyllum demersum</i> , Coontail	29.57	7.97	102	1.05	1
<i>Vallisneria americana</i> , Wild celery	27.25	7.35	94	1.60	
<i>Myriophyllum sibiricum</i> , Northern water-milfoil	23.19	6.25	80	1.43	6
<i>Lemna trisulca</i> , Forked duckweed	22.32	6.02	77	1.08	2
<i>Potamogeton zosteriformis</i> , Flat-stem pondweed	22.03	5.94	76	1.11	3
<i>Potamogeton praelongus</i> , White-stem pondweed	15.65	4.22	54	1.28	7
<i>Najas flexilis</i> , Slender naiad	14.49	3.91	50	1.30	3
<i>Potamogeton pusillus</i> , Small pondweed	11.59	3.13	40	1.08	2
<i>Potamogeton richardsonii</i> , Clasping-leaf pondweed	11.30	3.05	39	1.31	9
<i>Bidens beckii</i> , Water marigold	11.01	2.97	38	1.11	7
<i>Nymphaea odorata</i> , White water lily	8.41	2.27	29	1.10	10
<i>Brasenia schreberi</i> , Watershield	5.22	1.41	18	1.22	9
<i>Heteranthera dubia</i> , Water star-grass	4.64	1.25	16	1.25	6
<i>Chara sp.</i> , Muskgrasses	3.48	0.94	12	1.33	1
<i>Nuphar variegata</i> , Spatterdock	3.48	0.94	12	1.08	5
<i>Potamogeton friesii</i> , Fries' pondweed	2.90	0.78	10	1.00	2
<i>Utricularia vulgaris</i> , Common bladderwort	2.90	0.78	10	1.30	3
<i>Pontederia cordata</i> , Pickerelweed	1.74	0.47	6	1.33	9
<i>Schoenoplectus acutus</i> , Hardstem bulrush	1.74	0.47	6	1.00	1
<i>Stuckenia pectinata</i> , Sago pondweed	1.74	0.47	6	1.00	5
<i>Utricularia intermedia</i> , Flat-leaf bladderwort	1.74	0.47	6	1.00	
<i>Nitella sp.</i> , Nitella	1.45	0.39	5	1.00	
<i>Sparganium eurycarpum</i> , Common bur-reed	1.45	0.39	5	1.00	4
<i>Eleocharis acicularis</i> , Needle spikerush	1.16	0.31	4	1.00	
<i>Decodon verticillatus</i> , Swamp loosestrife	0.87	0.23	3	1.33	3
<i>Sagittaria sp.</i> , Arrowhead (rosette)	0.87	0.23	3	1.00	3
<i>Potamogeton gramineus</i> , Variable pondweed	0.58	0.16	2	1.00	
<i>Ranunculus aquatilis</i> , White water crowfoot	0.58	0.16	2	1.00	1
<i>Polygonum amphibium</i> , Water smartweed	0.25	0.10	1	1.00	1
<i>Eleocharis palustris</i> , Creeping spikerush	0.25	0.10	1	1.00	
<i>Isoetes lacustris</i> , Lake quillwort	0.25	0.10	1	1.00	2
<i>Potamogeton natans</i> , Floating-leaf pondweed	0.25	0.10	1	1.00	2
<i>Sagittaria rigida</i> , Sessile-fruited arrowhead	0.25	0.10	1	1.00	
<i>Hydrodictyon reticulatum</i> , waternet	0.25	0.10	1	1.00	
Aquatic moss	1.45		5	1.00	
Filamentous algae	10.14		35	1.03	

Species viewed only at sample points:

Comarum palustre, Marsh cinquefoil
Sagittaria graminea, Grass-leaved arrowhead
Sagittaria latifolia, Common arrowhead
Sparganium emersum, Short-stemmed bur-reed
Typha latifolia, Broad-leaved cattail
Carex sp, Sedge

Species observed in boat survey not seen at sample points:

Phalaris arundinacea, Reed canary grass*
Myosotis scorpioides, Aquatic for-get-me-not*
Typha x glauca Hybrid cattail
Carex camosa, Bottle brush sedge

***Not native.**

The Floristic Quality Index (FQI) is an index developed by Dr. Stanley Nichols of the University of Wisconsin-Extension. This index is a measure of the plant community response to development and human influence on the lake. It takes into account the species of aquatic plants present and their tolerance for changing water quality and habitat characteristics. A plant's tolerance is expressed as a coefficient of conservatism (C). Native plants in Wisconsin are assigned a conservatism value between 0 and 10. A plant with a high conservatism value has more specialized habitat requirements and is less tolerant of disturbance and/or water quality changes. Those with lower values are more able to adapt to disturbance or changing conditions, and can therefore be found in a wider range of habitats. The FQI is calculated using the number of species present and these plants' species conservatism values. A higher FQI generally indicates a healthier aquatic plant community.

Table 5: Floristic Quality Index species with conservatism value.

Species	Common Name	Conservatism
<i>Bidens beckii</i>	Water marigold	8
<i>Brasenia schreberi</i>	Watershield	6
<i>Ceratophyllum demersum</i>	Coontail	3
<i>Chara</i>	Muskgrasses	7
<i>Eleocharis acicularis</i>	Needle spikerush	5
<i>Eleocharis palustris</i>	Creeping spikerush	6
<i>Elodea canadensis</i>	Common waterweed	3
<i>Heteranthera dubia</i>	Water star-grass	6
<i>Isoetes lacustris</i>	Lake quillwort	8
<i>Lemna trisulca</i>	Forked duckweed	6
<i>Myriophyllum sibiricum</i>	Northern water-milfoil	6
<i>Najas flexilis</i>	Slender naiad	6
<i>Nitella</i>	Nitella	7
<i>Nuphar variegata</i>	Spatterdock	6
<i>Nymphaea odorata</i>	White water lily	6
<i>Polygonum amphibium</i>	Water smartweed	5
<i>Pontederia cordata</i>	Pickerelweed	8
<i>Potamogeton amplifolius</i>	Large-leaf pondweed	7
<i>Potamogeton friesii</i>	Fries' pondweed	8
<i>Potamogeton gramineus</i>	Variable pondweed	7
<i>Potamogeton natans</i>	Floating-leaf pondweed	5
<i>Potamogeton praelongus</i>	White-stem pondweed	8
<i>Potamogeton pusillus</i>	Small pondweed	7
<i>Potamogeton richardsonii</i>	Clasping-leaf pondweed	5
<i>Potamogeton robbinsii</i>	Fern pondweed	8
<i>Potamogeton zosteriformis</i>	Flat-stem pondweed	6
<i>Ranunculus aquatilis</i>	White water crowfoot	8
<i>Sagittaria rigida</i>	Sessile-fruited arrowhead	8
<i>Schoenoplectus acutus</i>	Hardstem bulrush	6
<i>Sparganium eurycarpum</i>	Common bur-reed	5
<i>Stuckenia pectinata</i>	Sago pondweed	3
<i>Utricularia intermedia</i>	Flat-leaf bladderwort	9
<i>Utricularia vulgaris</i>	Common bladderwort	7
<i>Vallisneria americana</i>	Wild celery	6

Stanley Nichols collected FQI data on a number of lakes in different ecoregions around the Wisconsin. This allows for a comparison between the Mercer Lake FQI data and the median for the lakes within the region Nichols researched. Figure 15 shows that comparison. The number of species is larger for Mercer Lake and the mean conservatism value is lower. The species number is so much higher the FQI is much higher too. This could be somewhat due to sampling techniques. However the difference is enough to suggest Mercer Lake is more diverse than the median lakes in the ecoregion.

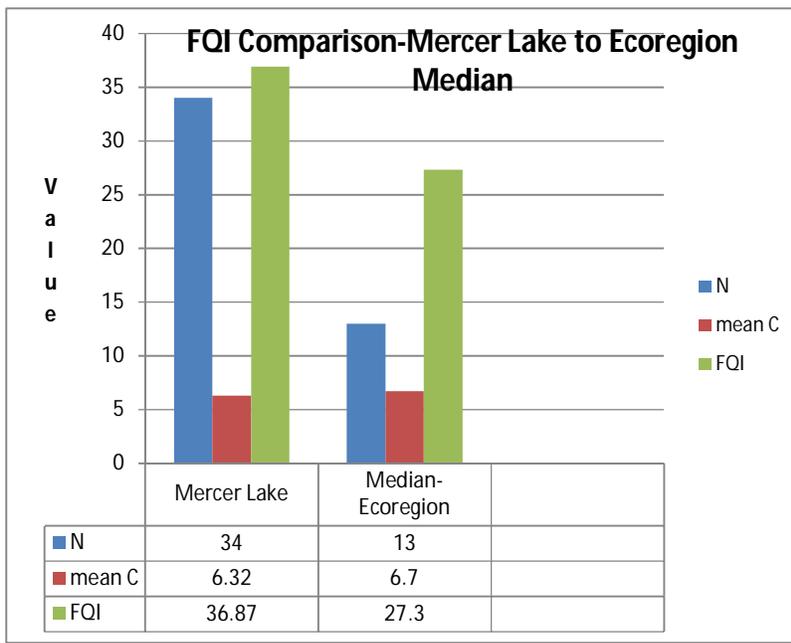


Figure 15: FQI comparison between Mercer Lake and ecoregion

Comparison to previous macrophyte survey

In 2003, an aquatic macrophyte survey was conducted. This survey used a protocol known as a transect survey. Several transects (straight lines) were established from the shoreline out to the end of the littoral zone. Along each transect, random points for sampling were selected. The sampling involved using a rake and a density of 0.5-5 was given for each plant sampled (ranging from least dense to most dense). No indication was given as to how each density was determined. The following data was available and allows for comparison:

Table 6: Plant survey comparison 2003 to 2010.

	# of species	Dominant species	Second dominant	Aerial coverage	Depth of plants	Non-native species
2003	21	<i>P. robbinsii</i>	<i>C. demersum</i>	51%	13 ft	none
2010	37	<i>P. robbinsii</i>	<i>E. canadensis</i>	74%	17 ft	2

There is significant difference in the two survey results. Due to the fact that different protocols were used, this could be the source of the differences. It is possible that over the last seven years the diversity and coverage of aquatic macrophytes in Mercer Lake has increased. The difference in results could be due to changes in the macrophyte community, but could also be due to differences in survey protocols.

Aquatic Invasive Species

Two species of non-native aquatic plants were observed in the aquatic plant survey of 2010. These species were reed canary grass and aquatic for-get-me-not. One invasive invertebrate species, the banded mystery snail, has been found in Mercer Lake. More information about several common aquatic invasive species is included in Appendix A. These species include curly leaf pondweed, Eurasian water milfoil, reed canary grass, and purple loosestrife.

Department of Natural Resource scientists have also found Eurasian water milfoil in other Iron County Lakes. They are: Long Lake, Long Lake Creek, and Wilson Lake.

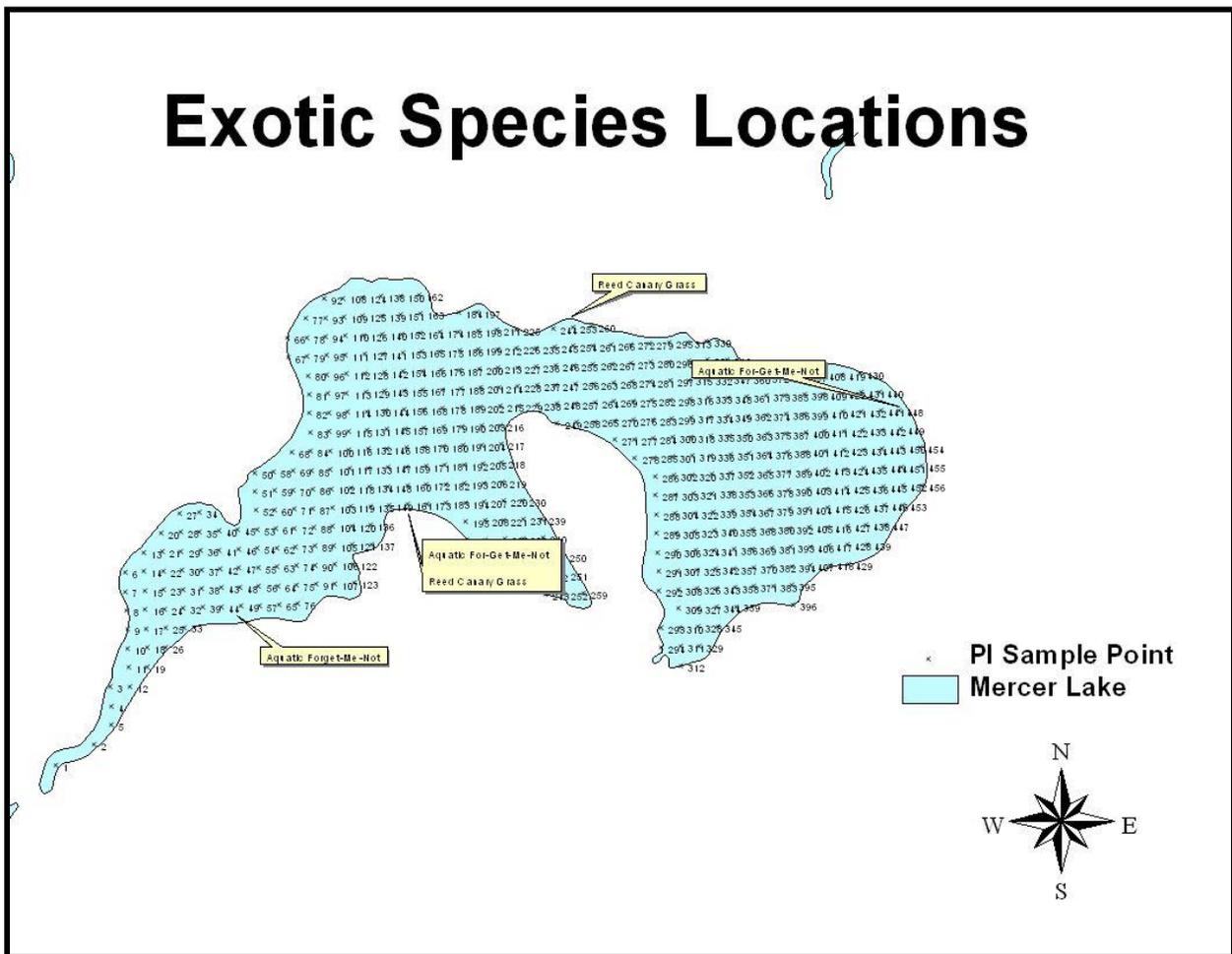


Figure 16: Locations of exotic plants species observed on Mercer Lake-2010.

Aquatic Plant Management

This section reviews the potential management methods available and reports recent management activities on the lakes.

Discussion of Management Methods

Permitting Requirements

The Department of Natural Resources regulates the removal of aquatic plants when chemicals are used, when plants are removed mechanically, and when plants are removed manually from an area greater than thirty feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107 – Aquatic Plant Management. **A permit is required for any aquatic chemical application in Wisconsin.**

The requirements for manual and mechanical plant removal are described in *NR 109 – Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations*. A permit is required for manual and mechanical removal except for when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline up to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal refers to the control of aquatic plants by hand or hand-held devices without the use or aid of external or auxiliary power.⁶

The *Department of Natural Resources Northern Region Aquatic Plant Management Strategy* (May 2007) requires documentation of impaired navigation or nuisance conditions before native plants may be managed with herbicides. Severe impairment or nuisance will generally mean that vegetation grows thickly and forms mats on the water surface.

Techniques to control the growth and distribution of aquatic plants are discussed in the following text. The application, location, timing, and combination of techniques must be considered carefully. A summary table of Management Options for Aquatic Plants from the WDNR is found in Appendix E.

Manual Removal⁷

Manual removal—hand pulling, cutting, or raking—will effectively remove plants from small areas. It is likely that plant removal will need to be repeated more than once during the growing season. The best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants with rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for rapid response to a Eurasian

⁶ More information regarding DNR permit requirements and aquatic plant management contacts is found on the DNR web site: www.dnr.state.wi.us.

⁷ Information from APIS (Aquatic Plant Information System). U.S. Army Corps of Engineers. 2005. and the *Wisconsin Aquatic Plant Management Guidelines*.

water milfoil establishment and for private landowners who wish to remove small areas of curly leaf pondweed growth. Raking is recommended to clear nuisance growth in riparian area corridors up to thirty feet wide. SCUBA divers may engage in manual removal for invasive species like Eurasian water milfoil. Care must be taken to ensure that all plant fragments are removed from the lake.

Mechanical Control

Larger-scale control efforts require more mechanization. Mechanical cutting, mechanical harvesting, diver-operated suction harvesting, and rotovating (tilling) are the most common forms of mechanical control available. WDNR permits under Chapter NR 109 are required for mechanical plant removal.

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cut to depths from one to six feet. A conveyor belt on the cutter head brings the clippings onboard the machine for storage. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

The size, and consequently the harvesting capabilities, of these machines vary greatly. As they move, harvesters cut a swath of aquatic plants that is between 4 and 20 feet wide, and can be up to 10 feet deep. The on-board storage capacity of a harvester ranges from 100 to 1,000 cubic feet (by volume) or 1 to 8 tons (by weight).

In some cases, the plants are transported to shore by the harvester itself for disposal, while in other cases, a barge is used to store and transport the plants in order to increase the efficiency of the cutting process. The plants are deposited on shore, where they can be transported to a local farm to be used as compost (the nutrient content of composted aquatic plants is comparable to that of cow manure) or to an upland landfill for proper disposal. Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate, and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are many environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area. This loss of plants results in a subsequent loss of the functions they perform,

including sediment stabilization and wave absorption. Shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole.

While the results of harvesting aquatic plants may be short term, the negative consequences are not so short lived. Much like mowing a lawn, harvesting must be conducted numerous times throughout the growing season. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures don't make their way back into the lake or to other lakes. The number of available disposal sites and their distance from the targeted harvesting areas will determine the efficiency of the operation, in terms of time as well as cost.

Timing is also important. The ideal time to harvest, in order to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. For curly leaf pondweed, it should also be before the plants form turions (reproductive structures) to avoid spreading the turions within the lake. If the harvesting is conducted too early, the plants will not be close enough to the surface, and the cutting will not do much damage to them. If too late, turions may have formed and may be spread, and there may be too much plant matter on the surface of the lake for the harvester to cut effectively.

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another. Harvesting contractors are not readily available in northern Wisconsin, so harvesting contracts are likely to be very expensive. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines.

Diver dredging operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against the pioneering establishment of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology can be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can result from diver dredging, but fragmentation is not as great a problem when infestations are small. Diver dredging operations may need to be repeated more than once to be effective. When applied to a pioneering infestation, control can be complete.

However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

Lake substrates play an important role in the effectiveness of a diver dredging operation. Soft substrates are very easy to work in. Divers can remove the plant and root crowns with little difficulty. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment. Diver dredging will be considered as a rapid response control measure for Eurasian water milfoil if discovered in the lake.

Biological Control⁸

Biological control is the purposeful introduction of parasites, predators, and/or pathogenic microorganisms to reduce or suppress populations of plant or animal pests. Biological control counteracts the problems that occur when a species is introduced into a new region of the world without a complex or assemblage of organisms that feed directly upon it, attack its seeds or progeny through predation or parasitism, or cause severe or debilitating diseases. With the introduction of pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

The effectiveness of bio-control efforts varies widely (Madsen, 2000). Beetles are commonly and successfully used to control purple loosestrife populations in Wisconsin. Weevils are used as an experimental control for Eurasian water milfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, an herbivorous fish, is sometimes used to feed on pest plant populations, but grass carp introduction is not allowed in Wisconsin. As a result, grass carp is not a viable bio-control in Wisconsin lakes and won't be utilized.

Weevils⁹ have potential for use as a biological control agent against Eurasian water milfoil. There are several documented "natural" declines of EWM infestations with weevil present. In these cases, EWM was not eliminated but its abundance was reduced enough so that it did not achieve dominance. These declines are attributed to an ample population of native milfoil weevils (Euhrychiopsis lecontei). Weevils feed on native milfoils but will shift preference over to EWM when it is present. Lakes where weevils can become an effective control have an abundance of native northern water milfoil and fairly extensive natural shoreline where the weevils can over winter. Any control strategy for EWM that would also harm native milfoil may hinder the ability of this natural bio-control agent. Lakes with large bluegill populations are not good candidates for weevils because bluegills feed on the weevils. The presence and efficacy of stocking weevils in EWM lakes is being evaluated in Wisconsin lakes. So far, stocking weevils does not appear to be effective.

⁸ Information from APIS (Aquatic Plant Information System). U.S. Army Corps of Engineers. 2005.

⁹ *Control of Eurasian Water Milfoil & Large-scale Aquatic Herbicide Use*. Wisconsin Department of Natural Resources. July 2006.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, and plant-specific control. On the other hand there are several disadvantages to consider, including very long control times (years instead of weeks), a lack of available biological control agents for particular target species, and relatively specific environmental conditions necessary for success. Biological control is not without risks; new non-native species introduced to control a pest population may cause problems of its own.

Re-vegetation with Native Plants

Another aspect to biological control is native aquatic plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols 1991; Smart and Doyle 1995). However, in communities that have only recently been invaded by nonnative species, a propagule (seed) bank probably exists that will restore the community after nonnative plants are controlled (Madsen, Getsinger, and Turner, 1994).

Physical Control¹⁰

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, and shading or light attenuation. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 WDNR permit would be required. Such permits are not commonly granted.

Dredging removes accumulated bottom sediments that support plant growth. Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, need deepening, or require removal of toxic substances (Peterson 1982). Lakes that are very shallow due to sedimentation tend to have excess plant growth. Dredging can form an area of the lake too deep for plants to grow, thus creating an area for open water use (Nichols 1984). By opening more diverse habitats and creating depth gradients, dredging may also create more diversity in the plant community (Nichols 1984). Results of dredging can be very long term. However, due to the cost, environmental impacts, and the problem of disposal, dredging should not be performed for aquatic plant management alone. It is best used as a lake remediation technique.

Drawdown, or significantly decreasing lake water levels can be used to control nuisance plant populations. With drawdown, the water body has water removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdowns need to be at least one month long to ensure thorough drying and effective removal of target plants (Cooke 1980a). In northern areas, a drawdown in the winter that will ensure freezing of sediments is also effective. Although drawdown may be effective for control of hydrilla for one to two years (Ludlow 1995), it is most commonly applied to Eurasian

¹⁰ Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

water milfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980).

Although drawdown can be inexpensive and have long-term effects (2 or more years), it also has significant environmental effects and may interfere with use and intended function (e.g., power generation or drinking water supply) of the water body during the drawdown period. Lastly, species respond in very different manners to drawdown and individual species responses can be inconsistent (Cooke 1980a). Drawdowns may provide an opportunity for the spread of highly weedy species, particularly annuals. Drawdown requires a mechanism to significantly lower water levels.

Benthic barriers or other bottom-covering approaches are another physical management technique. The basic idea is to cover the plants with a layer of a growth-inhibiting substance. Many materials have been used, including sheets or screens of organic, inorganic, and synthetic materials; sediments such as dredge sediment, sand, silt or clay; fly ash; and various combinations of the above materials (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with synthetic sheeting is that the gases evolved from plant and sediment decomposition collect underneath and lift the barrier (Gunnison and Barko 1992).

The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984).

Benthic barriers will typically kill the plants under them within 1 to 2 months, after which time they may be removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). Synthetic barriers, if left in place for multi-year control, will eventually become sediment-covered and will allow colonization by plants. Benthic barriers may be best suited to small, high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily affect benthic communities by removing fish and invertebrate habitat. A WDNR permit would be required for a benthic barrier, and these barriers are not recommended.

Shading or light attenuation reduces the amount of light plants have available for growth. Shading has been achieved by fertilization to produce algal growth, application of natural or synthetic dyes, shading fabric, or covers, and establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are only of limited applicability. Physical control is not currently proposed for management of aquatic plants in Mercer Lake.

Herbicide and Algaecide Treatments

Herbicides are chemicals used to kill plant tissue. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Thus, there are a limited number of active ingredients that are assured to be safe for aquatic use (Madsen, 2000).

An important caveat is that these products are considered safe when used according to the label. The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. WDNR permits under Chapter NR 107 are required for herbicide application.

General descriptions of herbicide classes are included below.¹¹

Contact herbicides

Contact herbicides act quickly and are generally lethal to all plant cells they contact. Because of this rapid action, or other physiological reasons, they do not move extensively within the plant and are effective only where they contact plants directly. They are generally more effective on annuals (plants that complete their life cycle in a single year). Perennial plants (plants that persist from year to year) can be defoliated by contact herbicides, but they quickly resprout from unaffected plant parts. Submersed aquatic plants that are in contact with sufficient concentrations of the herbicide in the water for long enough periods of time are affected, but regrowth occurs from unaffected plant parts, especially plant parts that are protected beneath the sediment. Because the entire plant is not killed by contact herbicides, retreatment is necessary, sometimes two or three times per year. **Endothall, diquat, and copper** are contact aquatic herbicides.

Systemic herbicides

Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides and those that are absorbed by leaves are referred to as foliar active herbicides. **2,4-D, dichlobenil, fluridone, and glyphosate** are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides. They must move to the part of the plant where their site of action is. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides. Systemic herbicides also generally have more selectivity than contact herbicides.

¹¹ This discussion is taken from: *Managing Lakes and Reservoirs*. North American Lake Management Society.

Broad spectrum herbicides

Broad spectrum (sometimes referred to as nonselective) herbicides are those that are used to control all or most species of vegetation. This type of herbicide is often used for total vegetation control in areas such as equipment yards and substations where bare ground is preferred. **Glyphosate** is an example of a broad spectrum aquatic herbicide. **Diquat, endothall, and fluridone** are used as broad spectrum aquatic herbicides, but can also be used selectively under certain circumstances.

Selective herbicides

Selective herbicides are those that are used to control certain plants but not others. Herbicide selectivity is based upon the relative susceptibility or response of a plant to an herbicide. Many related physical and biological factors can contribute to a plant's susceptibility to an herbicide. Physical factors that contribute to selectivity include herbicide placement, formulation, timing, and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

Environmental considerations

Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats and otters). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community, and in turn affect other organisms or weed control operations. These operations can also impact water chemistry which may result in further implications for aquatic organisms.

Table 7. Herbicides Used to Manage Aquatic Plants

Brand Name(s)	Chemical	Target Plants
Citrine Plus, CuSO ₄ , Captain, Navigate, Komeen	Copper compounds	Filamentous algae, coontail, wild celery, elodea, and pondweeds
Reward	Diquat	Coontail, duckweed, elodea, water milfoil, and pondweeds
Aquathol, Aquathol K, Aquathol Super K, Hydrothol 191	Endothall	Coontail, water milfoil, pondweeds, and wild celery as well as other submersed weeds and algae
Rodeo	Glyphosate	Cattails, grasses, bulrushes, purple loosestrife, and water lilies
Navigate, Aqua-Kleen, DMA 4 IVM, Weed-Rhap	2, 4-D	Water milfoils, water lilies, and bladderwort

General descriptions of the breakdown of commonly used aquatic herbicides are included below.¹²

Copper

Copper is a naturally occurring element that is essential at low concentrations for plant growth. It does not break down in the environment, but it forms insoluble compounds with other elements and is bound to charged particles in the water. It rapidly disappears from water after application as an herbicide. Because it is not broken down, it can accumulate in bottom sediments after repeated or high rates of application. Accumulation rarely reaches levels that are toxic to organisms or significantly above background concentrations in the sediment.

2,4-D

2,4-D photodegrades on leaf surfaces after being applied to leaves, and is broken down by microbial degradation in water and in sediments. Complete decomposition usually takes about 3 weeks in water but can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

A recent study in Tomahawk Lake in Bayfield County, Wisconsin illustrated a much slower breakdown time of 2,4-D than described above. Following a whole lake treatment of .5 mg/L 2,4-D, the chemical was still present 160 days after treatment. While there was successful removal of the target plant, Eurasian water milfoil, there were also significant declines in native plant biomass. A potential explanation was the low nutrient conditions in Lake Tomahawk which was described as an oligo-mesotrophic lake. (Nault 2010, Toshner 2010)

Diquat

When applied to enclosed ponds for submersed weed control, diquat is rarely found longer than 10 days after application and is often below detection levels 3 days after application. The most important reason for the rapid disappearance of diquat from water is that it is rapidly taken up by aquatic vegetation and bound tightly to particles in the water and bottom sediments. When bound to certain types of clay particles, diquat is not biologically available. When diquat is bound to organic matter, it can be slowly degraded by microorganisms. When diquat is applied foliarly, it is degraded to some extent on the leaf surfaces by photodegradation. Because it is bound in the plant tissue, a proportion is probably degraded by microorganisms as the plant tissue decays.

Endothall

Like 2,4-D, endothall is rapidly and completely broken down into naturally occurring compounds by microorganisms. The by-products of endothall dissipation are carbon dioxide and water. Complete breakdown usually occurs in about 2 weeks in water and 1 week in bottom sediments.

¹² These descriptions are taken from Hoyer/Canfield: *Aquatic Plant Management*. North American Lake Management Society. 1997.

Fluridone

Dissipation of fluridone from water occurs mainly by photodegradation. Metabolism by tolerant organisms and microbial breakdown also occurs, and microbial breakdown is probably the most important method of breakdown in bottom sediments. The rate of breakdown of fluridone is variable and may be related to time of application. Applications made in the fall or winter, when the sun's rays are less direct and days are shorter, result in longer half-lives. Fluridone usually disappears from pondwater after about 3 months but can remain up to 9 months. It may remain in bottom sediment between 4 months and 1 year.

Glyphosate

Glyphosate is not applied directly to water for weed control, but when it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive. Glyphosate is broken down into carbon dioxide, water, nitrogen, and phosphorus over a period of several months.

Copper Compounds

Copper-based compounds are generally used to treat filamentous algae. Common chemicals used are copper sulfate and Cutrine Plus, a chelated copper algaecide.

Herbicide Used to Manage Invasive Species

Eurasian Water Milfoil

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies the following herbicides for control of Eurasian water milfoil (EWM): 2,4-D, diquat, endothall, fluridone, and triclopyr.¹³ All of these herbicides with the exception of diquat are available in both granular and liquid formulations. It is possible to target invasive species by using the appropriate herbicide and timing of application. Diquat is used infrequently in Wisconsin because it is nonspecific.¹⁴ The herbicide 2,4-D is most commonly used to treat EWM in Wisconsin. This herbicide kills dicots including native aquatic species such as northern water milfoil, coontail, water lilies, spatterdock, and watershield. A project in Bayfield County on Lake Tomahawk also found unexpected impacts on pondweeds which are monocots.¹⁵ Early season (April to May) treatment of Eurasian water milfoil is recommended to limit the impact on native aquatic plant populations because EWM tends to grow before native aquatic plants.

Granular herbicide formulations are more expensive than liquid formulations (per active ingredient). However, granular formulations are generally thought to release the active

¹³ Additional information provided by John Skogerboe, Army Corps of Engineers, personal communication. February 14, 2008.

¹⁴ Frank Koshere. Wisconsin DNR. email communication. 3/03/10.

¹⁵ Nault 2010.

ingredient over a longer period of time. Granular formulations, therefore, may be more suited to situations where herbicide exposure time will likely be limited, as is the case of treatment areas in small bands or blocks. In large, shallow lakes with widespread EWM, a whole lake treatment with a low rate of liquid herbicide may be most cost effective because exposure time is greater. Factors that affect exposure time are size and configuration of treatment area, water flow, and wind.

Application rates for liquid and granular formulations are not interchangeable. A rate of 1 to 1.5 mg/L 2,4-D applied as a liquid is a moderate rate that will require a contact time of 36 to 48 hours. Negative impacts to native plants have occurred at whole-lake dosage rates as low as 0.5 mg/L.¹⁶ Application rates recommended for Navigate (granular 2,4-D) are 100 pounds per acre for depths of 0 to 5 feet, 150 pounds per acre for 5 to 10 feet, and 200 pounds per acre for depths greater than 10 feet. Allowed and recommended application rates are found on herbicide labels.

Curly Leaf Pondweed

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: diquat, endothall, and fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discrete area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

Studies have demonstrated that curly leaf pondweed can be controlled with Aquathol K (a formulation of endothall) in 50 to 60 degree F water, and that treatments of CLP this early in its life cycle can prevent turion formation.¹⁷ Since curly leaf pondweed is actively growing at these low water temperatures and many native aquatic plants are still dormant, early season treatment selectively targets curly leaf pondweed. Staff from the Minnesota Department of Natural Resources and the U.S Army Engineer Research and Development Center have conducted trials of this method. These methods are accepted as standard operating procedures being approved in Wisconsin for aquatic invasive species control projects.¹⁸

Because the dosage is at lower rates than the dosage recommended on the label, a greater herbicide residence time is necessary. To prevent drift of herbicide and allow greater contact time, application in shallow bays is likely to be most effective. Herbicide applied to a narrow band of vegetation along the shoreline is likely to drift, rapidly decrease in concentration, and be rendered ineffective.¹⁹ Steep drop-off, high winds, and other factors

¹⁶ Nault 2010.

¹⁷ *Research in Minnesota on Control of Curly Leaf Pondweed*. Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

¹⁸ Plan comments, Frank Koshere, September 16, 2010.

¹⁹ Personal communication, Frank Koshere. March 2005.

that increase herbicide dilution and contact time can decrease treatment effectiveness.²⁰ Early season treatment similar to that described above can be used to treat corridors for navigation purposes. Because of potential for drift, a higher concentration of endothall is generally used in navigation corridors.

Efforts are also made to treat as early in the season as possible and to absolutely not treat when temperatures reach 60 degrees F. Lake volunteers help to ensure that specified treatment conditions are followed. Because CLP is a monocot like many other aquatic plants, it is not possible to target its control later in the season when many other native plants are growing.

²⁰ *Draft Report Following April 2008 Aquatic Herbicide Treatments of Three Bays on Lake Minnetonka.* Skogerboe, John. Us Army engineer Research and Development Center.

Past Aquatic Plant Management

Historically Mercer Lake has had high density plant growth that has been managed for reduction. The more recent archives show that from 2004 until 2009, this reduction was achieved through harvesting. The following maps illustrate the location and amount of vegetation reduction that occurred. The exact date of harvest was not provided, but it is

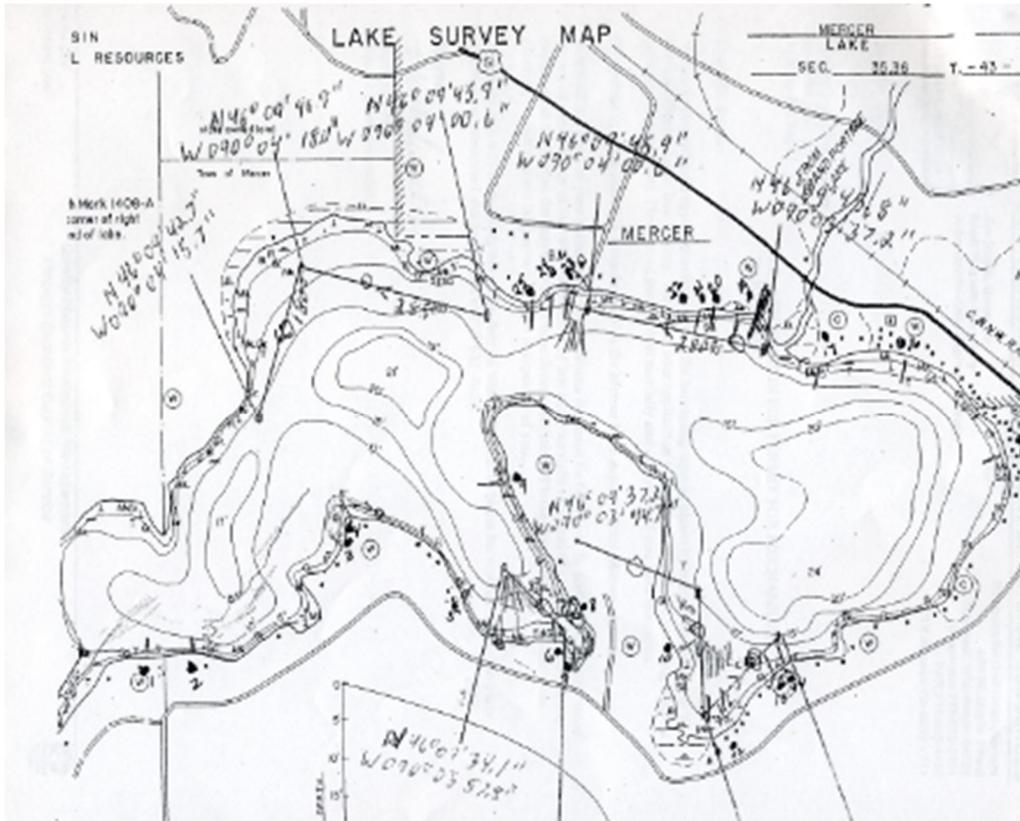


Figure 17: 2004 harvest locations with amount removed-22.5 tons

assumed to have been during peak growth in late July to early August. There is no record of any threshold or basis for harvest other than a request followed by a permit. No evaluation was conducted (or at least communicated) to determine if the harvest reduced macrophyte coverage into the following summer or not. All of this lack of information is needed if such harvest will be conducted in the future.

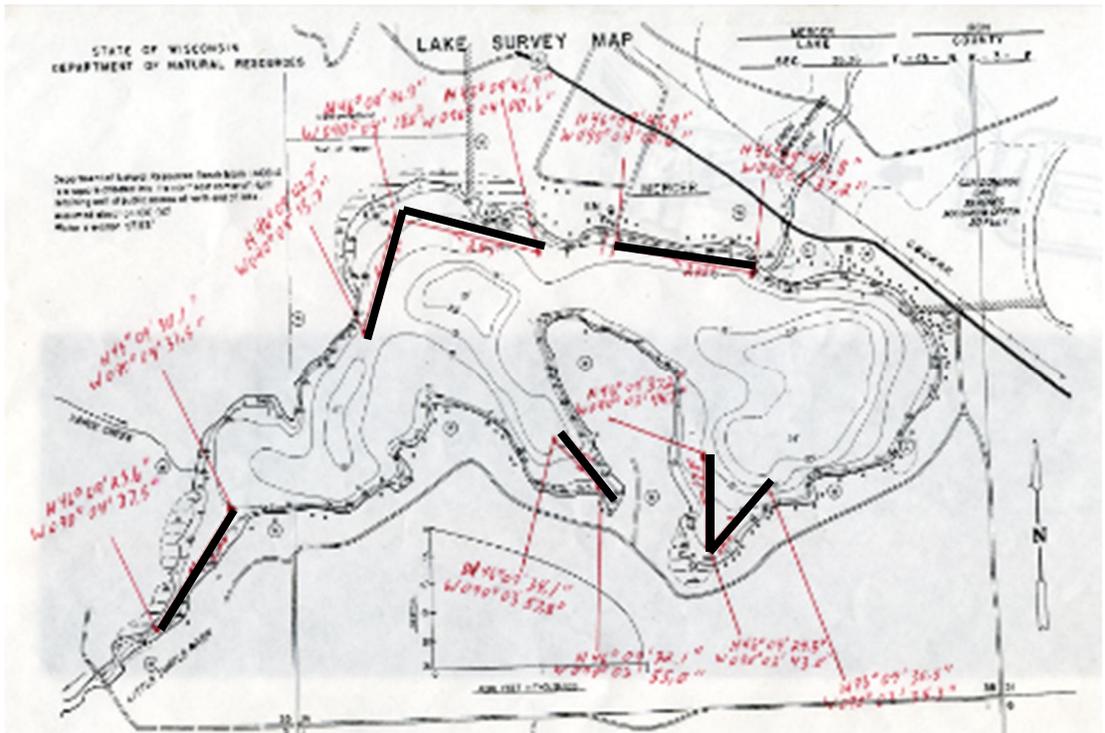


Figure 18: 2005 harvest locations-33 tons removed.

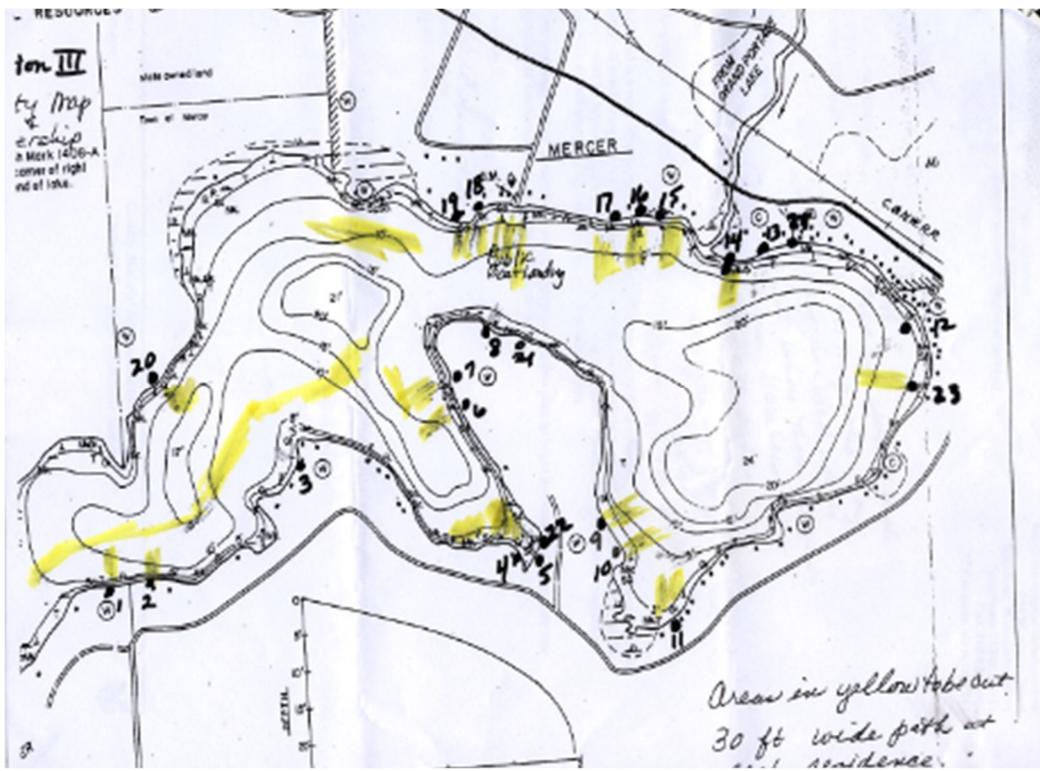


Figure 19: 2006 harvest locations-20 tons removed.

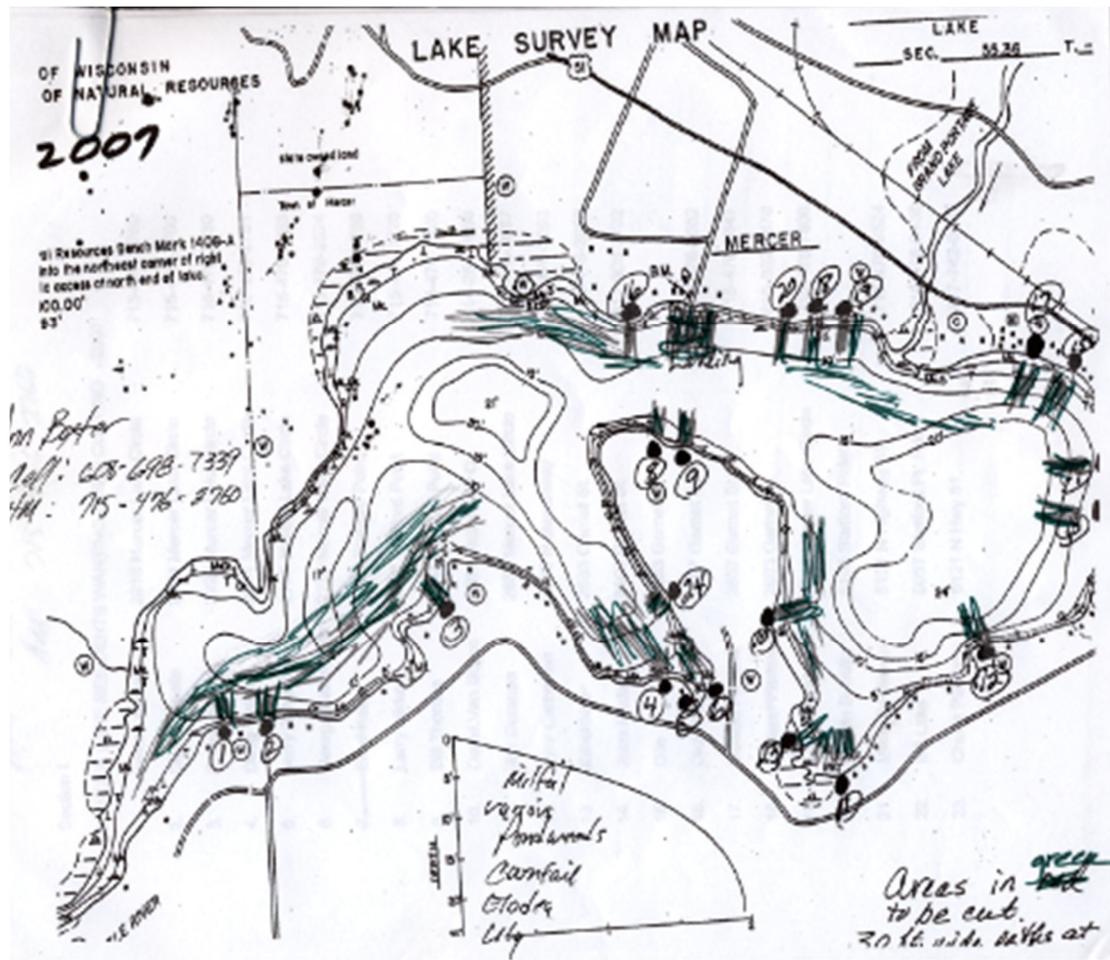


Figure 20: 2007 harvest locations-27.5 tons removed.

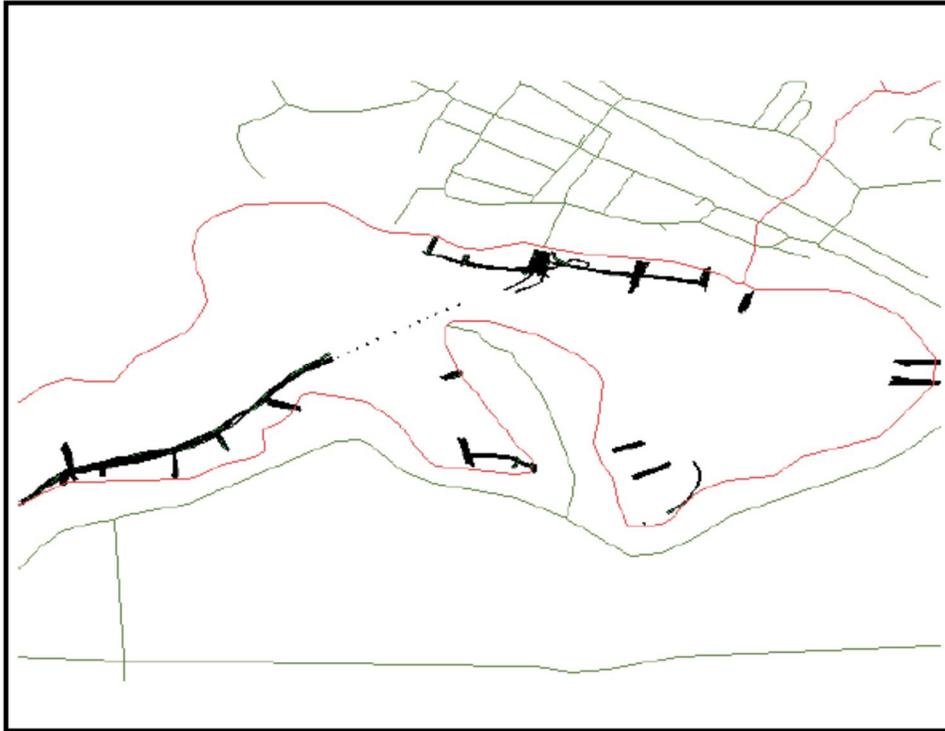


Figure 21: 2008 harvest locations-10 tons removed.

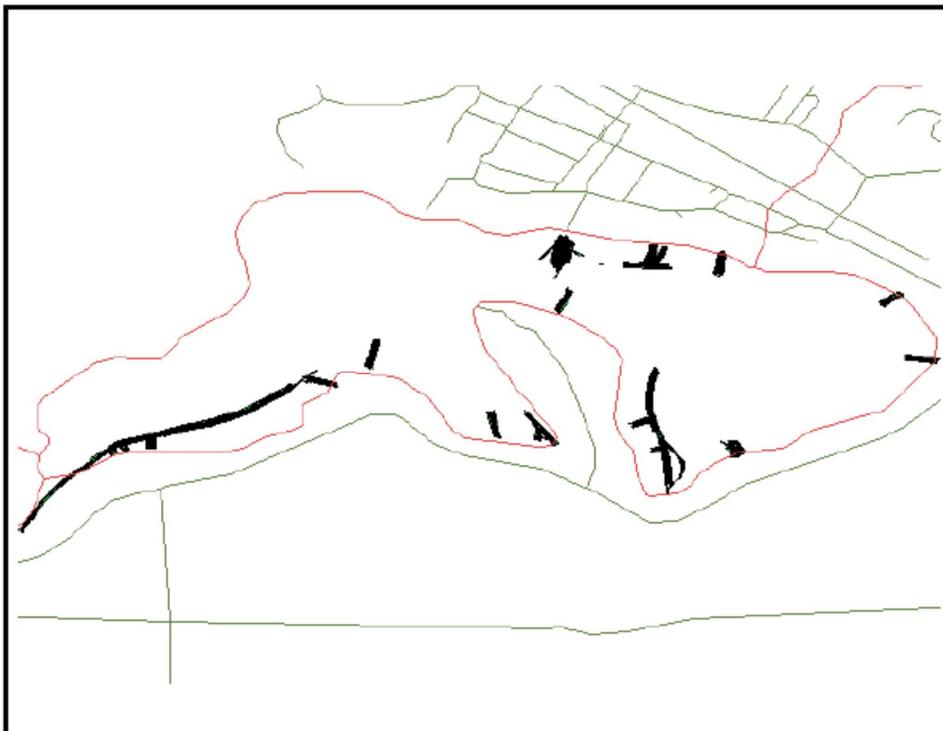


Figure 22: 2009 harvest locations-25 tons removed.

Table 7: Summary of past harvest amounts.

Year of harvest	Estimated amount removed (tons)
2004	22.5
2005	33
2006	20
2007	27.5
2008	10
2009	25

The DNR Northern Region released an Aquatic Plant Management Strategy (Appendix B) in the summer of 2007 to protect the important functions of aquatic plants in lakes. As part of this strategy, the DNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan.²¹ Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners must be carefully reviewed before permits are issued. The DNR will not allow removal after January 1, 2009 unless the "impairment of navigation" and/or "nuisance" conditions are clearly documented²².

²¹ Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

²² See Appendix B of the Aquatic Plant Management Strategy, Northern Region WDNR.

Plan Goals and Strategies

This section of the plan lists goals and objectives for aquatic plant management for Mercer Lake. It also presents a strategy of actions that will be used to reach aquatic plant management plan goals.

Goals are broad statements of direction.

Objectives are measurable steps toward the goal.

Actions are actions to take to accomplish objectives.

The **Implementation Plan** outlines timeline, resources needed, partners, and funding sources for each action item.

Plan Goals

- 1. Stop the introduction of aquatic invasive species (AIS).**
- 2. Educate residents about the importance of maintaining native species and stopping invasive species introduction.**
- 3. Restore developed shorelines to native vegetation.**
- 4. Preserve critical, native habitats in Mercer Lake.**
- 5. Reduce the density of native plants in areas that impede navigation and recreation use of the lake.**

Considerations in management

When the committee established goals and objectives, many considerations were used to develop management practices. First was the importance of native species. Mercer Lake has a very diverse and healthy native plant community. These native plants are important for the lake ecosystem and help maintain higher water clarity. There are areas that reach nuisance levels and the committee understands there must be a balance between native plant reduction and maintaining a healthy plant community.

Introduction aquatic invasive species (AIS) is of high concern. Mercer Lake has two non-native species. Curly-leaf pondweed and Eurasian watermilfoil have not been found in Mercer Lake. Safeguards must be taken to minimize the chance of their introduction into Mercer Lake. This can include maintaining a healthy native plant community, inspecting watercraft launching in Mercer Lake, and a diligent monitoring program so any new introductions can be dealt with in a timely manner.

This plant committee has very carefully weighed the needs of lake users, lake residents and the lake ecosystem in designing aquatic plant management.

Responsible Parties for APM Implementation and Monitoring

Mercer Lake Association (MLA) – Elected officers (and MLA members) responsible for oversight of lake management district. Some actions such as hiring a contractor or consultant require a vote of the board.

APM Lead/Committee – makes day-to-day APM decisions and directs contractors in herbicide treatments and related monitoring. The director will have interns, volunteers and consultants to assist in these activities. The Board APM Lead is currently (will need to be appointed/can be more than one person)

AIS Lead – leads and coordinates volunteer AIS education activities including Clean Boats, Clean Waters monitoring and education at the boat landings and lake monitoring. The AIS Lead is currently (will need/can be committee).

Herbicide/Harvester Contractor – the contractor hired by the MLA Board to complete aquatic plant harvesting or herbicide treatment as permitted by the Wisconsin Department of Natural Resources.

APM Monitor– a consultant hired (or qualified volunteer) to complete monitoring under the direction of the APM Lead and the MLA Board. The APM monitor is currently (need one/can be AIS-APM lead if needed)

DNR – Aquatic Plant Management staff will review aquatic plant management permit applications and enforce permit conditions. Typically one DNR staff person oversees regional permit applications.

Goal 1. Stop the introduction of aquatic invasive species (AIS).

Objectives 1.1: The Clean Boats/Clean Waters monitoring program will be enhanced by adding boat launch information/monitoring volunteers.

Keeping AIS out of Mercer Lake is important. The most effective method is to educate and monitor what is coming into the lake, as this is really the only source of AIS. Diligent monitoring can be paramount in protecting Mercer Lake. Any time spent monitoring incoming boat traffic will help.

Action: The Mercer Lake Association will ask for volunteers to be trained in Clean Boats/Clean Waters (CBCW) by attending a workshop. They will then be asked to monitor boat landings on key dates based upon volunteer availability. These dates may include the first weekend of the fishing season, Memorial Day weekend, July 4th weekend and Labor Day weekend. Other busy times could be analyzed and added if needed, depending on the availability of monitors.

Objective 1.2: Mercer Lake will be monitored for AIS twice per month during the growing season.

The best way to deal with AIS is to not have any introduced to the lake. However, if they do, quick observation of the AIS is critical. The key to AIS is to act when there is a pioneer community of that plant (organism). A pioneer population is a new, first established population and will tend to be localized to one location. If a pioneer population is located, it is much easier to reduce or even in some cases eradicate the AIS (although this is unlikely)

Routine monitoring will help located newly introduced AIS into Mercer Lake and will allow for a rapid response.

Action: Mercer Lake volunteers will be trained in aquatic invasive species (AIS) identification. The AIS monitors will periodically monitor Mercer Lake for AIS. It is recommended the monitoring occur once each month during May, June, July and August (if volunteers are available). There will be designated areas to concentrate monitoring.

Although AIS can show up anywhere in the lake, it can make monitoring more efficient to look in areas that have a higher chance for AIS to occur. These areas include boat landings, bays that receive predominant winds, and areas near high boat traffic. A monitoring kit is

recommended. This kit would include a GPS, maps of monitoring areas, data sheets, a viewing tube and ID plates.

Action: If Eurasian water milfoil (EWM) should be located (or suspected) the Rapid Response Protocol in Appendix D will be followed.

If any AIS are located, then the rapid response protocol should be followed. EWM is becoming a problem by being introduced to many lakes. It should be an emphasis while monitoring for all AIS. It is important that if EWM gets introduced into Mercer Lake that it get discovered as a pioneer community. This will help mitigation be more successful. The rapid response helps facilitate quick action.

Goal 2. Educate residents about the importance of maintaining native species and stopping invasive species introduction.

Objectives 2.1: Mercer Lake Association will take action to educate the lake residents about native plant species role and AIS over the next five years.

One key to lake protection and preservation is education. Most riparian owners and lake users want to do the right thing for lakes. However, these lake users don't always understand what is good and what is bad for the ecosystem as a whole. As a result, education is paramount.

Native plant species serve extremely important roles in the ecosystem. Since Mercer Lake is a macrophyte dominated lake, the excess nutrients are being used by plants rather than algae. As a result, a robust plant community will help maintain good water clarity in Mercer Lake. Native plants can help reduce the spread of AIS plants. Maintaining a healthy, diverse native plant community is important and therefore education is needed.

To address this need, yearly education methods will be implemented to help reach this goal.

Action: An annual newsletter will be published and distributed in each of the next five years which will contain an article on the importance of native plants species and one article on AIS.

Action: A speaker will be invited to the next three annual meetings addressing native plant species and/or AIS. This speaker may be from the Wisconsin DNR, Iron County (or other county), a consultant, or a trained Association member.

As an alternative, a speaker could be part of a presentation organized with a nearby lake organization on a date other than the annual meeting.

Goal 3. Restore developed shorelines to native vegetation.

Objectives 3.1-The shoreline habitat survey will be evaluated and enhanced (if needed) by 2015 to evaluate the degree of development and change that has occurred in the lake shoreline areas.

The riparian zone is the zone where the water meets the land, or the shoreline. This area is very important to a lake. Not only does it provide habitat for many aquatic organisms, it also can protect the lake. Natural shoreline areas can mitigate large amounts of nutrients that would otherwise runoff into the lake allowing for increased algae and aquatic plant growth. Since Mercer Lake has very dense plant growth, reduction of nutrients into the lake could help curb any density increases. Developed shorelines do little to reduce nutrient runoff into lakes. Use of fertilizer is also not good as it can lead to significant increases in plant and algae growth in the lake.

As discussed in the water quality section, the second highest source of nutrients into Mercer Lake is near-lake development. Shoreline restoration could be a good practice to mitigate this loading.

Action: The MLA will evaluate the shoreline survey that has been completed (three years ago and can be viewed in appendix F). If it is determined that more data is necessary, a volunteer group or preferably a qualified entity (based on funding availability) will conduct further analysis. This should include the delineation of natural shoreline and developed shoreline. The developed shoreline will be further delineated into rip rap, lawn, hard surface, and sea walls.

A shoreline habitat survey is an evaluation of the shoreline types and the manipulation that has taken place. A more natural/undeveloped a shoreline is the better as it provides habitat, reduces runoff and can help reduce nutrient loading into the lake. The more developed the shoreline is, the more negative the impact on the lake.

Approximately three years ago a shoreline inventory was conducted. Although the protocol for the inventory has not been provided with the data, the inventory does quantify

the degree of development away from natural. This data is provided in Appendix F. The data from the shoreline inventory can be used to identify the highest priority properties for potential restoration.

More updated and possibly more detailed information may be needed to better identify properties. Evaluation of the current inventory needs to take place.

Objective 3.2- Following the shoreline survey, the owners of several of the properties identified as good candidates for restoration will be approached to discuss possible restoration opportunities.

Action: Properties that are candidates for restoration after shoreline survey will be contacted and provided information about shoreline restoration. These property owners will be encouraged and assisted to do a restoration of their shoreline²³.

There are a few strategies for shoreline restoration. One effective one is to do a cost share program. This involves giving the property owner a grant to pay for a large percent of the project. Some counties have cost share programs and this may be the case for Iron County. Iron County was awarded a DNR grant for shoreline restoration projects, so this may still be available. Also, a lake protection grant could include a shoreline restoration cost share program.

The following steps are recommended for implementing a shoreline restoration program:

1. Identify some properties that would be good candidates based upon shoreline assessment.
2. Contact owners to determine if someone may be interested in entering a cost share for a project.
3. If more than one, choose one property that would make a good showcase for restoration.
4. Work with Iron County Land and Water Conservation Dept. to get this property in a cost share. Have them help plan and implement the project.
5. Show case the project in newsletters and an open house, emphasizing the benefits of such project.

²³ Iron County Land and Water Dept. has a cost-share program that could be utilized or a Wisconsin Lake Protection Grant could be utilized to help fund a cost share program.

The following is directly from the Iron County Land and Water Conservation Dept (LWCD) website outlining shoreland restoration assistance and funding:

The Iron County Land & Water Conservation Department provides financial and technical assistance to private landowners, municipalities, and towns for a variety of conservation practices through the Land & Water Cost-Share Program. These practices focus on erosion control and water quality improvement.

In order to receive funding, the applicant signs a Cost-Share Agreement which outlines the responsibilities of the landowner and the LCWD. Upon project completion, the landowner submits paid receipts for eligible practices and the LCWD will reimburse them for 70% of their project cost. The applicant is responsible for 30% of the project cost.

Timeline – Project installation usually occurs during the field season **FOLLOWING** sign-up:

- *Cost-Share Agreement signed*
- *LCWD conducts survey and develops plan according to standards & applicant needs*
- *Project installation*
- *Landowner submits eligible receipts*
- *Landowner receives reimbursement for 70% of eligible costs*

Eligible Projects-The following shoreland projects are eligible through the Cost-Share Program:

- *Shoreland Habitat Restoration*
- *Streambank & Shoreland Stabilization*
- *Stream Crossing & Culverts*
- *Access Roads*
- *Critical Area Planting*
- *Riparian Habitat*

More information can be obtained at the following website (Iron County Land Conservation: <http://ironcountylcd.org/shoreland/>)

The state law (NR151), which regulates shoreland has been changed recently. The law still requires a minimum of a 35 foot deep buffer back from the ordinary high watermark of natural/native vegetation. However, trees and shrubs can be removed for viewing purposes of either 30% of the shoreline or 200 feet, whichever is less. If the lake property is greater than 10 acres, removal can be increased. Removal of exotic species is also allowed. Municipalities such as the Town of Mercer, may be excluded from NR151.

Goal 4. Preserve critical, native habitats in Mercer Lake.

Objective 4.1: Critical, native habitats will be evaluated on Mercer Lake by 2014.

Action: A critical habitat analysis will be requested and if approved, conducted on Mercer Lake. This analysis may be completed by the Wisconsin DNR, Iron County Land and Water Conservation Dept. or a qualified consultant.

Critical habitat is habitat that is necessary for the successful survival of various aquatic species and species that rely on aquatic habitats. These could include various invertebrates, fish, amphibians, reptiles, birds and mammals. Habitats can be crucial for food, nesting/reproduction and rearing. The habitat survey should consider all of these issues and be designated based upon the needs of organisms found in and around Mercer Lake.

The critical habitat analysis will be done in accordance with a protocol outlined by the Wisconsin DNR, even if not conducted by the Wisconsin DNR. An emphasis on fish habitat would be desired as Mercer Lake is a robust fishery.

Action: Once critical habitats are designated, any plant management (or other management) of Mercer Lake will consider these areas and take safeguards to preserve these areas

Future projects for Mercer Lake should include analysis of key terrestrial sites around the lake. These areas could be evaluated for potential nutrient reduction practices as well as key natural areas for birds and wildlife that could become part of a conservancy. Many lakes use land purchases and/or conservancies to protect the watershed of the lake. These areas not only provide good habitat but also can reduce nutrient loading and can be important water recharge areas for the lake.

Action: The Mercer Lake Association Board will consider using critical habitat information to pursue future grants to protect the Mercer Lake water quality, fish habitat and watershed.

Goal 5. Reduce the density of native plants in areas that impede navigation and recreation use of the lake.

Objective 5.1-Areas that impede navigation will have navigation channels created to open up channels 30 feet wide with plant density less than "3."

Action: In areas defined nuisance areas that impeded navigation, a mechanical harvester, chemical herbicide or a combination can possibly be used to reduce plant density to form navigation channels 30 feet wide. This will take place prior to peak growth and no later than August 5, to allow for time of implementation.

Navigation channels may include channels for public navigation as well as access to landowners' docks or piers

The Mercer Lake Association Plant Committee has evaluated methods to reduce plant density for creating navigation channels. There are pros and cons associated with both mechanical harvesting and herbicide use. Historically mechanical harvesting has been utilized.

The method(s) used will be chosen based upon various factors associated with the navigation channel. These may include the following:

- Length of the navigation channel.
- Depth of the water.
- Plant community surrounding the navigation channel location.
- Sediment composition/characteristics of reduction location.
- Cost in consideration to effectiveness in previous year.
- Residual year to year effectiveness.
- Habitat use of the plant community at navigation channel location.

The use of chemical herbicide for native plant reduction may be considered as a viable option. The herbicide should be applied by a licensed, professional applicator that is skilled at using herbicides. Since native plants are so important, it is imperative that only those areas designated and approved for treatment get treated. As a result, the determination of chemical herbicide use may require a site visit by the Wisconsin DNR and may also be cause for a reduction in the area being reduced, as compared to a proposed harvest area. Mercer Lake should have the option of considering and using either mechanical harvesting or chemical herbicide in dealing with nuisance growth areas.

Each year, the density of the aquatic plants in areas historically meeting the nuisance threshold will be re-evaluated. If the navigation channels locations meet thresholds, then the most prudent method for reduction will be utilized. Any areas that do not meet the density threshold will not have harvesting or chemical treatment. Photo verification may

be needed. If a particular area is very dense late in a growing year but is too late for reduction, that area may be considered a candidate for herbicide or harvesting application in the following growing year.

Action: A professional aquatic biologist, County Water Quality Specialist²⁴, or the Wisconsin DNR will delineate navigation channels each year, to assure the threshold for harvest/treatment is met in each proposed location. Photo documentation can be provided as requested by Wisconsin DNR. This will occur annually as permits are required annually.

Individuals seeking native plant reduction due to navigation and/or recreation impediment, can also have the area of concern evaluated based upon annual need or concern. The same threshold for nuisance will be utilized for riparian owner for determining any treatment and/or harvest near shore, around piers, or corridor to reach an open navigation channel.

As outlined in the water quality section, Mercer Lake is right on the threshold for eutrophic status. Eutrophic lakes tend to have either excessive macrophyte growth or excessive algae (planktonic) growth. It is evident that Mercer Lake is a macrophyte-dominated, mesotrophic/eutrophic lake. Excessive plant removal/reduction could lead to a transition from a macrophyte dominated lake to an algae dominated lake. This then could result in poor water clarity and undesirable algae blooms. This is the reason native plant reduction in Mercer Lake must be done with caution.

Rake density reference:

Density	Criteria for rake fullness rating
1	Plant present, occupies less than ½ of tine space
2	Plant present, occupies more than ½ tine space
3	Plant present, occupies all or more than tine space

²⁴ Presently there is a committee member that holds a similar professional position at another county. This person has agreed to volunteer this service to help reduce costs.

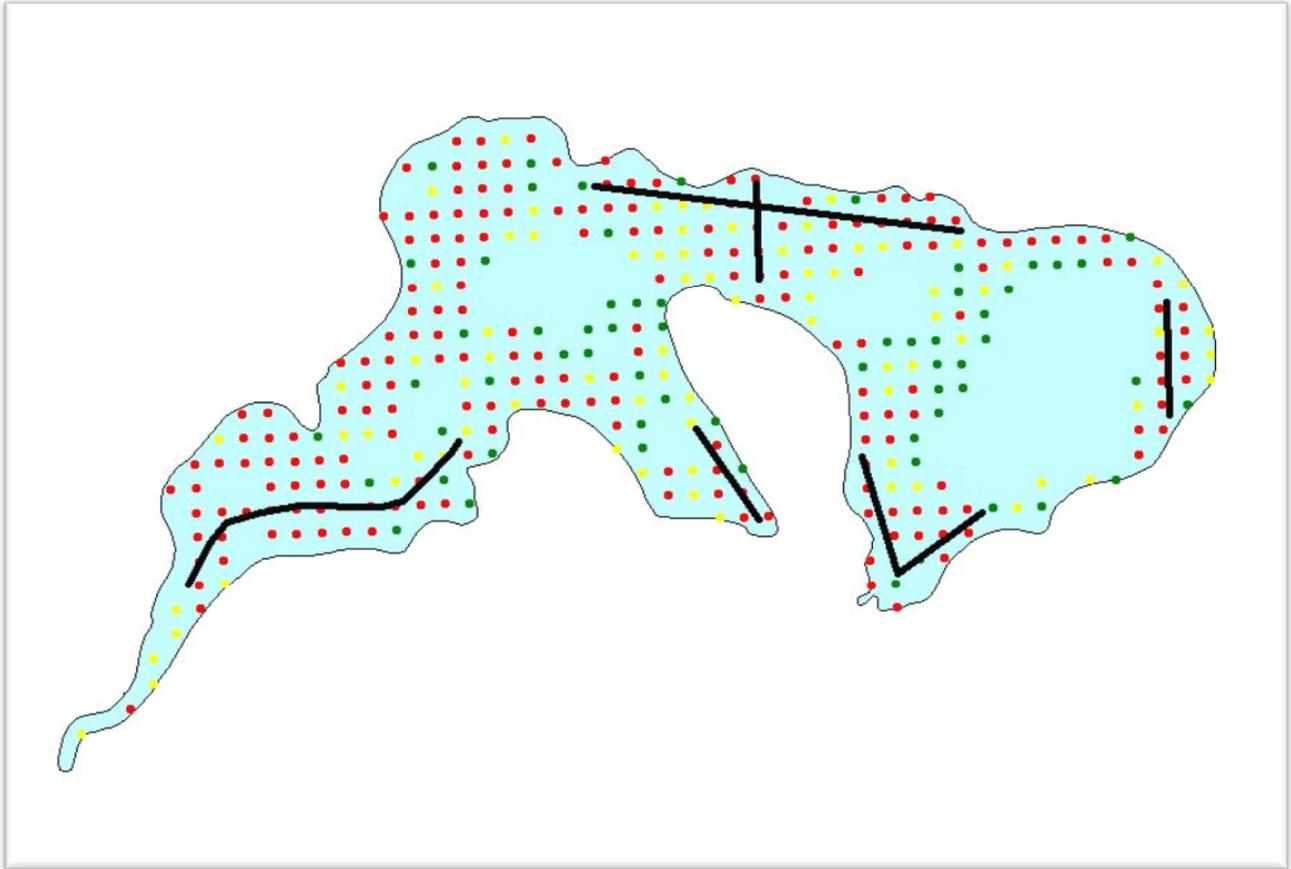


Figure 23: Proposed navigation corridor locations to be evaluated for density reduction.

Note: The navigation channel map shows maximum proposed distances. Only areas that meet or exceed the threshold for reduction will be included in the final permit application. Also, any areas that have high diversity and/or sensitive plants may be cause for no harvest in those areas.

Nuisance threshold for navigation impediment (all must be met to qualify for nuisance):

1. Plants have a mean density = "3" in defined area.
2. Plants at the surface that will clog a propeller.
3. Bed is at least 30 continuous feet and not convenient to go around (approximately 40 feet wide) or block access to piers.

In past years where harvesting occurred, there were some complaints over accumulations of loose plants by various riparian owners.²⁵ Every effort will be made by the harvester (if

²⁵ According to plant committee members that were associated with past management practices.

this is the method used) to reduce fragmentation. However, this is a common side effect of harvesting. Property owners will need to understand that fragmentation will occur and they will need to potentially clean up the shoreline if they feel it is necessary. Removal of plant material is not required but is recommended.

Individual Corridor Access

The only time a permit is not required to control aquatic plants is when a waterfront property owner manually removes (i.e., hand-pulls or hand rakes), or gives permission to someone to manually remove, plants (except wild rice) from his/her shoreline in an area that is 30 feet or less in width along the shore and is not within a designated sensitive area (if a sensitive area analysis has been conducted by the Wisconsin DNR). The non-native invasive plants (Eurasian watermilfoil, curlyleaf pondweed, and purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed. Wild rice removal always requires a permit, although no rice has been observed in Mercer Lake.

Individual Access Corridors are the openings from a waterfront property owner's shoreline out into the lake. These corridors may be a maximum of thirty feet wide and must remain in the same location from year to year. Herbicide treatment or harvesting may be permitted for individual corridors in front of waterfront property to control invasive or native plants.

Action: Individual corridors connecting or nearly connecting to main navigation channel would be opened to allow riparian owners with nuisance vegetation navigation to navigation channels (assuming the nuisance threshold is met and the individual corridor access monitoring occurs). These channels will not exceed 30 feet in width. See protocol that follows for individual corridors.

If an individual riparian owner wants to be considered to have plant reduction occur in front of their property, they will follow the protocol outlined on page 52. This protocol allows for an evaluation of the area so that no unnecessary plant removal occurs. This protocol will assure that all other options have been considered and that the area is at nuisance levels and should be considered for inclusion in the Mercer Lake Association's permit application. This will not assure permit will be accepted.

Procedure for Individual Corridor Permitting and Monitoring:

Document nuisance conditions (as soon as nuisance conditions are determined to be reached or nearly reached)

- Indicate when plants cause problems and how long problems persist.
- Include dated photos of nuisance conditions from previous season (or location relative to curly leaf pondweed bed map).
- List depth at end of dock.
- Provide examples of specific activities that are limited because of presence of nuisance aquatic plants.
- Describe practical alternatives to herbicide use or harvesting that were considered. These might include:
 - Hand removal/hand raking of aquatic plants
 - Extending dock to greater depth
 - Altering the route to and from the dock
 - Use of another type of watercraft or motor, i.e., is the type of watercraft used common to other sites with similar conditions on this lake?
- Aquatic Herbicide/Harvesting Contractor to provide this information in permit application based on information from the landowner.

Verify/refute nuisance conditions and/or navigation impairment

- Landowners will submit, no more than one season in advance, all documentation of nuisance conditions (photos recommended) for review by the APM Lead, designee or committee established by the Association.
- Landowner requests APM Lead review of their property prior to submitting a permit application to DNR.
- The APM Lead visits site, reviews documentation and provides a written opinion of navigation impairment i.e., is herbicide treatment or harvesting warranted?

Submit permit request to WDNR for remediation of plant nuisance condition

- MLA/Landowner/Contractor applies for permit to WDNR including information from the landowner, photographic documentation, identification of plants causing navigation problems, and MLA evaluation.
- WDNR will contact herbicide/harvesting contractor, MLA and owner with a notice to proceed with treatment or denial of permit application.

Monitoring and Assessment

Aquatic Plant Surveys

Aquatic plant (macrophyte) surveys are the primary means for tracking achievement toward plan goals. The whole lake surveys will be conducted in accordance with the guidelines established by the Wisconsin DNR. Any new species sampled will be saved, pressed, and mounted for voucher specimens.

Action. Conduct a whole lake point intercept survey every **four years if a monitoring program is in practice, otherwise every three years (and based on funding availability)**. If no management of nuisance native plants is undertaken, then this time period will be evaluated accordingly. This survey will include the same sample points and boat survey locations as the previous survey(s).

Since the implementation of a rented harvester may be part of this management, the potential for AIS introduction is increased. To help reduce the proliferation of any introduced AIS, a frequent whole lake PI survey will allow for observing any pioneer AIS communities. Chemical treatments can also increase establishment of AIS since if all plants are killed, it leaves an area with no competition for the AIS.

Aquatic Invasive Species Grants

Department of Natural Resources Aquatic Invasive Species (AIS) grants are available to assist in funding some of the action items in the implementation plan. Maintaining navigation channels to alleviate nuisance conditions are an exception. Grants provide up to 75 percent funding. Applications are accepted twice each year with postmark deadlines of February 1 and August 1. With completion and approval of the aquatic plant management plan, funds will be available not only for education and planning, but also for control of aquatic invasive species.

A small scale DNR Lake Planning Grant to the Mercer Lake Association funded the completion of an aquatic plant management survey and plan in 2003 and 2004. A 2009 large scale DNR Lake Planning Grant funded the aquatic plant survey in 2010. Other funds were utilized to fund this Aquatic Plant Management Plan.

Implementation Plan²⁶

Goal 1.				
Actions ²⁷	Timeline	Estimated \$\$ (potential grant application)	Vol. Hours ²⁸	Responsible Parties
Clean boats/clean waters	Some have been trained, increase by 2013	\$100 for expenses to send to training (DNR-AIS "education" grant)	8 hours for training each-landing monitoring TBD	APM lead/MLA Board ICLWRD
AIS monitoring team	Trained 2012 and annual monitoring May-Sept.	Training \$0 if by County; (\$400 if by consultant)	Estimated-4 hours each time for a total of 40 hours per summer	APM lead/MLA Board
Rapid response protocol	Established 2012 and then ongoing	\$0 (may consider establishing fund for rapid response grant match)	Not known until need for implementation	APMP committee/MLA Board
SUBTOTAL GOAL 1		\$100 (\$500)	48 hrs.	

²⁶ Costs are annual costs estimated for initial implementation. These costs will be reviewed each year during the budgeting process.

²⁷ See previous pages for action item detail.

²⁸ **These hours are for reference only. They may be used for grant application purposes and/or planning. They are not required in any way.**

Goal 2.				
Actions²⁹	Timeline	\$ Estimate	Vol. Hours	Responsible Parties
Annual newsletter	2012 and annually thereafter	\$600 depending on quality	Writing and distribution 20 hours each	MLA Board/APM lead
Speaker at annual meeting	2012 and annually until 2014	\$0 unless speaker fees	1 hour for arrangements	MLA Board
SUBTOTAL GOAL 2		\$600	21 hrs	

²⁹ See previous pages for action item detail.
ICLWRD = Iron County Land and Water Resources Department
WDNR = Wisconsin Department of Natural Resources

Goal 3.				
Actions³⁰	Timeline	\$ Estimate	Vol. Hours	Responsible Parties
Shoreline survey evaluation and potential enhancement	By 2013	\$0	8-30 hours	MLA Board/Plant Committee/Trained designee
Contacts with property owners with recommended restoration	By 2014	\$0(Lake Protection Grant/County Cost share if practices installed)	5-10 hours	MLA Board Iron County LWRD
SUBTOTAL GOAL 3		\$0	13-40 hours	

Goal 4.				
Actions³¹	Timeline	\$ Estimate	Vol. Hours	Responsible Parties
Assessment of critical habitat	2012-13	\$0 if DNR \$1500 consultant	10 hours	MLA Board/APM Lead WDNR
Recognition of critical habitat in plant management	2013 and implemented ongoing	\$0 (Lake Protection Grant for any land purchase)	4 hours for education and review of	MLA Board/APM Lead/Plant committee WDNR

³⁰ See previous pages for action item detail.

³¹ See previous pages for action item detail.

Goal 4.				
Actions³¹	Timeline	\$ Estimate	Vol. Hours	Responsible Parties
			permits	
Consider future grants for lake protection (See appendix G for options)	Review 2013 Grant 2015	\$0 but up to \$1000 if hire grant proposal/25% cost share for grant.	8 hours- can in-kind volunteer hours	MLA Board WDNR
Subtotal GOAL 4		\$0-\$2500	22 hours	

Goal 5.				
Actions³²	Timeline	\$ Estimate	Vol. Hours	Responsible Parties
Density reduction for navigation channels	2012 and potential for annual reduction	\$4000-\$6500/yr (if maximum reduction permitted)		MLA Board Harvester proprietor/Herbicide applicator WDNR
Annual evaluation/delineation of navigation channels	2012 and annually	\$1000/yr professional/\$0 if trained expert volunteer	8 hours	MLA Board
Individual corridor evaluation for potential permit	2012 and potential for annual permits	\$0	8 hours	MLA Board Landowner WDNR
Subtotal GOAL 5		\$5000-7500/yr	16 hours	

³² See previous pages for action item detail.

Monitoring and assessment.				
Actions³³	Timeline	\$ Estimate	Vol. Hours	Responsible Parties
Full Lake PI Survey	2018 (if herbicide application/harvesting occurs)	\$3500		Consultant
APMP Update	2018	\$3000	12 hours	MLA Board Consultant
Subtotal GOAL 5		\$6500	12 hours	

Total All actions per year (not including assessment and APMP update)		
Goal	\$ Estimate	Vol. Hours
1	\$100-500	48 hrs
2	\$600	21 hrs
3	\$0	13-40 hours
4	\$0-2500	22 hrs
5	\$5000-7500*	16 hrs
Total	\$5700-11,100	120-147 hrs

*If maximum reduction occurs, otherwise less depending on amount of channel produced.

³³ See previous pages for action item detail.

Appendix A. Invasive Plant Species Information

Curly Leaf Pondweed

Curly leaf pondweed is specifically designated as an invasive aquatic plant (along with Eurasian water milfoil and purple loosestrife) to be the focus of a statewide program to control invasive species in Wisconsin. Invasive species are defined as a “non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health (23.22(c).”

The Wisconsin Comprehensive Management Plan for Aquatic Invasive Species describes curly leaf pondweed impacts as follows:

It is widely distributed throughout Wisconsin lakes, but the actual number of waters infested is not known. Curly-leaf pondweed is native to northern Europe and Asia where it is especially well adapted to surviving in low temperature waters. It can actively grow under the ice while most plants are dormant, giving it a competitive advantage over native aquatic plant species. By June, curly-leaf pondweed can form dense surface mats that interfere with aquatic recreation. By mid-summer, when other aquatic plants are just reaching their peak growth for the year, it dies off. Curly-leaf pondweed provides habitat for fish and invertebrates in the winter and spring when most other plants are reduced to rhizomes and buds, but the mid-summer decay creates a sudden loss of habitat. The die-off of curly-leaf pondweed also releases a surge of nutrients into the water column that can trigger algal blooms and create turbid water conditions. In lakes where curly-leaf pondweed is the dominant plant, the summer die-off can lead to habitat disturbance and degraded water quality. In other waters where there is a diversity of aquatic plants, the breakdown of curly-leaf may not cause a problem.¹

The state of Minnesota DNR web site explains that curly leaf pondweed often causes problems due to excessive growth. At the same time, the plant provides some cover for fish, and some waterfowl species feed on the seeds and winter buds.²

¹ *Wisconsin's Comprehensive Management Plan to Prevent Further Introductions and Control Existing Populations of Aquatic Invasive Species*. Prepared by Wisconsin DNR. September 2003.

² Information from Minnesota DNR (www.dnr.state.mn.us/aquatic_plants).

The following description is taken from a Great Lakes Indian Fish and Wildlife Commission handout.

Curly Leaf Pondweed (*Potamogeton crispus*)³

Identification

Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters one to three meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as two meters. The stems are dark reddish-green to reddish-brown, with the mid-vein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa, and Australia and is now spread throughout most of the United States and southern Canada.



Characteristics

New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

Reproduction and Dispersal

Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 – 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer, and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, turions germinate in the fall, overwintering as a small plant. The next summer plants mature, producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

Ecological Impacts

Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

³ Information from GLIFWC Plant Information Center (<http://www.glifwc.org/epicenter>).

In late spring, curly leaf pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish populations. The foliage of curly leaf pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

Control

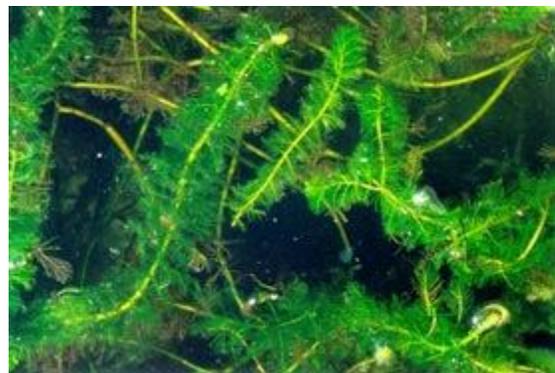
Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments, to keep them from re-establishing.

Control of large populations requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed bank over time. It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants may aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

Eurasian Water Milfoil (*Myriophyllum spicatum*)

Introduction

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 either 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, Eurasian water milfoil is nearly impossible to distinguish from Northern water milfoil. Eurasian water milfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

Distribution and Habitat

Eurasian milfoil first arrived in Wisconsin in the 1960's. During the 1980's, it began to move from several counties in southern Wisconsin to lakes and waterways in the northern half of the state. As of 1993, Eurasian milfoil was common in 39 Wisconsin counties (54%)

and at least 75 of its lakes, including shallow bays in Lakes Michigan and Superior and Mississippi River pools.

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 lake beds, lakes receiving nitrogen and phosphorous-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.

Life History and Effects of Invasion

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. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of Eurasian milfoil provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

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 user 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.⁴

⁴ Taken in its entirety from WDNR, 2008 (<http://www.dnr.state.wi.us/invasives/fact/milfoil.htm>)

Reed Canary Grass (*Phalaris arundinacea*)

Description

Reed canary grass is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. Blades are flat and have a rough texture on both surfaces. The leaf ligule is membranous and long. The compact panicles are erect or slightly spreading (depending on the plant's reproductive stage), and range from 3 to 16 inches long with branches 2 to 12 inches in length. Single flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.



Both Eurasian and native ecotypes of reed canary grass are thought to exist in the U.S. The Eurasian variety is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype. Agricultural cultivars of the grass are widely planted.

Reed canary grass also resembles non-native orchard grass (*Dactylis glomerata*), but can be distinguished by its wider blades, narrower, more pointed inflorescence, and the lack of hairs on glumes and lemmas (the spikelet scales). Additionally, bluejoint grass (*Calamagrostis canadensis*) may be mistaken for reed canary in areas where orchard grass is rare, especially in the spring. The highly transparent ligule on reed canary grass is helpful in distinguishing it from the others. Ensure positive identification before attempting control. The ligule is a transparent membrane found at the intersection of the leaf stem and leaf.

Distribution and Habitat

Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America. The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800's for forage and erosion control. It has become naturalized in much of the northern half of the U.S., and is still being planted on steep slopes and banks of ponds and created wetlands.

Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas.

Life History and Effects of Invasion

Reed canary grass reproduces by seed or creeping rhizomes. It spreads aggressively. The plant produces leaves and flower stalks for 5 to 7 weeks after germination in early spring, then spreads laterally. Growth peaks in mid-June and declines in mid-July. A second growth spurt occurs in the fall. The shoots collapse in mid to late summer, forming a dense, impenetrable mat of stems and leaves. The seeds ripen in late June and shatter when ripe. Seeds may be dispersed from one wetland to another by waterways, animals, humans, or machines.

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in less than twelve years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites.⁵

Purple Loosestrife (*Lythrum salicaria*)⁶

Description

Purple loosestrife is a non-native plant common in Wisconsin. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers vary from purple to magenta, possess 5-6 petals aggregated into numerous long spikes, and bloom from July to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes (underground stems) that form a dense mat.



Characteristics

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, about 24 states

⁵ Taken from WDNR, 2008. (http://www.dnr.state.wi.us/invasives/fact/reed_canary.htm).

⁶ Wisconsin DNR invasive species factsheets. (<http://dnr.wi.gov/invasives>).

have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators, like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. This plant's optimal habitat includes marshes, stream margins, river flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

Reproduction and Dispersal

Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local disturbance is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland.

Ecological Impacts

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

Mechanical Control

Purple loosestrife (PL) can be controlled by cutting, pulling, digging and drowning. Cutting is best done just before plants begin flowering. Cutting too early encourages more flower stems to grow than before. If done too late, seed may have already fallen. Since lower pods can drop seed while upper flowers are still blooming, check for seed. If none, simply bag all

cuttings (to prevent them from rooting). If there is seed, cut off each top while carefully holding it upright, then bend it over into a bag to catch any dropping seeds. Dispose of plants/seeds in a capped landfill, or dry and burn them. Composting will not kill the seeds. Keep clothing and equipment seed-free to prevent its spread. Rinse all equipment used in infested areas before moving into uninfested areas, including boats, trailers, clothing, and footwear.

Pulling and digging can be effective, but can also create disturbed bare spots, which are good sites for PL seeds to germinate, or leave behind root fragments that grow into new plants. Use these methods primarily with small plants in loose soils, since they do not usually leave behind large gaps nor root tips, while large plants with multiple stems and brittle roots often do. Dispose of plants as described above.

Mowing has not been effective with loosestrife unless the plants can be mowed to a height where the remaining stems will be covered with water for a full twelve months. Burning has also proven largely ineffective. Mowing and flooding are not encouraged because they can contribute to further dispersal of the species by disseminating seeds and stems.

Follow-up treatments are recommended for at least three years after removal.

Chemical Control

This is usually the best way to eliminate PL quickly, especially with mature plants. The chemicals used have a short soil life. Timing is important. Treat in late July or August, but before flowering to prevent seed set. Always back away from sprayed areas as you go, to prevent getting herbicide on your clothes. The best method is to cut stems and paint the stump tops with herbicide. The herbicide can be applied with a small drip bottle or spray bottle, which can be adjusted to release only a small amount. Try to cover the entire cut portion of the stem, but not let the herbicide drip onto other plants since it is non-selective and can kill any plant it touches.

Glyphosate herbicides: Currently, glyphosate is the most commonly used chemical for killing loosestrife. Roundup and Glyfos are typically used, but if there is any open water in the area use Rodeo, a glyphosate formulated and listed for use over water. Glyphosate must be applied in late July or August to be most effective. Since you must treat at least some stems of each plant and they often grow together in a clump, all stems in the clump should be treated to be sure all plants are treated.

Another method is using very carefully targeted foliar applications of herbicide (NOT broadcast spraying). This may reduce costs for sites with very high densities of PL, since the work should be easier and there will be few other plant species to hit accidentally. Use a glyphosate formulated for use over water. A weak solution of around 1% active ingredient can be used and it is generally necessary to wet only 25% of the foliage to kill the plant.

You must obtain a permit from WDNR before applying any herbicide over water. The process has been streamlined for control of purple loosestrife and there is no cost. Contact your regional Aquatic Plant Management Coordinator for permit information.

Biological Control

Conventional control methods like hand pulling, cutting, flooding, herbicides, and plant competition have only been moderately effective in controlling purple loosestrife. Biocontrol is now considered the most viable option for more complete control for heavy infestations. The WDNR, in cooperation with the U.S. Fish and Wildlife Service, is introducing several natural insect enemies of purple loosestrife from Europe. A species of weevil (*Hylobius transversovittatus*) has been identified that lays eggs in the stem and upper root system of the plant; as larvae develop, they feed on root tissue. In addition, two species of leaf eating beetles (*Galerucella californiensis* and *G. pusilla*) are being raised and released in the state, and another weevil that feeds on flowers (*Nanophyes marmoratus*) is being used to stress the plant in multiple ways. Research has shown that most of these insects are almost exclusively dependent upon purple loosestrife and do not threaten native plants, although one species showed some cross-over to native loosestrife. These insects will not eradicate loosestrife, but may significantly reduce the population so cohabitation with native species becomes a possibility.

Appendix B. Aquatic Plant Management Strategy WDNR

AQUATIC PLANT MANAGEMENT STRATEGY Northern Region WDNR

ISSUES

- Protect desirable native aquatic plants.
- Reduce the risk that invasive species replace desirable native aquatic plants.
- Promote “whole lake” management plans
- Limit the number of permits to control native aquatic plants.

BACKGROUND

As a general rule, the Northern Region has historically taken a protective approach to allow removal of native aquatic plants by harvesting or by chemical herbicide treatment. This approach has prevented lakes in the Northern Wisconsin from large-scale loss of native aquatic plants that represent naturally occurring high quality vegetation. Naturally occurring native plants provide a *diversity of habitat* that *helps maintain water quality, helps sustain the fishing quality* known for Northern Wisconsin, supports common lakeshore wildlife from loons to frogs, and helps to provide the *aesthetics* that collectively create the “up-north” appeal of the northwoods lake resources.

In Northern Wisconsin lakes, an inventory of aquatic plants may often find 30 different species or more, whereas a similar survey of a Southern Wisconsin lake may often discover less than half that many species. Historically, similar species diversity was present in Southern Wisconsin, but has been lost gradually over time from stresses brought on by cultural land use changes (such as increased development, and intensive agriculture). Another point to note is that while there may be a greater variety of aquatic vegetation in Northern Wisconsin lakes, the vegetation itself is often *less dense*. This is because northern lakes have not suffered as greatly from nutrients and runoff as have many waters in Southern Wisconsin.

The newest threat to native plants in Northern Wisconsin is from invasive species of aquatic plants. The most common include Eurasian Water Milfoil (EWM) and CurlyLeaf Pondweed (CLP). These species are described as *opportunistic invaders*. This means that these “invaders” benefit where an opening occurs from removal of plants, and without competition from other plants may successfully become established in a lake. Removal of native vegetation not only diminishes the natural qualities of a lake, *it may increase the risk that an invasive species can successfully invade onto the site where native plants have been removed*. There it may more easily establish itself without the native plants to compete against. This concept is easily observed on land where bared soil is quickly taken over by replacement species (often weeds) that crowd in and establish themselves as new occupants of the site. While not a providing a certain guarantee against invasive plants, protecting and allowing the native plants to remain may reduce the success of an invasive species becoming established on a lake. Once established, the invasive species cause far more inconvenience for all lake users, riparian and others included; can change many of the natural features of a lake; and often lead to *expensive annual control plans*. Native vegetation may cause localized concerns to some users, but as a natural feature of lakes, they generally do not cause harm.

To the extent we can maintain the normal growth of native vegetation, Northern Wisconsin lakes can continue to offer the water resource appeal and benefits they've historically provided. A regional position on removal of aquatic plants that carefully recognizes how native aquatic plants benefit lakes in Northern Region can help prevent a gradual decline in the overall quality and recreational benefits that make these lakes attractive to people and still provide abundant fish, wildlife, and northwoods appeal.

GOALS OF STRATEGY:

1. Preserve native species diversity which, in turn, fosters natural habitat for fish and other aquatic species, from frogs to birds.
2. Prevent openings for invasive species to become established in the absence of the native species.
3. Concentrate on a "whole-lake approach" for control of aquatic plants, thereby fostering systematic documentation of conditions and specific targeting of invasive species as they exist.
4. Prohibit removal of wild rice. WDNR – Northern Region will not issue permits to remove wild rice unless a request is subjected to the full consultation process via the Voigt Tribal Task Force. We intend to discourage applications for removal of this ecologically and culturally important native plant.
5. To be consistent with our WDNR Water Division Goals (work reduction/disinvestment), established in 2005, to "not issue permits for chemical or large scale mechanical control of native aquatic plants – develop general permits as appropriate or inform applicants of exempted activities." This process is similar to work done in other WDNR Regions, although not formalized as such.

BASIS OF STRATEGY IN STATE STATUTE AND ADMINISTRATIVE CODE

State Statute 23.24 (2)(c) states:

"The requirements promulgated under par. (a) 4. may specify any of the following:

1. The **quantity** of aquatic plants that may be managed under an aquatic plant management permit.
2. The **species** of aquatic plants that may be managed under an aquatic plant management permit.
3. The **areas** in which aquatic plants may be managed under an aquatic plant management permit.
4. The **methods** that may be used to manage aquatic plants under an aquatic plant management permit.
5. The **times** during which aquatic plants may be managed under an aquatic plant management permit.
6. The **allowable methods** for disposing or using aquatic

plants that are removed or controlled under an aquatic plant management permit.

7. The requirements for plans that the department may require under sub. (3) (b). "

State Statute 23.24(3)(b) states:

"The department may require that an application for an aquatic plant management permit contain a plan for the department's approval as to how the aquatic plants will be introduced, removed, or controlled."

Wisconsin Administrative Code NR 109.04(3)(a) states:

"The department may require that an application for an aquatic plant management permit contain an aquatic plant management plan that describes how the aquatic plants will be introduced, controlled, removed or disposed. Requirements for an aquatic plant management plan shall be made in writing stating the reason for the plan requirement. In deciding whether to require a plan, the department shall consider the potential for effects on protection and development of diverse and stable communities of native aquatic plants, for conflict with goals of other written ecological or lake management plans, for cumulative impacts and effect on the ecological values in the body of water, and the long-term sustainability of beneficial water use activities."

AQUATIC PLANT MANAGEMENT STRATEGY Northern Region WDNR

APPROACH

1. After January 1, 2009* no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents "impairment of navigation" and/or "nuisance conditions". Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of "impairment of navigation" and/or "nuisance conditions". No new individual permits will be issued during the interim.
2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report.
3. Invasive species must be controlled under an approved lake management plan, with two exceptions (these exceptions are designed to allow sufficient time for lake associations to form and subsequently submit an approved lake management plan):
 - a. Newly-discovered infestations. If found on a lake with an approved lake management plan, the invasive species can be controlled via an amendment to the approved plan. If found on a lake without an approved management plan, the invasive species can be controlled under the WDNR's Rapid Response protocol (see definition), and the lake owners will be encouraged to form a lake association and subsequently submit a lake management plan for WDNR review and approval.
 - b. Individuals holding past permits for control of *invasive* aquatic plants and/or "mixed stands" of native and invasive species will be allowed to treat via individual permit until January 1, 2009 if "impairment of navigation" and/or "nuisance conditions" is adequately documented, unless there is an approved lake management plan for the lake in question.
4. Control of invasive species or "mixed stands" of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on Spring treatment. (typically, a water temperature of less than 60 degrees Fahrenheit, or approximately May 31st, annually).
5. Manual removal (see attached definition) is allowed (Admin. Code NR.109.06).

* *Exceptions to the Jan. 1, 2009 deadline will be considered only on a very limited basis and will be intended to address unique situations that do not fall within the intent of this approach.*

AQUATIC PLANT MANAGEMENT STRATEGY Northern Region WDNR

DOCUMENTATION OF IMPAIRED NAVIGATION AND/OR NUISANCE CONDITIONS

Navigation channels can be of two types:

- Common use navigation channel. This is a common navigation route for the general lake user. It often is off shore and connects areas that boaters commonly would navigate to or across, and should be of public benefit.
- Individual riparian access lane. This is an access lane to shore that normally is used by an individual riparian shore owner.

Severe impairment or nuisance will generally mean vegetation grows thickly and forms mats on the water surface. Before issuance of a permit to use a regulated control method, a riparian will be asked to document the problem and show what efforts or adaptations have been made to use the site. (This is currently required in NR 107 and on the application form, but the following helps provide a specific description of what impairments exist from native plants).

Documentation of impairment of navigation by native plants must include:

- a. Specific locations of navigation routes (preferably with GPS coordinates)
- b. Specific dimensions in length, width, and depth
- c. Specific times when plants cause the problem and how long the problem persists
- d. Adaptations or alternatives that have been considered by the lake shore user to avoid or lessen the problem
- e. The species of plant or plants creating the nuisance (documented with samples or a from a Site inspection)

Documentation of the nuisance must include:

- a. Specific periods of time when plants cause the problem, e.g. when does the problem start and when does it go away.
- b. Photos of the nuisance are encouraged to help show what uses are limited and to show the severity of the problem.
- c. Examples of specific activities that would normally be done where native plants occur naturally on a site but can not occur because native plants have become a nuisance.

AQUATIC PLANT MANAGEMENT STRATEGY

Northern Region WDNR

DEFINITIONS

Manual removal:	Removal by hand or hand-held devices without the use or aid of external or auxiliary power. Manual removal cannot exceed 30 ft. in width and can only be done where the shore is being used for a dock or swim raft. The 30 ft. wide removal zone cannot be moved, relocated, or expanded with the intent to gradually increase the area of plants removed. Wild rice may not be removed under this waiver.
Native aquatic plants:	Aquatic plants that are indigenous to the waters of this state.
Invasive aquatic plants:	Non-indigenous species whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
Sensitive area:	Defined under s. NR 107.05(3)(i) (sensitive areas are areas of aquatic vegetation identified by the department as offering critical or unique fish and wildlife habitat, including seasonal or lifestage requirements, or offering water quality or erosion control benefits to the body of water).
Rapid Response protocol:	This is an internal WDNR document designed to provide guidance for grants awarded under NR 198.30 (Early Detection and Rapid Response Projects). These projects are intended to control pioneer infestations of aquatic invasive species before they become established.

Appendix C. References

Aquatic Ecosystem Restoration Foundation. *Aquatic Plant Management: Best Management Practices in Support of Fish and Wildlife Habitat*. 2005.
http://www.aquatics.org/aquatic_bmp.pdf

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

Chronology of Fisheries Management Events Mercer Lake – Iron County. Source and data unknown.

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.

Harmony Environmental. *Balsam Lake Aquatic Plant Management Plan*. Polk County, Wisconsin. October 2010.

Madsen, John D. *Aquatic Plant Management Guidelines for Wisconsin Lakes*. March 22, 2003 Draft.

Nault, Michelle. *Effects of Whole Lake Early Season 2,4-D on Eurasian Watermilfoil (Myriophyllum spicatum)*. Presentation at Minnesota-Wisconsin Invasive Species Conference. St. Paul, Minnesota. November 2010.

Newton, B.J., and Jarrell, W.M. *A procedure to estimate the response of aquatic systems to changes in phosphorus and nitrogen inputs*: U.S. Department of Agriculture. National Water and Climate Center. NWCC–TN–99–2. 1999. 37 p.

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

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.

North American Lake Management Society. *Managing Lakes and Reservoirs*. 2001.

Preliminary Lake Watershed Management Plan for Mercer Lake Iron County, Wisconsin. Prepared for: Mercer Lake Association. June 2007. Assistance from Cedar Corporation and Wisconsin Department of Natural Resources.

Robertson, Dale, et. al., *Water Quality, Hydrology, and Simulated Response to Changes in Phosphorus Loading of Mercer Lake, Iron County, Wisconsin, with Special Emphasis on the Effects of Wastewater Discharges*. U.S. Geological Survey. Scientific Investigations Report Draft 2012.

Skogerboe, John. *Sampling of Herbicide Residuals Confirms Extended Exposure to Low Concentrations of 2,4-D and Triclopyr can Control Eurasian Watermilfoil*. Presentation at Minnesota-Wisconsin Invasive Species Conference. St. Paul, Minnesota. November 2010.

Skogerboe, John and Michael Netherland. *Draft Report Following April 2008 Aquatic Herbicide Treatments of Three Bays on Lake Minnetonka*. US Army Engineer Research and Development Center.

Surface Water Resources of Iron County, WI: WI-DNR Mercer Lake, T43N, R3E, Section 36. 1970.

University of Wisconsin-Extension. *Citizen Lake Monitoring Manual*. Revised 2006.

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

University of Wisconsin – Madison. Wisconsin State Herbarium. *WISFLORA: Wisconsin Vascular Plant Species*. www.botany.wisc.edu/wisflora/

U.S. Army Corps of Engineers. *Aquatic Plant Information System (APIS)*. 2005.

Vilas County Land and Water Conservation Department. *Aquatic Invasive Species: A Guide for Proactive & Reactive Management*. 2006.
<http://wisconsinlakes.org/AboutLakes/PDFs/aisguidevc06.pdf>

Wisconsin Department of Natural Resources. *Control of Eurasian Water Milfoil & Large-scale Aquatic Herbicide Use*. July 2006.

Wisconsin Department of Natural Resources. *Natural Heritage Inventory County Data by Township: Iron County*. Last revised November 2011.

Wisconsin Department of Natural Resources. Northern Region. *Aquatic Plant Management Strategy*. Summer 2007.

Wisconsin Department of Natural Resources. *Reports and Data: Iron County*. December 2011. <http://www.dnr.state.wi.us/lakes/CLMN/reportsanddata/>.

Wisconsin Department of Natural Resources. Lakes web site pages.
www.dnr.wi.gov/lakes/LakePages

Wisconsin Department of Natural Resources. Wisconsin Webview GIS mapping.
<http://dnrmapping.wi.gov>

Wisconsin Department of Natural Resources. *Wisconsin Lakes*. PUB-FH-800. 2009.

Appendix D. Rapid Response Strategy for Eurasian Water Milfoil

If a plant or other potential AIS is observed contact a Mercer Lake Association (MLA) Board Member. The MLA Board is responsible to carry out this protocol.

1. Contact lead (Lead is: _____)
2. Obtain a sample of the plant/organism of question from reported location. If possible, mark the GPS coordinates of the sample location OR mark with a bouy OR as a last resort use landmarks to mark location with 24 hours of reported AIS
3. Bag sample and label with date, location and refrigerate.
4. Contact and forward specimen to Iron County AIS Coordinator within 24 hours.
5. AIS Coordinator will verify specimen (with the WDNR as needed) and go on site to determine (if it is AIS) is a pioneer community or not. If credible AIS possible continue on to 6. .

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6. Lead will contact Wisconsin DNR (Jim Krietlow) within 24 hours of verification.
 7. Lead will contact all Mercer Lake Board members.
 8. Residents nearest location will be contacted with 48 hours.
 9. Sign will be posted at landings with in 72 hours.
 10. A whole specimen will be bagged and sent to UW Stevens Point Herbarium.
 11. Evaluation of a need for control measures will be evaluated with AIS Coordinator, DNR and/or consultant within 72 hours.
 12. Implement control measures.
 13. Apply for rapid response grant.

Contacts:

Lead 715-

Iron County AIS Coordinator, Heather Palmquist; 715-561-2234; lakes@ironcountywi.org

Wisconsin DNR Jim Krietlow 715-365-8947 james.kreitlow@wi.gov

Consultant/Diver Steve Schieffer 715-554-1168 ecointegrity@hotmail.com

Herbicide Applicator Cliff Schmidt 715-445-3962 (office) 715-570-0954 (cell)

Appendix E. Management Options for Aquatic Plant Management

Management Options for Aquatic Plants				
Option	Permit Needed?	How it Works	PROS	CONS
 Draft updated Oct 2006				
No Management	N	Do not actively manage plants	Minimizing disturbance can protect native species that provide habitat for aquatic fauna; protecting natives may limit spread of invasive species; aquatic plants reduce shoreline erosion and may improve water clarity No immediate financial cost No system disturbance No unintended effects of chemicals Permit not required	May allow small population of invasive plants to become larger, more difficult to control later Excessive plant growth can hamper navigation and recreational lake use May require modification of lake users' behavior and perception
Mechanical Control	May be required under NR 109	Plants reduced by mechanical means Wide range of techniques, from manual to highly mechanized	Flexible control Can balance habitat and recreational needs	Must be repeated, often more than once per season Can suspend sediments and increase turbidity and nutrient release
a. Handpulling/Manual raking	Y/N	SCUBA divers or snorkelers remove plants by hand or plants are removed with a rake Works best in soft sediments	Little to no damage done to lake or to native plant species Can be highly selective Can be done by shoreline property owners without permits within an area <30 ft wide OR where selectively removing exotics Can be very effective at removing problem plants, particularly following early detection of an invasive exotic species	Very labor intensive Needs to be carefully monitored Roots, runners, and even fragments of some species, particularly Eurasian watermilfoil (EWM) will start new plants, so all of plant must be removed Small-scale control only

Management Options for Aquatic Plants				
 Draft updated Oct 2006				
Option	Permit Needed?	How it Works	PROS	CONS
b. Harvesting	Y	Plants are "mowed" at depths of 2-5 ft, collected with a conveyor and off-loaded onto shore Harvest invasives only if invasive is already present throughout the lake	Immediate results EWM removed before it has the opportunity to autofragment, which may create more fragments than created by harvesting Minimal impact to lake ecology Harvested lanes through dense weed beds can increase growth and survival of some fish Can remove some nutrients from lake	Not selective in species removed Fragments of vegetation can re-root Can remove some small fish and reptiles from lake Initial cost of harvester expensive
Biological Control	Y	Living organisms (e.g. insects or fungi) eat or infect plants	Self-sustaining; organism will over-winter, resume eating its host the next year Lowers density of problem plant to allow growth of natives	Effectiveness will vary as control agent's population fluctuates Provides moderate control - complete control unlikely Control response may be slow Must have enough control agent to be effective
a. Weevils on EWM	Y	Native weevil prefers EWM to other native water-milfoil	Native to Wisconsin: weevil cannot "escape" and become a problem Selective control of target species Longer-term control with limited management	Need to stock large numbers, even if some already present Need good habitat for overwintering on shore (leaf litter) associated with undeveloped shorelines Bluegill populations decrease densities through predation

Management Options for Aquatic Plants				
 Draft updated Oct 2006				
Option	Permit Needed?	How it Works	PROS	CONS
b. Pathogens	Y	Fungal/bacterial/viral pathogen introduced to target species to induce mortality	May be species specific May provide long-term control Few dangers to humans or animals	Largely experimental; effectiveness and longevity unknown Possible side effects not understood
c. Allelopathy	Y	Aquatic plants release chemical compounds that inhibit other plants from growing	May provide long-term, maintenance-free control Spikerushes (<i>Eleocharis</i> spp.) appear to inhibit Eurasian watermilfoil growth	Initial transplanting slow and labor-intensive Spikerushes native to WI, and have not effectively limited EWM growth Wave action along shore makes it difficult to establish plants; plants will not grow in deep or turbid water
d. Planting native plants	Y	Diverse native plant community established to repel invasive species	Native plants provide food and habitat for aquatic fauna Diverse native community may be "resistant" to invasive species Supplements removal techniques	Initial transplanting slow and labor-intensive Nuisance invasive plants may outcompete plantings Largely experimental; few well-documented cases If transplants from external sources (another lake or nursery), may include additional invasive species or "hitchhikers"

Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
Physical Control	Required under Ch. 30 / NR 107	Plants are reduced by altering variables that affect growth, such as water depth or light levels		
a. Fabrics/ Bottom Barriers	Y	Prevents light from getting to lake bottom	Reduces turbidity in soft-substrate areas Useful for small areas	Eliminates all plants, including native plants important for a healthy lake ecosystem May inhibit spawning by some fish Need maintenance or will become covered in sediment and ineffective Gas accumulation under blankets can cause them to dislodge from the bottom Affects benthic invertebrates Anaerobic environment forms that can release excessive nutrients from sediment
b. Drawdown	Y, May require Environmental Assessment	Lake water lowered with siphon or water level control device; plants killed when sediment dries, compacts or freezes Season or duration of drawdown can change effects	Winter drawdown can be effective at restoration, provided drying and freezing occur. Sediment compaction is possible over winter Summer drawdown can restore large portions of shoreline and shallow areas as well as provide sediment compaction Emergent plant species often rebound near shore providing fish and wildlife habitat, sediment stabilization, and increased water quality Success demonstrated for reducing EWM, variable success for curly-leaf pondweed (CLP) Restores natural water fluctuation important for all aquatic ecosystems	Plants with large seed bank or propagules that survive drawdown may become more abundant upon refilling May impact attached wetlands and shallow wells near shore Species growing in deep water (e.g. EWM) that survive may increase, particularly if desirable native species are reduced Can affect fish, particularly in shallow lakes if oxygen levels drop or if water levels are not restored before spring spawning Winter drawdown must start in early fall or will kill hibernating reptiles and amphibians Navigation and use of lake is limited during drawdown

Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
c. Dredging	Y	Plants are removed along with sediment Most effective when soft sediments overlay harder substrate For extremely impacted systems Extensive planning required	Increases water depth Removes nutrient rich sediments Removes soft bottom sediments that may have high oxygen demand	Severe impact on lake ecosystem Increases turbidity and releases nutrients Exposed sediments may be recolonized by invasive species Sediment testing may be necessary Removes benthic organisms Dredged materials must be disposed of
d. Dyes	Y	Colors water, reducing light and reducing plant and algal growth	Impairs plant growth without increasing turbidity Usually non-toxic, degrades naturally over a few weeks	Appropriate for very small water bodies Should not be used in pond or lake with outflow Impairs aesthetics Effects to microscopic organisms unknown
e. Non-point source nutrient control	N	Runoff of nutrients from the watershed are reduced (e.g. by controlling construction erosion or reducing fertilizer use) thereby providing fewer nutrients available for plant growth	Attempts to correct source of problem, not treat symptoms Could improve water clarity and reduce occurrences of algal blooms Native plants may be able to better compete with invasive species in low-nutrient conditions	Results can take years to be evident due to internal recycling of already-present lake nutrients Requires landowner cooperation and regulation Improved water clarity may increase plant growth

Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
Chemical Control	Y, Required under NR 107	Granules or liquid chemicals kill plants or cease plant growth; some chemicals used primarily for algae Results usually within 10 days of treatment, but repeat treatments usually needed Chemicals must be used in accordance with label guidelines and restrictions	Some flexibility for different situations Some can be selective if applied correctly Can be used for restoration activities	Possible toxicity to aquatic animals or humans, especially applicators May kill desirable plant species, e.g. native water-milfoil or native pondweeds; maintaining healthy native plants important for lake ecology and minimizing spread of invasives Treatment set-back requirements from potable water sources and/or drinking water use restrictions after application, usually based on concentration May cause severe drop in dissolved oxygen causing fish kill, depends on plant biomass killed, temperatures and lake size and shape Often controversial
a. 2,4-D	Y	Systemic ¹ herbicide selective to broadleaf ² plants that inhibits cell division in new tissue Applied as liquid or granules during early growth phase	Moderately to highly effective, especially on EWM Monocots, such as pondweeds (e.g. CLP) and many other native species not affected Can be selective depending on concentration and seasonal timing Can be used in synergy with endothall for early season CLP and EWM treatments Widely used aquatic herbicide	May cause oxygen depletion after plants die and decompose May kill native dicots such as pond lilies and other submerged species (e.g. coontail) Cannot be used in combination with copper herbicides (used for algae) Toxic to fish

Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
b. Endothall	Y	<p>Broad-spectrum³, contact⁴ herbicide that inhibits protein synthesis</p> <p>Applied as liquid or granules</p>	<p>Especially effective on CLP and also effective on EWM</p> <p>May be effective in reducing reestablishment of CLP if reapplied several years in a row in early spring</p> <p>Can be selective depending on concentration and seasonal timing</p> <p>Can be combined with 2,4-D for early season CLP and EWM treatments, or with copper compounds</p> <p>Limited off-site drift</p>	<p>Kills many native pondweeds</p> <p>Not as effective in dense plant beds; heavy vegetation requires multiple treatments</p> <p>Not to be used in water supplies; post-treatment restriction on irrigation</p> <p>Toxic to aquatic fauna (to varying degrees)</p>
c. Diquat	Y	<p>Broad-spectrum, contact herbicide that disrupts cellular functioning</p> <p>Applied as liquid, can be combined with copper treatment</p>	<p>Mostly used for water-milfoil and duckweed</p> <p>Rapid action</p> <p>Limited direct toxicity on fish and other animals</p>	<p>May impact non-target plants, especially native pondweeds, coontail, elodea, naiads</p> <p>Toxic to aquatic invertebrates</p> <p>Must be reapplied several years in a row</p> <p>Ineffective in muddy or cold water (<50°F)</p>
d. Fluridone	Y; special permit and Environmental Assessment may be required	<p>Broad-spectrum, systemic herbicide that inhibits photosynthesis</p> <p>Must be applied during early growth stage</p> <p>Available with a special permit only; chemical applications beyond 150 ft from shore not allowed under NR 107</p> <p>Applied at very low concentration at whole lake scale</p>	<p>Effective on EWM for 1 to 4 years with aggressive follow-up treatments</p> <p>Some reduction in non-target effects can be achieved by lowering dosage</p> <p>Slow decomposition of plants may limit decreases in dissolved oxygen</p> <p>Low toxicity to aquatic animals</p>	<p>Affects non-target plants, particularly native milfoils, coontails, elodea, and naiads, even at low concentrations</p> <p>Requires long contact time at low doses: 60-90 days</p> <p>Demonstrated herbicide resistance in hydrilla subjected to repeat treatments</p> <p>In shallow eutrophic systems, may result in decreased water clarity</p> <p>Unknown effect of repeat whole-lake treatments on lake ecology</p>

Management Options for Aquatic Plants



Draft updated Oct 2006

Option	Permit Needed?	How it Works	PROS	CONS
e. Glyphosate	Y	<p>Broad-spectrum, systemic herbicide that disrupts enzyme formation and function</p> <p>Usually used for purple loosestrife stems or cattails</p> <p>Applied as liquid spray or painted on loosestrife stems</p>	<p>Effective on floating and emergent plants such as purple loosestrife</p> <p>Selective if carefully applied to individual plants</p> <p>Non-toxic to most aquatic animals at recommended dosages</p> <p>Effective control for 1-5 years</p>	<p>RoundUp is often incorrectly substituted for Rodeo - Associated surfactants of RoundUp believed to be toxic to reptiles and amphibians</p> <p>Cannot be used near potable water intakes</p> <p>Ineffective in muddy water</p> <p>No control of submerged plants</p>
f. Triclopyr	Y	<p>Systemic herbicide selective to broadleaf plants that disrupts enzyme function</p> <p>Applied as liquid spray or liquid</p>	<p>Effective on many emergent and floating plants</p> <p>More effective on dicots, such as purple loosestrife; may be more effective than glyphosate</p> <p>Control of target plants occurs in 3-5 weeks</p> <p>Low toxicity to aquatic animals</p> <p>No recreational use restrictions following treatment</p>	<p>Impacts may occur to some native plants at higher doses (e.g. coontail)</p> <p>May be toxic to sensitive invertebrates at higher concentrations</p> <p>Retreatment opportunities may be limited due to maximum seasonal rate (2.5 ppm)</p> <p>Sensitive to UV light; sunlight can break herbicide down prematurely</p> <p>Relatively new management option for aquatic plants (since 2003)</p>
g. Copper compounds	Y	<p>Broad-spectrum, systemic herbicide that prevents photosynthesis</p> <p>Used to control planktonic and filamentous algae</p> <p>Wisconsin allows small-scale control only</p>	<p>Reduces algal growth and increases water clarity</p> <p>No recreational or agricultural restrictions on water use following treatment</p> <p>Herbicidal action on hydrilla, an invasive plant not yet present in Wisconsin</p>	<p>Elemental copper accumulates and persists in sediments</p> <p>Short-term results</p> <p>Long-term effects of repeat treatments to benthic organisms unknown</p> <p>Toxic to invertebrates, trout and other fish, depending on the hardness of the water</p> <p>Clear water may increase plant growth</p>

¹Systemic herbicide - Must be absorbed by the plant and moved to the site of action. Often slower-acting than contact herbicides.
²Broadleaf herbicide - Affects only dicots, one of two groups of plants. Aquatic dicots include waterlilies, bladderworts, watermilfoils, and coontails.
³Broad-spectrum herbicide - Affects both monocots and dicots.
⁴Contact herbicide - Unable to move within the plant; kills only plant tissue it contacts directly.
 Specific effects of herbicide treatments dependent on timing, dosage, duration of treatment, and location.
 References to registered products are for your convenience and not intended as an endorsement or criticism of that product versus other similar products.
This document is intended to be a guide to available aquatic plant control techniques, and is not necessarily an exhaustive list.
Please contact your local Aquatic Plant Management Specialist when considering a permit.

Appendix F. Shoreline Assessment Results/Template for further study

Shoreline Inventory Key

Canopy, Ground Cover, shoreline substrate, yard slope

0 = none

1 = up to 10%

2 = 11 to 25%

3 = 26 to 50%

4 = > 50%

Human Influence if noted is a 1

Buffer Width

0 = none

1 = 1-5'

2 = 5-15'

3 = 15-35',

4 =>35'

Unprotected = unprotected shoreline percentage

PS	Photo1	Photo2	Photo3	Photo4	Canopy	Cyard	Cbuffer	Understory	Woody	Grasses	Ground	Gwoody	Ggrasses	Gbare	Gerosion	Substrate	Gravel	Sand	Muck	Organic	Slope Yard	Slope Buffer	Influence	Building	Docks	Walls/Ritrap	Lawn to Shoreline	Beach Area	Mitigation	Restoration	Buffer Width	Unprotected	Comments	Rating
001	1	2			D	4	4	D	4	4		4	4	1	1		0	0	2	2	2	1		1	1	0	0	0	0	4	15%		15.0	
002	2				M	1	1	M	2	2		2	2	0	0		0	0	2	2	1	0		1	0	0	1	0	0	2	10%		7.0	
003	3	4	5		M	4	4	M	4	4		4	4	0	0		0	0	2	2	1	1		0	1	0	0	0	0	4	0%		21.0	
004	6	-			M	3	2	M	4	4		4	4	0	0		0	0	2	2	1	0		0	1	0	0	0	0	3	10%		18.5	
005	7	8			M	4	4	M	4	4		4	4	0	0		0	0	2	2	1	1		0	1	0	0	0	0	4	0%		21.0	
006	9	10			M	1	4	M	4	4		4	4	0	0		0	0	2	2	1	0		0	1	0	1	0	0	4	50%		14.5	
007	11				M	3	0	D	0	1		0	2	0	0		0	0	2	2	1	0		0	1	0	0	0	0	1	30%		0.5	
008	12				M	4	0	D	0	0		0	2	0	0		0	0	2	2	2	0		0	1	0	0	0	0	1	50%		-3.0	
009	13				M	4	4	D	0	0		0	2	0	0		0	0	2	2	3	2		0	1	0	0	0	0	1	50%		-4.0	
010	14				M	3	3	D	0	0		0	2	0	0		0	0	2	2	3	2		0	1	1	0	0	0	1	90%		-10.0	

011	15				C	1	1	D	1	0		0	0	0	0	0	0	2	2	2	1		0	1	1	1	0		0	0	100%		-14.0
012	16				M	3	3	D	0	0		0	0	0	0	0	0	2	2	2	1		0	1	1	1	0		0	0	100%		-13.0
013	17	18	19		M	3	3	D	1	0		0	0	0	0	0	0	2	2	2	1		0	1	1	1	0		0	0	90%		-11.0
014	20	-			D	3	4	D	1	0		0	0	0	0	0	0	2	2	2	1		0	1	1	1	0		0	0	90%		-10.5
015	21	-			M	2	2	M	0	0		0	0	0	0	0	0	2	2	2	1		1	1	0	1	0		0	0	100%		-14.0
016	22	-			M	4	4	M	1	0		0	0	0	0	0	0	2	2	3	1		0	1	0	1	0		0	0	100%		-11.0
017	23				M	2	2	M	1	0		0	0	0	0	0	0	2	2	2	1		0	1	1	1	0		0	0	100%		-13.0
018	24				M	2	2	D	1	0		0	0	0	0	0	0	2	2	2	1		0	1	1	1	0		0	0	100%		-13.0
019	25	-	-	-	M	4	2	D	1	0		0	0	0	0	0	0	2	2	2	1		0	1	0	1	0		0	0	100%		-11.0
020	26	-			M	2	2	D	1	0		0	0	0	0	0	0	2	2	2	1		0	1	0	1	0		0	0	100%		-12.0
021	27	28	-		M	2	2	D	0	0		0	0	0	0	0	0	2	2	2	1		0	1	0	1	0		0	0	100%		-13.0
022	29	-	-		M	2	1	D	0	0		0	0	0	0	0	0	2	2	2	1		0	1	0	1	0		0	0	100%		-13.5

034	53	-	-		M	4	4	M	4	4		4	4	0	0		0	0	2	2	2	2		0	1	0	0	0		0	4	0%		19.0
035	54	-	-		M	3	2		3	3		3	4	0	0		0	2	0	2	2	1		0	1	0	0	0		0	4	20%		13.5
036	55	56			M	2	1		1	1		1	1	0	0		0	2	0	2	2	1		0	1	0	1	1		0	1	70%		-6.5
037	57	58	59		M	4	3		3	3		1	1	0	0		0	2	0	2	2	1		0	1	0	1	0		0	4	25%		8.0
038	60	-			M	4	3	M	3	3		2	1	0	0		0	2	0	2	2	1		1	1	0	1	0		0	4	50%		5.5
039	61	62			M	4	4	M	4	4		4	4	0	0		0	2	0	2	2	2		0	1	0	0	0		0	4	0%		19.0
040	63	64			M	4	4	M	4	4		4	4	0	0		0	1	2	1	2	2		0	1	0	0	0		0	4	0%		19.0
041	65				M	4	4	M	4	4		4	4	0	0		0	1	2	1	2	2		0	1	0	0	0		0	4	0%		19.0
042	66	-	-		M	3	4	M	4	4		4	4	2	1		0	1	2	1	2	1		0	1	0	0	0		0	4	10%		15.0
043	67	68			M	3	3	M	1	1		1	1	1	1		0	0	2	2	3	1		0	1	1	0	0		0	2	30%		-2.5
044	69	70	-		M	4	4	M	4	4		4	4	0	0		0	0	2	2	3	1		0	1	0	0	0		1	4	5%	G e o r g e S i m a t o v i c h	18.5

045	71	72	-	M	0	0	M	0	0	0	0	0	0	0	0	2	2	2	1	0	1	1	1	0	0	0	100%	-	16.0	
046	73	74	-	M	2	2	M	2	2	2	2	0	0	0	0	2	2	2	1	0	1	1	0	0	1	2	30%	Doug Knudtson	4.0	
047	75	76	77	M	4	4	M	4	4	4	4	0	0	0	0	2	2	2	2	0	1	0	0	0	0	4	0%		19.0	
048	78	79	80	81	M	1	4	M	3	3	2	2	4	4	0	0	2	2	3	3	0	1	0	0	0	0	2	20%		-4.5
049	82	83		M	4	4	M	4	4	4	4	0	0	0	0	2	2	2	2	0	1	0	0	0	0	4	0%		19.0	
050	84	85		M	4	4	M	4	4	4	4	2	2	0	0	2	2	2	2	0	1	0	0	0	0	4	10%		13.0	
051	86	-		M	4	4	M	4	4	4	4	0	0	0	0	2	2	2	2	0	0	0	0	0	0	4	0%		20.0	
052	87	88		M	4	4	M	4	4	4	4	1	1	0	0	2	2	2	2	0	1	0	0	0	0	4	10%		15.5	
053	89	90	91	M	4	4	M	4	4	4	4	0	0	0	0	2	2	2	2	0	0	0	0	0	0	4	0%		20.0	
054	92	93	94	M	4	4	M	4	4	4	4	0	0	0	0	2	2	3	2	0	1	0	0	0	0	4	5%		17.5	
055	95	96		M	4	4	M	4	4	4	4	0	0	0	0	2	2	3	2	0	0	0	0	0	0	4	0%		19.0	

056	97	98	99		M	4	4	M	4	4		4	4	0	0		0	0	2	2	3	2		0	1	0	0	0		0	4	5%		17.5
057	100	101			M	4	4	M	4	4		2	2	0	0		0	0	2	2	3	2		0	1	0	0	0		0	4	5%		13.5
058	102	103			M	4	4	M	4	4		3	3	0	0		0	0	2	2	3	2		0	0	0	0	0		0	4	0%		17.0
059	104	105			M	4	4	M	4	4		3	3	0	0		0	0	2	2	3	2		0	0	0	0	0		0	4	0%		17.0
060	106	107			M	4	4	M	4	4		4	4	2	1		0	0	2	2	2	2		0	1	0	0	0		0	4	10%		14.5
061	108				M	4	4	M	4	4		3	3	0	0		0	0	2	2	3	2		0	0	0	0	0		0	4	5%		16.5
062	109	110			M	4	4	M	4	4		4	4	1	1		0	2	1	1	3	2		0	1	0	0	0		0	4	30%		12.5
063	111	112	113	114	M	4	4	M	4	4		4	4	1	1		0	2	1	1	2	2		0	1	0	0	0		0	4	10%		15.5
064	115	116	117		M	4	4	M	4	4		4	4	0	0		0	1	1	2	3	2		0	0	0	0	0		0	4	0%		19.0
065	118	119			M	4	4	M	4	4		4	4	0	0		0	2	1	1	3	2		0	0	0	0	0		0	4	0%		19.0
066	120	121			M	4	4	M	4	4		4	4	0	0		0	0	3	1	3	2		0	0	0	0	0		0	4	0%		19.0
067	122				M	4	4	M	4	4		4	4	0	0		0	1	3	0	3	2		0	0	0	0	0		0	4	0%		19.0

068	1 2 3	1 2 4	1 2 5		M	4	4	M	2	2		2	2	2	2		1	2	1	0	3	2		0	1	0	0	0		0	3	2 0 %		2.0
069	1 2 6	1 2 7	1 2 8		M	4	4	M	2	2		2	2	2	2		1	2	1	0	3	2		0	1	0	0	0		0	3	4 0 %		0.0
070	1 2 9	1 3 0			M	4	4	M	4	4		4	4	0	0		0	0	1	3	3	2		0	1	0	0	0		0	4	0 %		18.0
071	1 3 1	1 3 2			M	4	4	M	4	4		4	4	1	1		0	0	1	3	2	1		0	1	0	0	0		0	4	2 5 %		15.0
072	1 3 3	1 3 4	1 3 5		M	4	4	M	4	4		4	4	2	2		0	0	1	3	2	2		0	1	0	0	0		0	4	3 5 %		10.5
073	1 3 6	1 3 7	1 3 8		M	4	4	M	2	1		1	2	3	3		0	0	1	2	2	2		0	1	0	0	0		0	2	2 0 %		-2.5
074	1 3 9	1 4 0			M	4	4	M	3	1		1	2	2	2		0	0	1	3	2	2		0	1	0	0	0		0	1	3 0 %		-1.0
075	1 4 1	1 4 2			M	4	4	M	1	1		1	2	3	3		0	0	1	3	2	1		0	1	0	0	0		0	2	2 0 %		-2.5
076	1 4 3	1 4 4			M	3	4		2	2		2	2	0	0		0	0	1	3	1	1		0	1	0	0	0		0	3	3 0 %		8.5
077	1 4 5	1 4 6			M	1	1		1	1		2	1	0	0		0	0	1	3	1	1		0	1	1	0	0		0	1	1 0 0 %		-7.0
078	1 4 7				M	4	4		3	3		3	3	1	1		0	0	1	3	3	1		0	1	0	0	0		0	1	5 0 %		4.5
079	1 4 8	1 4 9	1 5 0	1 5 1	M	4	4		4	4		4	4	1	1		0	0	1	3	3	2		0	1	0	0	0		0	4	1 0 %		14.5

080	152	153	154		M	4	4		4	4		4	4	1	1		0	0	1	3	3	2		0	0	0	0	0		0	4	0%		16.5
081	155	156			M	4	4		4	4		4	4	1	1		0	0	1	3	1	1		0	0	0	0	0		0	4	0%		19.5
082	157	158	159		M	4	4		3	4		3	4	1	1		0	0	1	3	3	1		0	1	0	0	0		0	4	10%		13.5
083	160	161	162		M	2	3		4	4		4	4	0	0		0	0	1	3	3	3		0	1	0	0	0		0	4	10%		14.5
084	163	164	165		M	4	3		4	4		4	4	0	0		0	0	1	3	3	3		0	0	0	0	0		0	4	0%		17.5
085	166	167	168		M	4	4		3	3		3	4	1	1		0	0	1	3	2	1		1	1	0	0	0		0	4	40%		9.5
086	169	170	171		M	4	4	M	1	1		1	2	2	2		0	1	2	1	1	1		0	1	0	0	0		2	30%		0.0	
087	172	173	174	175	M	4	4	M	1	4		2	4	1	1		0	1	2	1	2	1		0	1	0	0	0		4	30%		9.5	
088	176	177	178		M	4	4	M	3	3		3	3	0	0		0	1	2	1	2	1		0	1	0	0	0		4	30%		13.0	
089	179	180	181		M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	1	0	1	0		4	25%		19.5	
090	182	183			M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%		24.0	
091	184	185	186		M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%		24.0	

092	187	188	189		M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%	24.0
093	190	191	192		M	4	4	M	4	4		4	4	2	2		0	1	2	1	3	1		0	1	1	0	0		4	20%	11.0
094	193	194	195		M	4	4	M	4	4		4	4	2	1		0	1	2	1	3	1		0	0	0	0	0		4	10%	15.5
095	196	197	198		M	4	4	M	1	1		1	3	0	0		0	1	2	1	2	1		0	1	1	0	0		1	20%	4.0
096	199	200			M	4	4	M	4	4		4	4	0	0		0	1	2	1	1	1		0	1	0	0	0		4	5%	20.5
097	201	202			M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%	24.0
098	203	204	205	206	M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%	24.0
099	207	208	209	210	M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%	24.0
100																	0	1	2	1											0.0	
101	211	212			M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%	24.0
102	213				M	4	4	M	4	4		4	4	0	0		0	1	2	1	0	0		0	0	0	0	0		4	0%	24.0
103	214	215	216		M	4	4	M	4	4		4	4	0	0		1	0	2	1	0	0		0	0	0	0	0		4	0%	24.0

104	217				M	4	4	M	4	4		4	4	0	0	1	0	2	1	1	1		0	0	0	0	0			4	5%	21.5
105	218	219	220		M	4	4	M	4	4		4	4	0	0	0	0	2	2	0	0		0	0	0	0	0			4	0%	24.0
106	221	222			M	4	4	M	4	4		4	4	0	0	0	0	2	2	0	0		0	0	0	0	0			4	0%	24.0
107	223				M	4	4	M	4	4		4	4	0	0	0	0	2	2	0	0		0	0	0	0	0			4	0%	24.0
108	224	225	226	227	M	4	4	M	4	4		4	4	0	0	0	0	2	2	0	0		0	0	0	0	0			4	0%	24.0
109	228	229	230	231	M	4	4	M	4	4		4	4	0	0	0	0	2	2	0	0		0	0	0	0	0			4	0%	24.0
110	232	233	234	235	M	4	4	M	4	4		4	4	0	0	0	0	2	2	0	0		0	0	0	0	0			4	0%	24.0
111	236	237	238		M	1	1	M	0	0		0	1	0	0	0	0	2	2	0	1		0	1	1	0	0			1	80%	-8.0
112	239	240			M	4	4	M	4	4		4	4	0	0	0	0	2	2	0	0		0	0	0	0	0			4	0%	24.0
113	241				M	2	3	M	4	4		4	4	0	0	0	0	2	2	1	0		0	1	0	0	0			4	5%	20.0
114	242	243			M	2	3	M	4	4		4	4	0	0	0	0	2	2	2	1		0	1	0	0	0			4	5%	18.0
115	244	245	246		M	3	2	M	4	4		4	4	0	0	0	0	2	2	3	1		0	1	0	0	0			4	20%	15.5

116	247	248	249		M	3	4	M	4	2		2	4	0	0		0	0	2	2	3	1		1	1	0	0	0			3	20%		10.5
117	250	251			M	4	4	M	4	4		4	4	0	0		0	0	2	2	3	1		0	0	0	0	0			4	0%		20.0
118	252				M	0	0	M	0	1		0	1	0	0		0	0	2	2	1	1		0	1	0	0	0			0	100%	Boat Landing	-11.0
119	253	254	255	256	M	4	4	M	4	4		4	4	0	0		0	0	2	2	2	1		0	0	0	0	0			4	10%		20.0
120	257	259			M	0	0	M	0	0		0	0	0	0		0	0	2	2	1	0		0	1	0	1	0			0	100%		-13.0
121	258				M	3	1	M	0	0		0	0	0	0		0	0	2	2	1	0		0	1	0	1	0			1	50%		-5.0
122	260	261	262		M	4	4	M	4	4		4	4	0	0		0	0	2	2	2	1		0	1	0	0	0			4	20%		18.0

Shoreland Survey

Lake Name:

Waypoint number (or range):

Within 35 feet of Ordinary High Water

<u>Vegetation</u>	<u>0-15</u>	<u>15-35</u>	<u>70-100%</u>	<u>30-70%</u>	<u>0-30%</u>
Canopy (>15 ft high)	1	1	2	1	0
Understory (1-15 ft high)	1	1	2	1	0
Woody shrubs and saplings	1	1	2	1	0
Native herbs, grasses, forbs	1	1	2	1	0
Wetlands	1	1			
Organic (leaf pack, detritus)	1	1			
Woody structure at water interface	2				
					Total pts <input type="text"/>

<u>Human Influence</u>		<u>0-15</u>	<u>15-35</u>
Artificial beach		-1	-1
Seawall		-2	-2
Rip-rap		-1	-1
Dock / pier at water		-1	
Boat landing		-1	-1
Mowed lawn		-1	-1
Barren, bare dirt		-2	-2
			Total pts <input type="text"/>

<u>Type</u>	<u>Erosion</u>	
None	1	1
Undercut banks/slumping	-3	-3
Furrow/gullies	-5	-5

<u>Erosion Length</u>		
<21 Feet	-1	-1
21-60 Feet	-2	-2
>60 Feet	-3	-3

<u>Slope</u>			
Flat (<10%)	3	3	
Moderate (10-25%)	2	2	
Steep (>25%)	1	1	
			Total pts <input type="text"/>

Within 75 feet of Ordinary High Water

<u>Buildings</u>	<u>0-35</u>	<u>35-75</u>	
Principal Structure	-3	-2	
Detached Deck/Patio/Gazebo/Boathouse	-2	-1	
Other Accessory Building/Impervious	-1	0	
			Total pts <input type="text"/>

<u>Land use</u>		
Residential	Yes	No
Cropland	Yes	No
Fallow	Yes	No
Forest	Yes	No

Mark on Map

Approx location of waypoint

Erosion (if any)

Grand Total

Appendix G. Funding options

Potential Funding Sources for Aquatic Invasive Species Monitoring, Planning, etc.

Grant Program: AIS Grant

Wisconsin Department of Natural Resources

Program Goals/Objectives: control aquatic invasive species

Eligible Applicants: Qualified lake and river management organizations and qualified school districts

Eligible Project Elements: education, prevention, and planning; early detection and response; controlling established infestations

Funding limits and rate: 75% of project costs up to \$75,000 for education, prevention, planning and controlling established infestations; 75% of project costs up to \$10,000 for early detection and rapid response

Application Deadline: February 1st of each year

Grant Program: Lake Planning

Wisconsin Department of Natural Resources

Program Goals/Objectives: collect information in order to manage lakes

Eligible Applicants: Qualified lake and local government organizations; qualified school districts

Eligible Project Elements: Monitoring and education; organization development; studies or assessments.

Funding limits and rate: Small scale-75% share costs with a cap of \$3000; large scale-75% share costs with a cap of \$10,000.

Application Deadline: Feb 1st and August 1st of each year.

Potential Funding Sources for Watershed Practices

SHORELINE BUFFERS AND INFILTRATION PRACTICES

Grant Program: Lake Protection

Wisconsin Department of Natural Resources

Program Goals/Objectives: lake protection and restoration

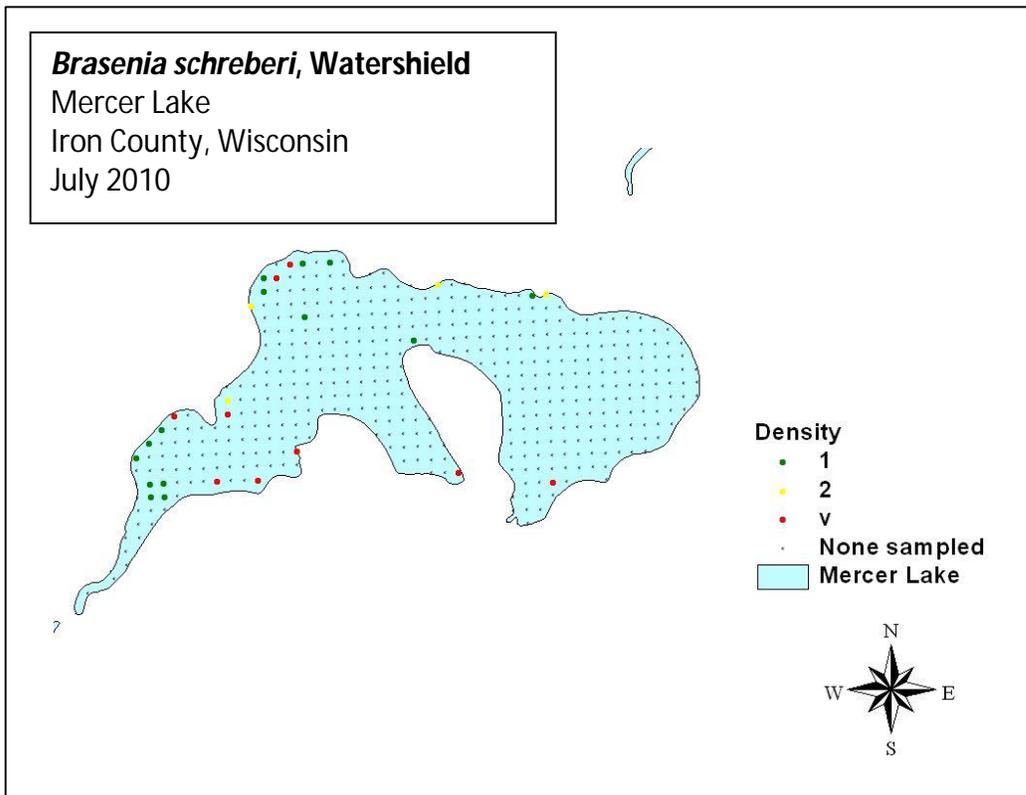
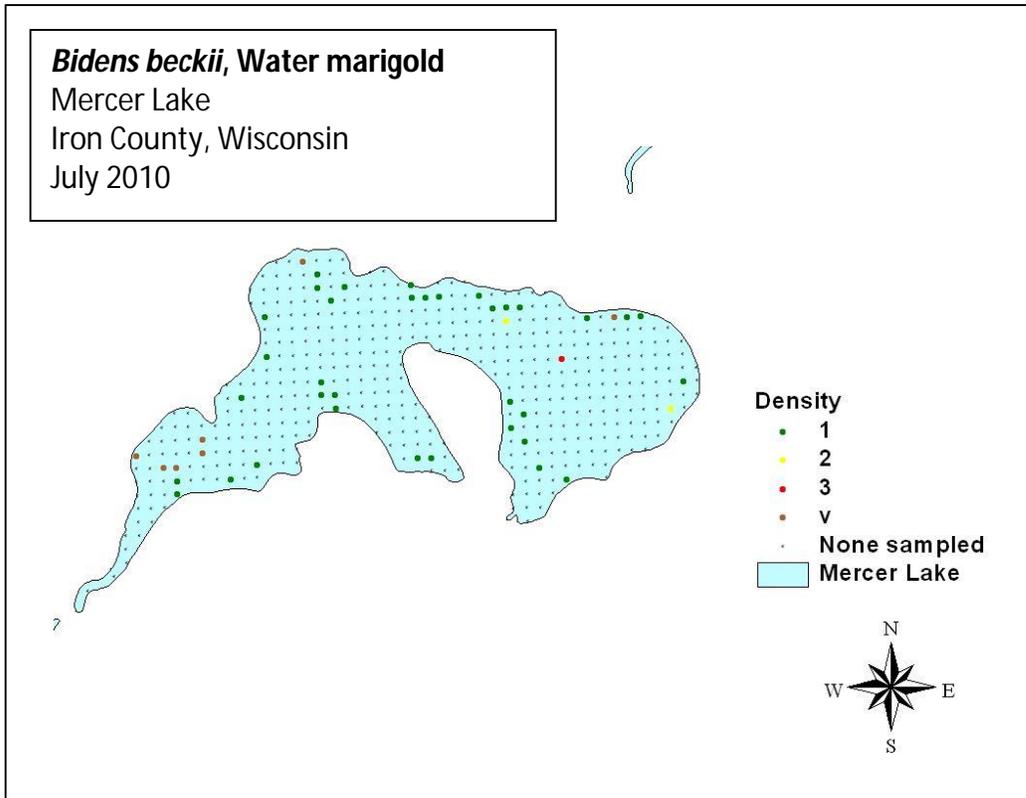
Eligible Applicants: Qualified lake and conservation organizations

Eligible Project Elements: plans and specifications, earth moving and structure removal, native plants and seeds, monitoring costs

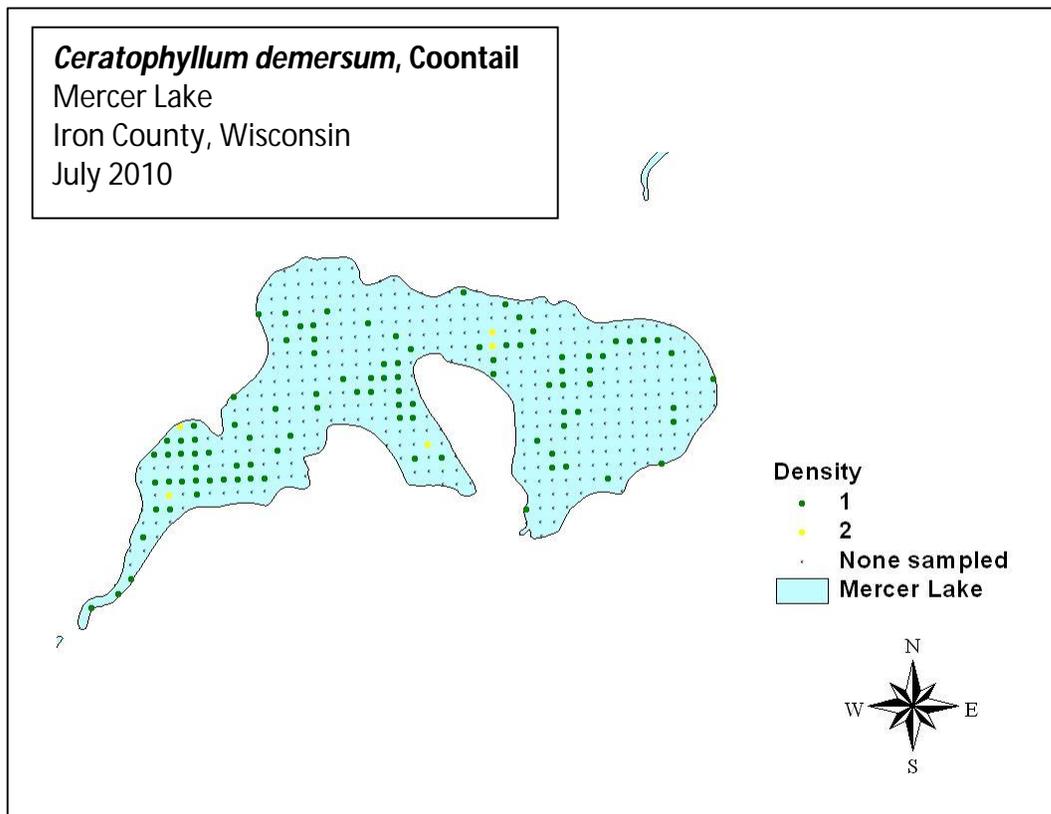
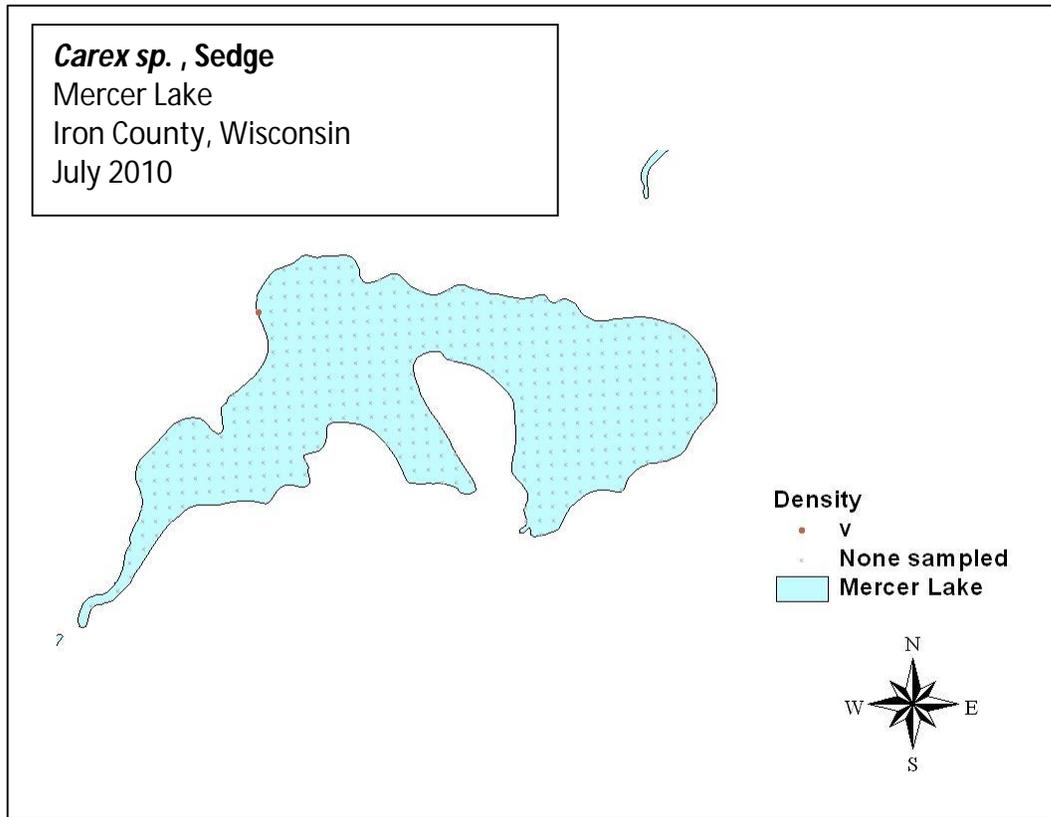
Funding Limits and Rates: 75 % of project costs up to \$100,000

Application Deadline: May 1st each year

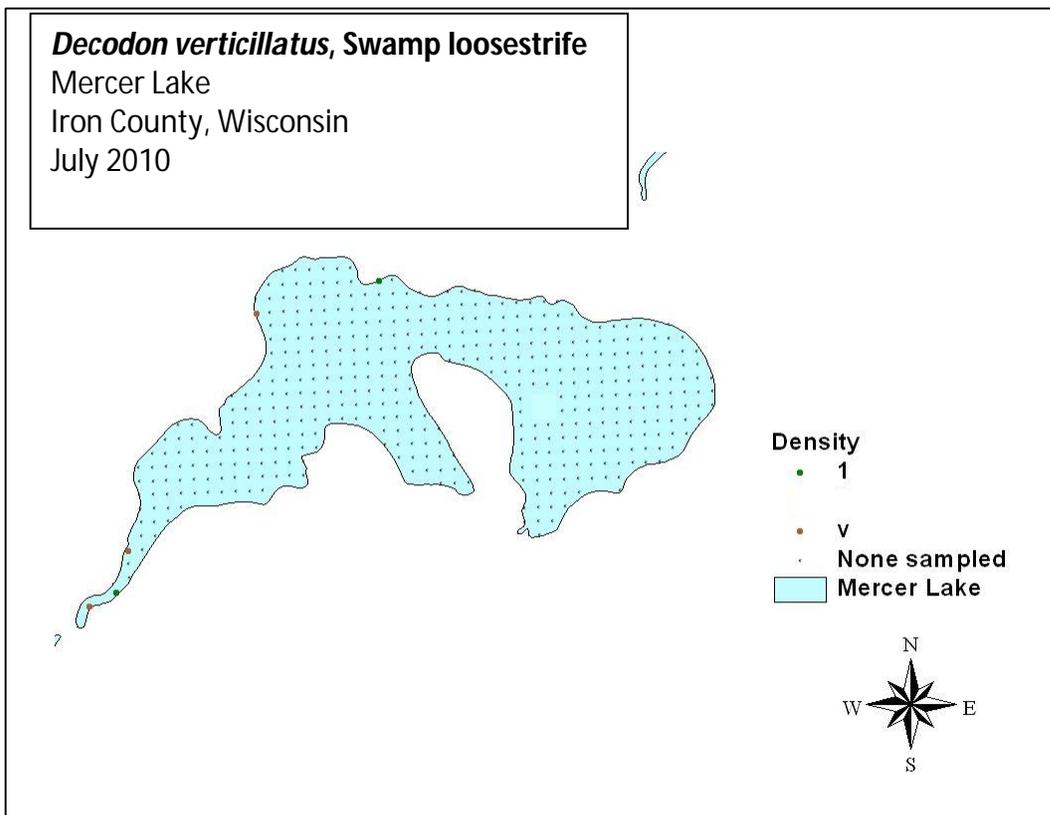
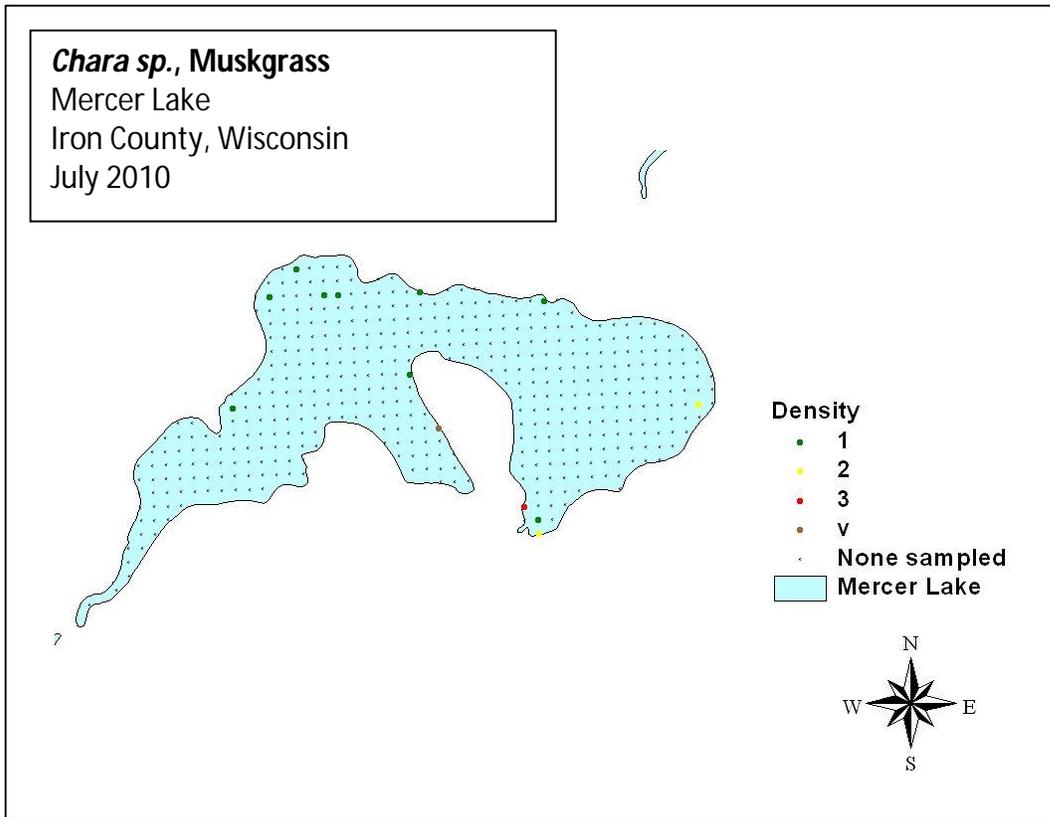
Appendix H-Aquatic macrophyte distribution maps



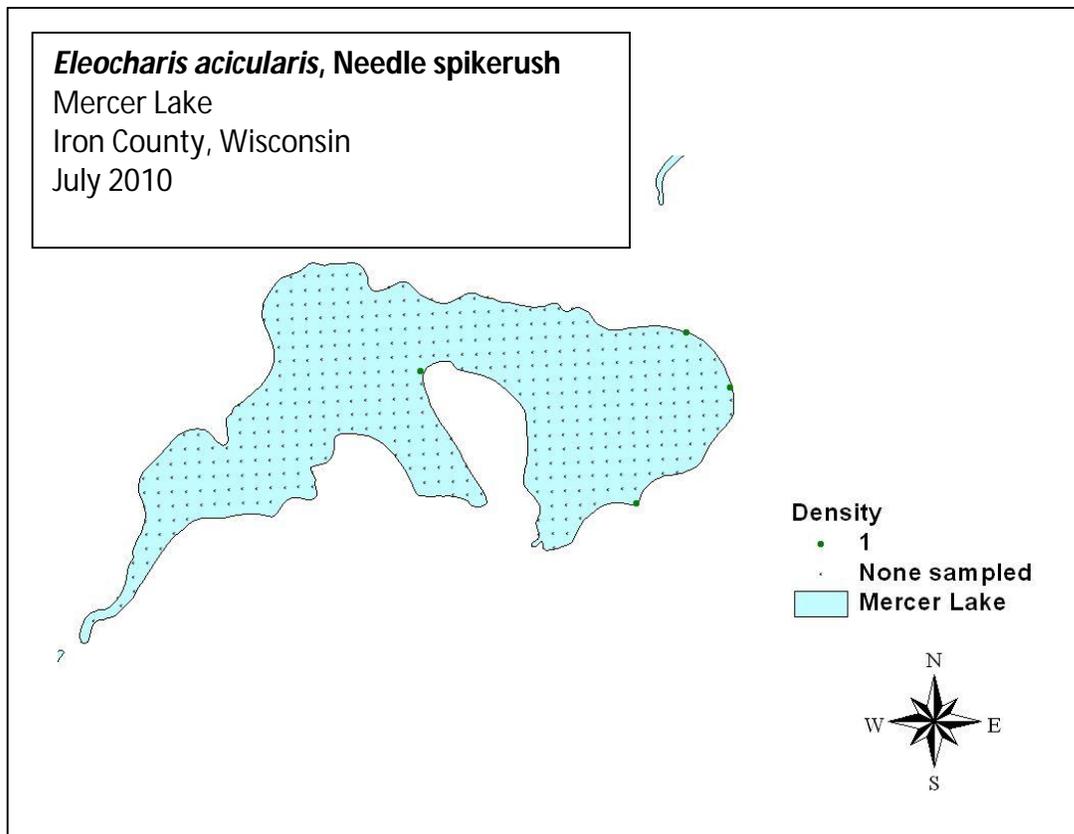
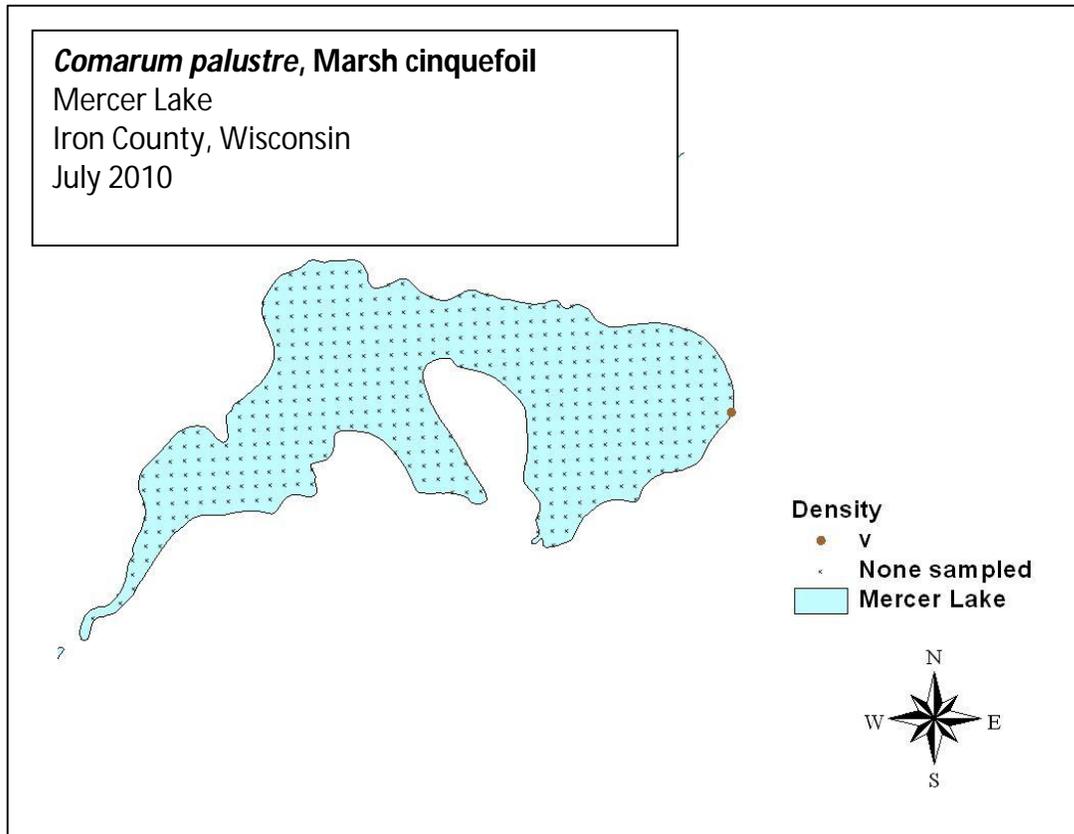
Appendix H-Aquatic macrophyte distribution maps



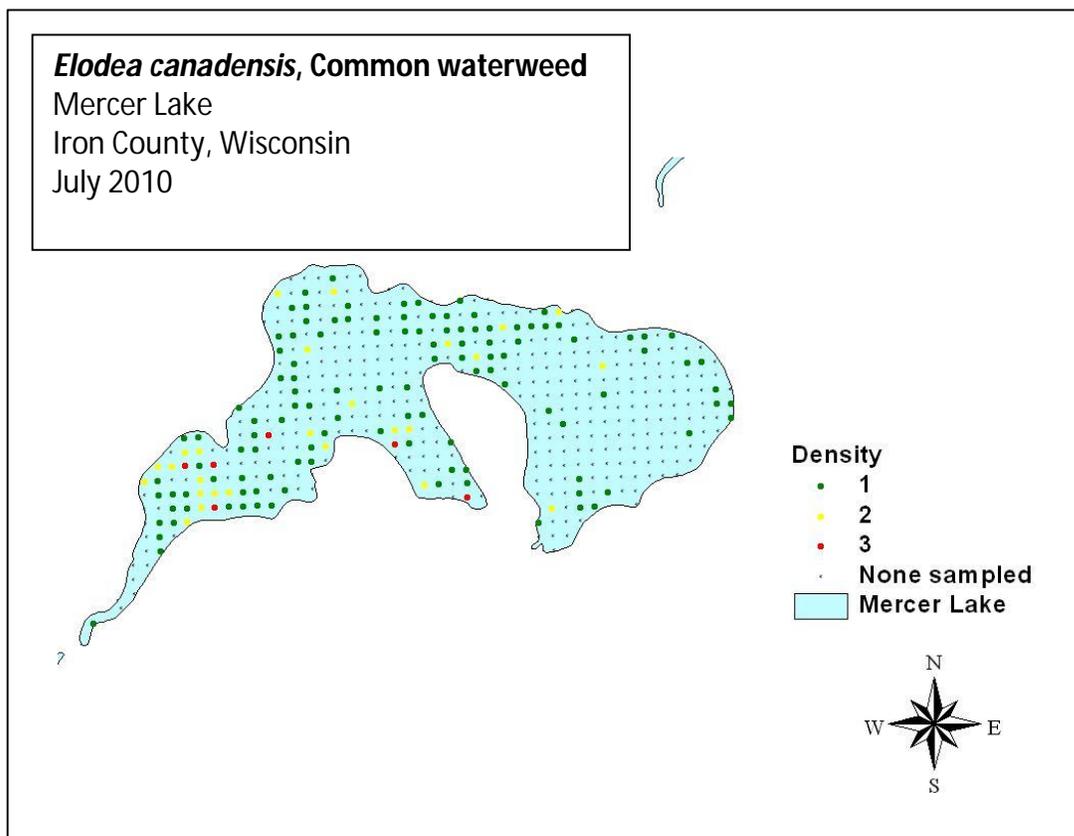
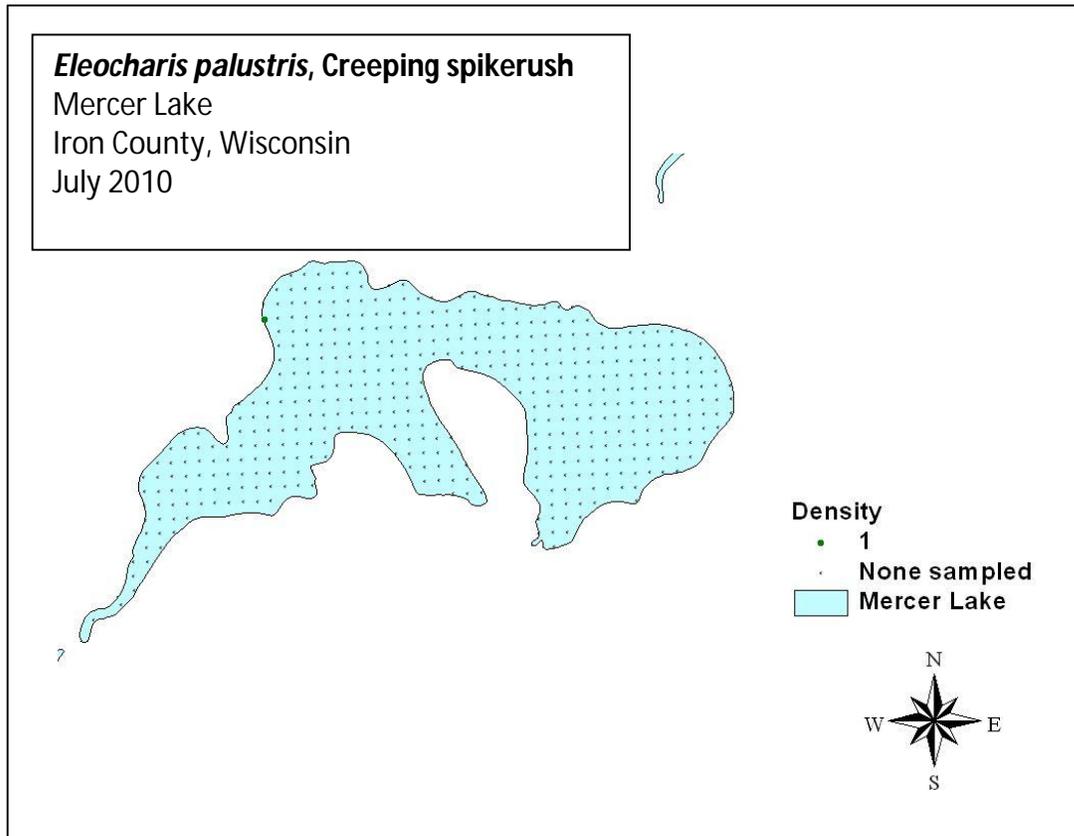
Appendix H-Aquatic macrophyte distribution maps



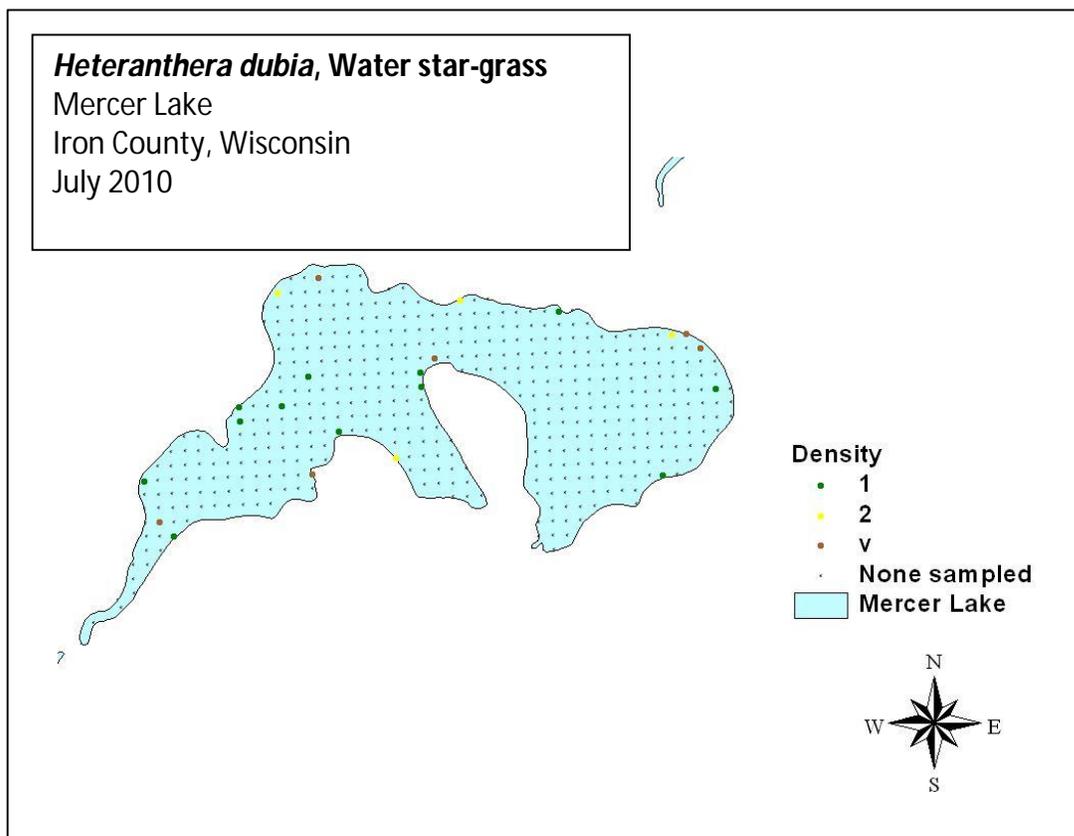
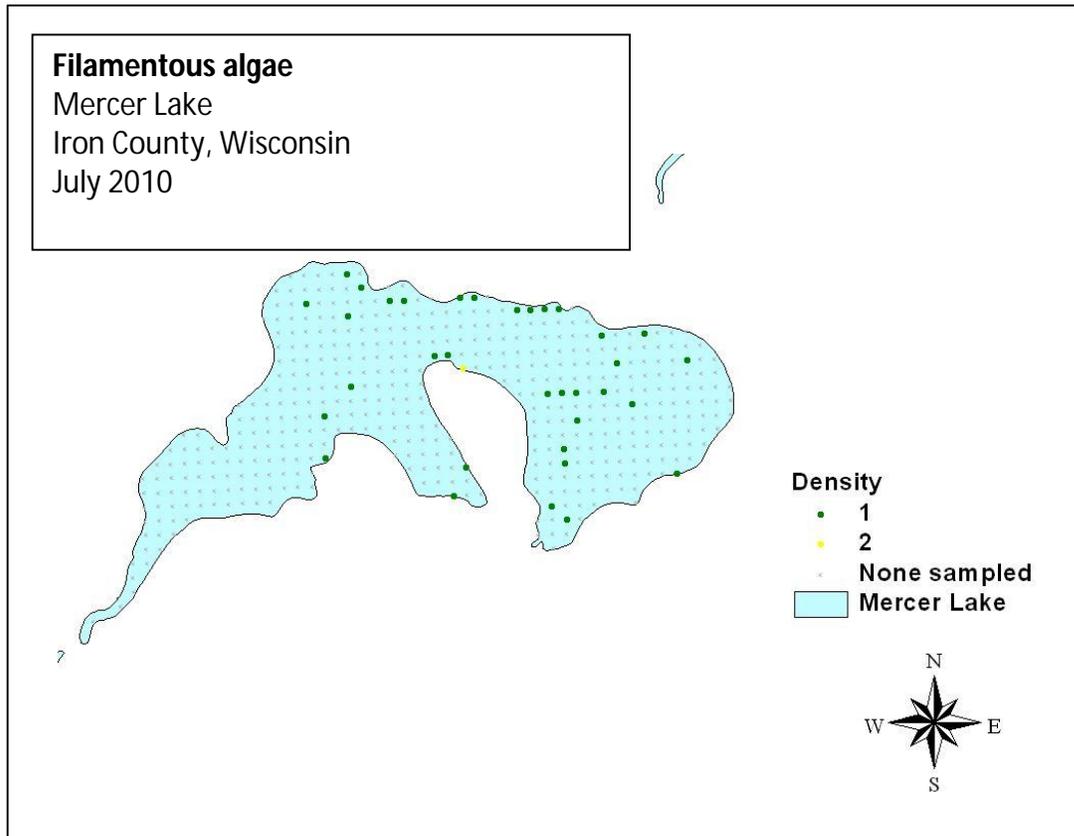
Appendix H-Aquatic macrophyte distribution maps



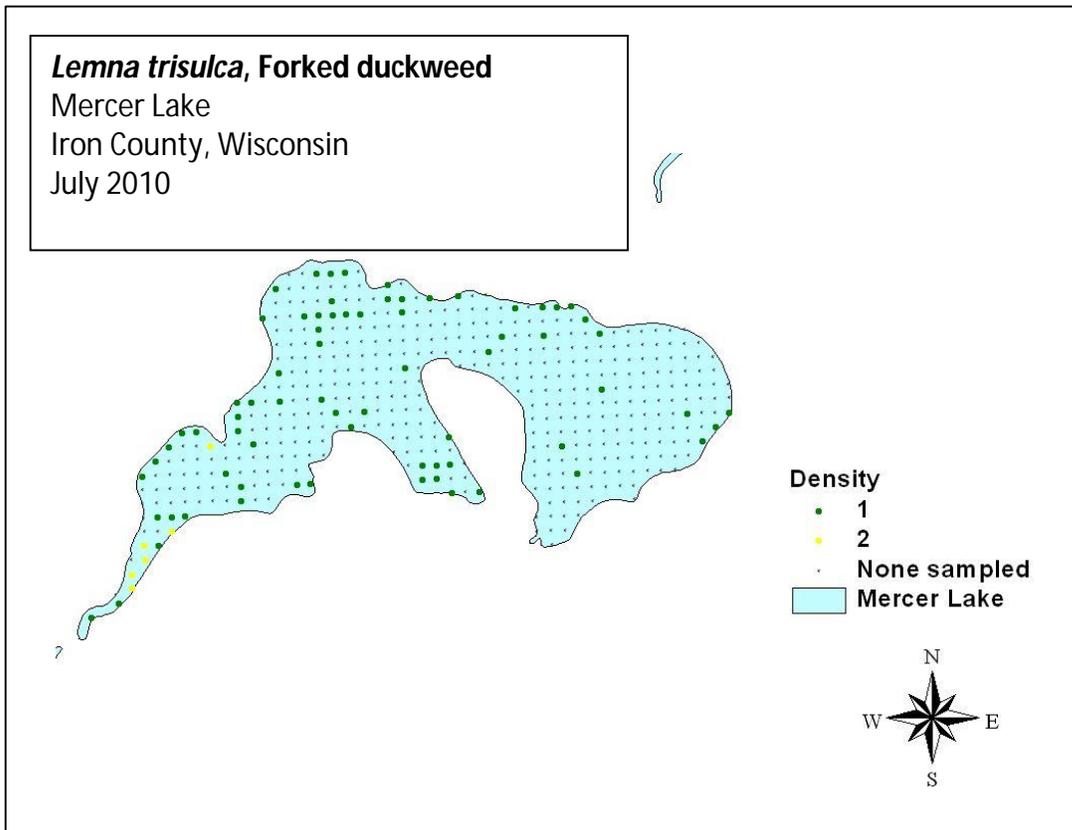
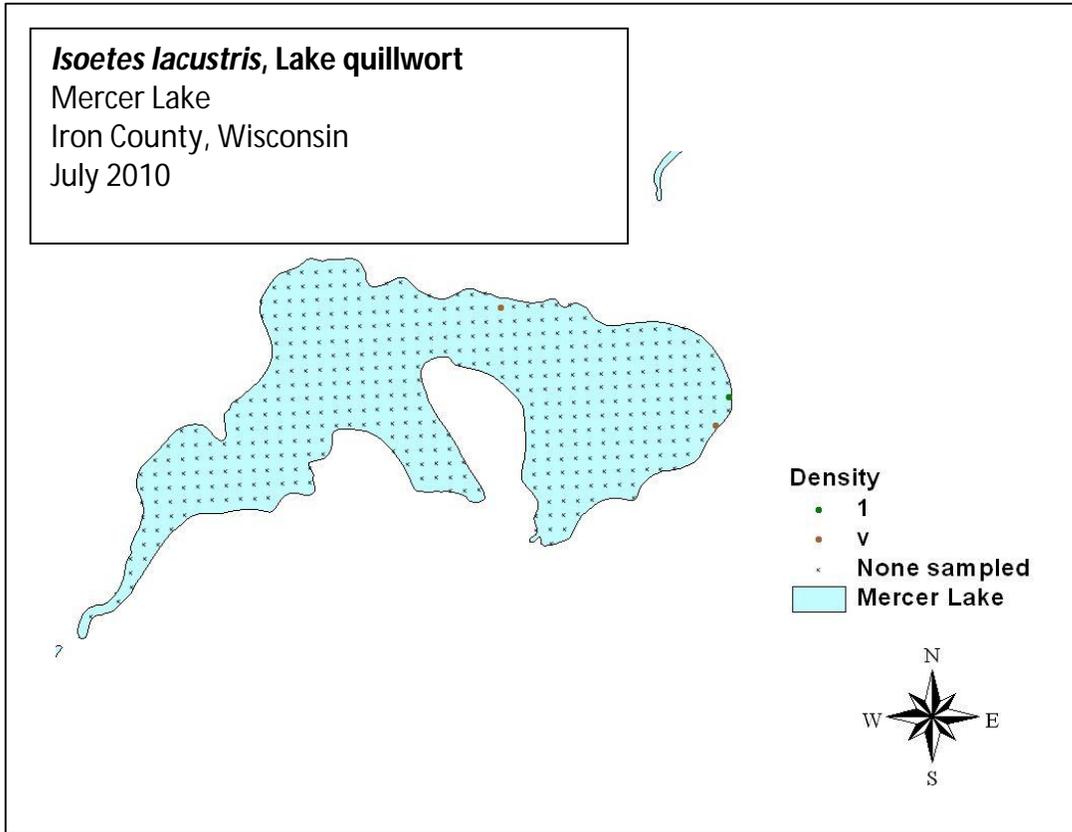
Appendix H-Aquatic macrophyte distribution maps



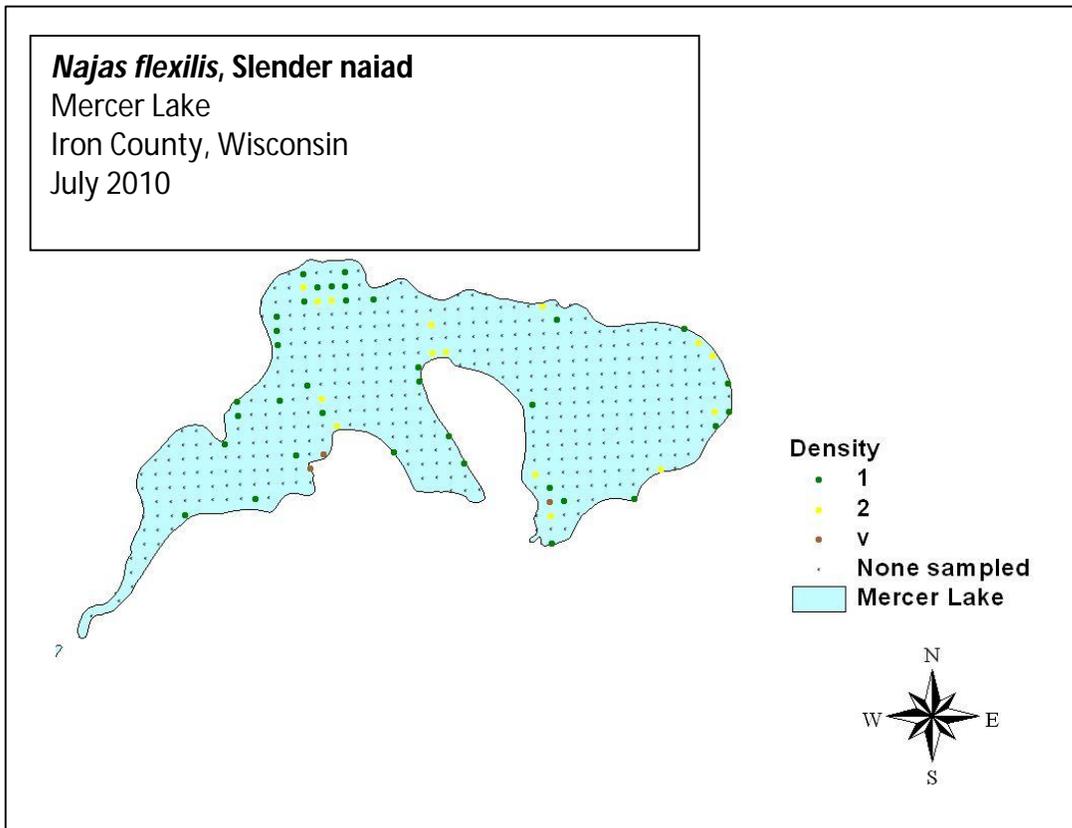
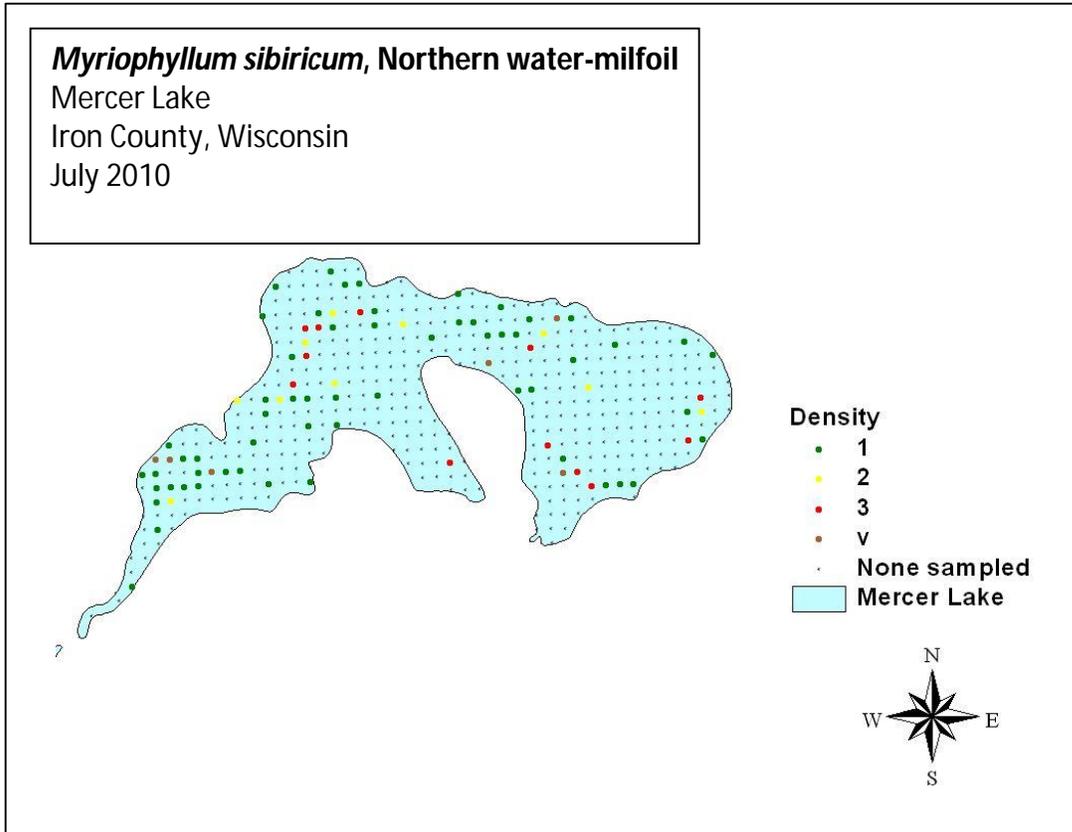
Appendix H-Aquatic macrophyte distribution maps



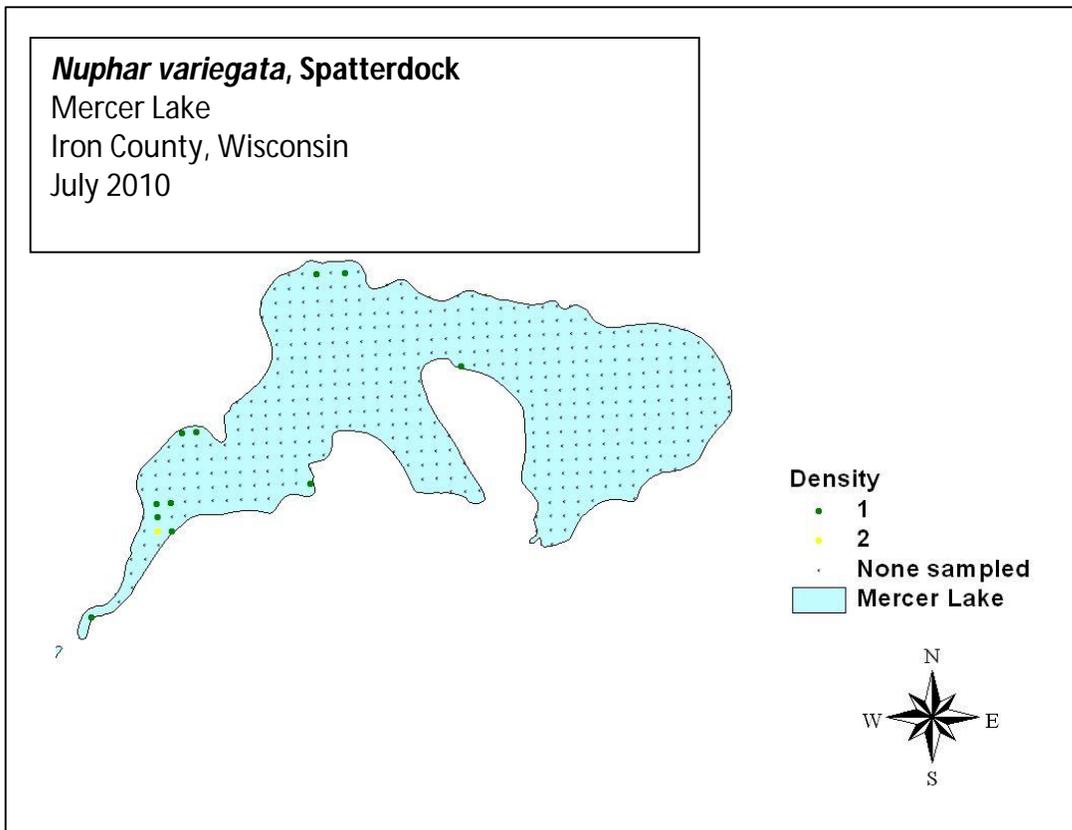
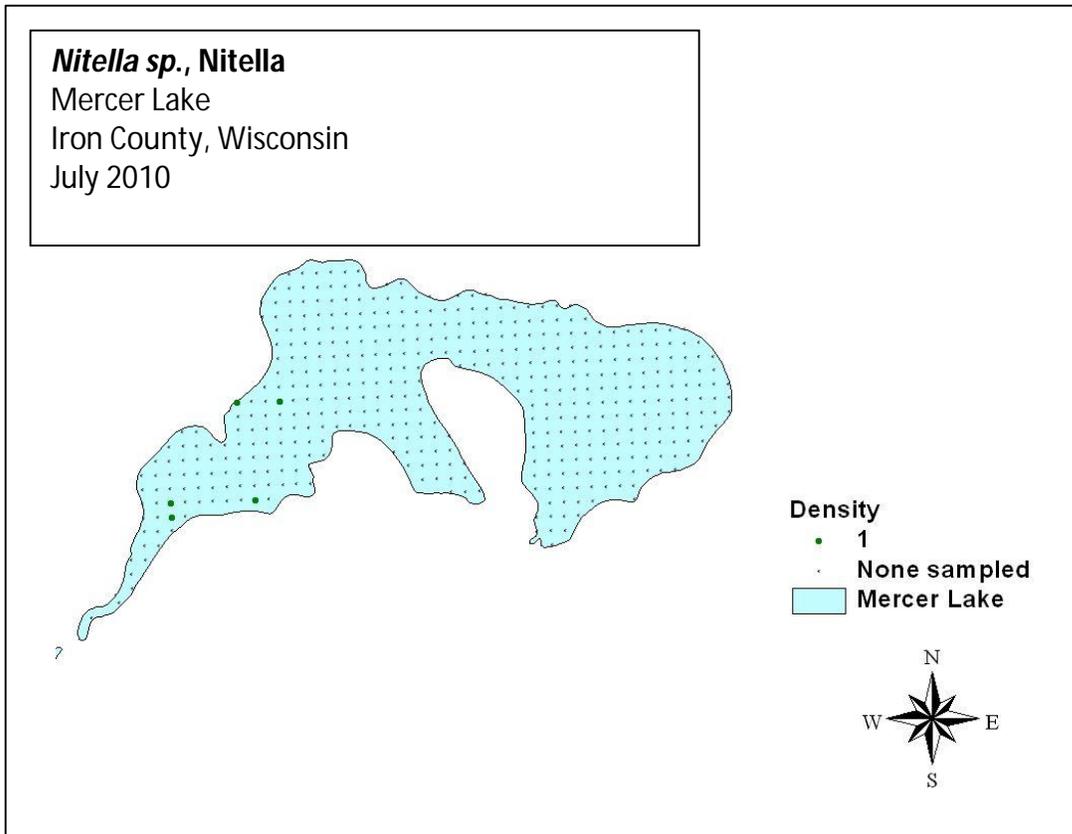
Appendix H-Aquatic macrophyte distribution maps



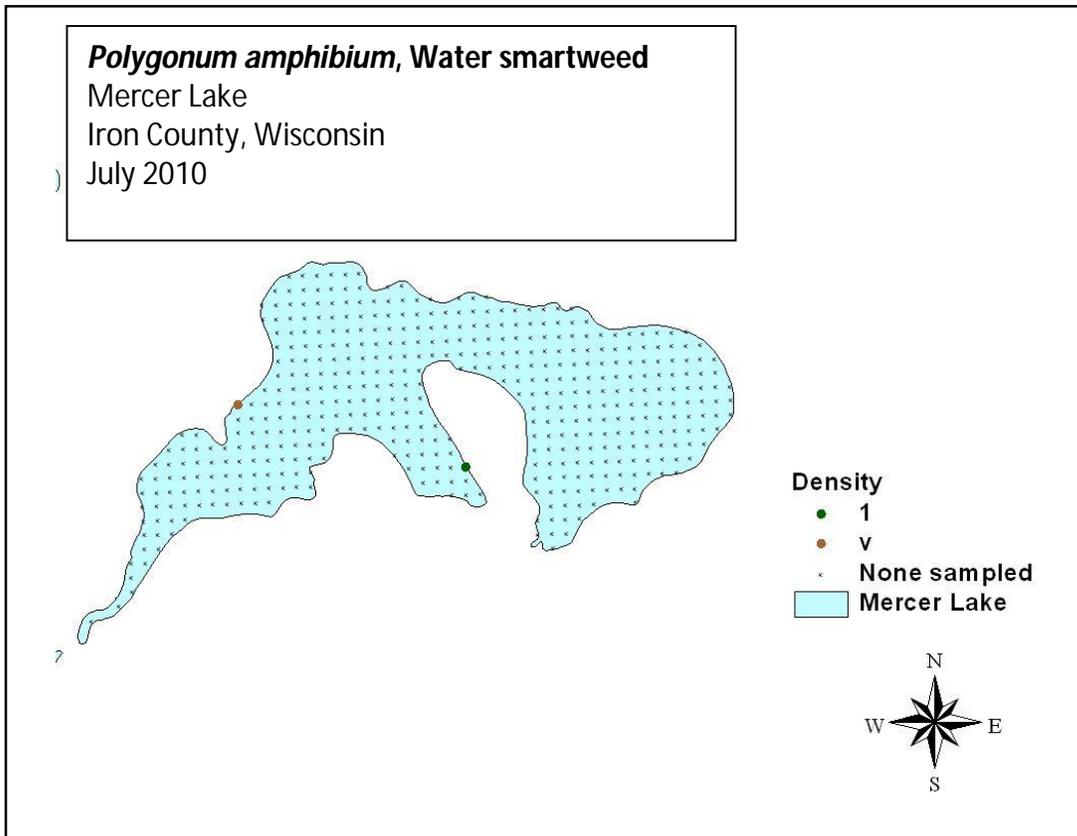
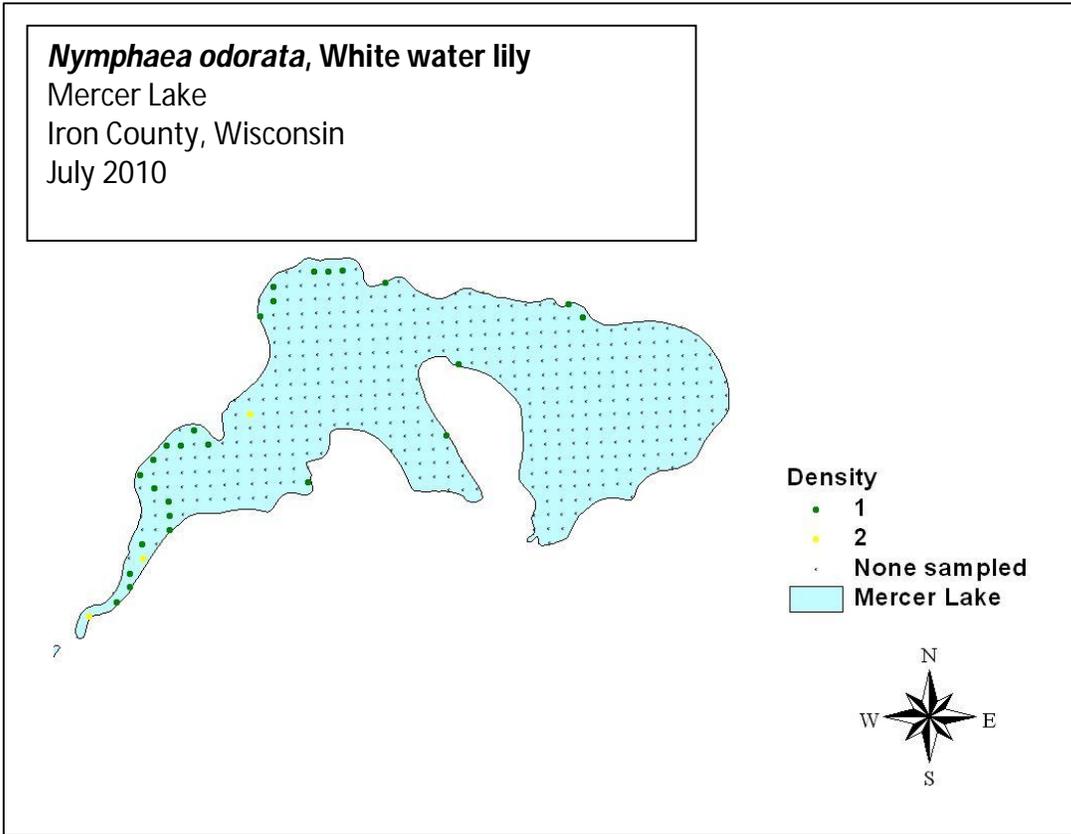
Appendix H-Aquatic macrophyte distribution maps



Appendix H-Aquatic macrophyte distribution maps

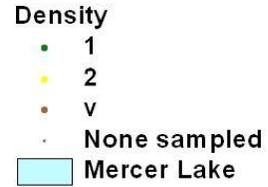
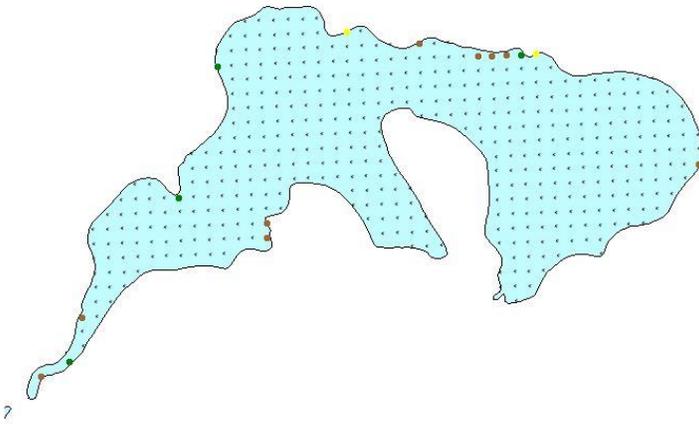


Appendix H-Aquatic macrophyte distribution maps



***Pontederia cordata*, Pickerelweed**

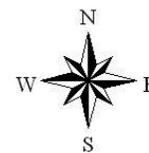
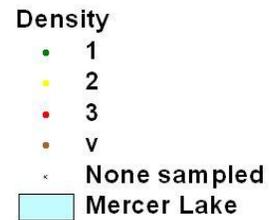
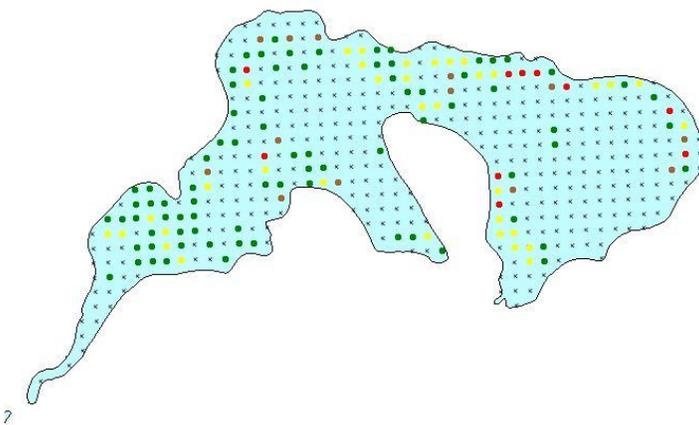
Mercer Lake
Iron County, Wisconsin
July 2010



?

***Potamogeton amplifolius*, Large-leaf pondweed**

Mercer Lake
Iron County, Wisconsin
July 2010

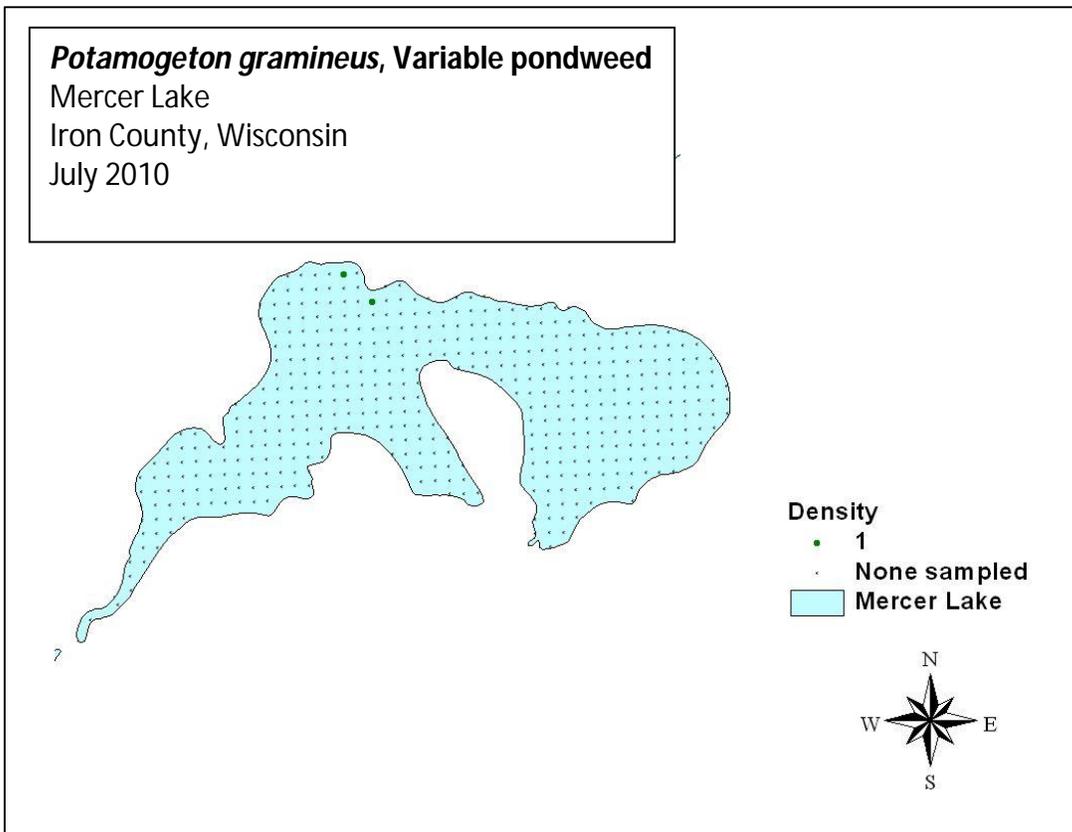
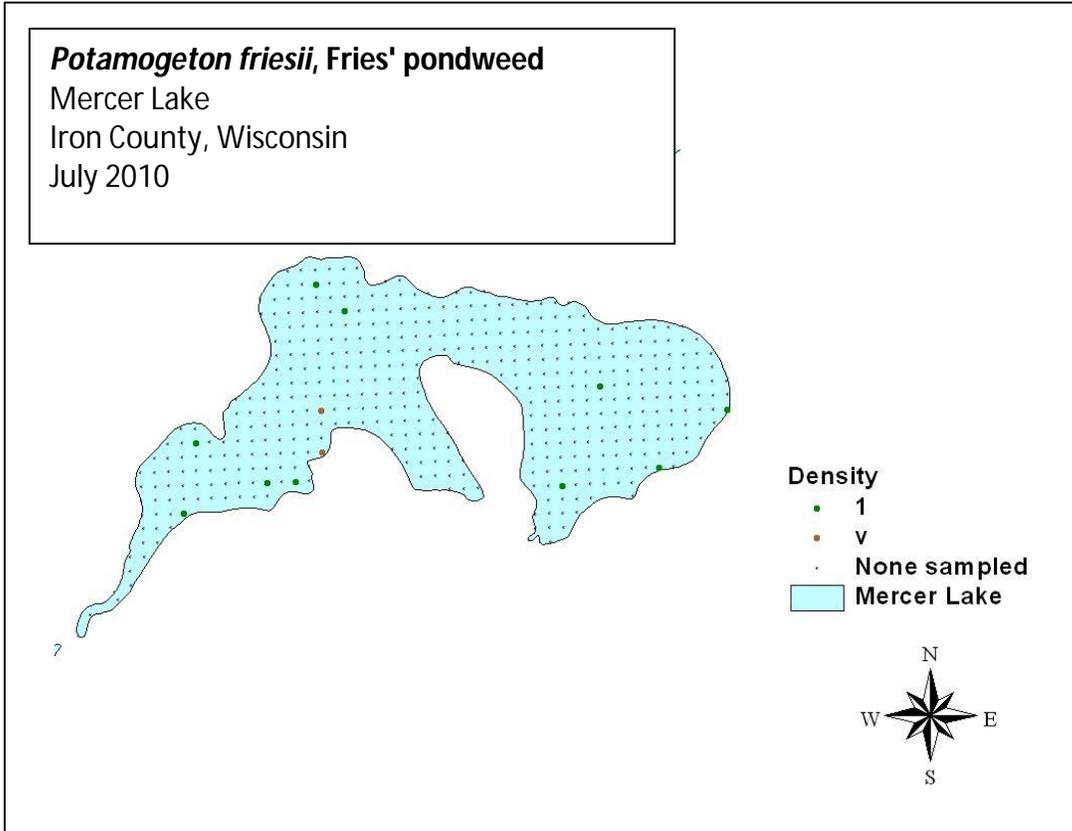


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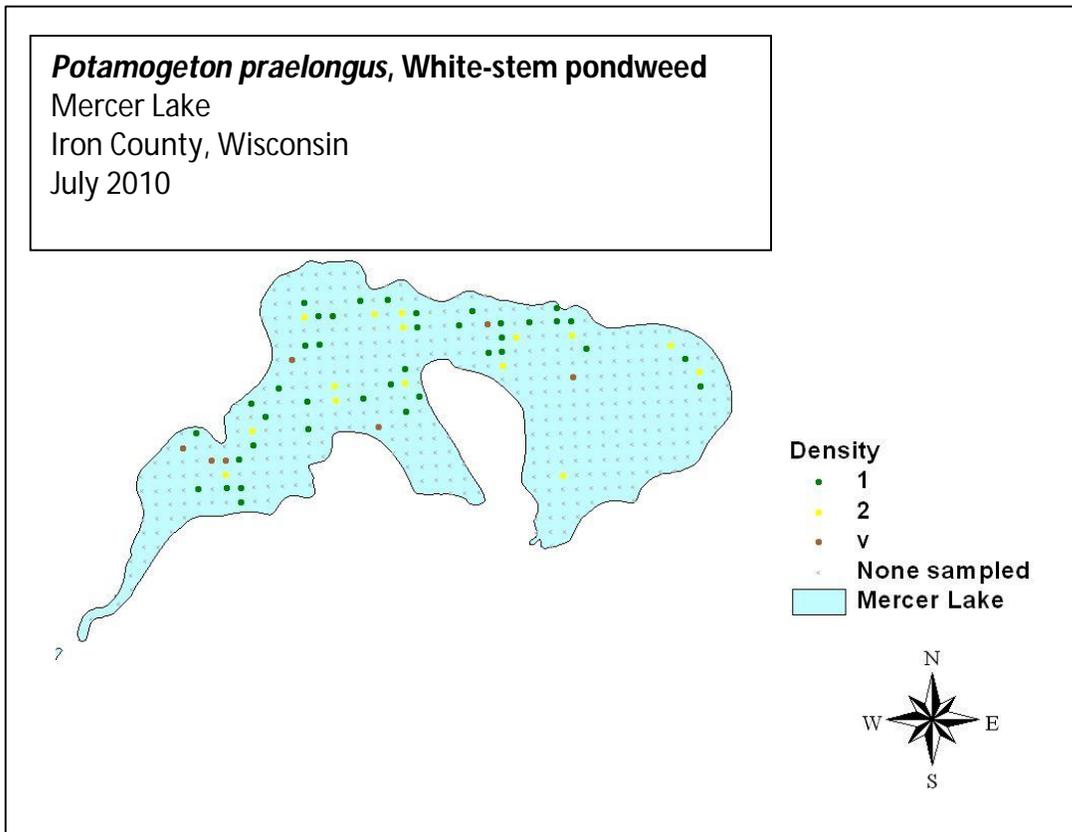
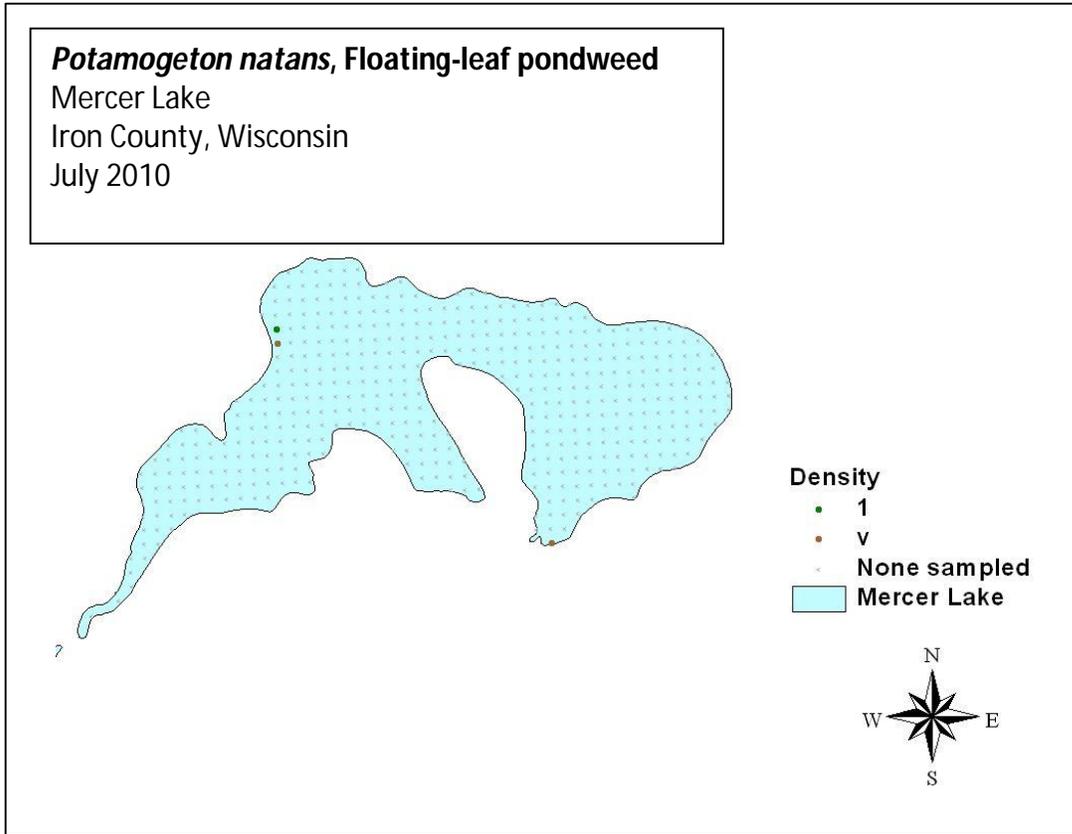
Vallisneria spiralis

Mercer Lake
Iron County, Wisconsin
July 2010

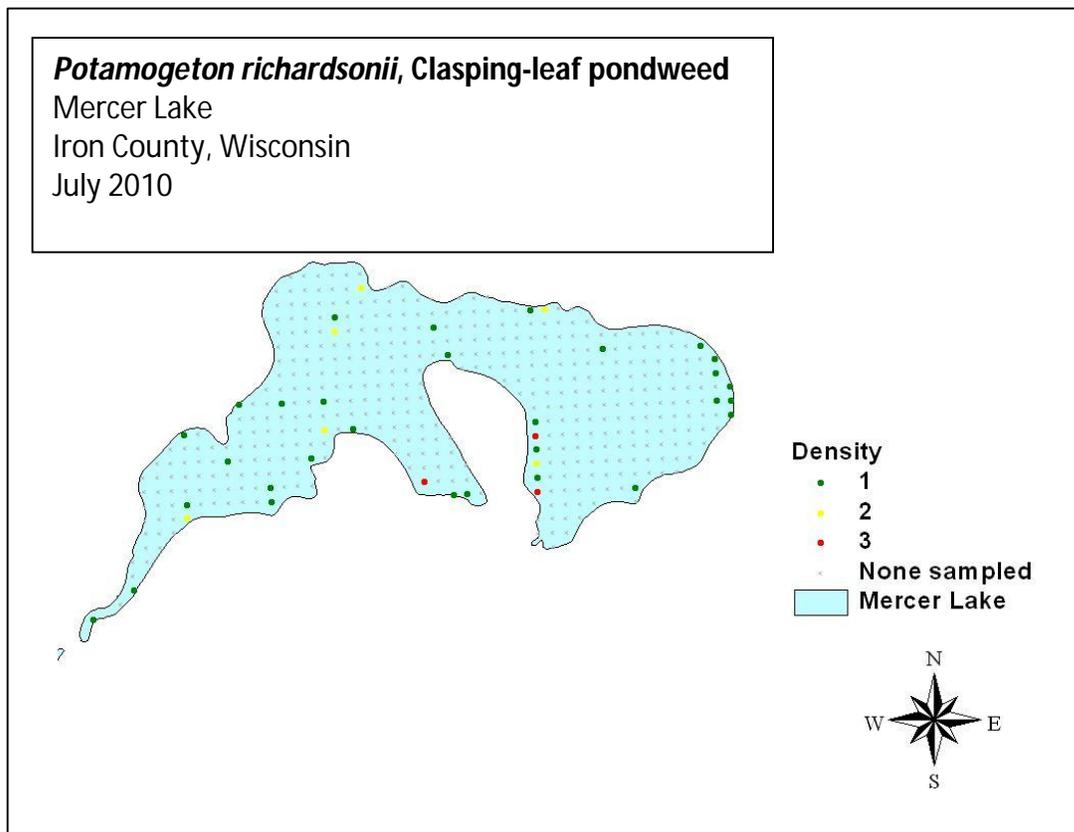
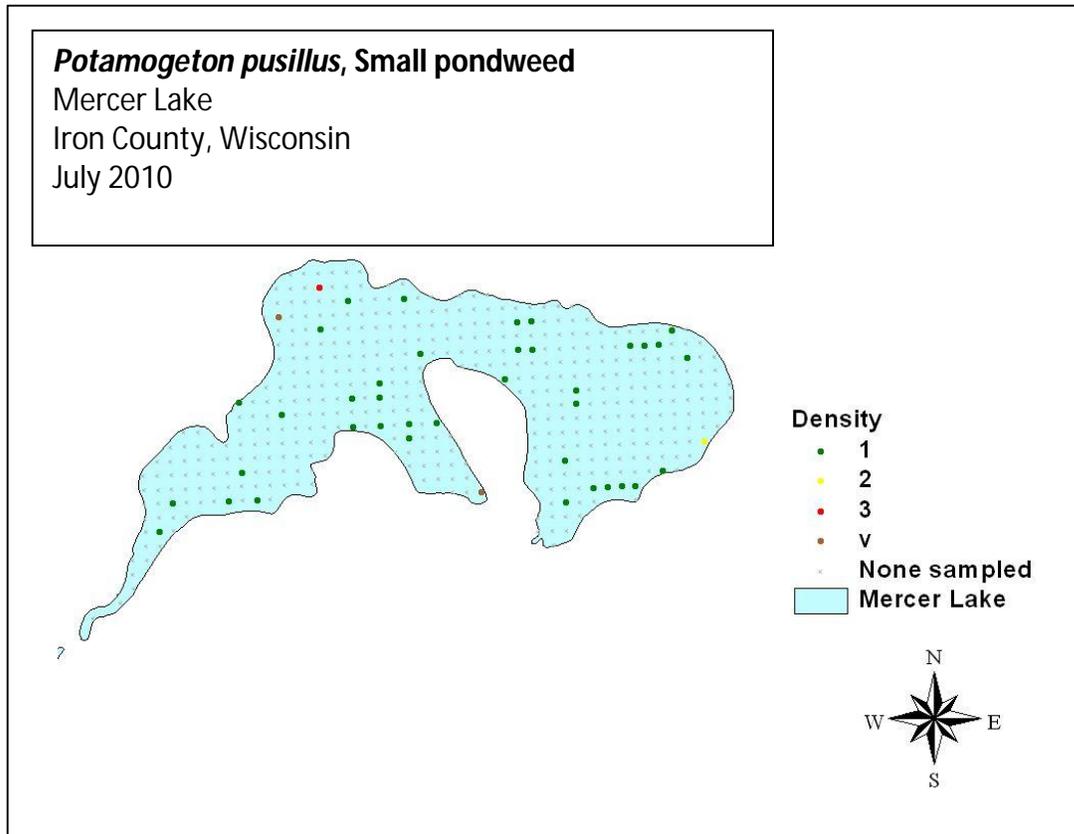
Appendix H-Aquatic macrophyte distribution maps



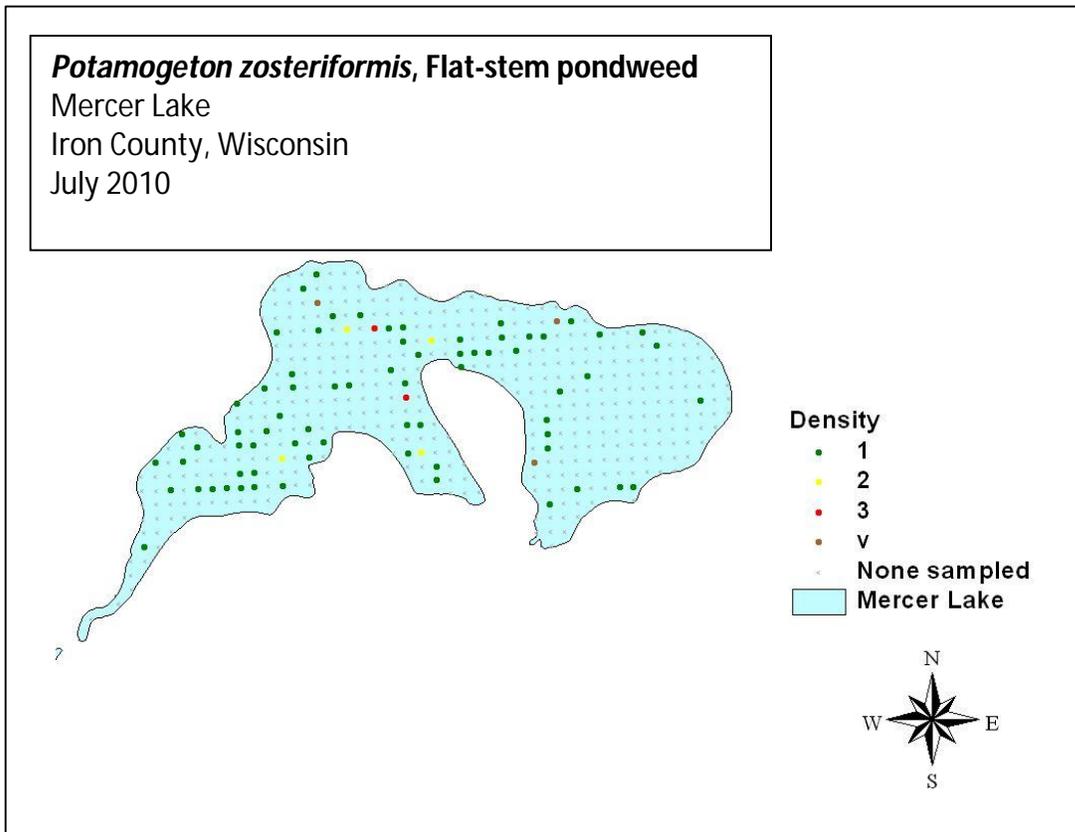
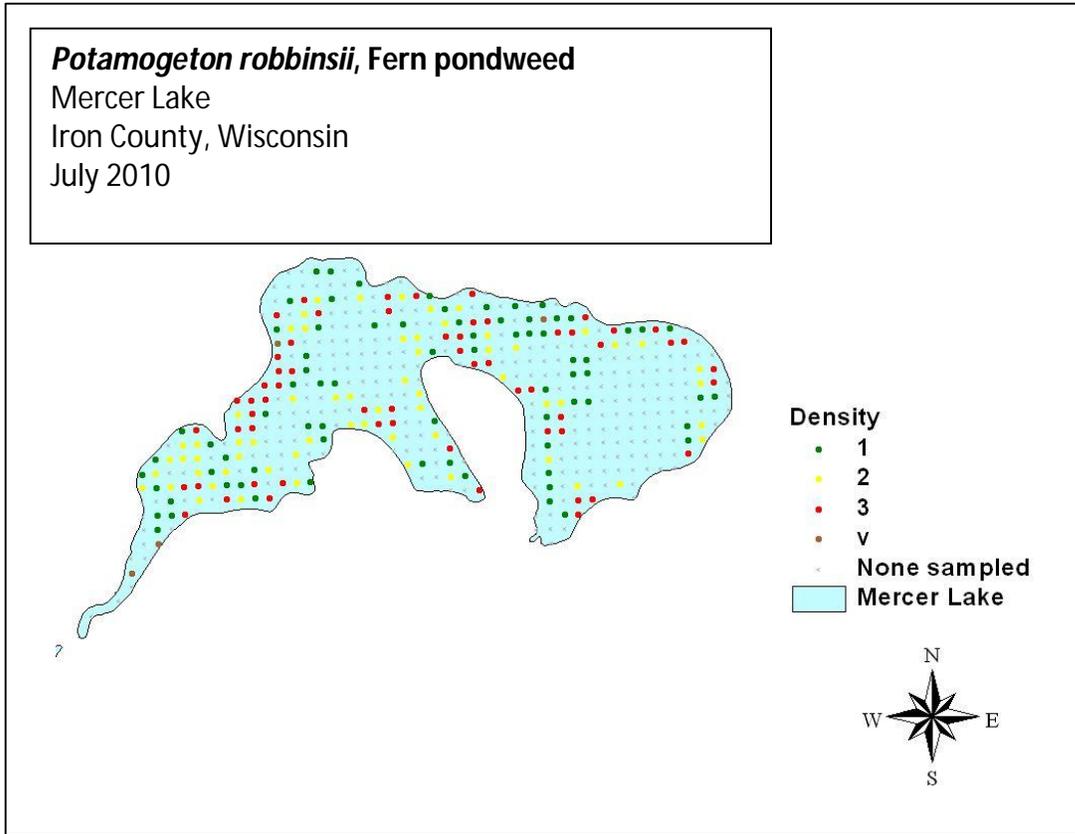
Appendix H-Aquatic macrophyte distribution maps



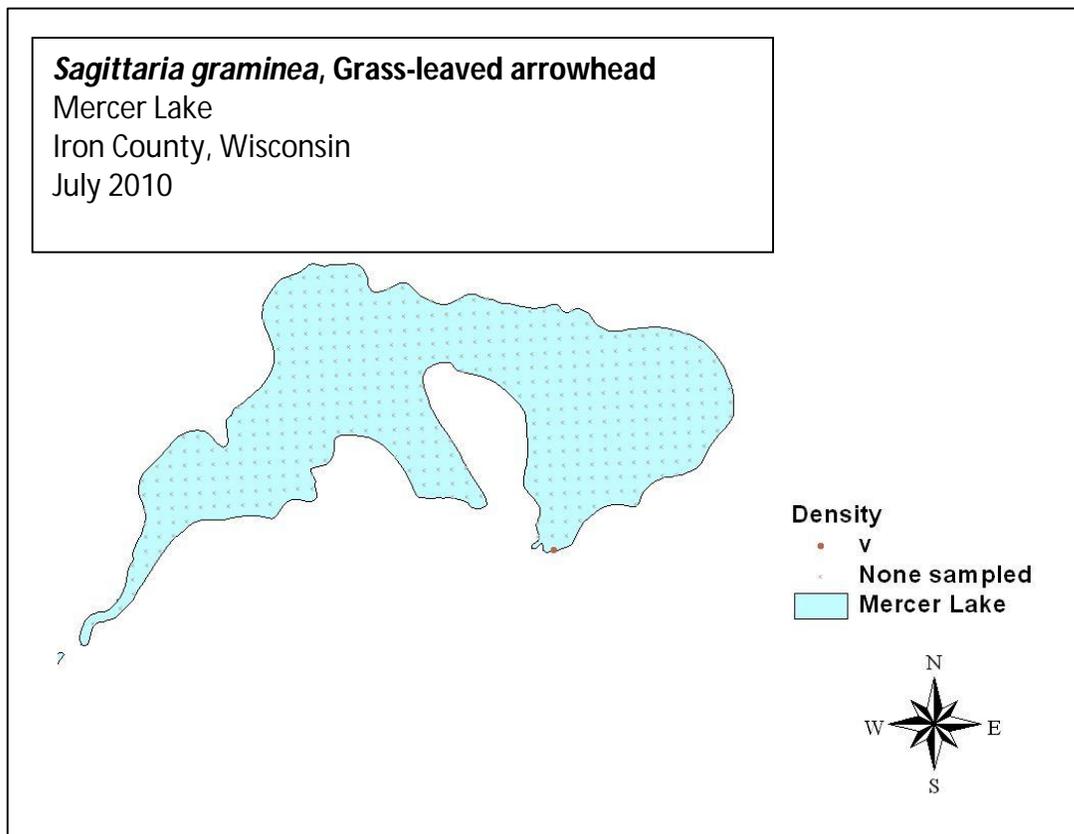
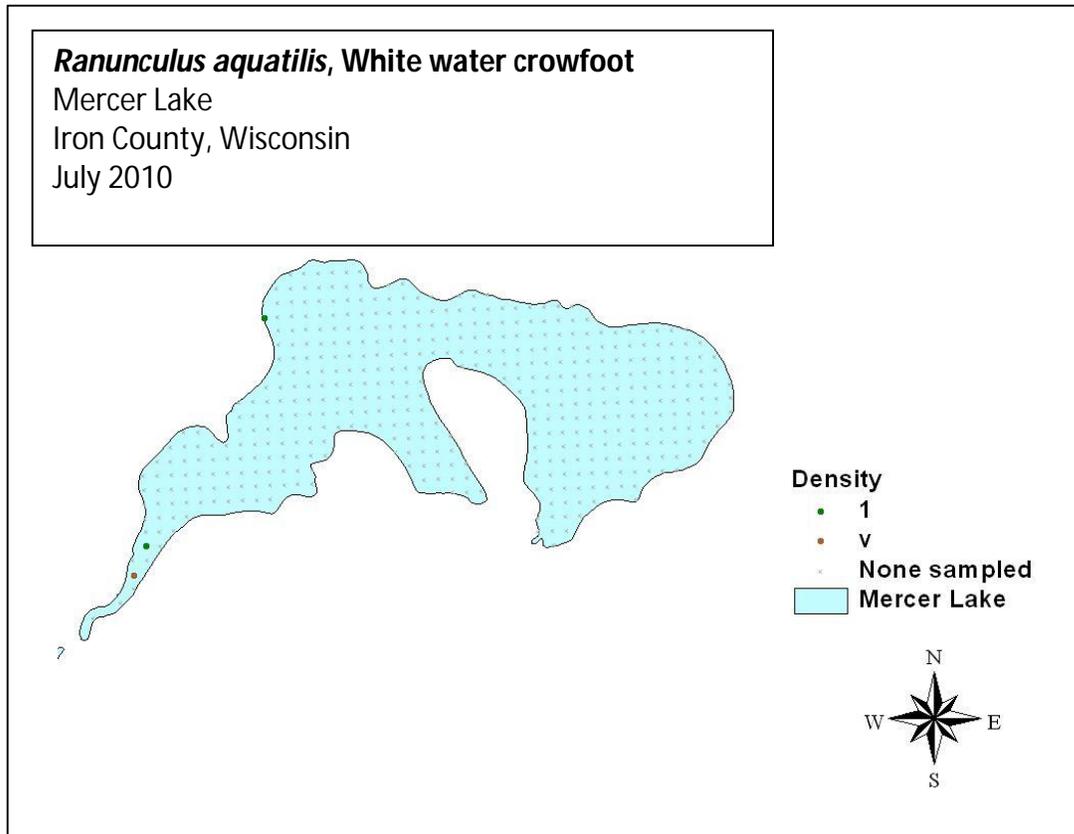
Appendix H-Aquatic macrophyte distribution maps



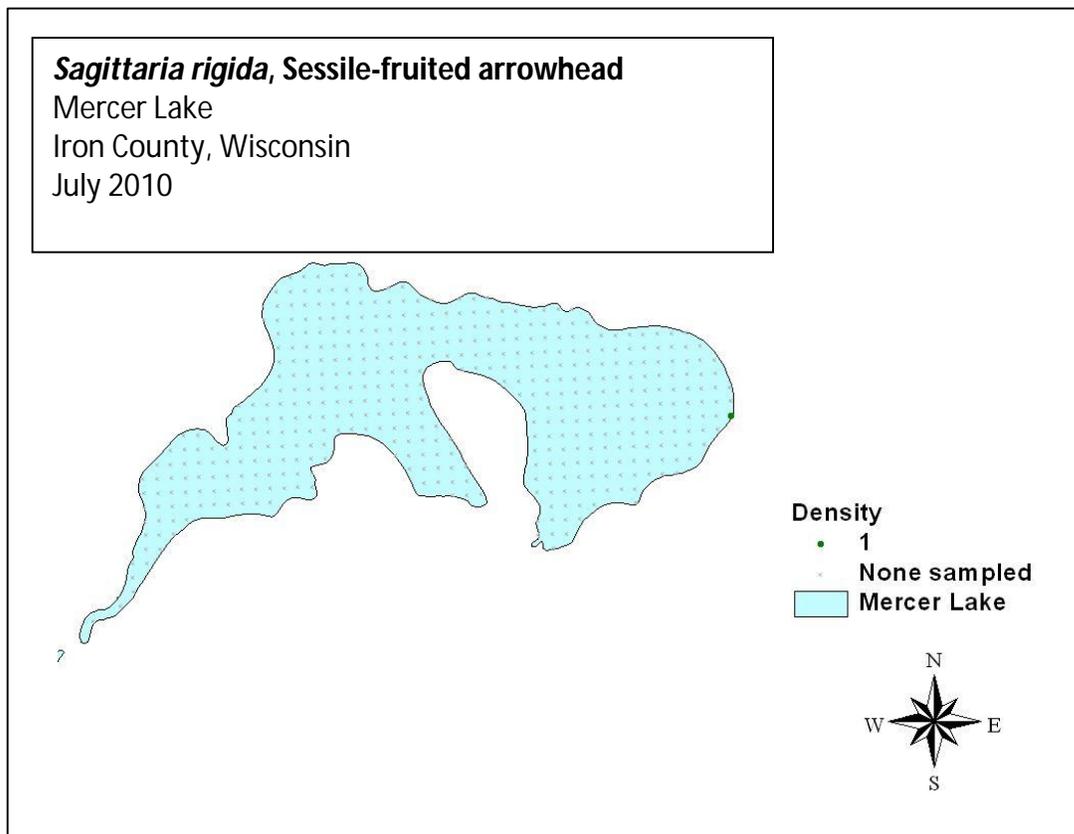
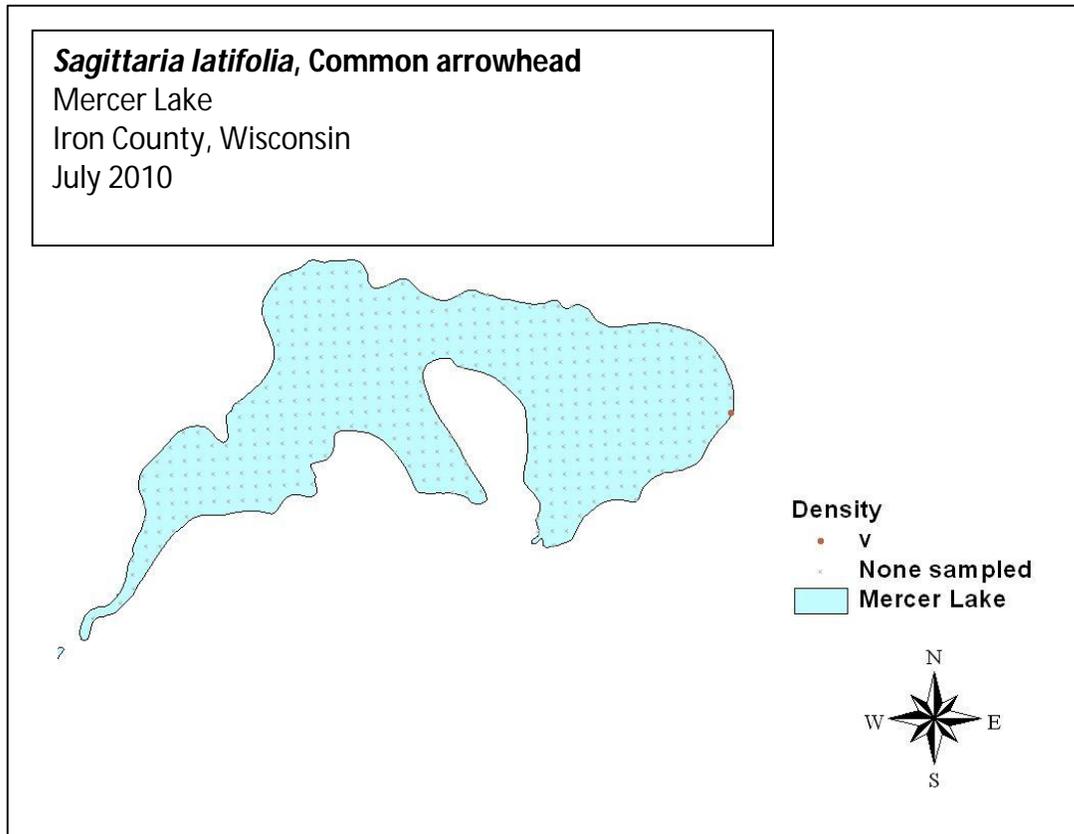
Appendix H-Aquatic macrophyte distribution maps



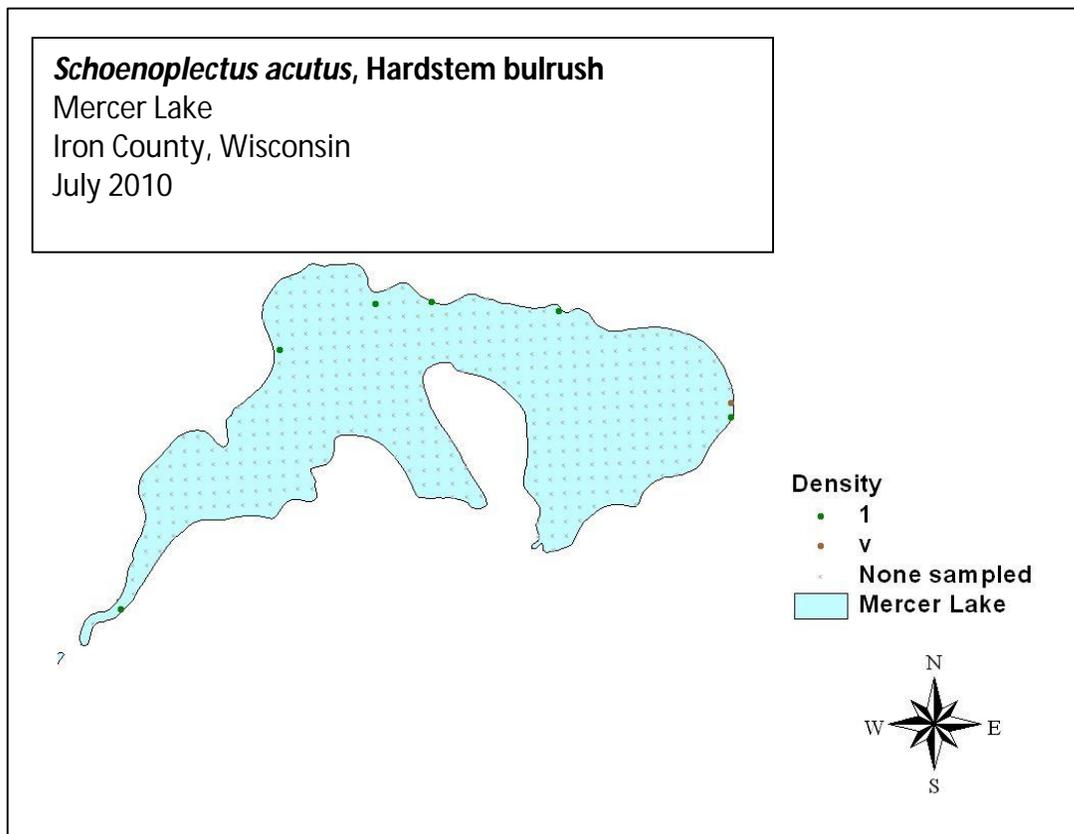
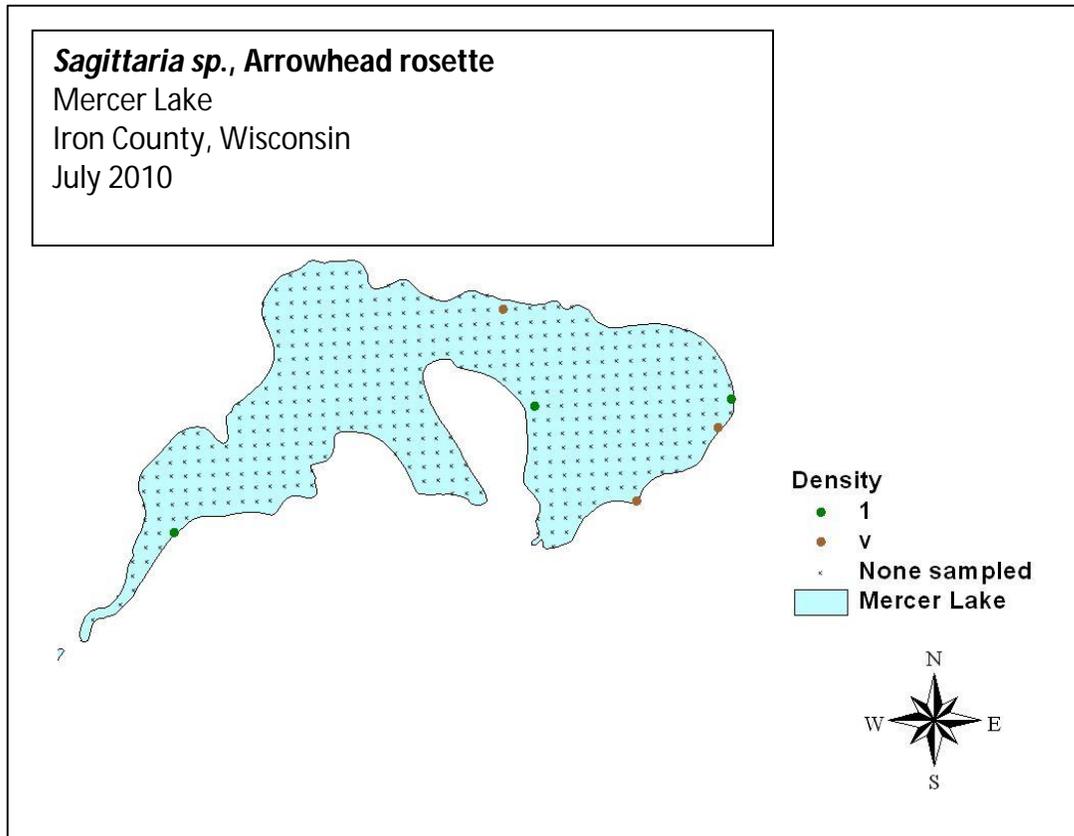
Appendix H-Aquatic macrophyte distribution maps



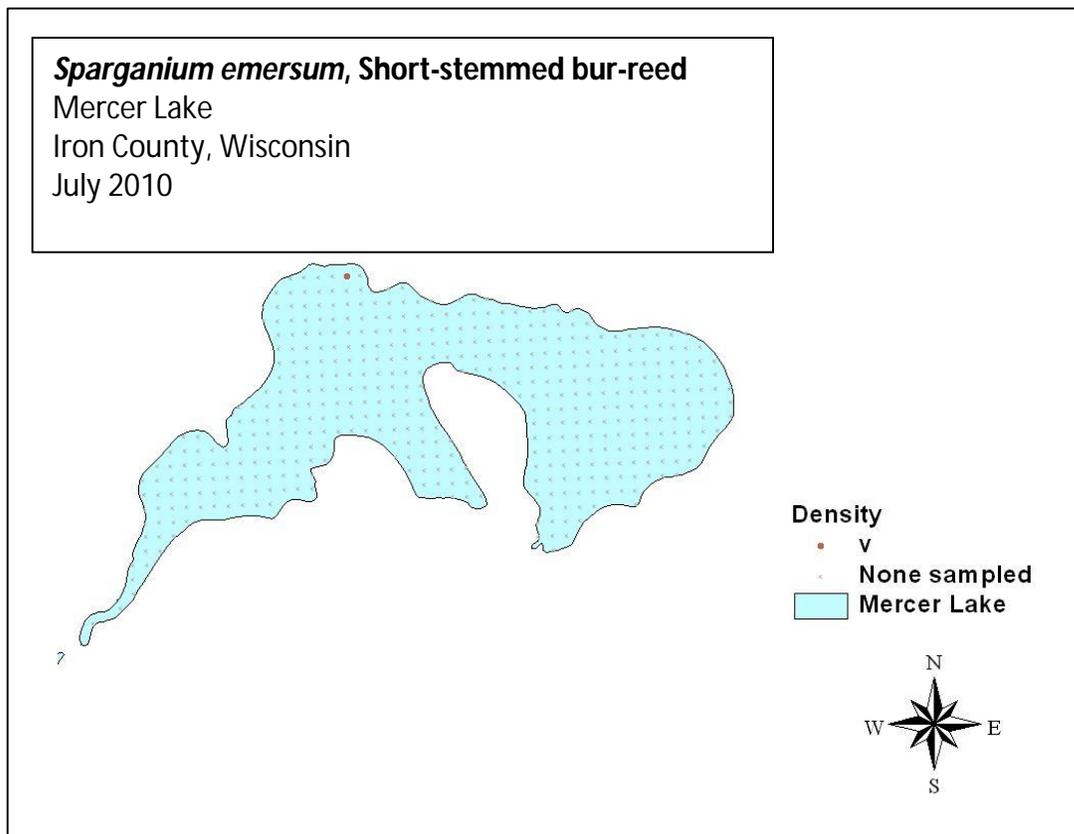
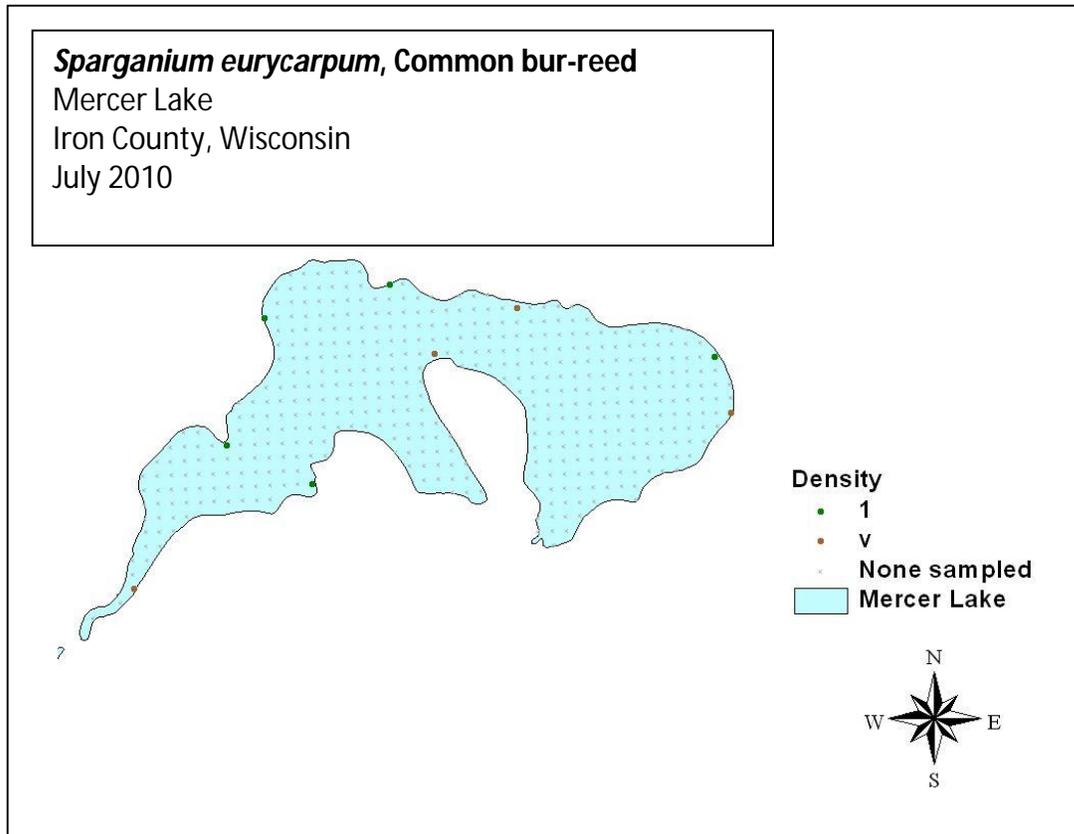
Appendix H-Aquatic macrophyte distribution maps



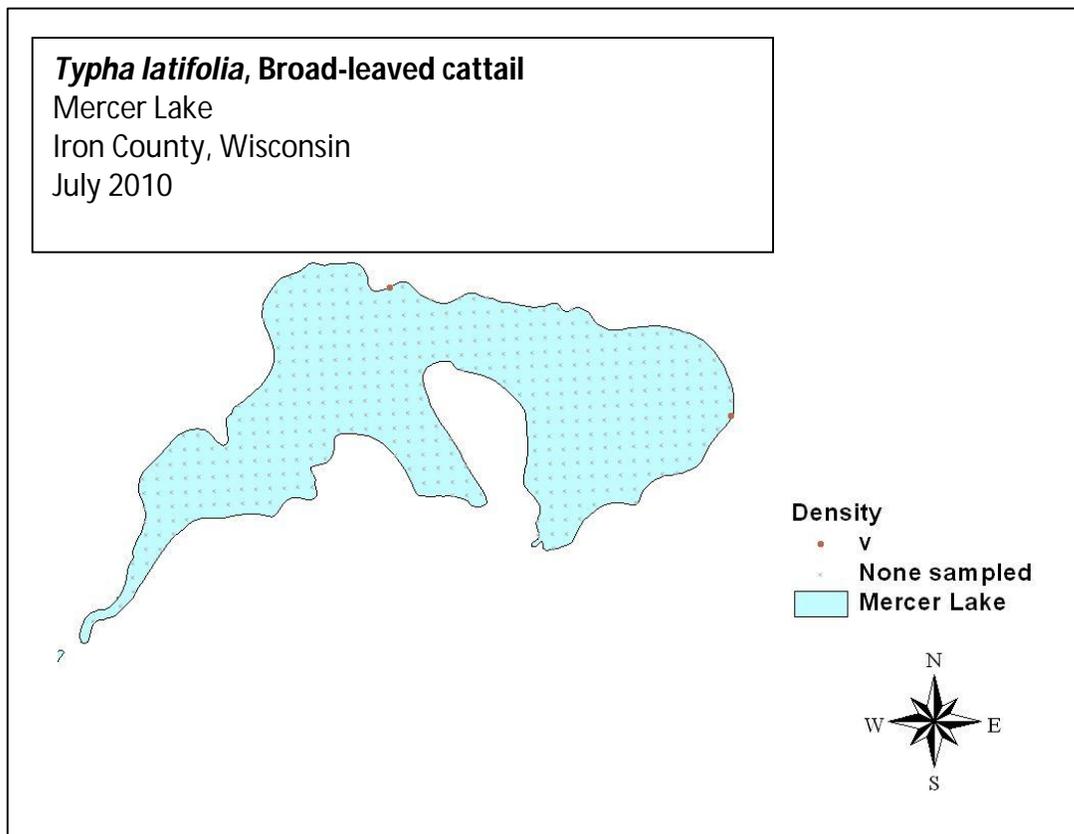
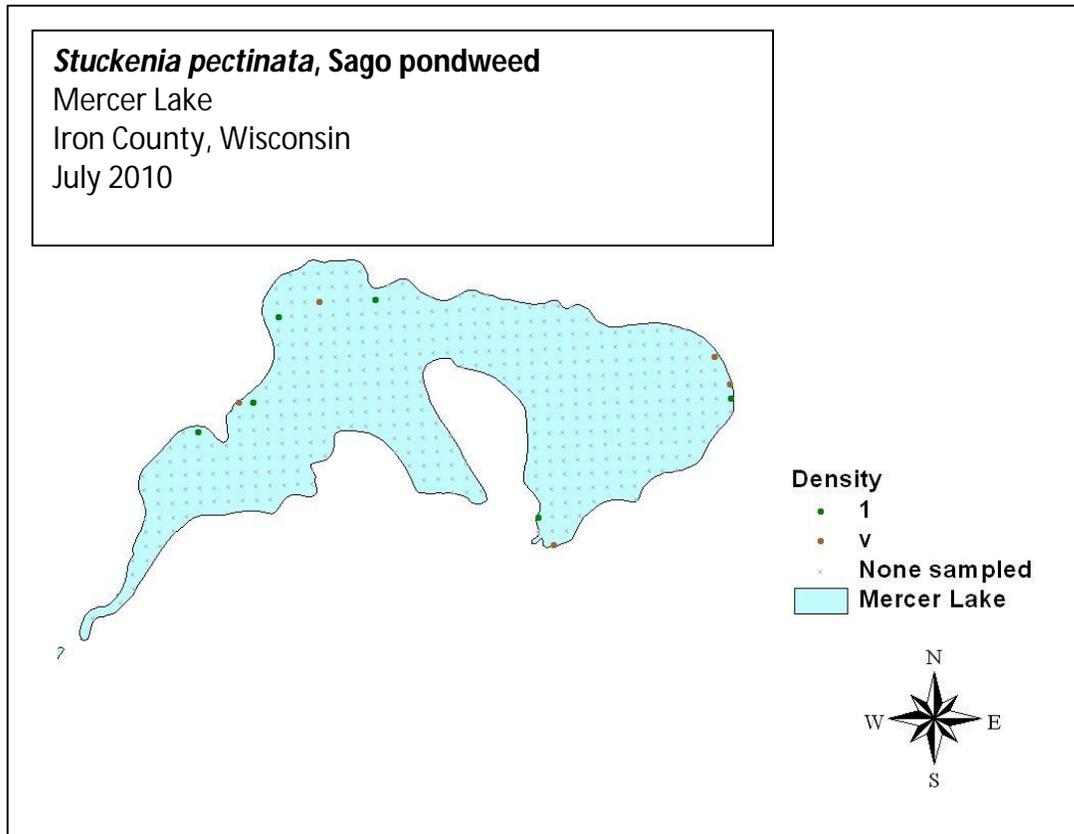
Appendix H-Aquatic macrophyte distribution maps



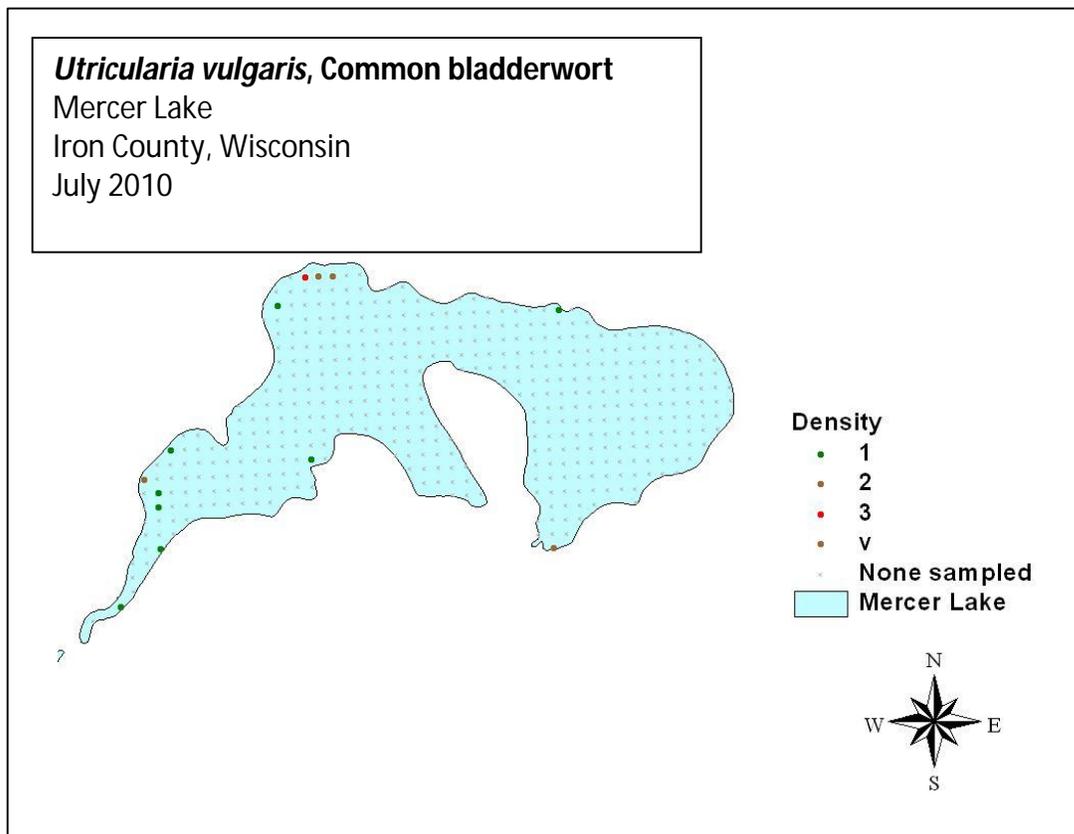
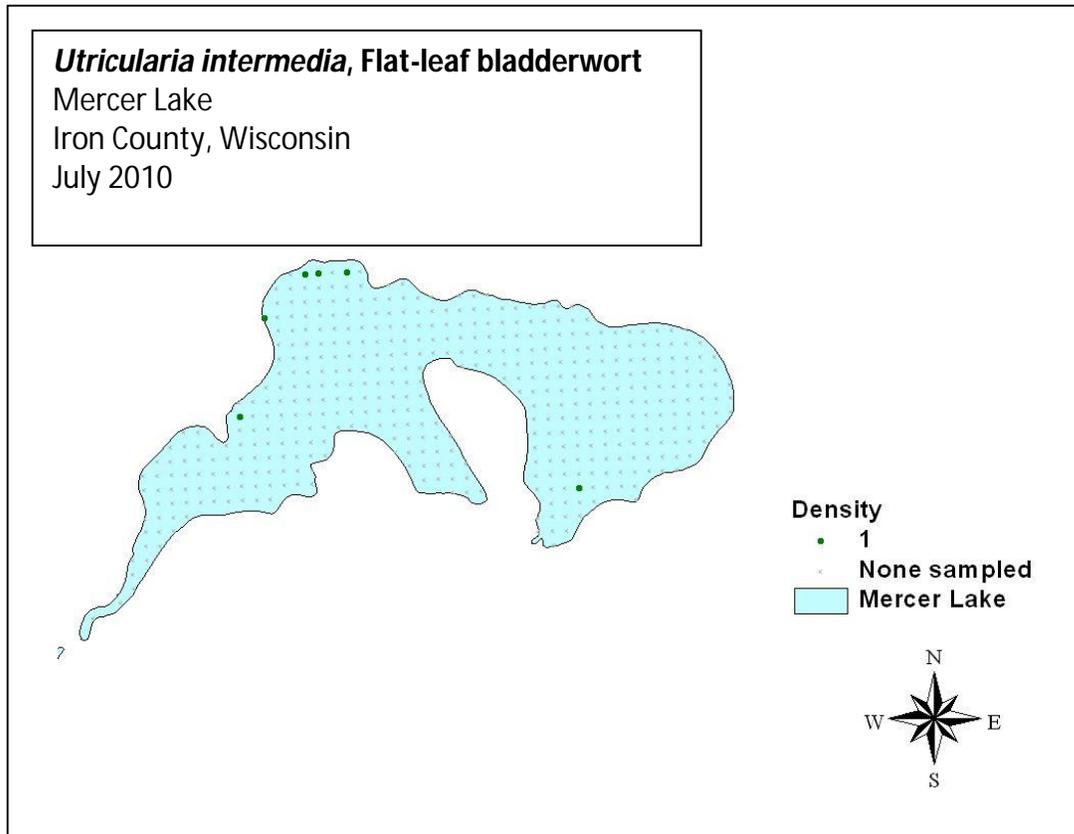
Appendix H-Aquatic macrophyte distribution maps



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