AQUATIC PLANT MANAGEMENT PLAN

LAKE MENDOTA
Lower Rock River Basin

DANE COUNTY, WISCONSIN

Madison’s Isthmus and Lake Mendota

January 2007

OFFICE OF LAKES AND WATERSHEDS
DANE COUNTY LAND AND WATER RESOURCES DEPARTMENT
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Summary

An aquatic plant survey was performed during the summer of 2006 on Lake Mendota. A total of 633 sites were sampled across the lake. Results of the point intercept survey indicated that coontail and Eurasian watermilfoil were the most frequently collected plants in 2006, as they were from 1989 – 1991. Coontail was the dominant plant in 2006 in terms of relative frequency, occurrence and density (rake fullness). Native species richness (the number of different species present) was higher in 2006 than in the most recent surveys conducted from 1989 through 1991. Additional species found in 2006 included horned pondweed and muskgrass. Overall densities of aquatic plants did not create significant nuisance problems in 2006. Very low plant densities were found in some areas. In the bay where the Yahara River and Six Mile Creek enter, poor water clarity and strong wind fetch may have contributed to low abundance of plants. Secchi measurements within the bay were only 2 feet compared to 15 feet throughout most of the lake. The poor water clarity within the bay appeared to reflect mostly fine suspended sediment as opposed to suspended algae. University Bay and Governor's Island were areas supporting favorable fisheries habitat including floating-leaf plants and coarse woody debris. These publicly-owned shorelines are recommended for Sensitive Areas designation under Wisconsin Administrative Code NR 107.05(3-i). In general, the low density of Eurasian watermilfoil and higher native species richness indicated more favorable conditions in Lake Mendota compared to surveys conducted over a decade ago. Native species appear to be increasing as Eurasian watermilfoil continues to decline in the lake.

In addition to monitoring aquatic plant communities and assessing management strategies, public participation was planned and executed at all stages of plan development. Prior to conducting the aquatic plant surveys, two public meetings were advertised and conducted to educate the public on ecological and habitat values of aquatic plants and management issues. A final public meeting was held in December 2006 to share results of the aquatic plant surveys and draft aquatic plant management plan for public review and input. Public comment on the draft plan was solicited on the Dane County Office of Lakes and Watersheds/Lakes and Watershed Commission website.

Also, an Aquatic Plant Management Committee created by the Dane County Board met for much of the time coincident with plan field work and preparation. Members of that Committee were invited to provide comments on the draft plan. Recommendations from the Committee's final report (October 20, 2006) are included in Appendix A. This plan will be amended as necessary to implement recommendations that are approved by the County Executive and County Board and implemented by county staff.

Ultimately, the plan recommendations did not represent a significant change from the relatively long history of mechanical harvesting operations on the lake. However, the plan has identified important steps that will enhance the county's aquatic plant harvesting program and protect important habitat features in the lake.

Recommendations

1. Conduct large-scale mechanical harvesting in areas not designated as Sensitive Areas under Wisconsin Administrative Code NR 107.05(3-i) where Eurasian watermilfoil inhibits boating access and recreation.
2. Prohibit chemical herbicide treatments and mechanical harvesting within Sensitive Areas. Sensitive Areas are undeveloped areas supporting coarse woody debris, floating-leaf plants including American lotus (*Nelumbo lutea*) and white water lily (*Nymphaea odorata*) and submersed native plant species including clasping-leaf pondweed (*Potamogeton richardsonii*), sago pondweed (*Struckenia pectinatus*), leafy pondweed (*Potamogeton foliosus*), flatstem pondweed (*Potamogeton zosteriformes*), water stargrass (*Heteranthera dubia*), wild celery (*Vallisneria Americana*), muskgrass (*Chara*), and horned pondweed (*Zannichelia palustris*).
3. Chemical herbicide treatments should focus on the selective control of Eurasian watermilfoil – EWM (*Myriophyllum spicatum*) since several native pondweeds and other valuable native species have increased in the lake.
4. Consider options for reducing motorboat impacts to floating-leaf plants (American lotus and white water lily) in University Bay and Governor's Island sheltered coves.
5. Consider expanding floating-leaf plant beds and introducing high value species (historically found in the lake) within proposed Sensitive Areas, University Bay and Governor's Island sheltered coves.

6. Dane County mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment. The fact sheet in Appendix B is included in the harvesting crews' operations manual.

Introduction

As required in Wisconsin Administrative Code NR 109.04(d), the purpose of this plan is to guide mechanical harvesting activities and the effective management of aquatic plants in Lake Mendota. Dane County periodically operates mechanical harvesters in Lake Mendota to primarily reduce dense beds of exotic EWM, exotic curly-leaf pondweed – CLP (*Potamogeton crispus*), and native coontail (*Ceratophyllum demersum*). Dense stands of these "weedy" plants have undermined boating access and other recreational uses in the lake. Harvesting efforts have been designed to enhance important lake management functions.

Aquatic plant beds in Lake Mendota have changed significantly since the nineteenth century. The combination of declining water quality, invasions of non-native carp (*Cyprinus carpio*) and weedy plants (EWM and CLP), shoreline development, herbicide treatments and heavy motorboat traffic have altered the plant communities in the lake (Nichols and Lathrop 1994). As a result, several high value species including large-leaf pondweed (*Potamogeton amplifolius*) and Illinois pondweed (*Potamogeton illinoensis*) have become extirpated, while other species have declined substantially from the lake.

The primary goals of this plan are to establish long-term realistic objectives for managing nuisance exotic plant species while protecting valuable native species and their important habitat functions. While the goal is not to create a comprehensive lake management plan, aquatic plant community relationships with other aspects of lake and watershed management cannot be ignored.

While the plan was designed to develop a variety of strategies for managing aquatic plants, chemical treatments are not performed or sponsored by either Dane County or Wisconsin

Department of Natural Resources (WDNR). WDNR regulates chemical herbicide treatments in public waters and permits are required under Administrative Code NR 107.

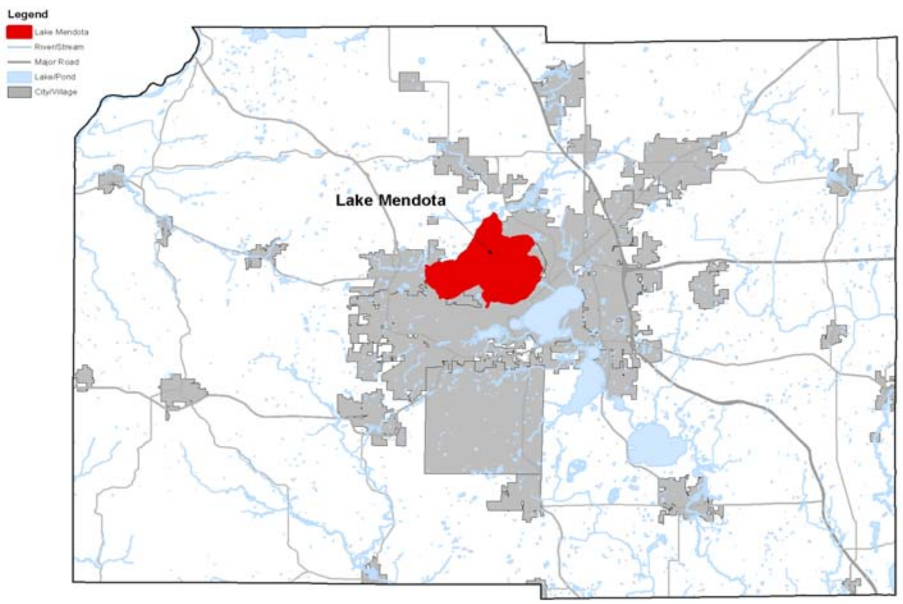
Goals

Because Eurasian watermilfoil has dominated the littoral zone for several decades, the goals for managing Lake Mendota aquatic plants are to: (1) improve recreational access in the lake, (2) identify and protect Sensitive Areas defined under Wisconsin Administration NR 107.05(3-i), and (3) restore documented losses and declines of high value species [NR 107.08(4)] in the lake including large-leaf pondweed (*Potamogeton amplifolius*), Illinois pondweed (*Potamogeton illinoensis*), clasping-leaf pondweed (*Potamogeton richardsonii*), horned pondweed (*Zannichelia palustris*), wild celery (*Vallisneria Americana*), sago pondweed (*Struckenia pectinatus*), bulrush (*Scirpus*), and wild rice (*Zizania*). Other important native plants that have declined in Lake Mendota and also require protection include flat-stem pondweed (*P. zosteriformis*) yellow water lily (*Nuphar*), white water lily (*Nymphaea tuberosa*), American lotus (*Nelumbo lutea*), *Chara*, slender naiad (*Najas flexilis*), leafy pondweed (*Potamogeton foliosus*), and water stargrass (*Heteranthera dubia*).

Background Information

Lake Mendota (9,740 acres) is the largest and northernmost lake in the Yahara Chain (Figure 1). The lake has a maximum depth of 83 feet and shoreline length of 21.6 miles. This deep lake was formed by moraine damming of the pre-glacial Yahara River (Day et al. 1985). The lake drains a 217 square mile watershed characterized as gently rolling glacial terrain underlain by alkaline geology. The watershed to lake area ratio is about 16:1. Although it is more difficult to see water quality improvement in lakes where the watershed to lake ratio exceeds 10:1, the Priority Lake Project for Lake Mendota includes management recommendations which, if implemented, should result in improved water quality.

Figure 1: Lake Mendota location within Dane County



Lake Mendota is famous to limnologists because of extensive research dating back to the late nineteenth century (Lathrop 1990). The location of the University of Wisconsin -Madison along the south shore has undoubtedly contributed to these efforts. By the mid 1940s, some of the focus on Lake Mendota had shifted from a limnological laboratory to concern for declining water quality in the lake. Extensive fertile agricultural lands and expanding urbanization drained into the lake and contributed to severe blue-green algae blooms and other water quality problems for decades. In addition to agricultural runoff from fertile cornfields and livestock operations, discharges of effluent and sewage up until 1898 were sources of phosphorus to the lake as well. Sources of pollution were severe enough to cause fish kills in lake tributaries. In Pheasant Branch Creek, a fertilizer spill in the early 1980s caused a complete fish kill in the creek and contributed over 40% of the annual phosphorus load to the lake. In Six Mile Creek, runoff of both canning waste and silage juice occurred numerous times during the 1970s and 1980s causing fish kills and nutrient loading into the lake. Unsolved fish kills encompassing miles of the upper Yahara River occurred several times during the 1980s and early 1990s. More recently, a massive manure spill occurred in Dorn Creek in 2005. Collectively, cultural sources of nutrient loading and pollution caused significant long-term water quality problems in Lake Mendota. Construction site erosion has also been added to the long list of water quality concerns for Lake Mendota. Severe erosion from the Bishop's Bay golf course and housing development in 1998 and from a construction site along the North Fork of Pheasant Branch in 2003 highlighted the threats of construction erosion to Lake Mendota and other water resources in Dane County.

All significant point source discharges had been diverted from Lake Mendota and its watershed by the early 1970s. Phosphorus loading to the lake declined by the mid-1970s after the diversion of point source effluents coupled with lower precipitation rates. Responses in the lake included a gradual decline in blue-green algae blooms severity and improved water clarity (Lathrop 1990). But these trends were also complicated by annual variability associated with internal loading and phosphorus entrainment from the thermocline (Soranno et al. 1997) and variable runoff rates (Carpenter and Lathrop 1999). Additional phosphorus load reductions are needed to reduce some of the variability and extremes in blue-green algae densities (Lathrop et al. 1998). The Lake Mendota Priority Watershed Project has set goals to reduce nutrient loading (especially phosphorus) to the lake. These goals involve reducing sediment input from new building sites and runoff of sediment and nutrients from agricultural operations. Other alternatives, such as streambank stabilization, reducing runoff and nutrients from existing structures and use of no phosphorus fertilizers, are also part of the overall program. The intent is to reduce the severity and frequency of blue-green algae blooms during the entire summer by lowering phosphorus input.

In addition to focusing on watershed sources of phosphorus, a biomanipulation experiment was conducted on Lake Mendota in an attempt to heavily stock predators to reduce planktivore eating fish like yellow perch and cisco, and enhance large *Daphnia* grazing of phytoplankton (Lathrop et al. 2002). A total of 2.7 million walleye fingerlings and 170,000 northern pike fingerlings were stocked in Lake Mendota from 1987-99 and coincided with restrictive harvest regulations. A summer die-off of cool water cisco (*Coregonus artedii*) in 1987 coincided with clear water and demonstrated potential benefits of biomanipulation to reduce planktivore feeders (Rudstam et al. 1993, Lathrop et al. 1996, Lathrop et al. 2000).

Regardless of the measured water clarity improvements over the last few decades, the long-term eutrophication of the lake has altered aquatic plant communities in the lake. Declines in water clarity have apparently caused the size of the littoral zone to shrink. In the early 1900's, the maximum depth of aquatic plant growth was approximately 18 feet but declined to less than 7 feet by 1980 (Nichols and Lathrop 1994). More recently, rooting depths for aquatic plants has increased to about 12 feet, reflecting improved water clarity. Coinciding with the trend of declining water clarity was the elimination and decline of selected native plants. Extirpations included large-leaf pondweed and Illinois pondweed and declines of flatstem pondweed, wild celery, slender naiad, water crowfoot, and muskgrass.

In addition to declining water quality, other factors leading to native plant declines included invasions by common carp, CLP and EWM. Carp apparently undermined plants within the bays in 1951 due to their rooting and turbidity causing feeding behavior. EWM appeared to have a pronounced impact as native plant declines coincided with rapid expansion of this exotic plant by 1966 (Nichols and Lathrop 1994, Madsen et al. 1991). Because they begin their growth early in the year, both EWM and CLP can create dense canopies before native species emerge from winter dormancy. For approximately a decade after its introduction, EWM became well established in Lake Mendota and remained very abundant until the first noted decline in 1976. Since then, periodic declines and resurgence of EWM have occurred in Lake Mendota and in the other Yahara lakes, a typical sequence found for EWM and other exotic plant invasions (Nichols 1994, Smith and Barko 1992).

EWM has undermined boating, fishing, water skiing, and swimming in Lake Mendota. This is a common pattern found throughout the United States when EWM enters a lake (Madsen 2005). In addition to human use impairments, the ecological side effects of dense stands of EWM and other weedy plants on fisheries have been extensively evaluated (Dibble et al. 1996, Engel 1990, Olson et al. 1998, Savino and Stein 1982, Trebitz et al. 1997). Dense EWM beds are linked with slow fish growth rates in some lakes. However the effects of EWM on panfish and predator growth rates in Lake Mendota are unclear given the relatively modest littoral area compared to the large productive pelagic area. Growth rates and production of a variety of sportfishes in Lake Mendota have been considered excellent for decades. EWM in Lake Mendota may have contributed to the disappearance of nongame fishes including banded killifish (*Fundulus diaphanus*), blackstripe topminnow (*Fundulus notatus*) blackchin shiner (*Notropis heterodon*), blacknose shiner (*Notropis heterolepis*), pugnose shiner (*Notropis anogenus*), and tadpole madtom (*Noturus gyrinis*) (Lyons 1996). Other factors such as shoreline development and piers may have also affected these species due to their strong affinity for nearshore aquatic plant habitat (Garrison et al. 2005, Bryan and Scarnecchia 1992, Becker 1983 and Gaumitz 2005). Heavy motorboat traffic is also linked to declining aquatic plant habitat in lakes (Asplund and Cook 1997).

In addition to the nongame fish declines noted above, Lake Mendota supports diverse warmwater fisheries including coolwater cisco (*Coregonus artedii*), a member of the trout and salmon family (Salmonidae). The fish species list also includes lake sturgeon (*Acipenser fulvescens*), longnose gar (*Lepisosteus osseus*), bowfin (*Amia calva*), northern pike (*Esox lucius*), musky (*Esox masquinongy*), common carp (*Cyprinus carpio*), golden shiner (*Notemigonus crysoleucas*), emerald shiner (*Notropis atherinoides*), spotfin shiner (*Cyprinella spiloptera*), bluntnose minnow (*Pimephales notatus*), fathead minnow (*Pimephales promelas*), white sucker (*Catostomus commersoni*), bigmouth buffalo (*Ictiobus cyprinellus*), black bullhead (*Ameiurus melas*), yellow bullhead (*Ameiurus melas*), brown bullhead (*Ameiurus nebulosus*), channel catfish (*Ictalurus punctatus*), brook silverside (*Labedesthes sicculus*), white bass (*Morone chrysops*), yellow bass (*Morone mississipiensis*), rock bass (*Ambloplites rupestris*), green sunfish (*Lepomis cyanellus*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), white crappie (*Pomoxis annularis*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), logperch (*Percina caprodes*), Iowa darter (*Etheostoma exile*), walleye (*Stizostediun vitreum*), and freshwater drum (*Aplodinotus grunniens*).

Recent Chemical and Harvesting Aquatic Plant Management Records

Dane County's mechanical harvesting program typically runs from mid-May to mid-August each summer. Priority harvesting includes emergency flood relief, boat navigation and public access areas such as beaches and boat landings. Harvested plants are composted. Figure 2 contains the annual tonnage of aquatic plants harvested from Lake Mendota from 1989 to 2006. Harvesting efforts typically focus on EWM but also include dense coontail beds. Dane County harvesting priorities for Lake Mendota are indicated in Figure 3.

Figure 2: Lake Mendota mechanical harvesting summary

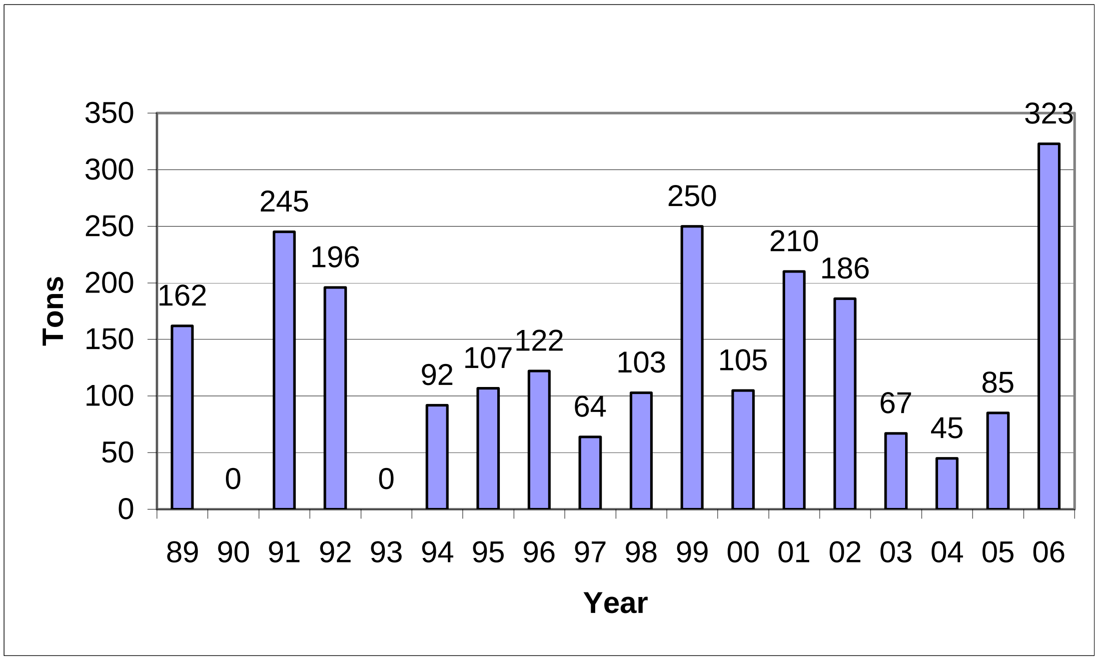
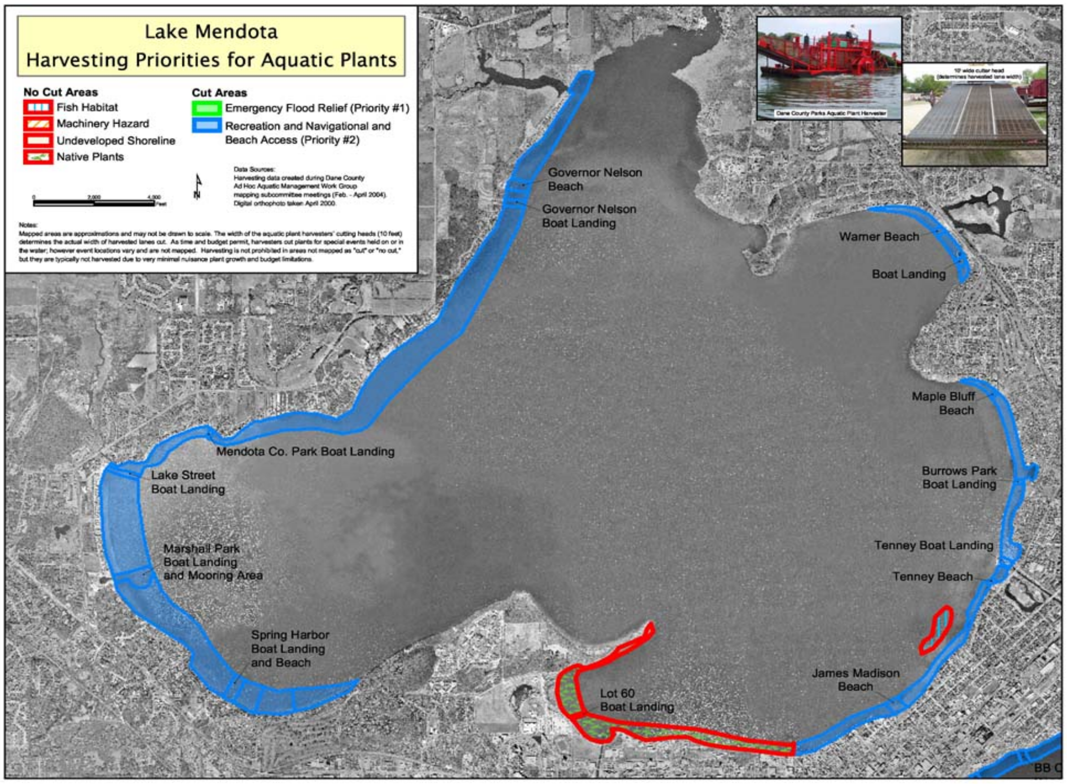
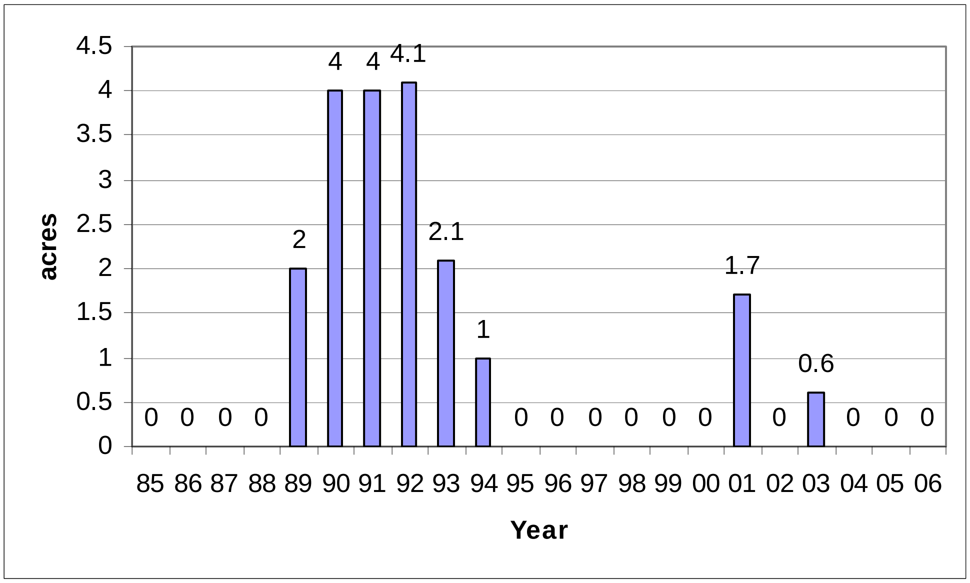


Figure 3: Lake Mendota harvesting priorities for aquatic plants



While Dane County operates mechanical harvesting equipment in water deeper than 2 feet, a number of the private riparian property owners collectively hire one or more certified chemical applicators each year. These chemical herbicide applications are for individual property owners and include areas adjacent to their docks. Chemical applications have been a controversial issue for managing aquatic plants in the Yahara lakes since the 1970s. In general, applications have been fairly consistent over the last few decades and treatment areas have been relatively modest in relation to the total littoral zone in the lake. One concern has been that herbicide treatments focus on near shore plant communities where most of the native plants occur. Figure 4 lists total littoral zone acres chemically treated annually for EWM and filamentous algae from 1985 to 2006.

Figure 4: Acres chemically treated in Lake Mendota by private entities



2006 Aquatic Plant Survey Update

Methods

The sampling protocol was developed by Jen Hauxwell, a research scientist with Wisconsin Department of Natural Resources, Bureau of Integrated Science Services. The point intercept method was used where a large number of sampling sites are distributed equidistantly across a lake. GPS units were used to locate the sites and double-headed rakes were used to collect aquatic plants. Two forms of sampling rakes were used. The pole rake was used for sampling aquatic plants up to 15 ft (4.6 m) and rope rake was used to sample deeper areas. Density ratings from 1-3 were determined by the amount of plant material in the two-headed rake. Plants that were observed near the boat but were not collected in the rake were also noted. Samples of each species found in a lake were collected, pressed and submitted as voucher specimens to the UW Madison Herbarium.

Statistical analysis included the following:

- Frequency of occurrence within vegetated sites (number of times a species was found divided by the total number of vegetated sites).
- Relative frequency of plant species collected (describes each species contributing a certain percentage of the whole aquatic plant community).

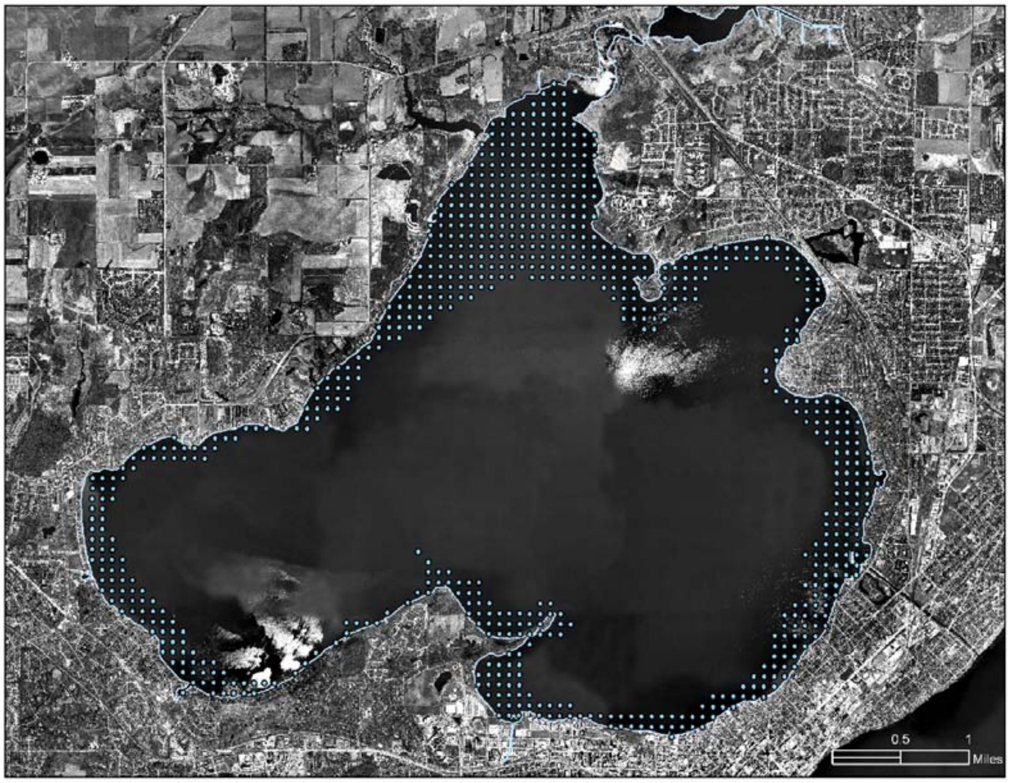
Detailed statistical results appear in Appendix C.

Wisconsin Department of Natural Resources staff provided the sampling grids and spreadsheet software for data entry and analysis. A more detailed sampling description can be found in Baseline Monitoring of Aquatic Macrophytes (Hauxwell 2006).

Results and Discussion

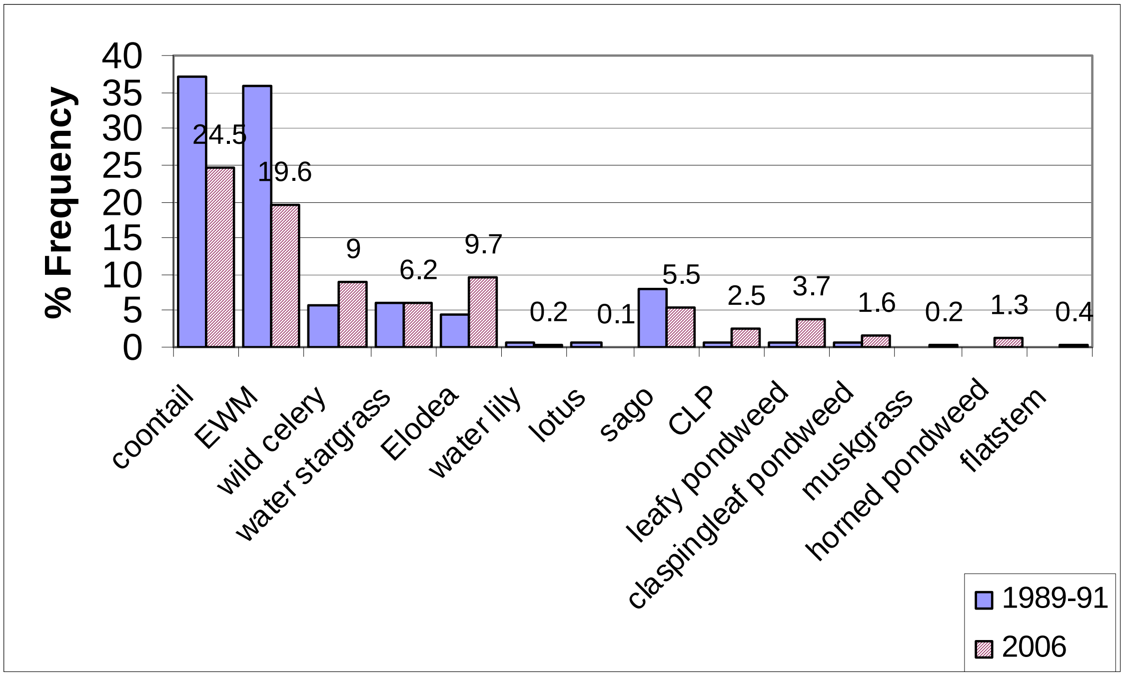
The aquatic plant survey was conducted on June 24, July 1, July 2, July 7, July 8 and July 10, 2006. Secchi depths were measured at 15 feet throughout most of the lake, generating a favorable TSI score of 38 (suggesting mesotrophic conditions). A 787-point grid was established across the lake containing potential sampling sites (Figure 5). After eliminating sites with depths beyond the littoral zone, a total of 633 points were sampled.

Figure 5: Point intercept sampling grid for Lake Mendota



Results of the 2006 plant survey included greater depths supporting aquatic plant growth and greater native species richness than in prior surveys. Plants were found at a maximum depth of 16 feet in 2006 compared with about 13 feet during the early 1990's (Deppe and Lathrop 1993). Two additional species were also found in 2006 that had not been found in decades. Low numbers of muskgrass (*Chara*) and horned pondweed (*Zannichelia palustris*) were collected in 2006. Since the sampling protocol differed somewhat (transect sampling from 1989-91 and grid sampling in 2006) it is not clear if the additional species found in 2006 reflected sampling differences or improved diversity. However, another positive finding in 2006 was greater relative frequencies for nearly all native species in 2006. Coontail was the most abundant plant based on both relative frequency and rake fullness (2). EWM was the second most abundant plant but rake fullness measures averaged 1, indicating that it was not a significant nuisance in 2006. The total native species richness was 16. Figure 6 contains 2006 survey results and Table 1 and Figure 7 indicate greater native species richness and relatively frequency in 2006 compared to surveys from 1989-91. Appendix D includes distribution maps for the plants sampled in 2006. Appendix E notes fish and waterfowl values of desirable native plants in Lake Mendota.

Figure 6: Lake Mendota relative aquatic plant frequency results



The relative frequency describes the percentage that each aquatic plant species contributes to the whole aquatic plant community. Relative frequency is a commonly used metric since survey results can be compared with surveys that used different sampling techniques.

While water clarity was generally very good in 2006, poor water clarity was measured within the bay where the Yahara River and Six Mile Creek flow into Lake Mendota. Secchi measurements were only 2 feet, due to turbidity from fine suspended solids loads from the river. Few plants were found in the entire area and likely reflect a combination of poor transparency and strong southwest wind fetch.

Sensitive Areas (NR 107.05(3)(i) had not been officially designated in Lake Mendota but previously DNR had proposed that public shorelines should be considered for designation. Based on the 2006 survey, publicly-owned areas were found to support white water lily, American lotus and coarse woody habitat. These areas provide critical habitat for early life stages for fish populations in the lake (Figure 8). The floating-leaf plant communities should not be chemically treated or mechanically harvested. The ecological values of these areas can be enhanced by reducing motorboat impacts along with native plantings of wild celery, wild rice, bulrush, American lotus, large-leaf pondweed and clasping-leaf pondweed (Nichols and Lathrop 1994).

Table 1: Comparison of Species and Relative Frequency Results

Species	1989	1990	1991	2006
Coontail	42.5	42.4	26.4	24.5
Eurasia watermilfoil	34.1	32	40.9	19.6
Wild celery	5.4	5.8	6.3	9
Water stargrass	5.8	5.5	7.1	6.2
Waterweed	3.6	3.3	7	9.7
White water lily	0.3	0.3	0.8	0.2
American lotus	0.3	1.1	0.2	0.1
Sago pondweed	6.8	8.5	8.3	5.5
Curly-leaf pondweed	0.7	0.5	0.9	2.5
Leafy pondweed	0	0.1	1.5	3.7
Clasping-leaf pondweed	0.5	0.4	0.6	1.6
Horned pondweed	0	0	0	1.3
Flatstem pondweed	0.1	0	0	0.4
Muskgrass	0	0	0	0.2

Figure 7: Lake Mendota aquatic plant native species richness

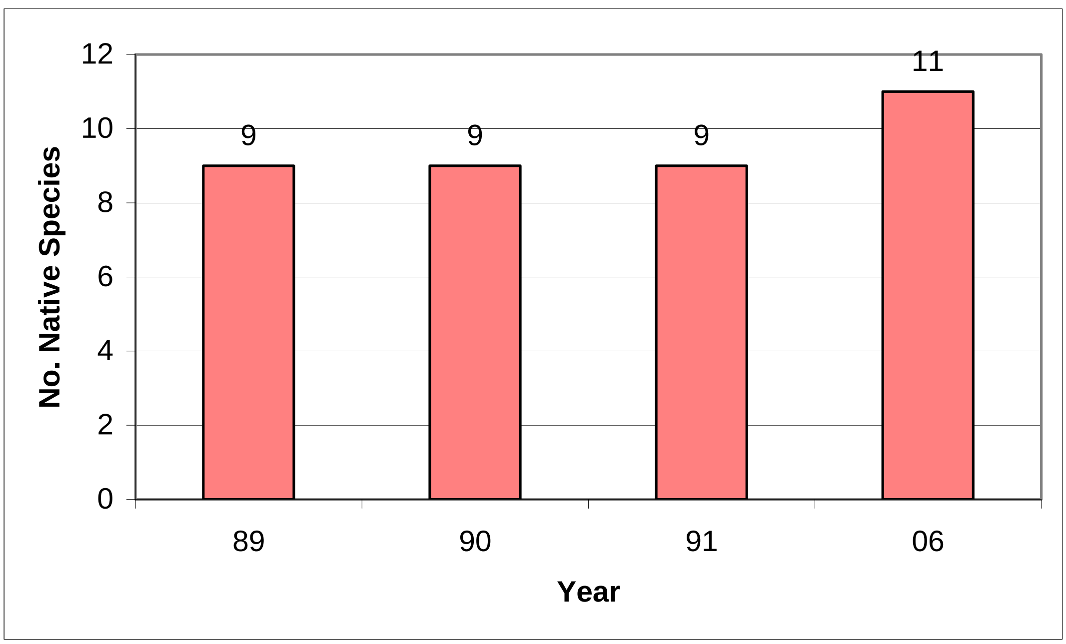
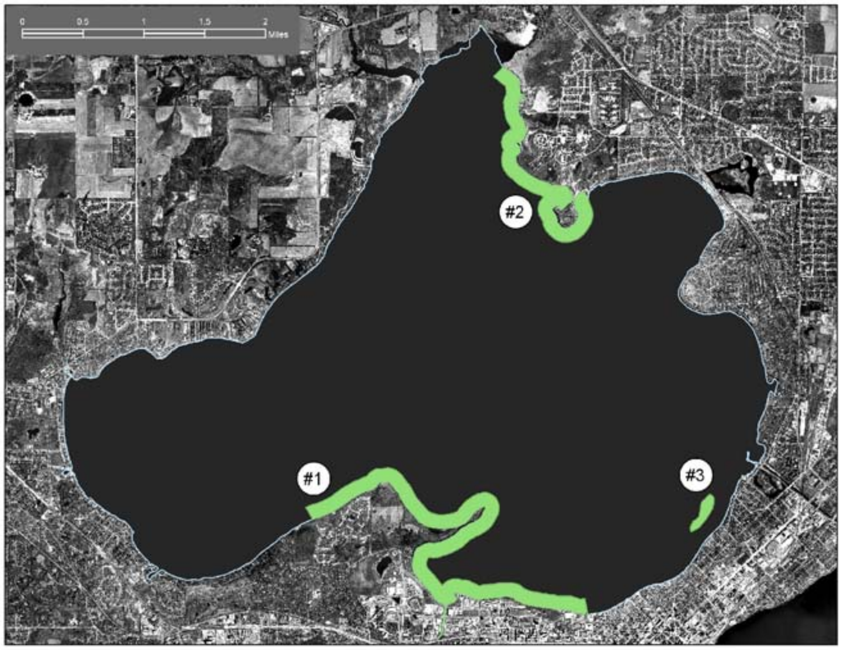


Figure 8: Proposed Lake Mendota sensitive areas



Aquatic Plant Management Alternatives

While the primary emphasis of this plan is to protect important aquatic plant habitats and control nuisance EWM growths with mechanical harvesting equipment, additional management tools are available to individual property owners. Chemical treatments are regulated under Wisconsin Administrative Code NR 107. Figure 4 demonstrates the annual frequency and application coverage for herbicides. In some areas of the lake, limited stands of Chara may be affected by copper sulfate compounds while valuable pondweeds may be susceptible to diquat applications.

Under NR 109.06 (a-1), a riparian owner is not required to obtain a plant removal permit from WDNR if the removal involves invasive species or removal of native species is limited to a single area with a maximum width of no more than 30 feet measured along the shoreline.

Dredging is generally not considered to be a practical option due to high costs. Limited dredging efforts have been publicly-funded for selected boat ramps and river channel access. Dredging as a form of aquatic plant management would require a Chapter 30 permit from WDNR.

Another alternative is the use of aquatic weevils. Weevils have been demonstrated to control EWM in laboratory and enclosure studies (Mazzei et al. 1999, Sheldon and Creed 1995). An EWM decline in Fish Lake occurred in 1994, coinciding with evidence of weevil damage (Lillie

2000), however EWM rebounded a few years later and high densities continue in the presence of the insect. More detailed discussions on aquatic plant management alternatives can be found in Cooke et al. (2005) and Petty (2005).

Mechanical harvesting often removes juvenile panfish in the conveyor with the vegetation. However, WDNR biologists consider the inadvertent removal of small panfish to have no effect on population levels. In some cases, removal of juvenile panfish may actually improve size structure when population levels are too high.

Specific Alternatives

1) **No treatment**: Rejecting all types of aquatic plant management does not appear realistic, given the extent of EWM coverage and heavy recreational needs across the lake.
2) **Biological control**: This method does not appear realistic at this time. Research findings suggest that weevils are difficult and expensive to establish in a lake and effectiveness has been mixed. Research will no doubt continue on biological control. If a method proves viable as a possible control method, it will be evaluated as a potential control method for Lake Mendota or other Yahara Lakes.
3) **Chemical control:** Herbicide use should be restricted to those selective at controlling EWM. 2, 4-D is the likely agent given the partial selectivity for controlling EWM. However, several valuable native plants including water lilies can be damaged from 2, 4-D so WDNR permit applications should be carefully screened to avoid loss of already declining native plants. Whole-lake chemical applications in Lake Mendota are not feasible given its enormous size. The U.S. Army Corps of Engineers (COE) is working on using herbicides to control exotic plants while not adversely impacting and/or enhancing native plants. Dane County will continue coordination in this area to look at possible sites for a demonstration project. This possible option is one being advanced through recommendations to the County Board from the Aquatic Plant Management Committee (see Appendix A).
4) **Manual - hand removal**: Manually removing plants around piers and swimming areas is a viable option. However, property owners should be educated about the importance of high value native species so that their efforts should focus on weedy exotics such as EWM. All plants that are cut must be removed. Plants should not be removed from Sensitive Areas.

5) **Mechanical harvesting**: Given the extent of EWM throughout Lake Mendota, mechanical harvesting provides effective temporary access through the dense monotypic beds as well as providing habitat improvements. Sensitive Areas should be avoided to prevent loss of floating-leaf plants.
6) **Physical control**: Most physical methods of controlling aquatic plants require permits from WDNR under Chapter 30 Wisconsin State Statutes. Hydraulic dredging can be an option for removing the nutrient-rich sediments within designated navigation channels. This method has the greatest potential for long-term control but can be initially expensive. Whole lake dredging is unrealistic given the vast littoral areas affected by EWM. Sheets of dark fabrics anchored to the bottom covering the plants from any light create bottom or benthic barriers. A benthic barrier eliminates all plants, including non-target species, with the exception of free-floating plants and algae. These types of barriers can interfere with fish spawning and other pond wildlife. Over time, barriers may require maintenance due to siltation, ice damage, bubbling up and normal wear and tear. Fabrics applied in this way will require a permit. Fabrics are rarely used by property owners because of the labor of installation and maintenance. Drawdown is infrequently used in Wisconsin for aquatic plant management and would not likely affect the weedy stands of EWM and coontail beyond the nearshore areas. Nearshore valuable native plants could be negatively affected by a drawdown, and water replacement may be an issue during a drought cycle.

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GLOSSARY

Alleopathy	Harmful effect of one plant on another caused by the release of chemical compounds produced by the first plant.
Biomanipulation	A technique involving using predatory fish to reduce the number of fish that feed on organisms that eat algae.
Chlorophyll a	The green pigment present in all plant life and needed for photosynthesis. The amount present in lake water is related to the amount of algae found there and is used as an indicator of water quality.
Columnaris	Bacterial infection of fish which especially occurs when they are stressed. The disease is highly contagious to fish and typically enters through gills, mouth or small skin wounds.
Cyanobacteria	Another name for blue-green algae. A group of algae that are often associated with "problem" lake blooms. Certain species can produce toxins which can cause illness and even death in animals and humans. Blue-green algae can "fix" nitrogen from the atmosphere and thus are often found when phosphorus levels in water are high.
Dessicated	Something that is thoroughly dried.
Emergent plants	Species with leaves that extend above the water surface that are usually found in shallow water.
Eutrophication	The process by which lakes are enriched with nutrients thereby increasing the amount of rooted plants and algae. The extent to which this process has occurred is reflected in a trophic state classification system.
Eutrophic	Within a lake trophic state classification system, this is a lake that is rated as being very productive and fertile.
Extirpation	The act of being eliminated.
Floating-leaf plants	Rooted plants with leaves that float on the water surface, such as water lilies.
Filamentous algae	Algae that forms filaments or mats which attach to the bottom sediments, rooted plants, piers, etc.
Hectare	A metric unit of measure which is equivalent to about 2.47 acres.
Herptiles	A broad group of cold-blooded animals including turtles and amphibians.
Hypereutrophic	A very nutrient-enriched lake characterized by severe and dominant algal blooms and very poor water quality.

Hypolimnion	The layer of the lake closest to the bottom and immediately below the metalimnion or thermocline, within lakes deeper than 20 feet stratify, or layer, based on temperature differences.
Hypolimnetic	Referring to the hypolimnion.
Internal loading	Internal loading refers to sources of phosphorus within a lake, typically from deep water sediment or decaying aquatic plants in the littoral zone.
Intolerant	Aquatic species that are impacted by changing conditions. For example, if water quality worsens, certain intolerant species may disappear because of lowered oxygen levels or a loss of their habitat.
Limnologist	A specialist in the study of freshwater ponds and lakes.
Littoral zone	The shallow part of a lake where most of the rooted aquatic plants are found.
Littoriprofundal	Transition zone below the littoral zone, characterized by its lack of macrophytes; often adjacent to the metalimnion of stratified lakes.
Macrophytes	The higher (multi-celled) plants found growing in or near the water. They produce oxygen and provide food and cover for lake organisms.
Mesotrophic	Lakes that are in-between eutrophic (very fertile) and oligotrophic (infertile) waters. They exhibit fairly good water quality and rooted aquatic plant growth.
Monotypic	Involving only one species.
Moss	Mosses are bryophytes or non-vascular plants. These primitive plants lack flowers and seeds and produce spore capsules to reproduce. Mosses live in a variety of shady moist environments including deeper areas in clear lakes.
Oligotrophic	Very low nutrient, clear lakes having lower amounts of rooted aquatic plant growth and productivity, but rich in oxygen throughout their depth.
Pelagic	The open water zone of a lake outside of the littoral zone.
Phosphorus entrainment	Movement of phosphorus and other nutrients from the hypolimnion into the epilimnion due to wind-generated mixing and erosion of the thermocline.
Phytoplankton	Algae-like organisms found in waters that use light to support photosynthesis. Examples include diatoms, cyanobacteria and dinoflagellates.

Planktivores	A free-floating or drifting organism (example Daphnia) that feeds on phytoplankton.
Planktonic algae	Small free-floating algae including green algae, blue-green algae and diatoms.
Point source	Source of pollution (e.g. wastewater treatment plant) with a defined discharge point such as a discharge pipe.
Secchi disc	An 8-inch diameter disc with four alternating quadrants of black and white. It is lowered into a lake on a rope and used to measure light penetration. Lakes are infertile (oligotrophic) if the depth you can see the disc are great. Lakes are fertile (eutrophic) if the disc disappears quickly.
Species richness	The number of different species present.
Thermocline	The narrow transition zone between the epilimnion (top lake temperature layer) and the hypolimnion (bottom lake temperature layer). This portion of a lake is where the temperature changes most rapidly, and in most waters is found around 20 feet or deeper. Also called the metalimnion.
Trophic State Index (TSI)	A way to measure, rate and classify the quality of a water body. Trophic state (e.g. eutrophic, mesotrophic, oligotrophic and hypereutrophic) is a measure of biological productivity.
Turion	The over-wintering bud produced by aquatic plants.
Two story fisheries	Fisheries that support both warm water and cold water fish species, and that are thermally segregated for most of the year.
Winter dormancy	Refers to the condition of aquatic plants during the winter months, often in the form of seeds, turions, rhizomes or non-growing vegetation.