Executive Summary

An aquatic macrophyte (plant) survey in Mason Lake was conducted using a modified Point Intercept (PI) method during the summer of 2014 by staff of Adams County LWCD and Golden Sands RC & D. This was a follow-up to the vegetation studies of Mason Lake done in 2009, 2005, 2001, 1998, and 1992.

Mason Lake is an 855-acre impoundment on the South Branch of Neenah Creek, located mainly in Adams County. The eastern ¼ of the lake is located in Marquette County and Amey Pond, to the south of Mason Lake, is in Columbia County. In 1970, it had a maximum depth of 9 feet, but it is likely that sedimentation has resulted in a shallower lake by now. The town of Douglas (Marquette County) owns the dam that forms Mason Lake. Two large creeks (Cody and Big Springs) feed into the lake, as well as some minor creeks. Big Spring Creek is on the 303(d) impaired watered waterways list, as is Mason Lake itself.

The trophic state of a lake is a classification of its water quality. Phosphorus concentration, chlorophyll concentration and water clarity data are collected and combined to determine the trophic state. The combination of phosphorus concentration, chlorophyll concentration and water clarity indicate that Mason Lake is an eutrophic to hypereutrophic lake with high total phosphorus levels and low Secchi disk readings, plus high chlorophyll-a levels. This trophic state indicates a turbid system dominated by algae, instead of a clear water system dominated by aquatic plants. Frequent and/or ongoing algal blooms would be expected.

Based on relative frequency, Watermeal, a free-floating plant, was by far the most frequently-occurring aquatic plant in the 2014 survey. The non-native invasive Eurasian Watermilfoil and the native Coontail were tied for the next most frequently-occurring plants. Both of these are submergent plants. Based on the Dominance Value, the 2014 PI survey showed that Coontail was the dominant aquatic plant species in Mason Lake, with Eurasian Watermilfoil and Watermeal tying for subdominance. Other common species were Lesser Duckweed, Floating-Leaf Pondweed, and Sago Pondweed.

The Average Coefficient of Conservation and Floristic Quality Index were calculated as outlined by Nichols (1998) to measure plant community disturbance. The Average Coefficient of Conservatism for Mason Lake in 2014 was 3.3. The FQI was 12.72 when adjusted for frequency. These Average Coefficient of Conservatism and Floristic Quality Index scores place Mason Lake in the lowest quartile of lakes for Average Coefficient of Conservatism for lakes in Wisconsin overall and for the North Central Hardwoods Region.

Based on water clarity and the concentrations of algae and nutrients, Mason Lake was an eutrophic/hypereutrophic lake with poor/very poor water quality and poor water clarity from 1986-2014. Since 1986, nutrient levels have increased, and water clarity has decreased. Although aquatic plant growth in Mason Lake should be favored by the high nutrients of its trophic state, hard water, dominance of rich sediments, the shallow depth of the lake and the very gradually sloped littoral zone, such growth is no longer occurring in Mason Lake. The aquatic plant growth in Mason Lake continues to decrease coverage of the lake, even by plants tolerant of high disturbance and lower water quality and clarity.

MANAGEMENT RECOMMENDATIONS

1) The aquatic plant community has decreased drastically since 2005, when aquatic plants covered over 90% of the lake and many species occurred in more than average density of growth. While that situation was not ideal, the crash in plant coverage suggests a significant negative change in the lake's ecosystem. It would be appropriate to conduct some studies to attempt to determine what is causing this change.

2) Participation by the Mason Lake District and watershed citizens/users in carrying out the recommendations from UW-Stevens Point, Adams County Land & Water Conservation Department, and Wisconsin Department of Natural Resources, is recommended. The activities include:

    - In-lake growing season water quality monitoring in at least 2 sites in Mason Lake, plus one in Amey Pond
    - In-lake open water season temperature monitoring through the water column
    - In-lake water quality monitoring for spring and fall overturn
    - Sediment testing to gather information for modeling for internal loading
    - Modeling for internal loading in the lake
    - Measuring water quality and discharge/flow rates in at least 2 sites along the two creeks feeding into Mason Lake
    - Mapping tile drains in the watershed, which is largely agricultural, including some sampling, especially for nitrogen and phosphorus, and for volume
    - Updated land use information gathering and mapping
    - Modeling to determine tributary loads and landscape contribution
    - Social & Water Governance assessment activities, including exploring resistance to watershed wide actions
    - Completion of the study of carp and gizzard shad presence and possible contribution to turbidity or other water quality changes
    - Completing revision of the lake-management plan started in 2005, being sure to include watershed actions
    - Location of septics and evaluations of any contributions to loading
    - Installation of stormwater runoff and buffer practices to reduce inputs

to the lake

- Updating the depth map of the lake (current one is from 1970)

3) All lake residents should practice best management on their lake properties. Mason Lake is already on the impaired waterways list. A small increase in nutrients could push the lake past likely recovery, resulting in long-term worse water quality. Reducing nutrients would have a favorable impact on water quality. These activities would include:

   - Keeping septic systems inspected,cleaned and in proper condition;
   - Using no chemicals within 50 feet of the lake;
   - Cleaning up pet wastes;
   - No composting should be done near the water nor should yard wastes nor clippings be allowed to enter the lake (Do not compost near the water or allow yard wastes and clippings to enter the lake)

4) Although Mason Lake is on the WDNR Trend Lake list, so that some regular water quality monitoring occurs, it would be a good idea to recruit and train several volunteers who could test and track water quality through the Citizen Lake Monitoring Program. Some citizens were trained, but have moved away. Having several trained may increase the likelihood of some continuity, instead of having gaps in information gathering.

5) Mason Lake is extremely vulnerable to colonizations by additional aquatic invasives. With so much of the lake bottom unvegetated, opportunistic invasives could take hold quickly. Regular involvement in the Clean Boats, Clean Waters Program, either by volunteers or paid staff, is recommended at the three main boat launches on the lake to try to prevent further invasions.

6) A map of the sensitive areas should be posted at the public boat ramps with a sign encouraging avoidance of disturbance to these areas should also be posted. Landowners on the lake should watch for disturbance of these areas and report any violations. These areas are very important for habitat and maintaining water quality and for preserving endangered and rare species.

7) Part of the evaluation for helping the lake regain better water quality should include a variety of attacks on the continuing problem of Eurasian Watermilfoil, as well as Curly-Leaf Pondweed. It should also include management strategies for coping with Brittle Naiad and Japanese

Knotweed (the latter was found on the shore, but not in the water, so doesn't appear in the aquatic plant survey results).

8) Drawdowns of the lake should only be done when needed. Annual drawdowns destabilize the littoral zone habitat. However, since it has been some years since the last drawdown for EWM control, so it might be time to try it again.

9) An updated depth map should be completed as soon as possible. The last depth map is dated 1970; in planning for the lake's future, it is important that updated information on sedimentation (depth) be obtained.

10) Since the shore is so heavily developed, with several older cabins close to the water, installation of vegetative buffers and stormwater runoff management is essential. An increase in the depth of these buffer areas is recommended. A buffer of 35 feet landward from shore should be the goal when possible.

11) Steps should be taken to regulate boat speed in the shallow water areas to reduce disturbance to aquatic plants and the sediment.

12) The aquatic plant survey should be repeated in 3 to 5 years in order to continue to track any changes in the community and the lake's overall health.

13) In 2014, the Mason Lake District paid two interns to inventory the two main creeks in the watershed that feed into Mason Lake and identify problem spots. That information should be used to help approach watershed landowners about best management practices that will reduce nutrient and sediment loading to Mason Lake.

I. INTRODUCTION

An aquatic macrophyte (plant) survey in Mason Lake was conducted using a modified Point Intercept (PI) method during the summer of 2014 by staff of Adams County LWCD and Golden Sands RC & D. This was a follow-up to the vegetation studies of Mason Lake done in 2009, 2005, 2001, 1998, and 1992.

A study of the diversity, density, and distribution of aquatic plants is an essential component of understanding a lake ecosystem due to the important ecological role of aquatic vegetation in the lake and the ability of the vegetation to characterize the water quality (Dennison et al. 1993).

Ecological Role: All other life in the lake depends on the plant life - the beginning of the food chain. Aquatic plants and algae provide food and oxygen for fish, wildlife, and the invertebrates that in turn provide food for other organisms. Plants provide habitat, improve water quality, protect shorelines and lake bottoms, add to the aesthetic quality of the lake and impact recreation.

Characterization of Water Quality: Aquatic plants serve as indicators of water quality because of their sensitivity to water quality parameters, such as water clarity and nutrient levels (Dennison et. al. 1993).

This study will provide updated information for effective management of the lake, including fish habitat improvement, protection of sensitive habitat, aquatic plant management and water quality protection. It will also allow tracking of any significant changes in the aquatic plant community that may indicate changes in the lake's overall health.

Background and History:

Mason Lake is an 855-acre impoundment on the South Branch of Neenah Creek, located mainly in Adams County. The eastern ¼ of the lake is located in Marquette County and Amey Pond, to the south of Mason Lake, is in Columbia County. At one time its maximum depth was 9 feet, but it is likely less now after years of sedimentation. The town of Douglas (Marquette County) owns the dam that forms Mason Lake. Two large creeks (Cody and Big Springs) feed into the lake, as well as some minor creeks. Big Spring Creek is on the 303(d) impaired watered waterways list, as is Mason Lake itself.

Mason Lake is part of the WDNR Long Term Trend Monitoring Program involving 50 lakes throughout the state. The program was initiated in 1986 to provide long-term water quality and biological data on a variety of Wisconsin lakes. The lakes were selected to represent a wide range of water quality, size and development pressure. Aquatic plant data is collected every three years and water quality data is collected every year on the trend lakes. Some data has also been collected by through the Citizen Lake Monitoring Program and the Adams County Land & Water Conservation Department.

Long term studies of the diversity, density, and distribution of aquatic plants are ongoing and provide information that is valuable for decisions about fish habitat improvements, designation of sensitive wildlife areas, water quality improvement and aquatic plant management. Trend data can reveal changes occurring in the lake ecosystem. The aquatic plant surveys in Mason Lake appear to be doing so, i.e., revealing changes in the lake ecosystem, including the watershed.

Mason Lake has a long history of algae blooms and abundant plant growth; it also has a long history of chemical treatments that attempted to reduce this growth. The first recorded complaints concerning excessive plant growth occurred in 1947 and concerning algae occurred in 1952. Requests for information about chemical treatments for algae and aquatic plants had been ongoing since 1947, but no record of treatment exists before 1972. No chemicals have been used for management of aquatic plants since about 2009, when the big decline in aquatic plant growth in the lake was noted.

Several chemicals were applied to the lake during the years 1972-2005. These included the use of copper sulfate, cutrine, Diquat, Endothall, and 2,4-D. These were generally targeted at clearing navigational channels through what was heavy, dense aquatic plant growth.

Winter drawdowns have also been used to control aquatic plants. The first permit for a drawdown was applied for in 1988; it was a two-year permit. Subsequent permits for winter drawdown have been approved. Winter drawdowns were conducted annually from 1988-1995. There was a discontinuation of winter drawdowns for three years (1995-1998) and resumption of winter drawdowns in 1998-2010 on a multi-year basis. These have not continued since 2010.

Most of the shoreline of Mason Lake is disturbed by long-term development, including the concentration of buildings in Briggsville (on the southeast part of the lake). Because the lake has been developed for so long, many of the dwellings along the lake shore are less than 75 feet landward from the shore, since they were built before state and county shoreline setback laws went into effect.

Several areas on Mason Lake have been designated as critical habitat by the Wisconsin Department of Natural Resources. Sensitive Area 1 (Burn's Cove) covers about 4000 feet of shoreline in the cove and up the stream (Cody Creek) and supports important near-shore terrestrial habitat, shoreline habitat and shallow water habitat. This area is the site of one of the tributaries feeding into Mason Lake and has a large wetland area that serves as a filter. It has a fairly diverse terrestrial and aquatic plant community (compared to other parts of this lake) and has natural scenic beauty, since it is one of the few undeveloped areas of the lake shore. A substantial growth of wild rice was discovered there during the 2014 survey.

Sensitive Area 2a extends along 800 feet of the northwest shore and supports near-shore terrestrial habitat. Area 2b, located at the Big Spring Inlet, extends for 800 feet along the lake shore at the mouth and up the Big Spring tributary and supports important near-shore terrestrial habitat, shoreline habitat and shallow water habitat. The shoreline is entirely wooded with small areas of shrub and herbaceous plant growth. The wetlands contain emergent herbaceous wetlands and shallow open water wetlands. Sensitive Area 3 extends along 2000 feet of shoreline and supports important shoreline habitat and near-shore terrestrial vegetation. The area has a high quality terrestrial plant community.

Sensitive Area 4 is approximately 60-acres, the entire wetland (Amey) pond south of the highway, and supports important near-shore terrestrial habitat, shoreline habitat and shallow water habitat. Additionally, it has high quality wildlife and aquatic habitat. This waterbody is operated jointly by the WDNR and Ducks Unlimited as a waterfowl sanctuary.

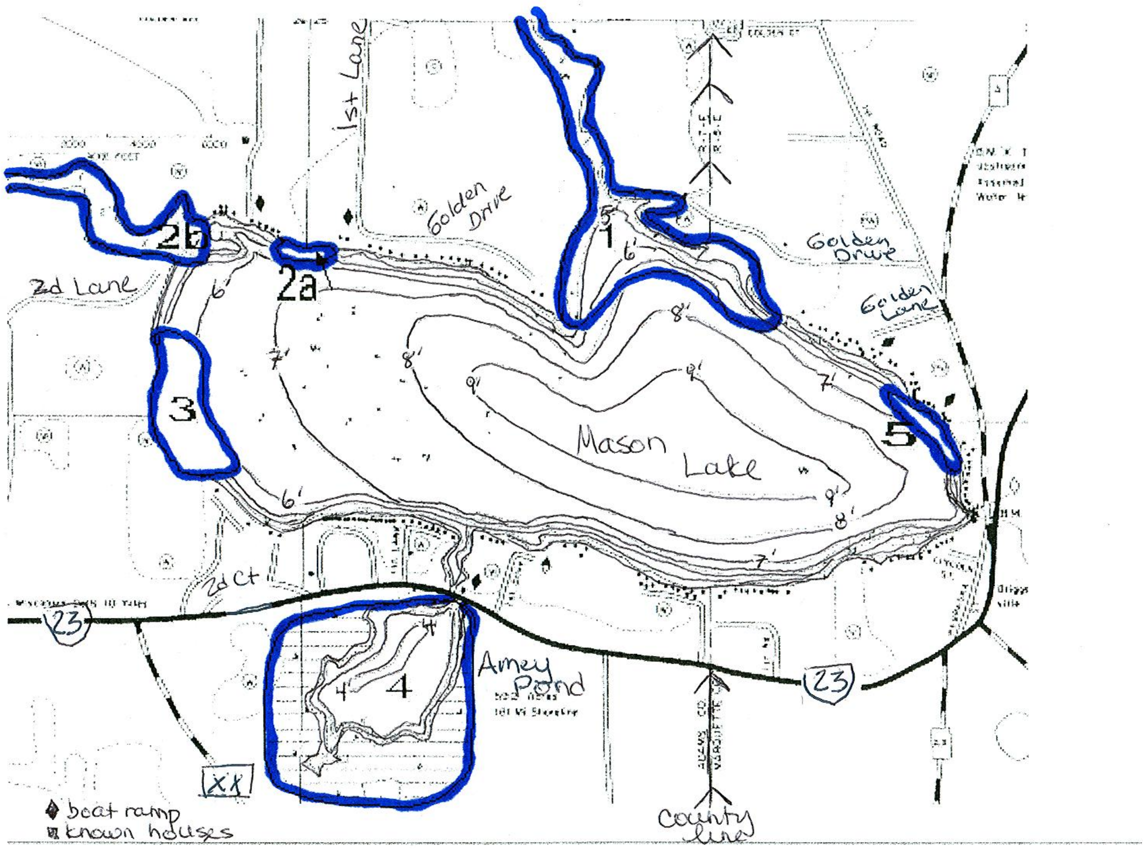


Figure 1: Critical Habitat Areas on Mason Lake

Sensitive Area 5 extends along 1000 feet of shoreline and supports important spawning habitat. Maintaining the lakebed of the littoral zone in this area is important for panfish spawning in the lake.

II.METHODS

Field Methods

The aquatic plant survey method used in 2009 and 2014 was a modified Point Intercept Method (modified to include near-shore areas). This method involves calculating the surface area of a lake and dividing it (using a formula developed by the WDNR) into a grid of several points, always placed at the same interval from the next one(s). These points are related to a particular latitude and longitude reading. At each geographic point, the depth is noted and one rake is taken, with a score given between 1 and 3 to each species on the rake.

A rating of 1 = a small amount present on the rake;
A rating of 2 = moderate amount present on the rake;
A rating of 3 = large amount present on the rake.

A visual inspection was done between points to record the presence of any species that didn't occur at the raking sites. Gleason and Cronquist (1991) nomenclature was used in recording plants found.

Data Analysis

The percent frequency of each species was calculated (number of sampling sites at which it occurred/total number of sampling sites). Relative frequency was calculated (number of occurrences of a species/sum of all species occurrences). Mean density was calculated for each species (sum of a species' density ratings/number of sampling sites). Relative density was calculated (sum of a species density/sum of all plant densities). "Mean density where present" was calculated for each species (sum of a species' density ratings/number of sampling sites at which the species occurred). The relative frequency & relative density of each species were summed for a dominance value for each species. Species diversity was measured by Simpson's Diversity Index.

The Aquatic Macrophyte Community Index (AMCI) developed by Nichols (2000) was applied to Mason Lake. Measures for each of seven categories that characterize a plant community are converted to values between 0 and 10 and summed to measure the quality of the plant community. These include maximum rooting depth, percent of littoral zone vegetated, percent of submergent species (based on relative frequency), percent of invasive species (using relative frequency), percent of sensitive species (using relative frequency), Simpson's Diversity Index, and number of taxa (species) found.

The Average Coefficient of Conservatism and Floristic Quality Index were calculated, as outlined by Nichols (1998), to measure disturbance in the plant community. A coefficient of conservatism is an assigned value, 0-10, the probability that a species will occur in an undisturbed habitat. The Average Coefficient of Conservatism is the mean of the coefficients for all species found in the lake. The Floristic Quality Index is calculated from the Coefficient of Conservatism (Nichols 1998) and is a measure of a plant community's closeness to an undisturbed condition.

III. RESULTS

PHYSICAL DATA

Many physical parameters impact the aquatic plant community. Water quality (nutrients, algae, water clarity and water hardness) influence the plant community as the plant community can in turn modify these parameters. Lake morphology, sediment composition and shoreline use also impact the aquatic plant community.

WATER QUALITY - The trophic state of a lake is a classification of its water quality. Phosphorus concentration, chlorophyll-a concentration and water clarity data are collected and combined to determine the trophic state. This scale is used world-wide.

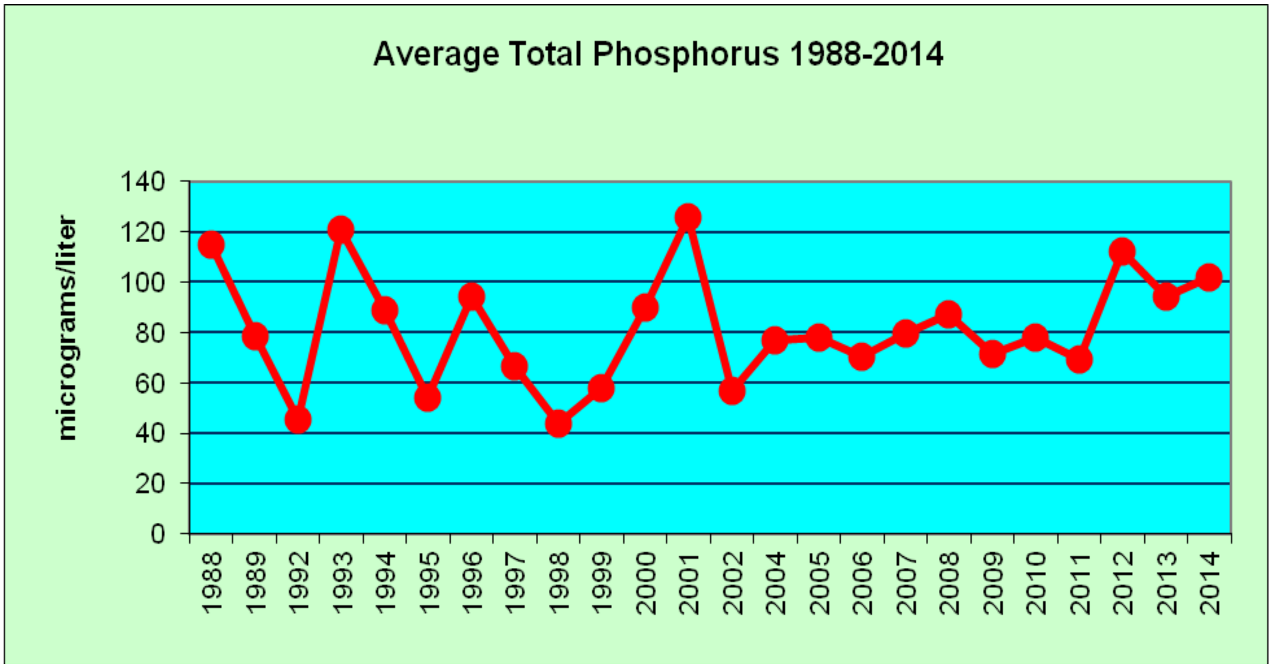
- Eutrophic lakes are high in nutrients and support a large biomass.
- Oligotrophic lakes are low in nutrients and support limited plant growth and smaller populations of fish.
- Mesotrophic lakes have intermediate levels of nutrients and biomass.

Phosphorus

Phosphorus is a limiting nutrient in many Wisconsin lakes and is measured as an indication of nutrient enrichment in a lake. Increases in phosphorus in a lake can feed algae blooms and, occasionally, excess plant growth.

For Mason Lake, there is water quality information going back to 1973. The average overall growing season (May through September) total phosphorus has been steadily increasing since the first total phosphorus testing done in 1988. The lowest total phosphorus reading was 19 micrograms/liter in February 1990; the highest was 240 micrograms/liter in August 1977. The average from 1988 to 1999 was 76.6 micrograms/liter. That average rose to 81.8 micrograms/liter for 2000 to 2009. By 2010 to 2014, the average rose again to 91.1 micrograms/liter.

Figure 2: Average Growing Season Phosphorus



Chlorophyll-a

Chlorophyll-a growing season levels are available for Mason Lake back to 1980. From 1988 to 1999, the average was 46.6 micrograms/liter, above the 30 micrograms/liter recommended for avoiding algae blooms. From 2000 to 2009, the average went down to 31.4 micrograms/liter, but by 2010 to 2015, the average had grown to 68.1 micrograms/liter. The highest growing season chlorophyll-a level reported was 139.0 micrograms/liter in August 1995, with the lowest found in March 1991 when it was 1.0 micrograms/liter.

Water Clarity

Water clarity is a critical factor for aquatic plants, because if they don't get more than 2% of surface illumination, they won't survive (Chambers and Kalff 1985, Duarte et. al. 1986, Kampa 1994). Water clarity is reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color the water. Water clarity is measured with a Secchi disc that shows the combined effect of turbidity and color. Mason Lake has traditionally had low Secchi disk readings, since they were first taken in May 1973. The lowest recorded was 0.66 feet in August 1997; the highest recorded was 8 feet, found in May 1973, July 1977, June 1992, June 1994, May 1998 and July 2001. Secchi disk readings have shown a significant downward trend: for 1992 to 1999, the growing season average was 4.5 feet. By 2000 to 2009, the average was down to 3.0 feet, and by 2010 to 2015, the growing season average was down to 2.2 feet.

Figure 3: Average Growing Season Chlorophyll-a Levels

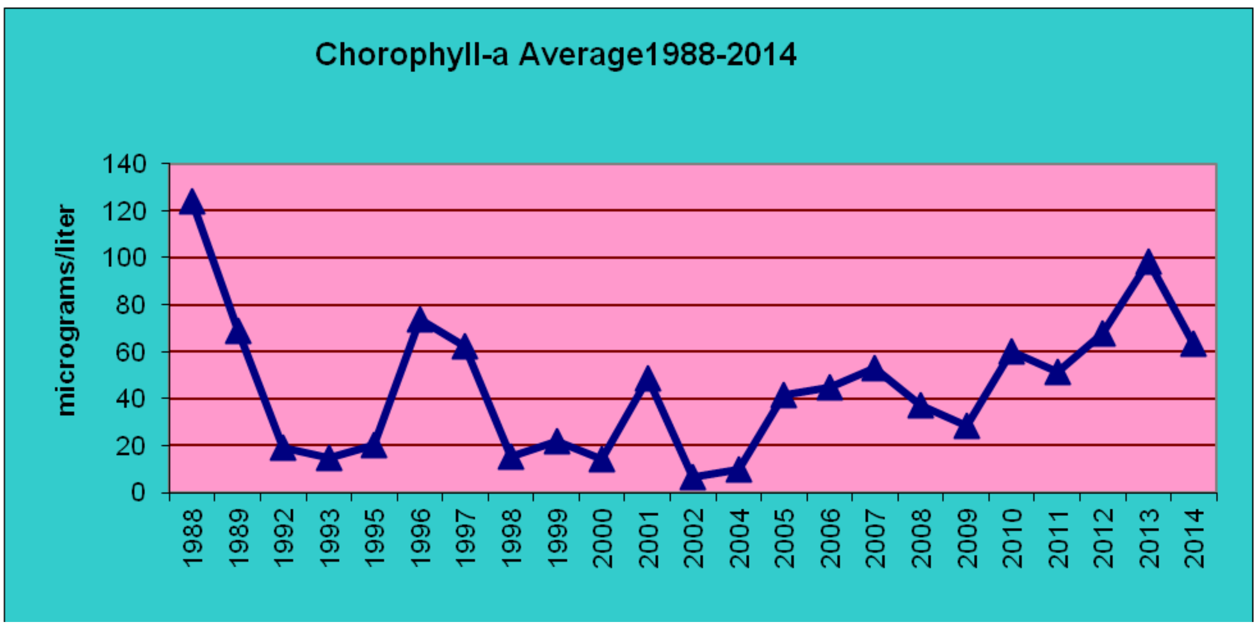
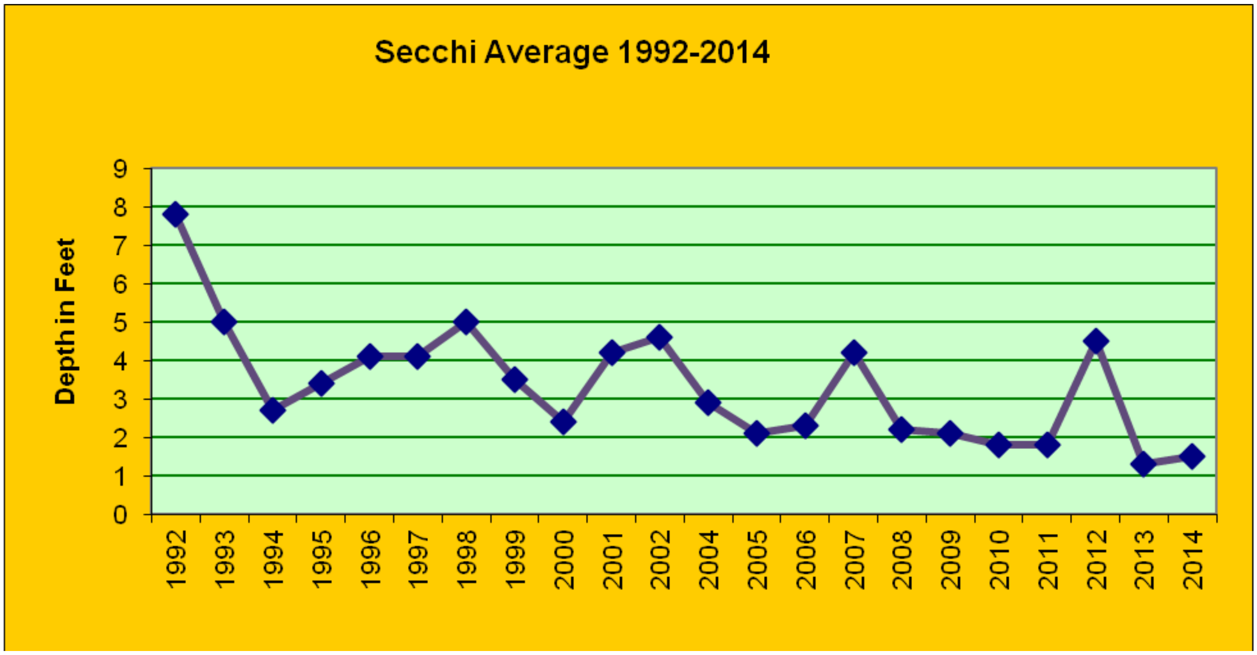


Figure 4: Growing Season Secchi Averages



A look at a table showing the changes in average water clarity by decades against the changes in average total phosphorus makes it clear that water clarity has decreased as total phosphorus increased.

Figure 5: Total Phosphorus & Water Clarity by Decades

	Average Total Phosporus	Water Clarity
	In Micrograms/liter	In Feet
1988 to 1999	76.6	4.5
2000 to 2009	81.8	3
2010 to 2014	91.1	2.2

Overall Water Quality

The combination of phosphorus concentration, chlorophyll-a concentration, and water clarity indicate that Mason Lake is an eutrophic to hypereutrophic lake with high total phosphorus levels and low Secchi disk readings, plus high chlorophyll-a levels. This trophic state indicates a turbid system dominated by algae, instead of a clear water system dominated by aquatic plants. Frequent and/or ongoing algal blooms would be expected.

Figure 6: Trophic Status

	Quality Index	Phosphorus micro/liter	Chlorophyll micro/liter	Secchi Disc feet
Oligotrophic	Excellent	<1	<1	> 19
	Very Good	1-10	1-5	8-19
Mesotrophic	Good	10-30	5-10	6-8
	Fair	30-50	10-15	5-6
Eutrophic	Poor	**50-150**	15-30	3-4
Hypereutrophic	Very Poor	>150	**>30**	**<3**
Mason Lake Growing Season 2010-2014		91.1	68.1	2.2

LAKE MORPHOMETRY

The morphometry of a lake is an important factor in determining the distribution of aquatic plants. Duarte and Kalff (1986) found that the slope of the littoral zone could explain 72% of the observed variability in the growth of submerged plants. Gentle slopes support more plant growth than steep slopes (Engel 1985).

The littoral zone is very gradually sloped in Mason Lake and the shallow basin provides light availability to nearly the entire lake, if the water is clear. With clearer water, aquatic plant growth over the entire basin would be expected. However, since the water clarity in Mason Lake tends to be poor to very poor, aquatic plant growth should not be expected in many areas of the lake, as is the case.

SHORELINE LAND USE

Land use can strongly impact the aquatic plant community and therefore the entire aquatic community. Land use can directly impact the plant community through increased erosion and sedimentation and increased run-off of nutrients, fertilizers and toxics applied to the land. These impacts occur in both rural and residential setting. Mason Lake continues to be a lake with shores with lots of cultivated lawn from a building all the way to the shore.

Some type of vegetated shoreline (wooded, shrub, herbaceous) covered 54% shore area sample sites This, of course, means that some type of disturbed shoreline from human impact (cultivated lawn, rock riprap, hard structure, erosion, etc) covered 46% of the shore sites.

A survey sent out to landowners in the Mason Lake subwatershed in the mid-2000s revealed that most of the septic systems around the lake were over 20 years old. Adams County Planning & Zoning is still working identifying all septics in that area and putting them on a regular inspection/pumping schedule. The status of septics on such a schedule in the Marquette part of the lake shore is unknown.

WATERSHED LAND USE

In 2002, Mason Lake was placed on the federal impaired waterways list (commonly called the "303(d)" list). The reasons for this placement included highly-elevated phosphorus level, eutrophication, high turbidity, pH problems, NPS contamination and degraded habitat. One of the streams that feeds Mason

Lake is also on the impaired waterways list. Mason Lake is one of the WDNR's "trend lakes", meaning that the WDNR regularly examines the lake for water quality and related issues.

The surface watershed for Mason Lake is large. The bulk of the watershed (57.8%) is in agricultural use; second largest land use is woodlands (31.7%). Residential use tends to be scattered, except for around the lake itself. The largest land use in the surface watershed for Mason Lake is non-irrigated agriculture; however, as dairy farms are switched to row cropping, irrigation systems have started appearing in the watershed. Woodlands are the second largest land use category in Mason Lake's surface watershed.

MACROPHYTE DATA

SPECIES PRESENT

Of the 36 species found in Mason Lake during the 2014 survey, 20 were emergent species, 2 were floating-leaf species, 3 were free-floating species and 11 were submergent species. No endangered species were found. Four invasive species were found: *Myriophyllum spicatum* (Eurasian watermilfoil); *Najas minor* (Brittle nymph); *Phalaris arundinacea* (Reed canarygrass); and *Potamogeton crispus* (Curly-leaf pondweed).

Figure 7: Mason Lake Aquatic Plant Species, 2014

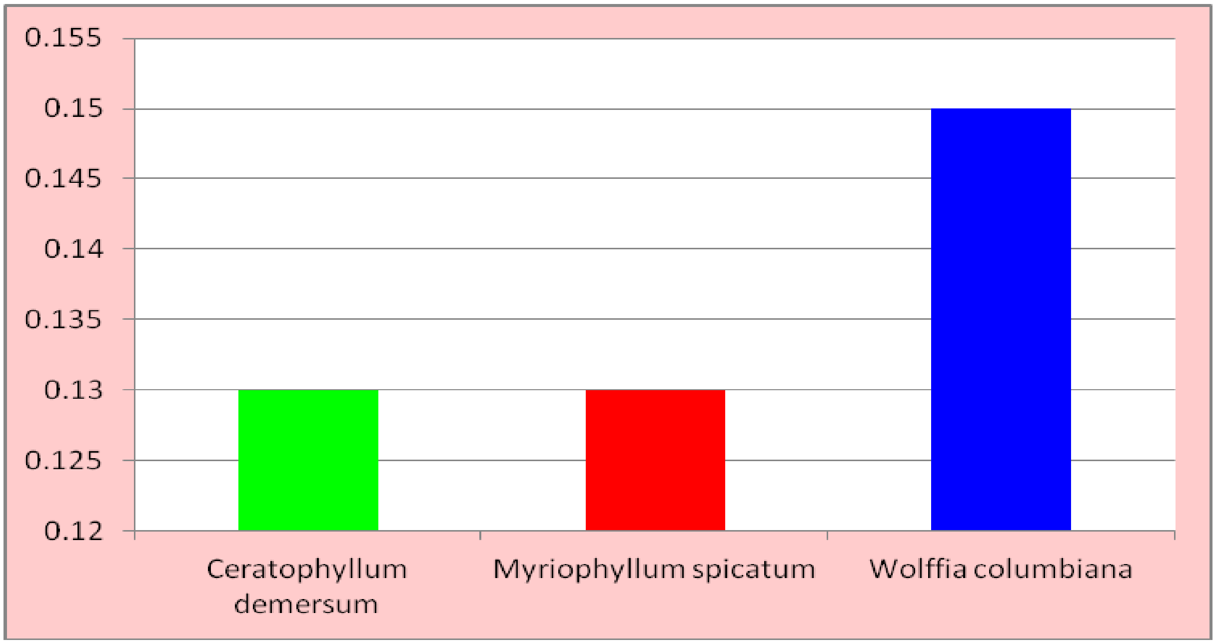
Scientific Name	Common Name	Plant Type
Bidens connatus	Purple-Stemmed Beggar's Tick	Emergent
Carex spp	Sedge	Emergent
Ceratophyllum demersum	Coontail	Submergent
Cicuta bulbifera	Bulb-Bearing Water Hemlock	Emergent

Cyperus bipartitis	Shining Sedge	Emergent
Cyperus odoratus	Flat Sedge	Emergent
Decodon verticillatus	Swamp Loosestrife	Emergent
Eleocharis acicularis	Needle Spikerush	Emergent
Eleocharis erythropoda	Bald Spikerush	Emergent
Elodea canadensis	Common Waterweed	Submergent
Impatiens capensis	Jewelweed	Emergent
Iris versicolor	Blue-Flag Iris	Emergent
Lemna minor	Lesser Duckweed	Free-Floating
Lycopus uniflorus	Northern Bugleweed	Emergent
Myriophyllum sibiricum	Northern Milfoil	Submergent
Myriophyllum spicatum	Eurasian Watermilfoil	Submergent
Najas flexilis	Bushy Pondweed	Submergent
Najas minor	Brittle Naiad	Submergent
Nymphaea odorata	White Water Lily	Floating-Leaf
Phragmites australis	Common Reed Grass	Emergent
Phalaris arudinacea	Reed Canarygrass	Emergent
Polygonum lapathifolia	Heart's Ease	Emergent
Polygonum punctatum	Dotted Smartweed	Emergent
Potamogeton crispus	Curly-Leaf Pondweed	Submergent
Potamogeton foliosus	Leafy Pondweed	Submergent
Potamogeton friesii	Fries' Pondweed	Submergent
Potamogeton nodosus	Floating-Leaf Pondweed	Floating-Leaf
Potamogeton praelongus	White-Stemmed Pondweed	Submergent
Sagittaria latifolia	Common Arrowhead	Emergent
Salix spp	Willow	Emergent
Scho tabernaemontani	Soft-Stemmed Bulrush	Emergent
Scutellaria galericulata	Marsh Skullcap	Emergent
Spirodela polyrhiza	Mad-Dog Skullcap	Emergent
Stuckenia pectinata	Sago Pondweed	Submergent
Typha spp	Cattail	Emergent
Wolffia columbiana	Watermeal	Free-Floating
Zizania palustris	Northern Wild Rice	Emergent

FREQUENCY OF OCCURRENCE

Based on actual frequency of occurrence and relative frequency, Watermeal, a free-floating plant, was the most frequently-occurring aquatic plant in the 2014 survey. The non-native invasive Eurasian Watermilfoil and the native Coontail were tied for the next most frequently-occurring plants.

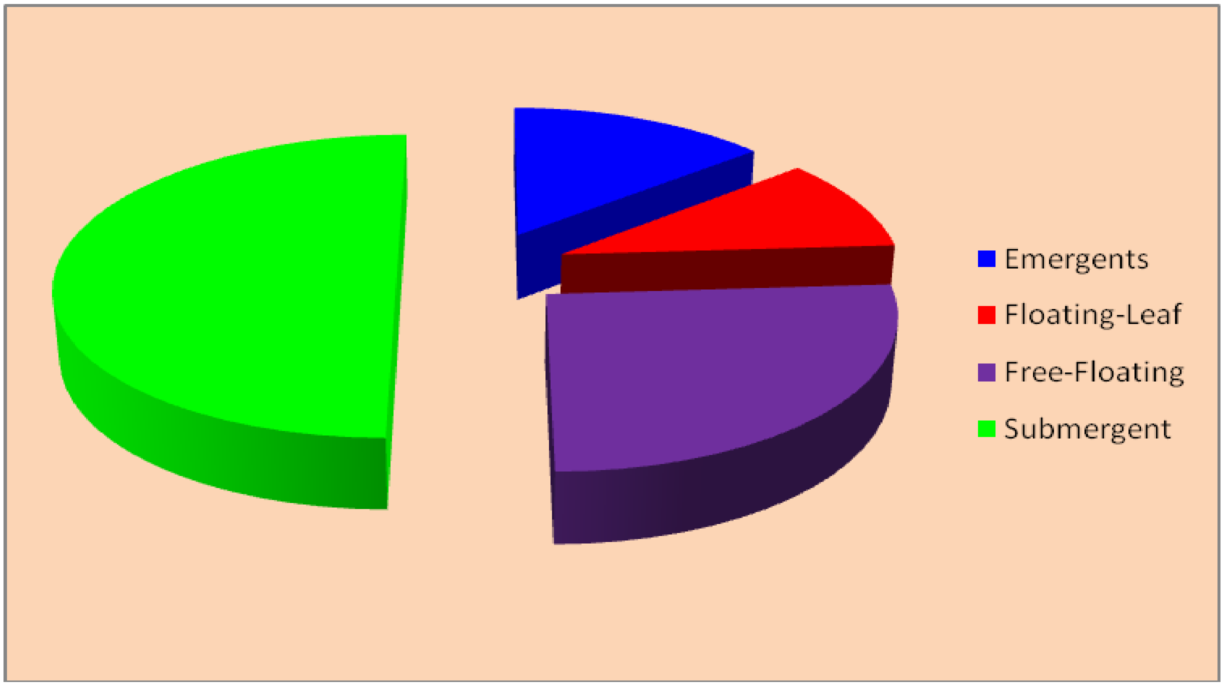
Figure 8: Most Frequently-Occurring Plants (using Relative Frequency)



Results of the survey were examined based on actual frequency of occurrence overall and actual frequency of occurrence where present. The same sequence of plants was found using those scales.

The survey results were examined in light of the relative frequency of types of aquatic plants found in Mason Lake in 2014. Although now sparsely vegetated, submergent plants still dominate the lake's aquatic plant community structure, as they have historically. The lake does have all types of structure in its aquatic plant community: emergent; rooted floating-leaf; free-floating; and submergent. However, the presence of emergent and rooted floating-leaf species tends to be minimal. High growth of free-floating plants like duckweeds tends to be associated with nutrient-rich waters (Neonakis, 2011), which is in keeping with the phosphorus levels present in Mason Lake. It is no surprise that these free-floating plants are the sub-dominant plant type in Mason Lake.

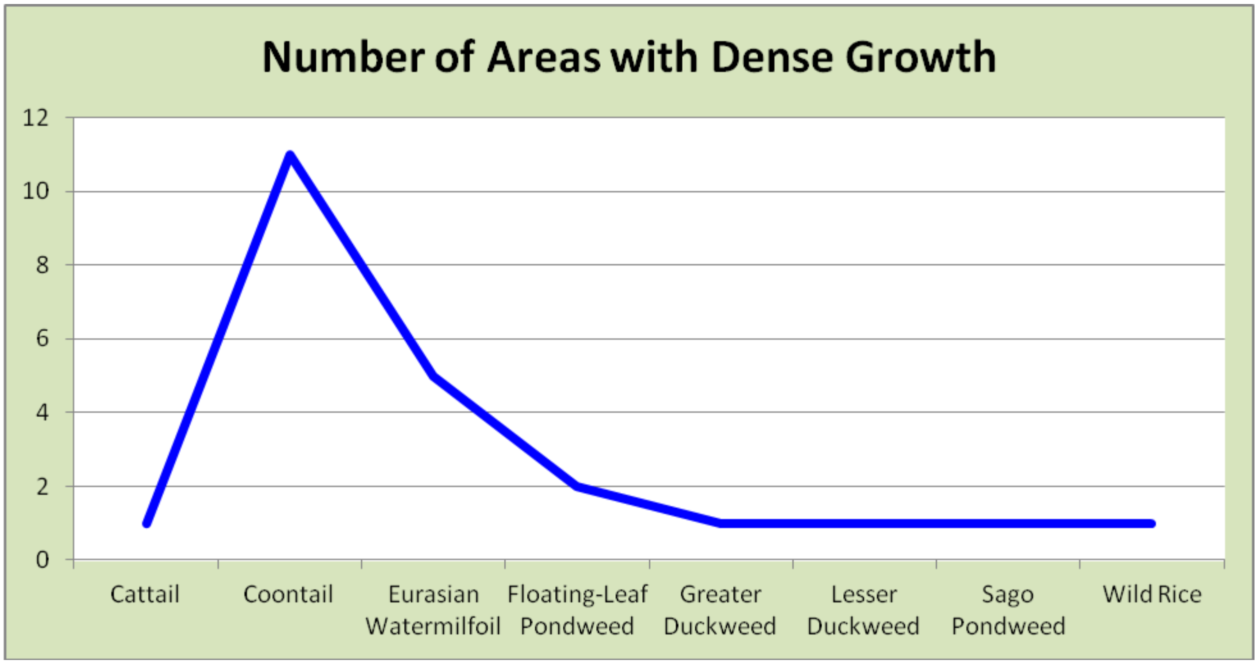
Figure 9: Plant Type by Relative Frequency of Occurrence



DENSITY

In the 2014 PI survey, the aquatic plants in Mason Lake had only localized density, not lake-wide density. This pattern was the same whether looking at the density of plants overall, or confining it to density evaluation where the species was actually present. Aquatic vegetation in the lake was so sparse overall that dense growth was found at only 15 of the 418 sample points. The plants that exhibited the most areas of dense growth were also those among the most-frequently occurring: Coontail and Eurasian Watermilfoil.

Figure 10: Plants with Dense Areas of Growth



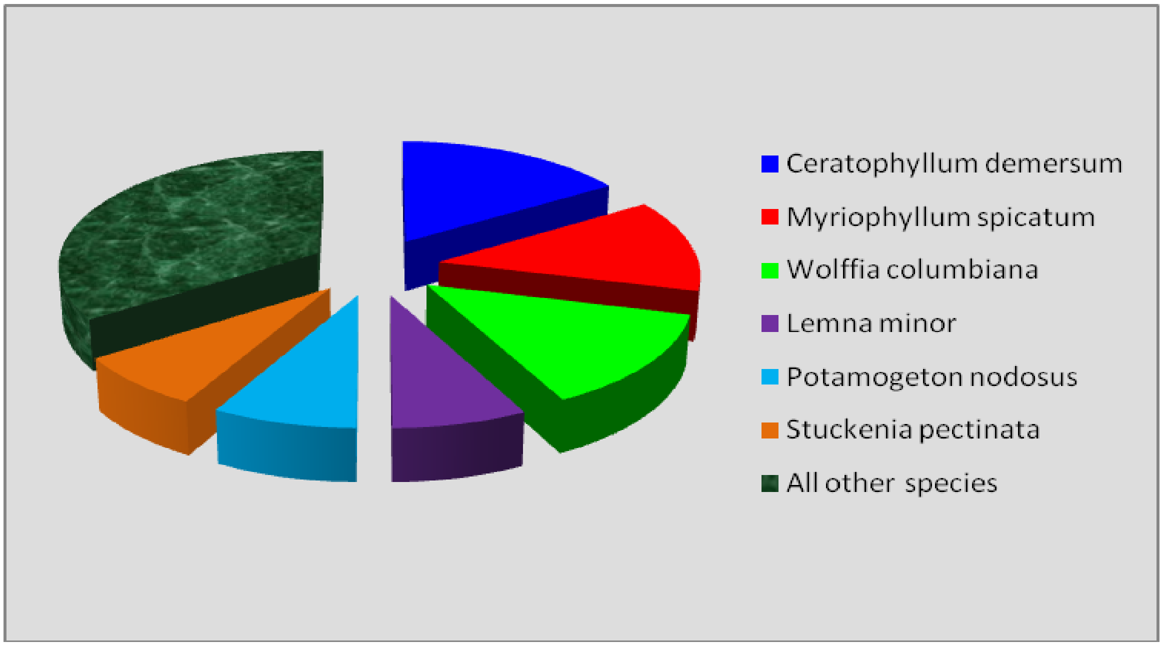
DOMINANCE

Combining the relative frequency and relative density of a species into a Dominance Value illustrates how dominant that species is within the aquatic plant community. Based on the Dominance Value, the 2014 PI survey showed that Coontail was the dominant aquatic plant species in Mason Lake, with Eurasian Watermilfoil and Watermeal tying for subdominance. Other common species were Lesser Duckweed, Floating-Leaf Pondweed, and Sago Pondweed.

DISTRIBUTION

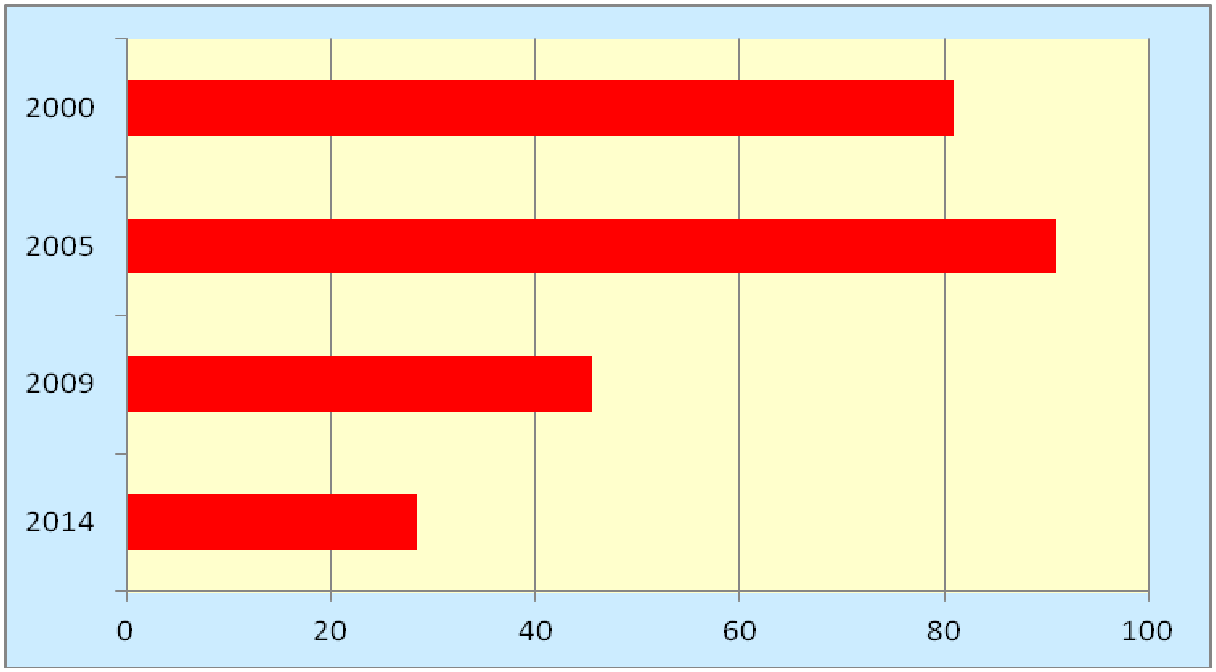
In the past, aquatic plants tended to occur throughout Mason Lake, since the entire lake was a littoral zone as recently as 2005. However, by the surveys in 2009, several areas of the lake bed had no aquatic vegetation. Most of these areas were in the deeper parts of the lake, but not all. By the 2014 survey, there were even

Figure 11: Dominance in 2014 (PI)



more areas without any aquatic vegetation. One of the reasons is likely the decrease in water clarity, resulting in little or no light for photosynthesis reaching those areas of the lake, but this probably not the whole problem. Besides the long-time high nutrient loading in Mason Lake, it suffers from a significant carp and gizzard shad population. These fish may be adding to the turbidity of Mason Lake's water, since they not only prefer dirty water, but also actually create dirty water by resuspending sediment when bottom feeding, excreting nutrients causing a spike in phytoplankton biomass, and causing sediment resuspension by vegetation destruction (Dibble et al, 1997; Warner, 2004).

Figure 12: Percent of Lake Vegetated 2000-2014



The following maps, drawn from the 2014 PI survey results, visually outline the lack of aquatic plants in the deeper areas of the lake. The only rooted plant found in water over 6 feet deep was the invasive Eurasian Watermilfoil, and no plants at all were found in water more than 7.0 feet deep.

Figure 13: Distribution of Emergent Plants (in pink)

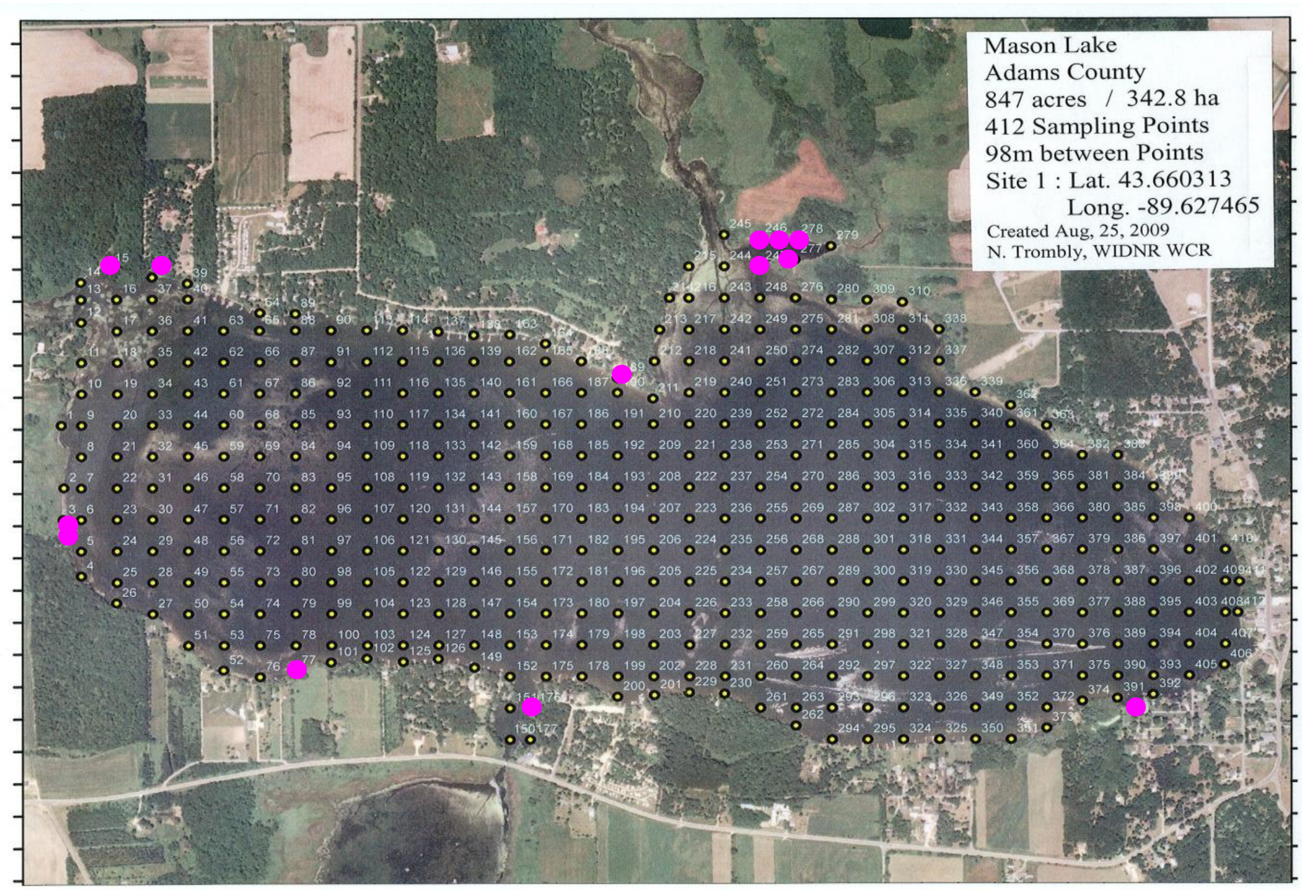


Figure 14: Distribution of Rooted Floating-Leaf Plants (in green)

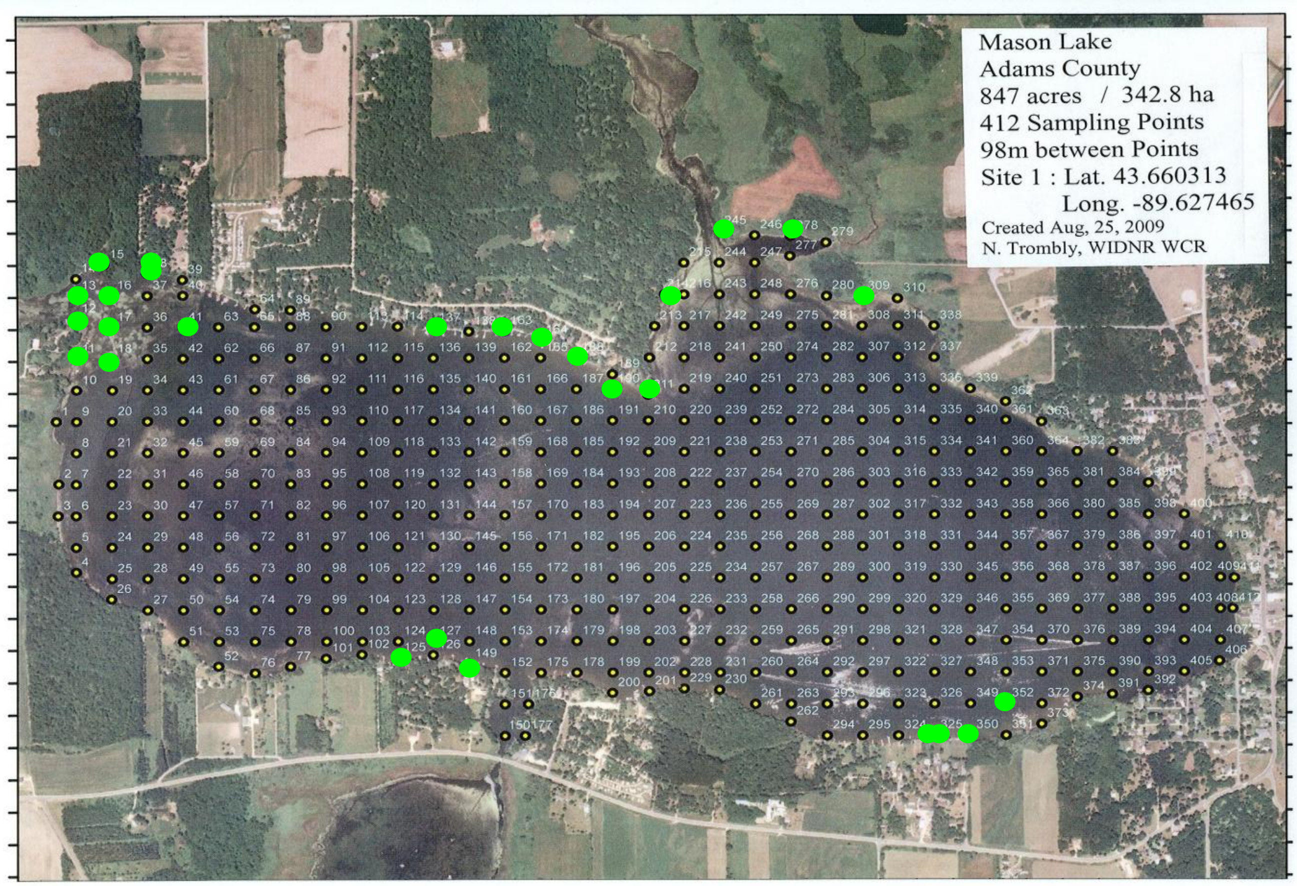
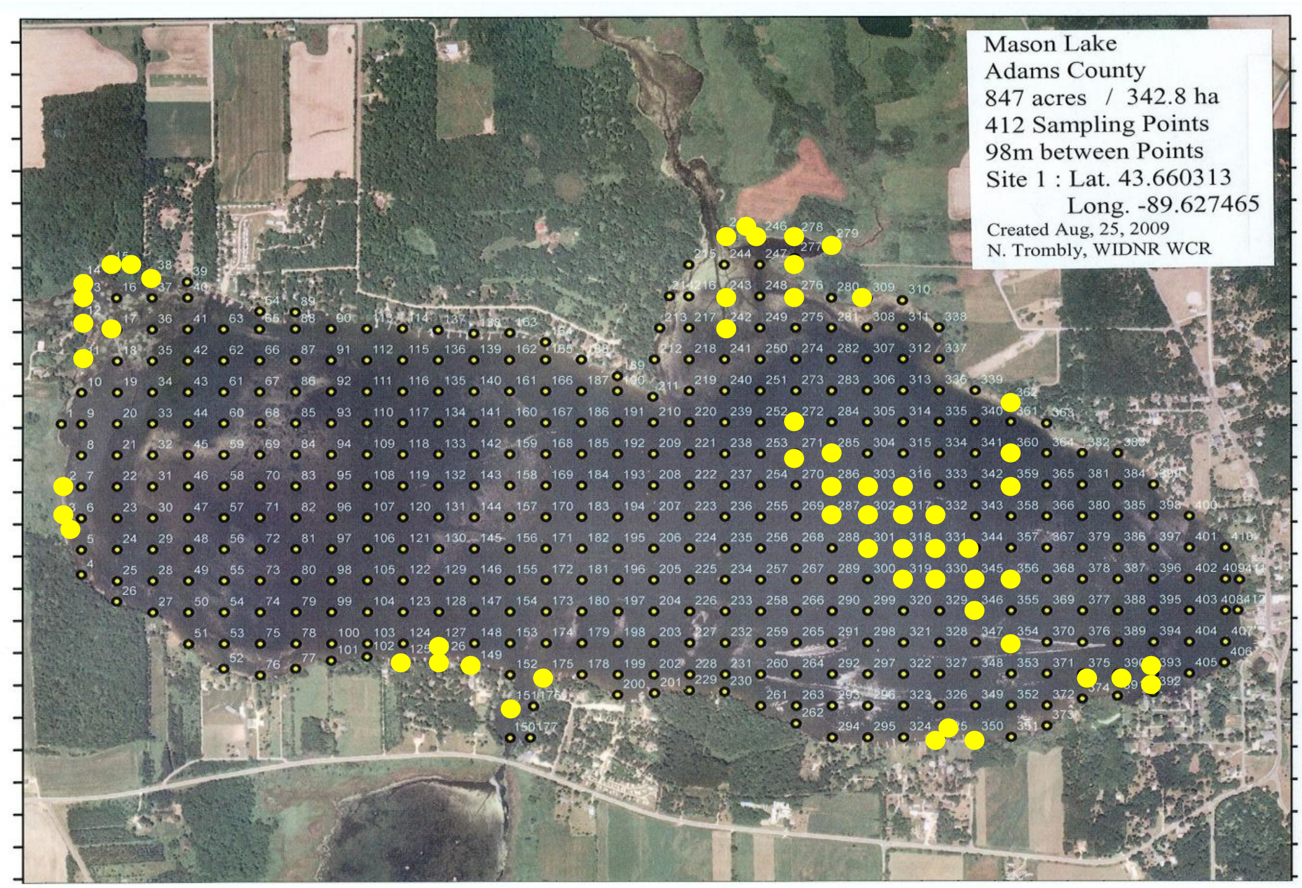


Figure 15: Distribution of Free-Floating Plants (in yellow)



As noted earlier in this report, aquatic vegetation coverage has been declining in Mason Lake over the past 10 years. Looking at the following distribution maps of the most common aquatic plant type, submergent, visually demonstrates what a difference there has been in only the five years between 2009 and 2014. From 2005 to 2009, aquatic vegetation cover in the lake went from 90.7% to 45.6%, a decline of over 50%. From 2009 to 2014, coverage went from 45.6% to 28.5% (counting duckweed), or from 45.6% to 24.4% if duckweed only sites are excluded. Roughly, this indicates that in about 10 years, aquatic vegetation in Mason Lake declined by almost 75%. In lake time, this is fast…and troublesome.

Figure 16a: Distribution of Submergent Plants 2009 (in blue)

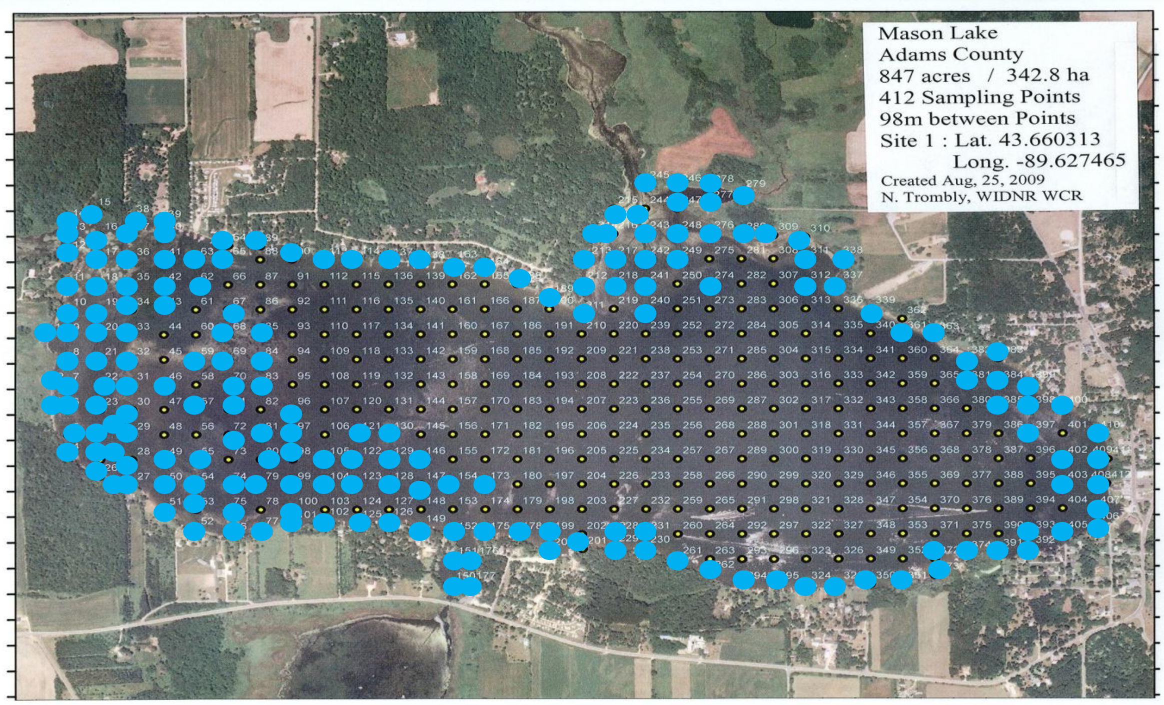
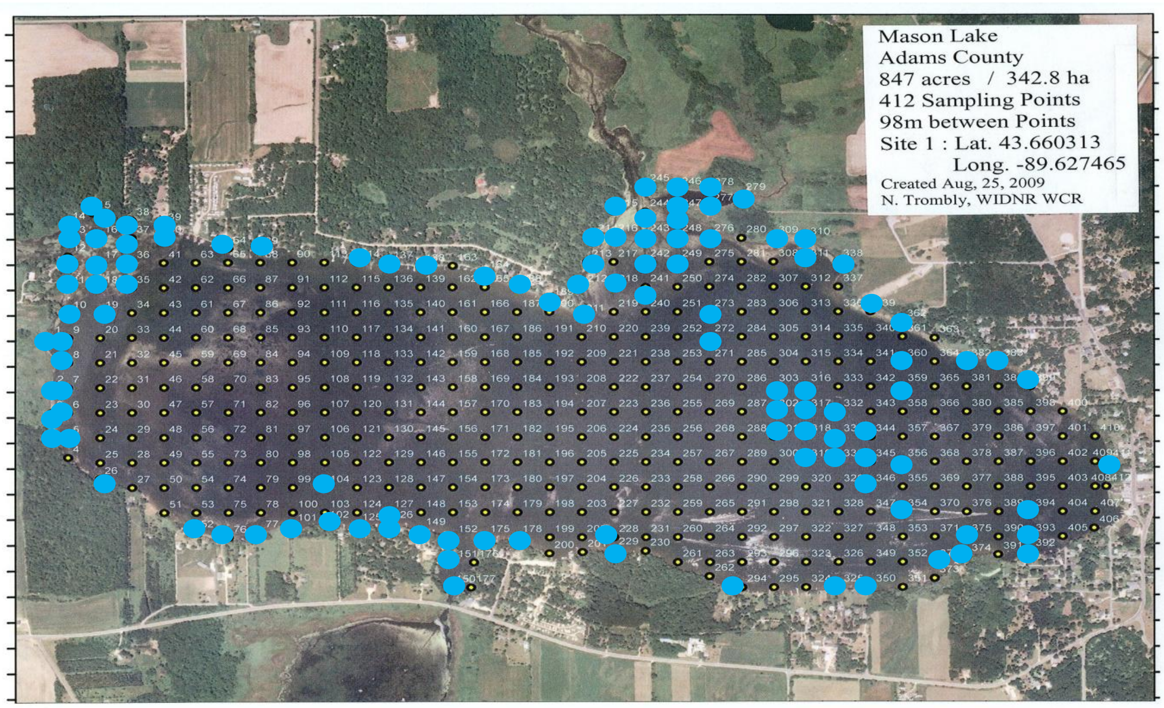
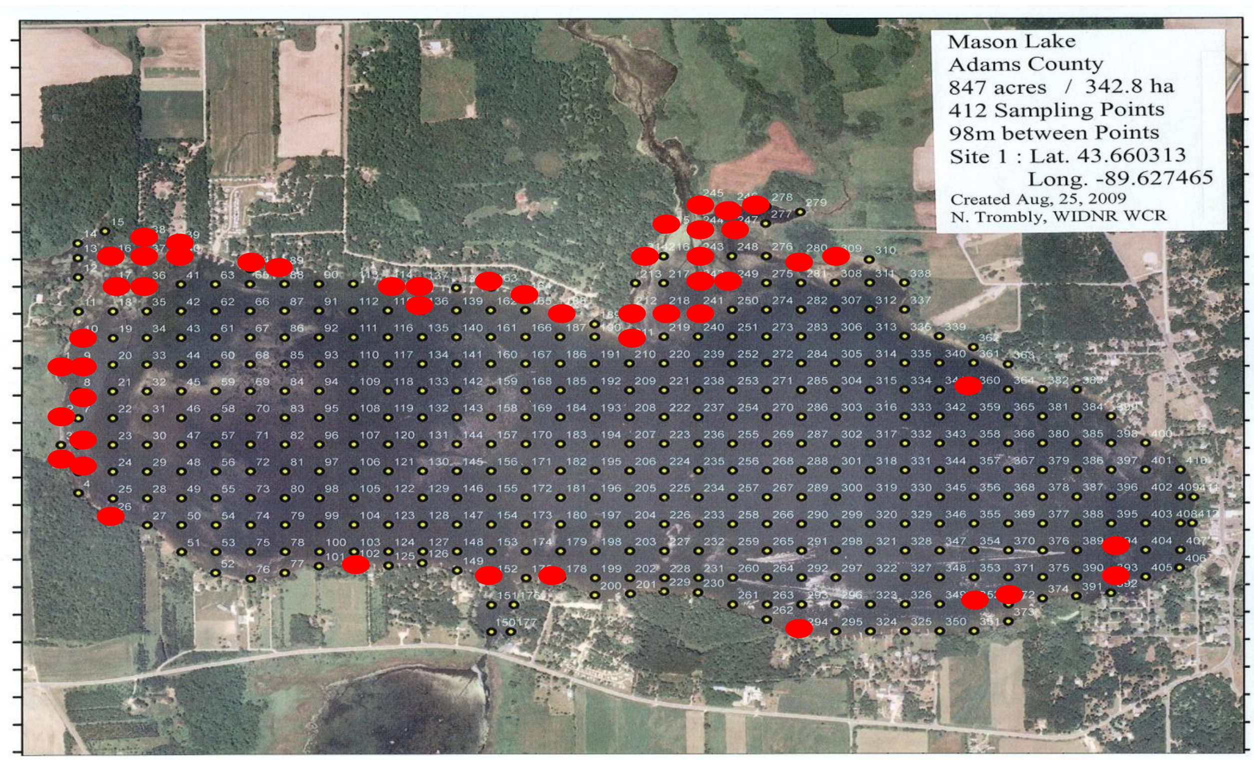


Figure 16b: Submergent Plant Distribution 2014 (in blue)



Eurasian Watermilfoil) was the dominant species in 1992. Although it declined according to the 1998 survey, becoming sub-dominant, it showed an increase again in 2001, becoming the dominant species again. It was again subdominant to Coontail in 2005. In 2009, it again was the dominant species, considerably ahead of Coontail in presence. By the 2014 survey, Coontail and Eurasian Watermilfoil were co-dominant in Mason Lake.

Figure 17: Distribution of Eurasian Watermilfoil 2014 (in red)



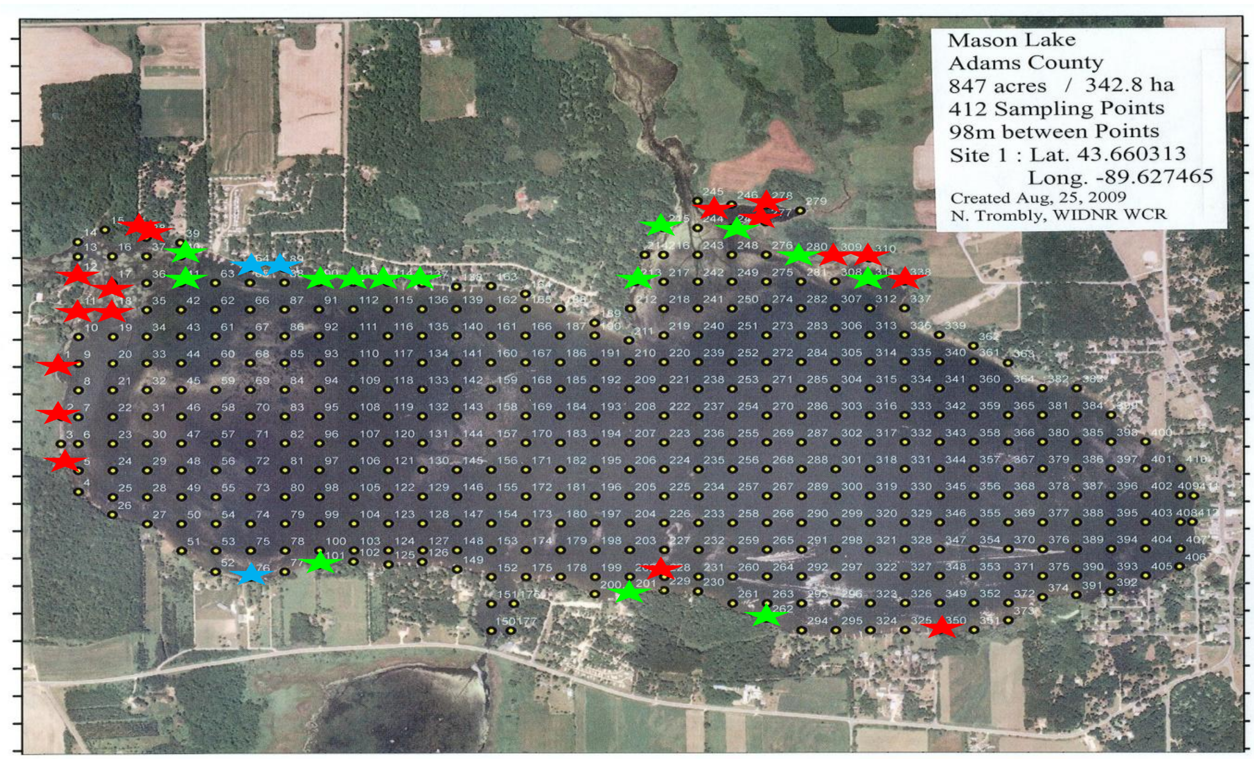
Since both the 2009 and 2014 surveys were done in August, it is likely they may underestimate the presence of Curly-Leaf Pondweed in Mason Lake. It showed a low presence in both surveys, appearing in only a few spots away from shores. Reed Canarygrass also maintains a low presence. Common Reed Grass was found along one shore of the lake in 2014, but examination of the specimen revealed it to be the native, non-invasive form of this emergent plant. Besides Curly-Leaf Pondweed and Eurasian Watermilfoil, both common aquatic invasives in Adams County, the other invasives found in 2014 were Brittle Naiad (*Najas minor*) and Reed Canarygrass (*Phalaris arundinacea*). Brittle Naiad was first found in Mason Lake in 2009; Mason Lake was the second lake in Wisconsin at that time to have that species present. It has now been found in a third lake in Wisconsin. The other lakes with this invasive are a considerable distance from Mason Lake, so how it entered in Mason Lake is still a question. It has only been found in less than 3 feet of depth in Mason Lake. Reed Canarygrass has been on the shores of Mason Lake for many years and has remained a small part of the emergent landscape.

Brittle Naiad has been extremely invasive in the eastern and northeastern part of the U.S., where it has been prohibited. There is a proposal to make it prohibited in Wisconsin as well. The Wisconsin Department of Natural Resources has not issued any suggestions on managing this invasive.

THE COMMUNITY

The Simpson's Diversity Index for the 2014 survey was .92. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable). This figure places Mason Lake in the top of the median for diversity for all the lakes in Wisconsin and for the North Central Hardwoods Region. These SI scores place Mason Lake in the fair category of diversity for lakes in Wisconsin and in the North Central Hardwoods Region. This score only relies on the number of species found and their density.

Figure 18: Location of Brittle Naiad 2009 and 2014



Found 2014 only   Found both 2009/2014   Found 2009 only

Species richness is the number of species in a given area. When looking at aquatic survey results, high species richness generally indicates a higher quality aquatic plant community. Species richness in Mason Lake decreased from 3.2 in 2005 to 0.97 in 2009, then down to 0.76 in 2014. This is a further indication of the rapid negative decline in the presence of aquatic vegetation in Mason Lake.

The Average Coefficient of Conservation and Floristic Quality Index were calculated as outlined by Nichols (1998) to measure plant community disturbance. A coefficient of conservation is an assigned value between 0 and 10 that measures the probability that the species will occur in an undisturbed habitat. The Average Coefficient of Conservationism is the mean of the coefficients for the species found in the lake. The coefficient of conservatism is used to calculate the Floristic Quality Index (FQI), a measure of a plant community's closeness to an undisturbed condition.

The Average Coefficient of Conservatism for Mason Lake in 2014 was 3.3. The FQI was 19.44. The Average Coefficient of Conservatism score places Mason Lake in the lowest quartile of lakes for Average Coefficient of Conservatism for lakes in Wisconsin overall (range 5.5-6.9) and for the North Central Hardwoods Region (range 5.2-5.8).

Figure 19: Floristic Quality and Coefficient of Conservatism of Mason Lake, Compared to Wisconsin Lakes and Northern Central Hardwood Wisconsin Lakes.

	Average Coefficient of Conservatism †	Floristic Quality ‡
Wisconsin Lakes	5.5, 6.0, 6.9 *	16.9, 22.2, 27.5
NCHR	5.2, 5.6, 5.8 *	17.0, 20.9, 24.4
Mason Lake 2014	3.3	19.44

* - Values indicate the highest value of the lowest quartile, the mean and the lowest value of the upper quartile.

† - Average Coefficient of Conservatism for all Wisconsin lakes ranged from a low of 2.0 (the most disturbance tolerant) to a high of 9.5 (least disturbance tolerant).

‡ - lowest Floristic Quality was 3.0 (farthest from an undisturbed condition) and the high was 44.6 (closest to an undisturbed condition).

The Floristic Quality Index is a tool that can be used to identify areas of high conservation value, monitor sites over time, assess the anthropogenic (human-caused) impacts affecting an area and measure the ecological condition of an area (M. Bourdaghs, 2006).

These values were based only on the occurrence of disturbance tolerant or intolerant species and did not take into consideration the frequency or dominance of these tolerant or intolerant species in the community. The Floristic Quality was recalculated, weighting each species coefficient with its relative frequency and dominance value. When the FQI is adjusted for frequency of occurrence for each species, the 2014 FQI drops to 12.72. This indicates that the plant community in Mason Lake is within the group of lakes subject to high disturbance. This is in keeping with the 2002 placement of Mason Lake on the federal impaired (303(d)) list.

Disturbances can be of many types:

1) Physical disturbances to the plant beds result from activities such as boat traffic, recreational activities, the placement of docks and other structures and fluctuating water levels.
2) Indirect disturbances from factors that impact water clarity and thus stress species that are more sensitive: resuspension of sediments, sedimentation from erosion and increased algae growth due to nutrient inputs.
3) Biological disturbances include competition from the introduction of a non-native or invasive plant species, grazing from an increased population of aquatic herbivores and destruction of plant beds by a fish or wildlife population.

Major disturbances in Mason Lake likely include past broad-spectrum chemical treatments, fairly heavy boat and recreational traffic in the shallow basin, introduction of several exotic invasive aquatic plant species, winter drawdowns, significant shoreline development, presence of carp and gizzard shad, and very poor water clarity.

The 2014 Aquatic Macrophyte Community Index (AMCI) for Mason Lake (Figure 19) is 34. This value is in the lowest quartile for lakes in the North Central Hardwoods Region and all of Wisconsin lakes, indicating that the aquatic plant community in Mason Lake is of below average quality.

Figure 20: Aquatic Macrophyte Community Index 2014

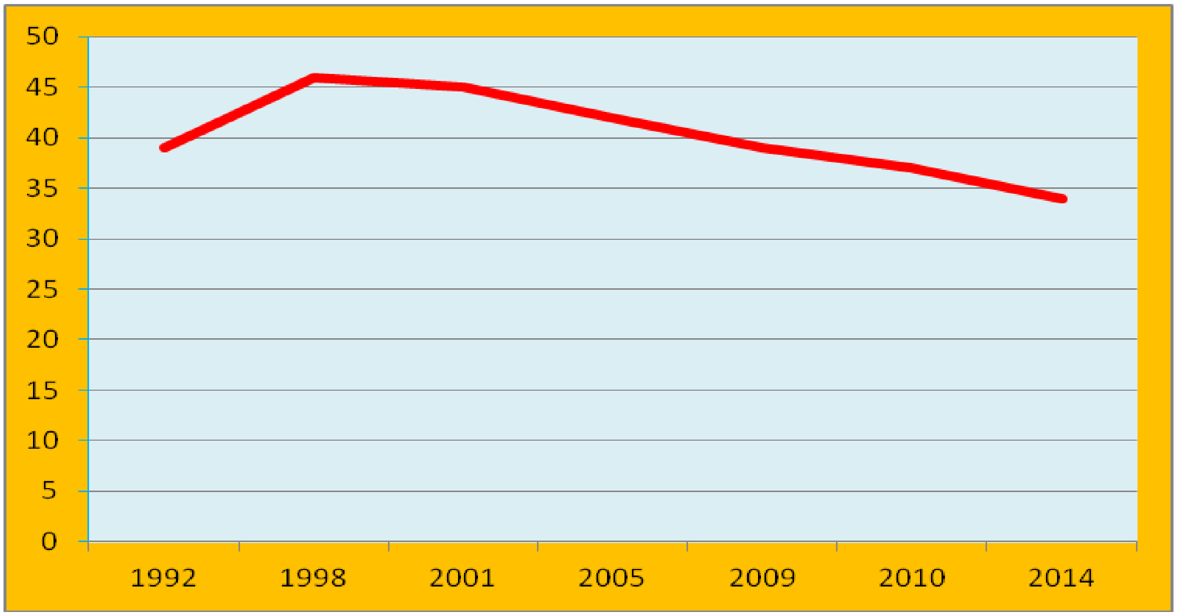
	Parameter	Score
Maximum rooting Depth	6.5	2
% littoral vegetated	28.47	3
% submergent plants (using relative frequency)	43	2
% invasive species (using relative frequency)	15	4
% sensitive species (using relative frequency)	3	4
Siimpson's Index of Diversity	0.92	9
taxa # (number of species)	35	10
		34

This calculation further verifies the decline in the aquatic plant community in Mason Lake and its overall health. A look at the history of AMCI calculations in Mason Lake show the 2014 figure is the all-time low:

COMPARISON TO PRIOR RESULTS

Aquatic plant survey records from Mason Lake go back to 1988. Records from 1988 indicate that only 5 plant genera were found: *Ceratophyllum demersum, Myriophyllum* spp. (species unidentified), *Najas flexilis, Potamogeton* spp. (species unidentified), and *Potamogeton praelongus.* This increased to 16 by 1992, up to 26 in 1995, then down to 20 in 1998. The number of species went up to 25 in 2002, but decreased again in 2005 to 19. The 2009 survey resulted in 47 species. By 2014, the species number was again declining, down to 35.

Figure 21: AMCI Figures 1992-2014



The changes noted from 1992 to 2009 included more species present, more sites with emergent species, higher Simpson's Diversity Index, higher Floristic Quality Index, and higher Aquatic Macrophyte Community Index. However, decreases since 1992 were a lower percent of littoral zone vegetation, reduced maximum rooting depth, fewer free-floating & rooted floating-leaf plant sites, fewer submersed plant sites, lower species richness and lower average coefficient of conservatism.

Surveys done from 1998 through one in 2009 were done using the transect method. A survey done by WDNR staff in 2010 used a 700-point PI grid, although only 465 sites were samples. Only 45.4% of the sample sites in that survey were vegetated, with only 13 species found (including 3 invasives). Only 1 emergent plant and one rooted floating-leaf plant were recorded, along with 3 free-floating and 8 submergent species.

In 2009, WDNR required switching to the Point Intercept method. A modified PI grid was prepared by WDNR staff to be sure the near shore shallow area was sampled. Because the modified PI method differs greatly from the transect method and, to some extent, from the 700-point grid, specific comparisons to results are really not scientifically appropriate. However, some general conclusions can be drawn, and the results of the 2009 PI survey can be compared to that done in 2014. These two surveys used the same GPS points, the same modified PI method, and were conducted on the same days near the end of August.

The coefficient of similarity is an index, first developed by Jaccard in 1901, which compares the similarity and diversity of sample sets. In this instance, the figure considers the frequency of occurrence and relative frequency of all species found, then determines how similar the overall aquatic plant communities are. Similarity percentages of 75% or more are considered statistically similar (Dennison et al, 1993).

The PI plant communities of 2009 and 2014 were compared by calculating coefficients of similarity, using actual frequency of occurrence and relative frequency of occurrence. The result of the calculation was that the 2009 and 2014 PI communities were 81.5% similar based on actual frequency of occurrence and 81.4% based on relative frequency.

However, these figures don't accurately reflect the history of Mason Lake's plant community. When the 1992 transect results were compared to the transect results from 2009, those two communities were only 59% similar.

Figure 22: Similarity Comparison by Actual Frequency

Comparison Years	% Similarity	Comparison Years	% Similarity
1992 to 1995 (transect)	61%	1992 to 2009	59%
1998 to 2001 (transect)	75%	1995 to 2009	55%
2001 to 2005 (transect)	63%	1998 to 2009	61%
2005 to 2009 (transect)	73%	2001 to 2009	61%
2009 to 2014 (PI)	82%		

Calculations were also performed to compare the aquatic plant communities to those found in 1992, 1995, 1998 and 2005. Using this figure, the 2009 transect plant community was only 63% similar to the 1992 plant community and only 72% similar to the community found in 2005. As noted earlier, the 2014 results cannot be properly compared to those transect survey results from 1992, 1995, 1998, 2001, 2005 and 2009.

Figure 23: Similarity Comparison Using Relative Frequency

Comparison Years	% Similarity
1992 to 2009 (transect)	63%
1995 to 2009 (transect)	42%
1998 to 2009 (transect)	63%
2001 to 2005 (transect)	62%
2005 to 2009 (transect)	72%
2009 to 2014 (PI)	81%

The table below shows the specifics of various aquatic species found through the years.

Figure 24: Plant Lists 1992-2014

Scientific Name	1988 (t)	1992 (t)	1995 (t)	1998 (t)	2001 (t)	2005 (t)	2009 (t)	2009 (pi)	2010(pi)	2014 (pi)
Emergent Plants										
Asclepias incarnata					x		x			
Bidens connatus				x				x		x
Carex spp		x			x	x	x	x		x
Cicuta bulbifera										
Cornus sericea					x					
Cyperus bipartitus										x
Cyperus odoratus								x		x
Decodon verticillatus				x	x		x	x	x	x
Echinochloa muricata								x		
Echinochloa walteri			x					x		
Eleocharis acicularis										x
Eleocharis erythropoda										x
Eleocharis palustris			**x**							
Eupatorium maculatum								x		
Impatiens capensis			x	x				x		x
Iris versicolor			x				x	x		x
Leersia oryzoides							x			
Lycopus americanus								x		
Lycopus uniflorus								x		
Onoclea sensibilis								x		
Phalaris arundinacea			x		x	x	x		x	x
Phragmites australis										x
Pilea fontana								x		
Polygonum cuspidatum								x		
Polygonum lapathifolia										
Polygonum punctatum										x
Rumex spp								x		x
Sagittaria latifolia		x	x					x		x
Salix spp							x	x		x
Schoeno.tabernaemontani		x			x				x	x
Scutellaria galericulata										x
Spirodela polyrhiza										x
Silphium terebinthinaceum								x	x	
Sparganium eurycarpum		x	x	x	x	x		x		
Typha spp		x	x	x	x	x	x	x	x	x
Zizania spp								x		x
Floating Leaf Plants										
Nasturtium microphyllum							x			
Nuphar variegata					x					

Nymphaea odorata			x		x			x	x	x
Potamogeton nodosus			x			x	x	x	x	x
Free Floating Plants										
Lemna minor			x	x	x	x		x	x	x
Spirodela polyrhiza			x	x	x	x	x	x	x	x
Wolffia columbiana				x	x	x	x	x	x	x
Submergent Plants										
Ceratophyllum demersum	x	x	x	x	x	x	x	x	x	x
Chara spp			x	x	x	x	x	x		x
Elodea canadensis		x	x	x	x	x	x	x	x	x
Myriophyllum spp	x									
Myriophyllum sibiricum		x	x	x	x	x	x	x		x
Myriophyllum spicatum		x	x	x	x	x	x	x	x	x
Najas flexilis	x	x	x	x	x	x	x	x		x
Najas minor								x	x	x
Nitella spp		x								
Potamogeton spp	x	x	x							
Potamogeton amplifolius			x			x				
Potamogeton crispus		x	x	x	x	x	x	x	x	x
Potamogeton foliosus						x	x	x	x	x
Potamogeton praelongus	x		x	x				x	x	x
Potamogeton pusillus			x	x			x			
Potamogeton richardsonii						x				
Potamogeon zosteriformis		x			x			x		
Ranunculus longirostris		x		x	x			x		
Stuceknia pectinata		x	x	x	x	x	x	x	x	x
Zosterella dubia			x	x	x			x		

V. DISCUSSION

In regards to the aquatic plant community in Mason Lake, the rapid decrease of the aquatic plant community suggests something negative is going on in the lake. Aquatic plants not only contribute to pleasing aesthetics in water bodies, but are also an essential part of the life systems, especially in maintaining the food chain. For example, their leaves and stems provide habitat for small plants and animals (some even microscopic)—these in return are food for animals higher in the food chain such as fish or birds. Decomposing plants on the bottom of a lake often serve as nurseries for insects that provide food for fish. Aquatic plants also provide food and cover for fish and waterfowl. And by competing for nutrients like phosphorus, a healthy aquatic plant community usually helps a lake avoid large nuisance algae blooms. They provide life-giving oxygen for the animals that need it (like fish) and serve as a lake's filtering system. They help stabilize lake and river bottoms. Emergent and floating-leaf plants can provide shore buffering from waves and reduce erosion. Finally, a healthy aquatic plant community is less likely to be vulnerable to the colonization of invasives.

Based on water clarity and the concentrations of algae and nutrients, Mason Lake was an eutrophic/hypereutrophic lake with poor to very poor water quality and poor water clarity during the study period (1986-2009). Since 1986, nutrient levels have increased, and water clarity has decreased. Although aquatic plant growth in Mason Lake should be favored by the high nutrients of its trophic state, hard water, dominance of rich sediments, the shallow depth of the lake and the very gradually sloped littoral zone, that is no longer occurring in Mason Lake. The aquatic plant growth in Mason Lake continues to decrease in its coverage of the lake, even by plants usually tolerant of high disturbance.

Shoreline Impacts

Large areas of the shoreline on Mason lake is disturbed (cultivated lawn, rip-rap and hard structures). Disturbed shorelines occurred at more than half of the sites, covering nearly ½ of the shores. Cultivated lawn continues to be the dominant shoreline cover, with rip-rap and hard structures common. These types of disturbed shoreline are likely a contributing factor to the degraded water quality through increased run-off carrying added nutrients from lawn chemicals, soil erosion and pet waste. Mowed lawn, rip-rap and hard structures speed run-off to the lake without filtering out nutrients and impurities as natural shoreline would.

Natural shorelines, however, could help prevent shoreline erosion and reduce additional nutrient/chemical run-off that can add to algae growth and sedimentation of the lake bottom.

Some waterfront residents appear to believe that because many of the shores are relatively flat, there isn't any runoff into the lake. However, unlike the soils in most of Adams County, soils around Mason Lake tend to be combinations mostly of silt and clay. Soil particles for these soil types tend to cling together, making runoff more likely. In addition, it is unknown at this time how many of the old septic systems may be non-functional. If that number is substantial, that could also be a factor in the lake's decline.

In the past, large populations of carp at times contributed to poorer water quality in Mason Lake. A fish survey was conducted by the WDNR in 2011-2012. Although both carp and gizzard shad were present in the fish community, the overall health of the fishery in Mason Lake was average, rather than being dominated by the two species of rough fish.

V. CONCLUSIONS

Mason Lake is an eutrophic/hypereutrophic lake with poor to very poor water clarity and quality. Since 1986, nutrient levels in Mason Lake have increased and water clarity has decreased. The aquatic plant community characterized by fair diversity, but low quality, aquatic plants that have a high tolerance to disturbance. Only about ¼ of the lake is vegetated. Not only does this negatively affect fish habitat, but it also makes algae blooms more likely, since there is little competition for nutrients by aquatic plants—thus leaving algae free to feast.

The Average Coefficient of Conservatism of the aquatic plant community in Mason Lake and the Floristic Quality Index are in the lowest quartile for Wisconsin lakes and for lakes in the North Central Hardwood region. The AMCI is similarly in the bottom quartile for both North Central Hardwood Region and all Wisconsin lakes, indicating an aquatic plant community of high average quality. Structurally, the aquatic plant community contains emergent plants, free-floating plants, and submergent plants, although dominated by submergent species, with free-floating plants sub-dominant.

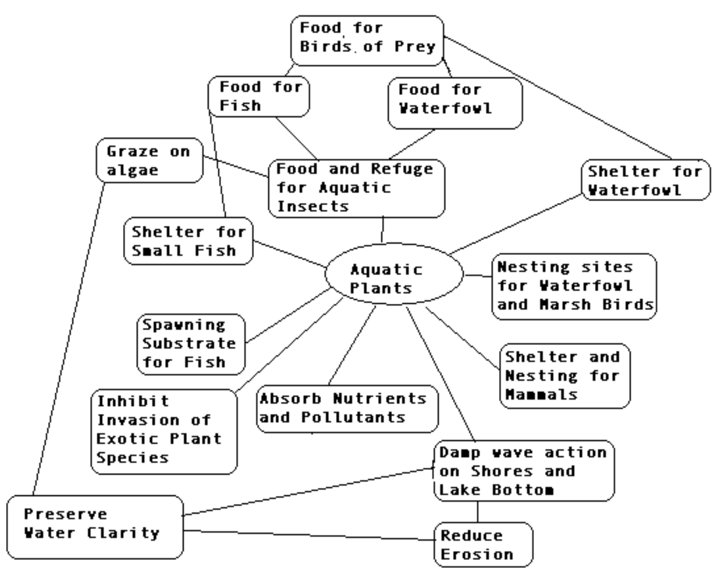
A healthy and diverse aquatic plant community plays a vital role within the lake ecosystem. Plants help improve water quality by trapping nutrients, debris and pollutants in the water body; by absorbing and/or breaking down some pollutants; by reducing shore erosion by decreasing wave action and stabilizing shorelines and lake bottoms; and by tying-up nutrients that would otherwise be available for algae blooms. Aquatic plants provide valuable habitat resources for fish and wildlife, often being the base level for the multi-level food chain in the lake ecosystem, and also produce oxygen needed by animals.

Further, a healthy and diverse aquatic plant community can better resist the invasion of species (native and non-native) that might otherwise "take over" and create a lower quality aquatic plant community. A well-established and diverse plant community of natives can help check the growth of more tolerant (and less desirable) plants that would otherwise crowd out some of the more sensitive species, thus reducing diversity.

Also, vegetated lake bottoms support larger and more diverse invertebrate populations that in turn support larger and more diverse fish and wildlife populations (Engel, 1985). Also, a mixed stand of aquatic macrophytes (plants) supports 3 to 8 times more invertebrates and fish than do monocultural stands (Engel, 1990). A diverse plant community creates more microhabitats for the preferences of more species.

In Mason Lake's current situation, it lacks a healthy aquatic plant community and thus is subject to the negative impacts of its degraded state. Placement on the federal 303(d) list generally suggests that a lake is at a turning point, i.e., if action isn't taken, the lake may be beyond recovery. Mason Lake is clearly at that tipping point.

Figure 25: Aquatic Ecosytem Food Web



MANAGEMENT RECOMMENDATIONS

1) The aquatic plant community has decreased drastically since 2005, when aquatic plants covered over 90% of the lake and many species occurred in more than average density of growth. While that situation was not ideal, the crash in plant coverage suggests a significant change in the lake's ecosystem. It would be appropriate to conduct some studies to attempt to determine what is causing this change.

2) Participation by the Mason Lake District and watershed citizens/users in carrying out the recommendations from UW-Stevens Point, Adams County Land & Water Conservation Department, and Wisconsin Department of Natural Resources, including:

- In-lake growing season water quality monitoring in at least 2 sites in Mason Lake, plus one in Amey Pond
- In-lake open water season temperature monitoring through the water column
- In-lake water quality monitoring for spring and fall overturn
- Sediment testing to gather information for modeling for internal loading
- Modeling for internal loading in the lake
- Measuring water quality and discharge/flow rates in at least 2 sites along the two creeks feeding into Mason Lake
- Mapping tile drains in the watershed, which is largely agricultural, including some sampling, especially for nitrogen and phosphorus, and for volume
- Updated land use information gathering and mapping
- Modeling to determine tributary loads and landscape contribution
- Social & Water Governance assessment activities, including exploring resistance to watershed wide actions
- Completion of the study of carp and gizzard shad presence and possible contribution to turbidity or other water quality changes
- Completing revision of the lake-management plan started in 2005, being sure to include watershed actions
- Location of septics and evaluations of any contributions to loading

- Installation of stormwater runoff and buffer practices to reduce inputs to the lake
- Updating the depth map of the lake (current one is from 1970)

3) All lake residents should practice best management on their lake properties. Mason Lake is already on the impaired waterways list. A small increase in nutrients could push the lake past likely recovery, resulting in long-term worse water quality. Reducing nutrients would have a favorable impact on water quality. These activities would include:

- Keeping septic systems inspected,cleaned and in proper condition;
- Using no chemicals within 50 feet of the lake;
- Cleaning up pet wastes;
- No composting should be done near the water nor should yard wastes nor clippings be allowed to enter the lake (Do not compost near the water or allow yard wastes and clippings to enter the lake)

4) Although Mason Lake is on the WDNR Trend Lake list, so that some regular water quality monitoring occurs, it would be a good idea to recruit and train several volunteers that could test and track water quality through the Citizen Lake Monitoring Program. Some citizens have been trained, but moved away. Having several trained may increase the likelihood of some continuity, instead of having gaps in information gathering.

5) Mason Lake is extremely vulnerable to colonizations by additional aquatic invasives. With so much of the lake bottom unvegetated, opportunistic invasives could take hold quickly. Regular involvement in the Clean Boats, Clean Waters Program, either by volunteers or paid staff, is recommended at the three main boat launches on the lake to try to prevent further invasions.

6) A map of the sensitive areas should be posted at the public boat ramps with a sign encouraging avoidance of disturbance to these areas should also be posted. Landowners on the lake should designate watch for disturbance of these areas and report any violations. These areas are very important for habitat and maintaining water quality and for preserving endangered species.

7) Part of the evaluation for helping the lake regain better water quality should include a variety of attacks on the continuing problem of Eurasian Watermilfoil, as well as Curly-Leaf Pondweed. It should also include management strategies for

coping with Brittle Naiad and Japanese Knotweed (the latter was found on the shore, not in the water, so was not included in the aquatic plant survey results).

8) Drawdowns of the lake should only be done when needed. Annual drawdowns destabilize the littoral zone habitat. It has been some years since the last drawdown for EWM control, so it might be time to try it again.

9) An updated depth map should be completed as soon as possible. The last depth map is dated 1970; in planning for the lake's future, it is important that updated information on sedimentation (depth) be obtained.

10) Since the shore is so heavily developed, with several older cabins close to the water, installation of vegetative buffers and stormwater runoff management is essential. An increase in the depth of these buffer areas is recommended. 35 feet landward from shore should be the goal when possible.

11) Steps should be taken to regulate boat speed in the shallow water areas to reduce disturbance to aquatic plants and the sediment.

12) The aquatic plant survey should be repeated in 3 to 5 years in order to continue to track any changes in the community and the lake's overall health.

13) In 2014, the Mason Lake District paid two interns to inventory the two main creeks in the watershed that feed into Mason Lake and identify problem spots. That information should be used to help approach watershed landowners about best management practices that will reduce nutrient and sediment loading to Mason Lake.

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