THE AQUATIC PLANT COMMUNITY OF EASTON LAKE, ADAMS COUNTY, WISCONSIN SEPTEMBER 2012

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ADAMS COUNTY 2012

I. INTRODUCTION

An aquatic macrophytes (plants) field study in Easton Lake was conducted during August 2012 by the Adams County Land and Water Conservatism Department.
At the time the survey was conducted in 2012, the lake had been refilled for two years.

Information about the diversity, density and distribution of aquatic plants is an essential component in understanding the lake ecosystem due to the integral ecological role of aquatic vegetation in the lake and the ability of vegetation to impact water quality (Dennison et al, 1993). This study will provide information useful for effective management of Easton Lake, including fish habitat improvement, protection of sensitive areas, aquatic plant management, and water resource regulation.

There was a previous survey completed in 2006. However, since the Easton Dam was replaced, requiring the lake to be drawn down to the stream level for nearly two years, the 2012 aquatic plant survey will also provide a baseline by which to measure the return of the aquatic plant community to the lake.

Ecological Role: Lake plant life is the beginning of the lake's food chain, the foundation for all other lake life. Aquatic plants and algae provide food and oxygen for fish and wildlife, as well as cover and food for the invertebrates that many aquatic organisms depend on. Plants provide habitat and protective cover for aquatic animals. They also 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 can serve as indicators of water quality because of their sensitivity to water quality parameters such as clarity and nutrient levels (Dennison et al, 1993).

Easton Lake readings for hardness and pH score its water as “hard” to “very hard”, with the average pH running over 8.00.

Background and History: Easton Lake is located in the Town of Easton, Adams County, Wisconsin. The impoundment is 24 surface acres in size. Maximum depth is 11 feet, with an average depth of 5 feet. During the summer of 2012 when this aquatic plant survey was conducted, the lake was at slightly lower level than usual due to drought and very hot weather.

There is a public boat ramp located on the north side of the lake owned by the Adams County Parks Department.

Easton Lake is easily accessible off of County Road A, not far off of State Highway 13. Residential development around the lake is most concentrated along the north and south lakeshores. The surface watershed is 11 % residential, 16.6% non-irrigated agriculture, 17.5% irrigated agriculture, 48.2% woodlands .3% open grasslands and 6.4% water. The ground watershed contains 23.21%% irrigated agriculture, 17.97% non-irrigated agriculture, 43.71% woodlands, 15.45% residential, .36% open grasslands and 3.47% water. There are no known endangered or threatened species in or around the lake.

Fish inventories dating back to 1954 show that panfish are abundant to common, depending on the species. Bullheads, northern pike, trout and bass tend to be scarce. Stocking from 1937 to 1944 consisted entirely of bullheads of various ages. Some fish restocking occurred after the lake was refilled. In 2010, black crappie, bluegills, fathead minnows, and largemouth bass were stocked. In 2011, black crappie, bluegills, fathead minnows, largemouth bass, and yellow perch were stocked. No further restocking is planned at this time.

Soils directly around Easton Lake tend to be sands or loamy sands, except directly around the lake, where silt loam is found. Such soils tend to be well-drained or excessively-drained, with infiltration of water being rapid to very rapid, and permeability also high. Such soils also usually have low water-holding and low organic matter content, thus making them difficult to establish vegetation on. These soils tend to be easily eroded by both water and wind.

The Easton Lake District has been working on controlling aquatic plant growth by machine harvesting since 2002. In 2002, 140,000 pounds of aquatic plant growth were harvested from the lake. Machine harvesting removed 116,000 pounds of aquatic plants in 2003. In 2004, 212,000 pounds were harvested. Machine harvesting in 2005 removed 140,000 pounds of aquatic plant growth from the lake. Machine harvesting continued in 2006, but obviously stopped when the lake was drawn down. Harvesting has not yet resumed on the lake, due to the low aquatic plant population levels so far.

II. METHOD

Field Methods

The survey method used was the Point Intercept Method. 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 georeferenced to a particular latitude and longitude reading. At each point, the depth is noted and one rake is taken, with a score given between 1 and 3 to the density of 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 (number of sampling sites at which it occurred/total number of sampling sites) of each species was calculated. Relative frequency (number of species occurrences/total all species occurrences) was also determined. The mean density (sum of species' density rating/number of sampling sites) was calculated for each species. Relative density (sum of species' density/total plant density) was also determined. Mean density where present (sum of species' density rating/number of sampling sites at which species occurred) was calculated. Relative frequency and relative density results were summed to obtain a dominance value. Species diversity was measured by Simpson's Diversity Index.

The Average Coefficient of Conservatism and Floristic Quality Index were calculated as outlined by Nichols (1998) to measure plant community disturbance. A coefficient of Conservatism 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 Conservatism 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, a measure of a plant community's closeness to an undisturbed condition.

An Aquatic Macrophyte Index was determined using the method developed by Nichols et al (2000). This measurement looks at the following seven parameters and assigns each of them a number on a scale of 1-10: maximum depth of plant growth; percentage of littoral zone vegetated; Simpson's diversity index; relative frequency of submersed species; relative frequency of sensitive species; taxa number; and relative frequency of exotic species. The average total for the North Central Hardwoods lakes and impoundments is between 48 and 57.

III. RESULTS

Physical Data

The aquatic plant community can be impacted by several physical parameters. Water quality, including nutrients, algae and clarity, influence the plant community; the plant community in turn can modify these boundaries. Lake morphology, sediment composition and shoreline use also affect the plant community.

The trophic state of a lake is a classification of water quality (see Figure 1). Phosphorus concentration, chlorophyll a concentration and water clarity data are collected and combined to determine a trophic state. Eutrophic lakes are very productive, with high nutrient levels and large biomass presence. Oligotrophic lakes are those low in nutrients with limited plant growth and small fisheries. Mesotrophic lakes are those in between, i.e., those which have increased production over oligotrophic lakes, but less than eutrophic lakes; those with more biomass than oligotrophic lakes, but less than eutrophic lakes; those with a good and more varied fishery than either the eutrophic or oligotrophic lakes.

The limiting factor in most Wisconsin lakes, including Easton Lake, is phosphorus. Measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. The 2004-2006 average growing season total phosphorus concentration in Easton Lake was 50 micrograms/liter**.** Since the lake was refilled, the growing season average is 58.7 micrograms/liter. This is slightly below the average for Wisconsin impoundments of 65 micrograms/liter. (Shaw, 1993). This concentration suggests that Easton Lake is likely to have some nuisance algal blooms, but perhaps not as frequently as many impoundments. These averages place Easton Lake in the “fair” water quality section for lakes, but in the “eutrophic” level for phosphorus.

Chlorophyll-a pigment concentrations provide a measurement of the amount of algae in a lake’s water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth. The 2004-2006 growing season average chlorophyll-a concentration in Easton Lake was 20.6 micrograms/liter**.** However, since the lake was drawn down and refilled, the growing season chlorophyll-a average has increased to 27.9 micrograms/liter.

Water clarity is a critical factor for plants. If plants receive less than 2% of the surface illumination, they won't survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. Average growing season Secchi disk clarity in Easton Lake in 2004-2006 was 8 feet**.** This is good clarity, putting Easton Lake into the "mesotrophic" category for water clarity. However, since the lake has refilled, the water has been murky and turbid, with an average growing season Secchi reading of only 3 feet.

It is normal for all of these values to fluctuate during a growing season. They can be affected by human use of the lake, by summer temperature variations, by algae growth & turbidity, and by rain or wind events. Phosphorus tends to rise in early summer, than decline as late summer and fall progress. Chlorophyll- a tends to rise in level as the water warms, then decline as autumn cools the water. Water clarity also tends to decrease as summer progresses, probably due to algae growth, then increase as fall approaches.

Figure 1: Trophic States

Trophic State	Quality Index	Phosphorus	Chlorophyll a	Sechhi Disk
		(ug/l)	**(ug/l)**	**(ft)**
Oligotrophic	Excellent	<1	<1	>19
	Very Good	1 to 10	1 to 5	8 to 19
Mesotrophic	Good	10 to 30	5 to 10	6 to 8
	Fair	30 to 50	10 to 15	5 to 6
Eutrophic	Poor	50 to 150	15 to 30	3 to 4
Easton—2004-06		**50**	**20.6**	**8**
Easton—2011-12		**58.7**	**27.9**	**3**

Lake morphology is an important factor in distribution of lake plants. Duarte & Kalff (1986) determined that the slope of a littoral zone could explain 72% of the observed variability in the growth of submerged plants. Gentle slopes support higher plant growth than steep slopes (Engel, 1985).

Easton Lake is a narrow, shallow lake fed by a very large stream system. Most of the lake is shallow, although there are a couple of areas of steeper slopes within the lake near the dam. Where it once had good water clarity, so plant growth would be favored in Easton Lake since the sun can get to most of the sediment to stimulate plant growth, it now has turbid murky water which has poor sunlight penetration.

Sediment composition can also affect plant growth, especially those rooted. The richness or sterility and texture of the sediment will determine the type and abundance of macrophyte species that can survive in a particular lake (see Figure 2).

Figure 2: Sediment Composition—Easton Lake

Sediment	**Type**	**0-1.5'**	**1.5'-5'**	**5'-10'**	**10'-20'**	**All Sites**
Hard	Sand	7.14%	7.14%	44.44%	100.00%	18.42%
	Sand/Brick	7.14%				2.63%
Mixed	Sand/Silt	14.29%	7.14%			7.90%
	Sand/Muck	7.14%				2.63%
Soft	Silt/Muck		7.14%			2.63%
	Muck	50.00%	42.86%	55.56%		34.21%
	Silt	14.29%	35.72%			31.58%

78.95% of the sediment in Easton Lake is soft, with natural fertility and significant available water holding capacity. The remaining 21.05% is sand or sand/brick mixture. Although sand sediment may limit growth, all sandy sites in Easton Lake previously were vegetated. However, since the lake was refilled, aquatic plants were only found at 44.4% of the 151 sample sites, with submergent plants only present at 21.9% of the sites

Shoreline land use often strongly impacts the aquatic plant community and thus the entire aquatic community. Impacts can be caused by increased erosion and sedimentation and higher run-off of nutrients, fertilizers and toxins applied to the land. Such impacts occur in both rural and residential settings.

Native wooded vegetation was the shoreline cover of the highest mean coverage of 41.43% (see Figure 3). But disturbed sites, such as those with traditional lawn, rock/riprap, hard structures and pavement, were also frequent, covering nearly 21% of the shoreline (20.72%). Some bare unprotected soil was found (1.07%).

Figure 3: Shoreland Land Use—Easton Lake

Cover Type		Occurrence frequency at transects	Percent Coverage
Vegetated	Wooded	92.86%	41.43%
Shoreline	Herbaceous	57.14%	24.64%
	Shrubs	57.14%	11.79%
Disturbed	Cultivated Lawn	35.71%	16.79%
Shoreline	Hard Structures	21.43%	1.79%
	Rock/riprap/pavement	21.42%	2.49%
	Bare Soil	14.29%	1.07%

Some type of vegetated shoreline was found at 100% of the sites and covered 77.86% of the lake shoreline.

Macrophyte Data

SPECIES PRESENT

Only 18 species were found in Easton Lake in 2012, all but two were native. In the native plant category, 10 were emergent, 3 were free-floating plants, and 3 were submergent types (see Figure 4). Two exotic invasives, *Myosotis scorpioides* (Aquatic Forget-Me-Not), and *Phalaris arundinacea* (Reed Canarygrass) were found.

Figure 4—Plants Found in Easton Lake, 2012

Scientific Name	Common Name	Type
Asclepias incarnata	Swamp Milkweed	Emergent
Carex spp	Sedge	Emergent
Carex aquatilus	Tussock Lake Sedge	Emergent
Ceratophyllum demersum	Coontail	Submergent
Elodea canadensis	Common Waterweed	Submergent
Eupatorium maculatum	Joe Pye Weed	Emergent
Eupatorium perfoliatum	Boneset	Emergent
Impatiens capensis	Jewelweed	Emergent
Iris versicolor	Blue-Flag Iris	Emergent
Lemna minor	Lesser Duckweed	Free-Floating
Myosotis scorpioides	Aquaitc Forget-Me-Not	Emergent
Phalaris arundinacea	Reed Canarygrass	Emergent
Salix spp	Willow	Emergent
Schoenoplectus tabernaemontani	Soft-Stemmed Bulrush	Emergent
Solanum dulcamata	Bittersweet Nightshade	Emergent
Spirodela polyrhiza	Greater Duckweed	Free-Floating
Stuckenia pectinata	Sago Pondweed	Submergent
Typha spp	Cattail	Emergent
Wolffia columbiana	Watermeal	Free-Floating

FREQUENCY OF OCCURRENCE

Wolffia columbiana was the most frequently-occurring plant in Easton Lake in 2012 (this was true in the past as well), followed by *Lemna minor*, *Elodea canadensis*, and *Spirodea polyrhiza.* Thus, three of the four most frequently-occurring plants in Easton Lake in 2012 were free-floating plants.

When it came to relative frequency in the aquatic plant community, free-floating plants occurred with 39% relative frequency, submerged plants occurred with 26% relative frequency, and emergent plants were at 35% relative frequency.

Figure 5: Most Frequently-Occurring Plants

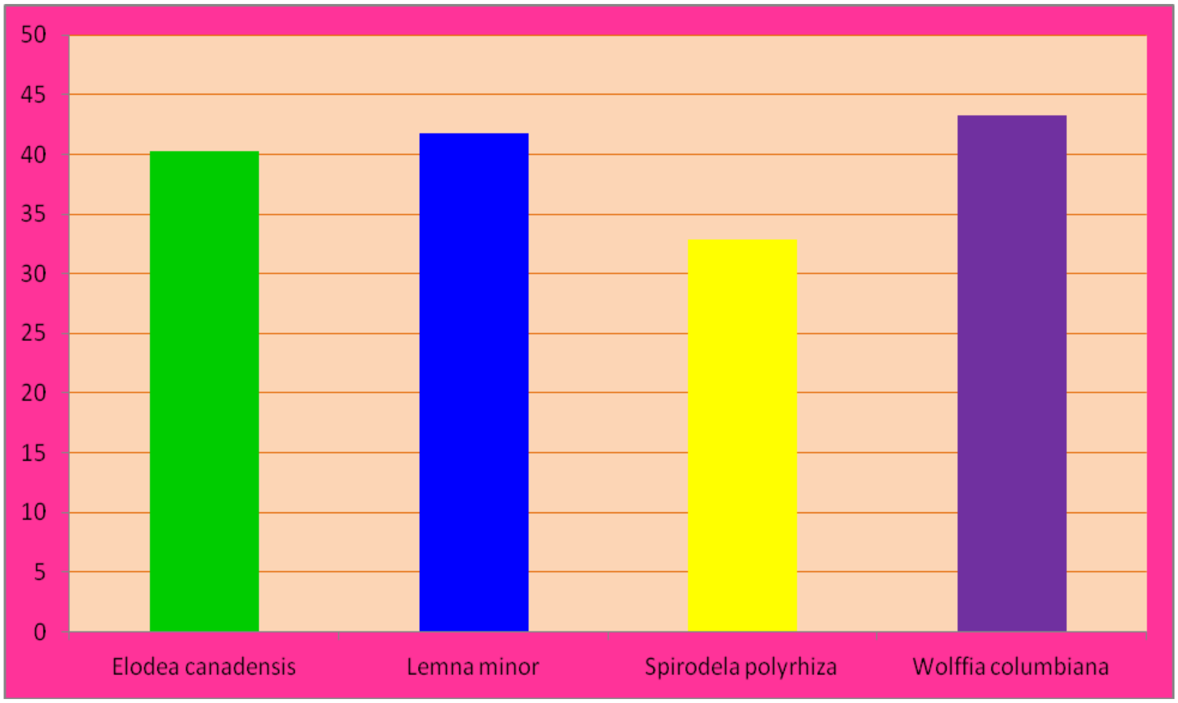
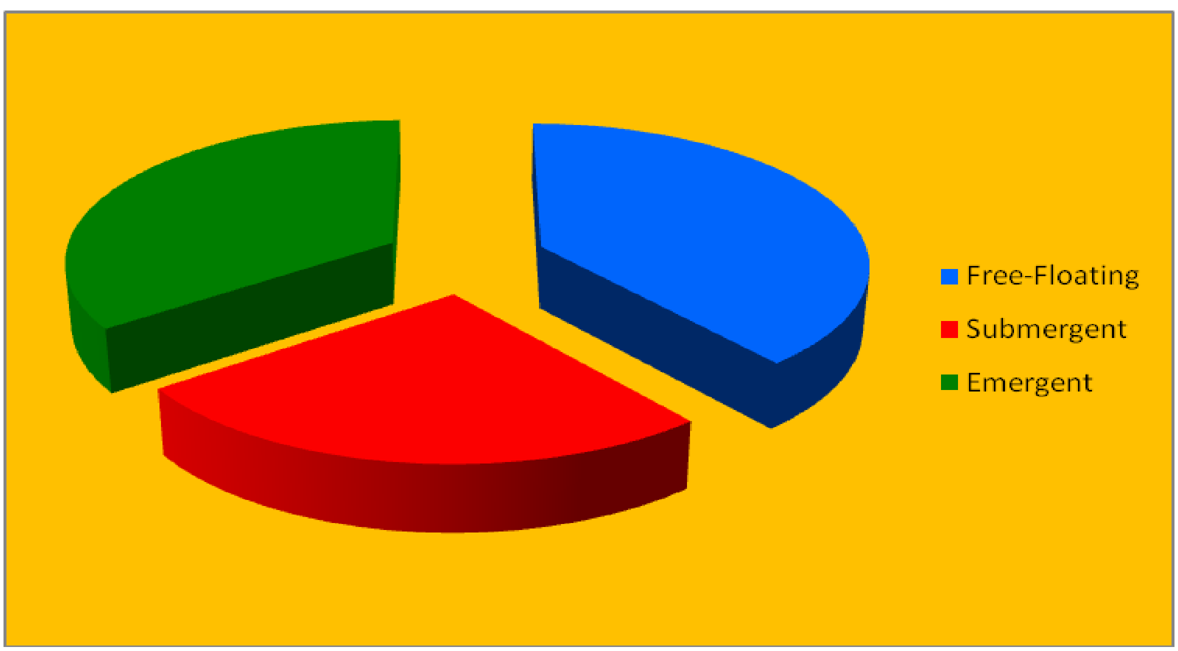


Figure 6: Relative Frequency of Occurrence of Plant Types



DENSITY OF OCCURRENCE

Overall, aquatic plants were not particularly dense in Easton Lake in 2012. Several of the emergent plants—such as Cattails and Aquatic-Forget-Me-Not—tended to occur in dense patches, rather than populating the entire lake densely.

DOMINANCE

Relative frequency and relative density are combined into a dominance value that demonstrates how dominant a species is within its aquatic plant community. Based on dominance value, *Wolffia columbiana* and *Lemna minor* were the dominant aquatic plant species in Easton Lake in 2012. Sub-dominant were *Elodea canadensis*, *Typha* spp, and *Spirodela polyrhiza*, in that order.

The two invasives found in 2012, *Myosotis scorpioides* and *Phalaris arundinacea*, were present in significant occurrence frequency, density and dominance. Between the two, they were 12% of the total aquatic plant community in Easton Lake in 2012. Although *Potamogeton crispus* was found previously in Easton Lake, none was found in 2012. The most common invasive aquatic plant in Adams County, *Myriophyllum spicatum* (Eurasian Watermilfoil), has not been found in Easton Lake so far.

In considering dominance and the types of aquatic plants, emergent plants dominated Easton Lake in 2012, with free-floating plants scoring as sub-dominant.

Figure 7: Species Dominance in 2012

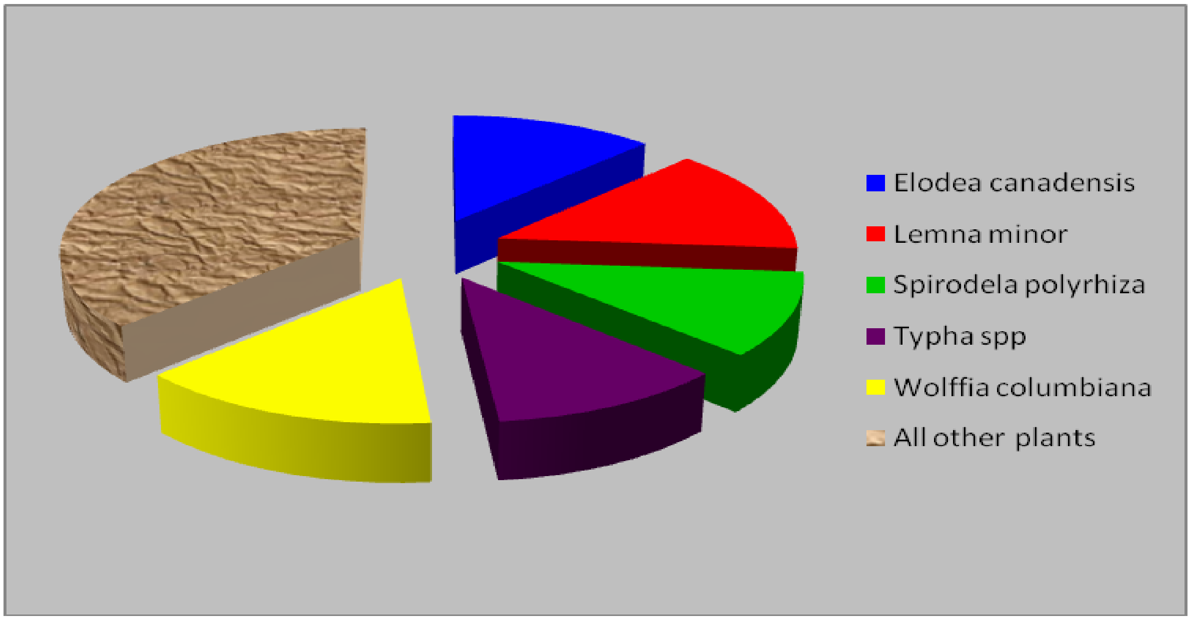
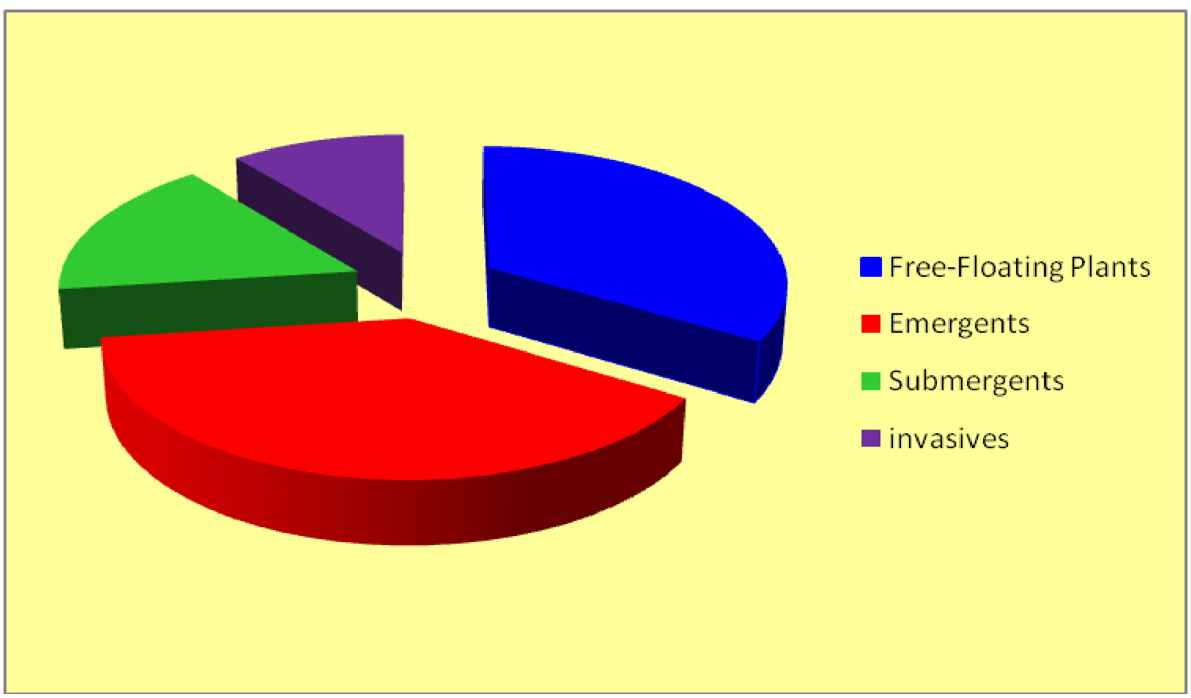


Figure 8: Plant Type Dominance 2012



DISTRIBUTION

Aquatic plants occurred at only slightly over 44% of the151 sample sites in Easton Lake in 2012. The deepest rooted plant was found at 6.7 feet. There was only one other site over 3 feet in depth that had a rooted aquatic plant. The bulk of rooted plants were in less than 3 feet of water.

Figure 9a: Distribution of Submergent Plants—West End of Lake

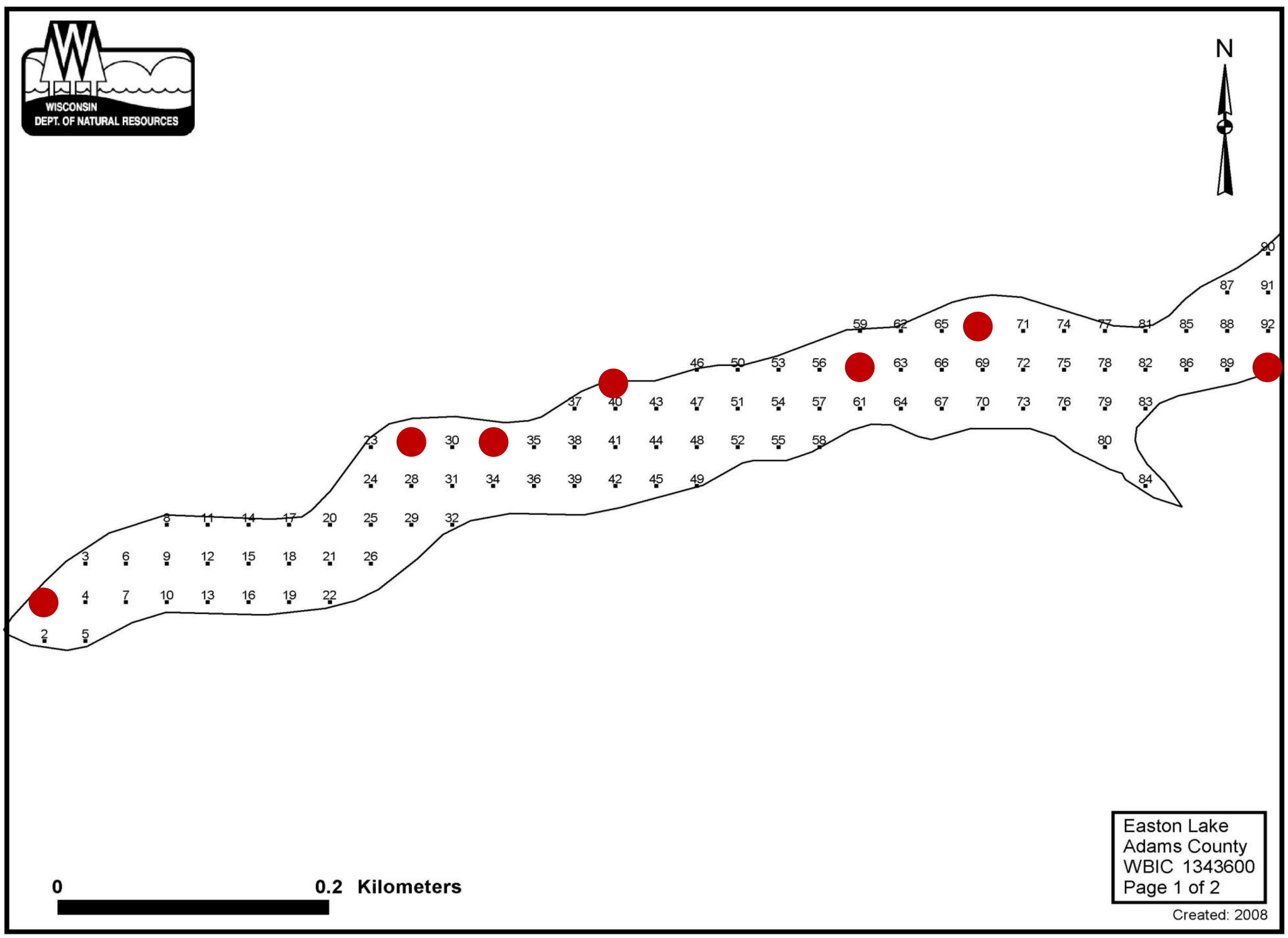


Figure 9b: Distribution of Submergent Plants—East End of Lake

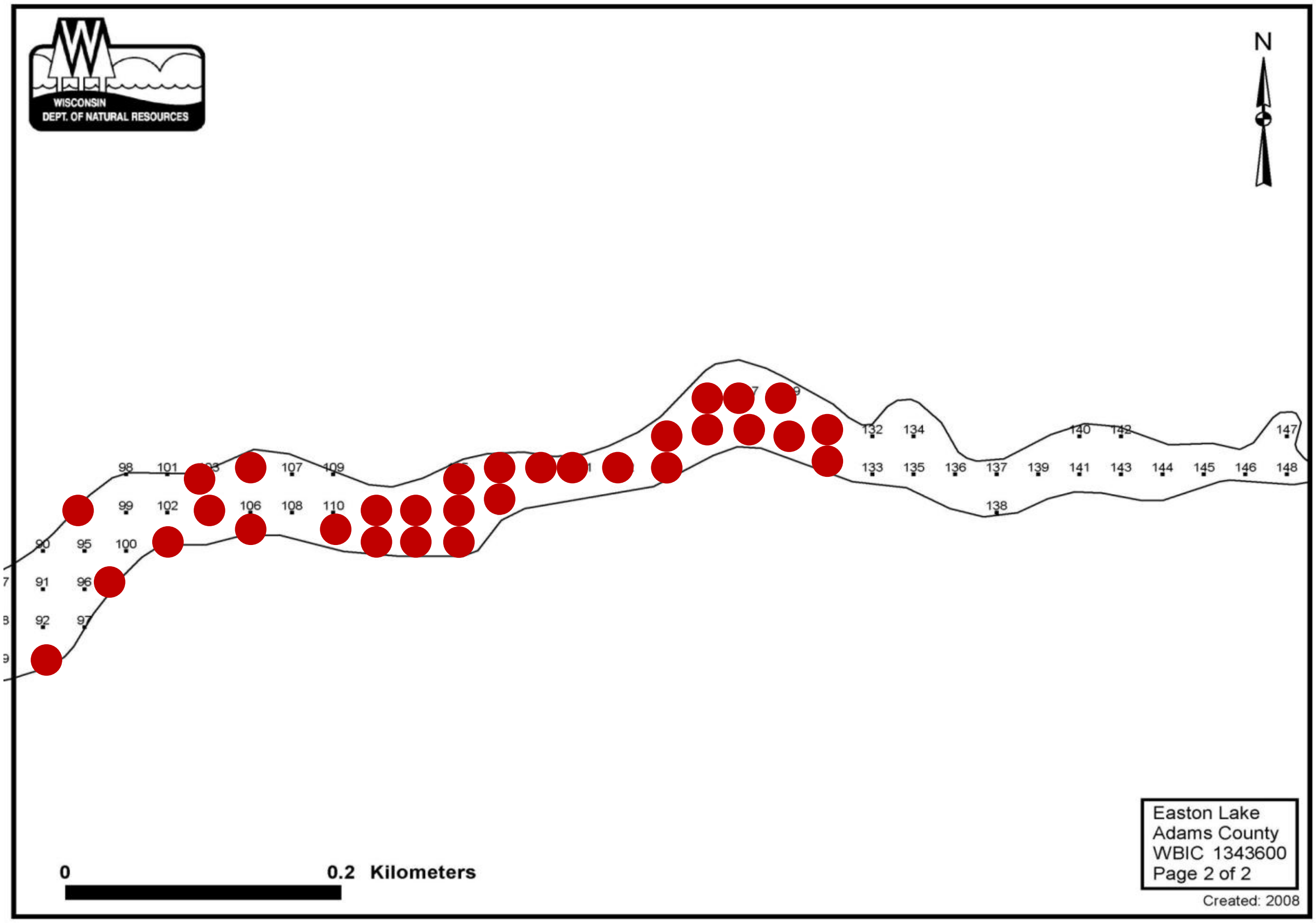


Figure 10a: Distribution of Emergent Plants—West End

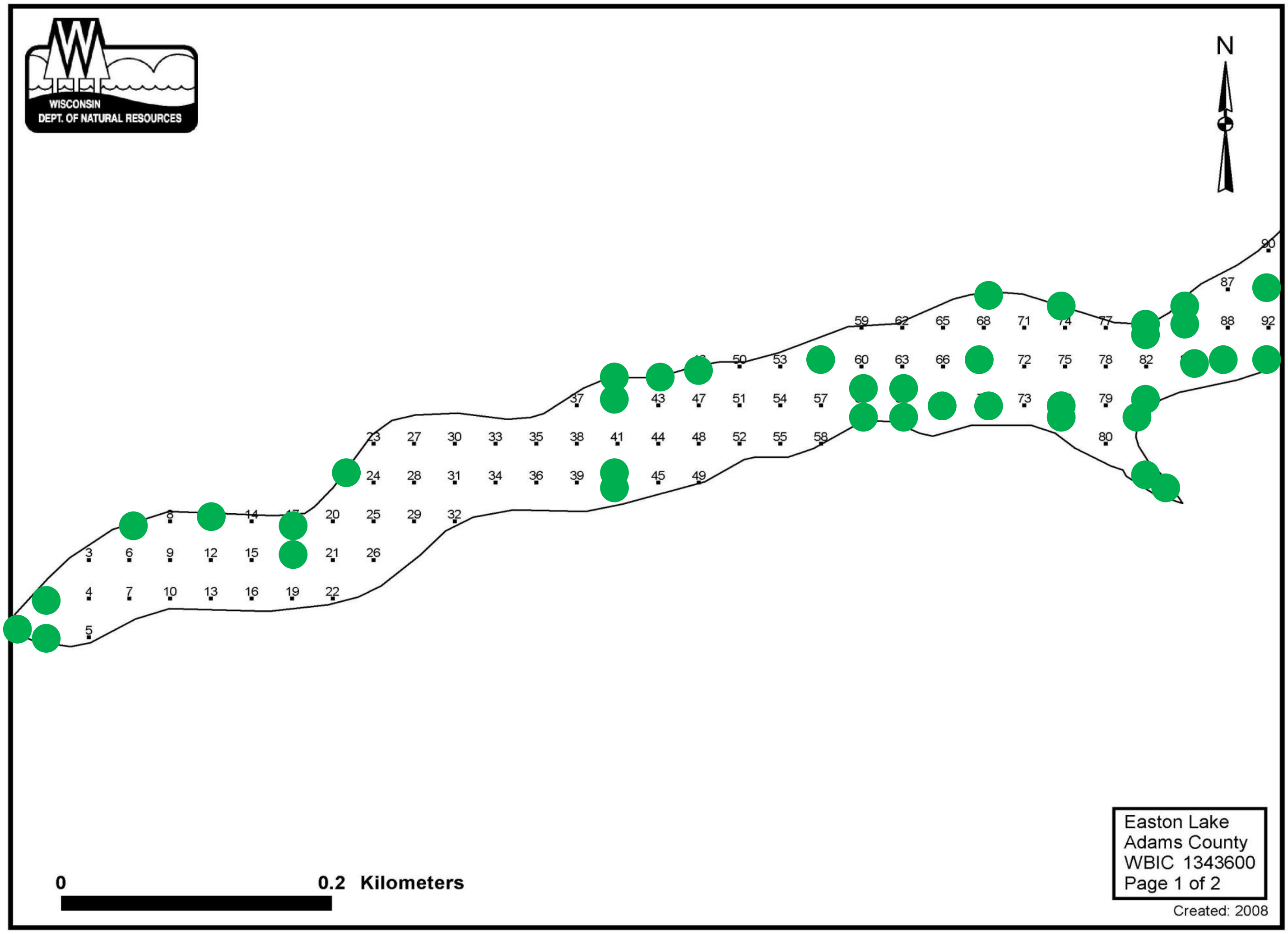


Figure 10b: Distribution of Emergent Plants—East End

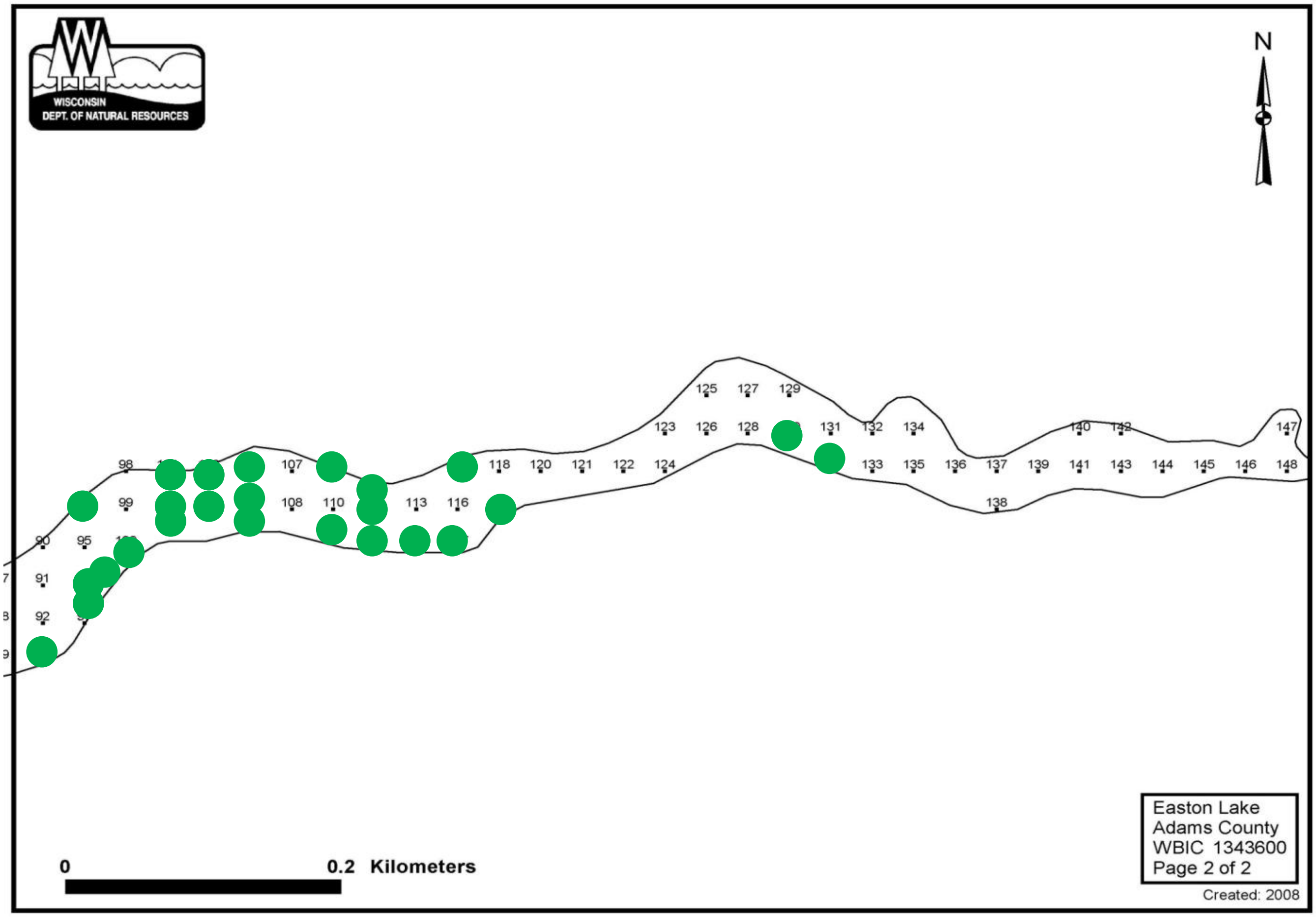


Figure 11a: Free-Floating Plants—West End

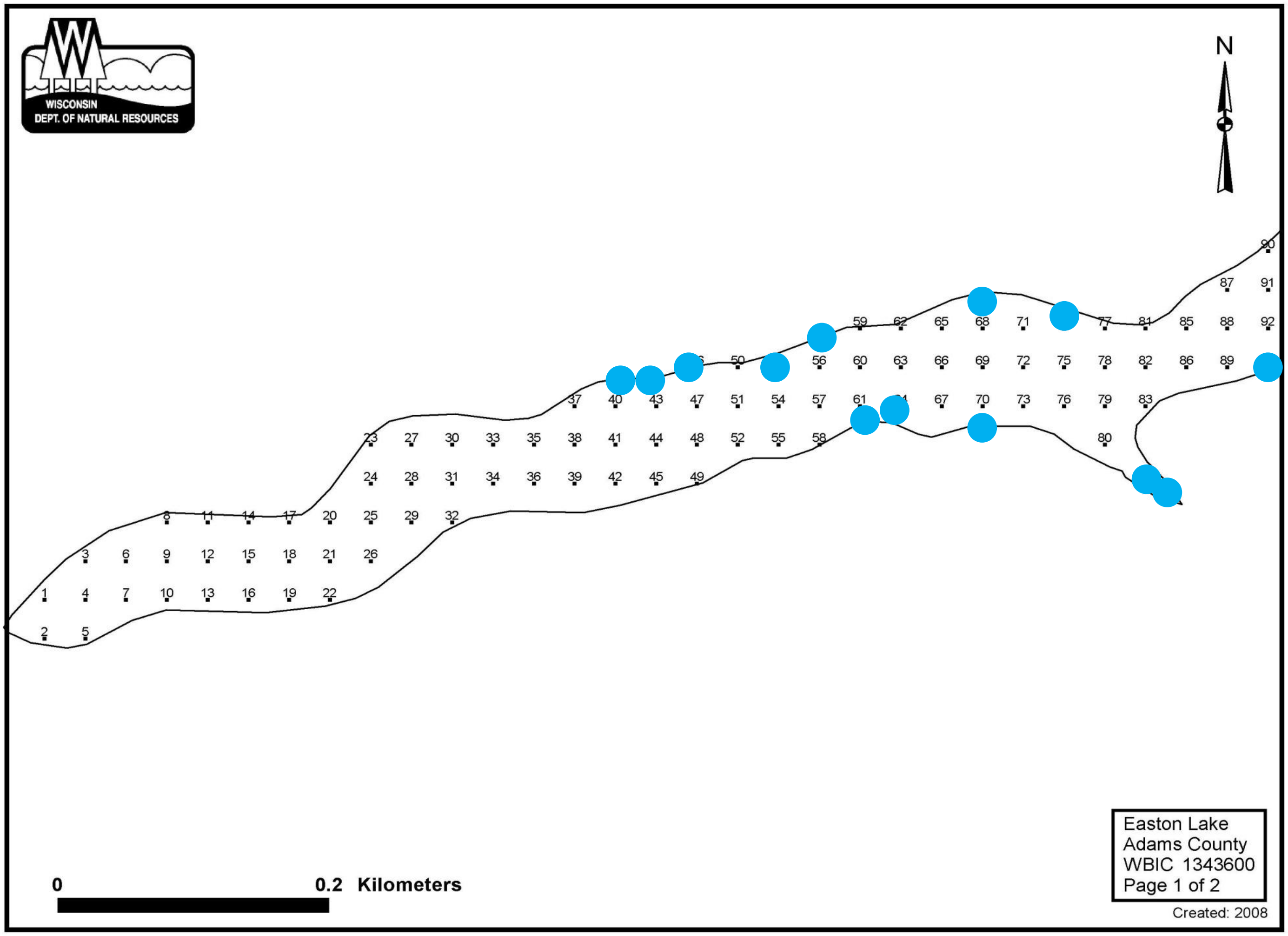
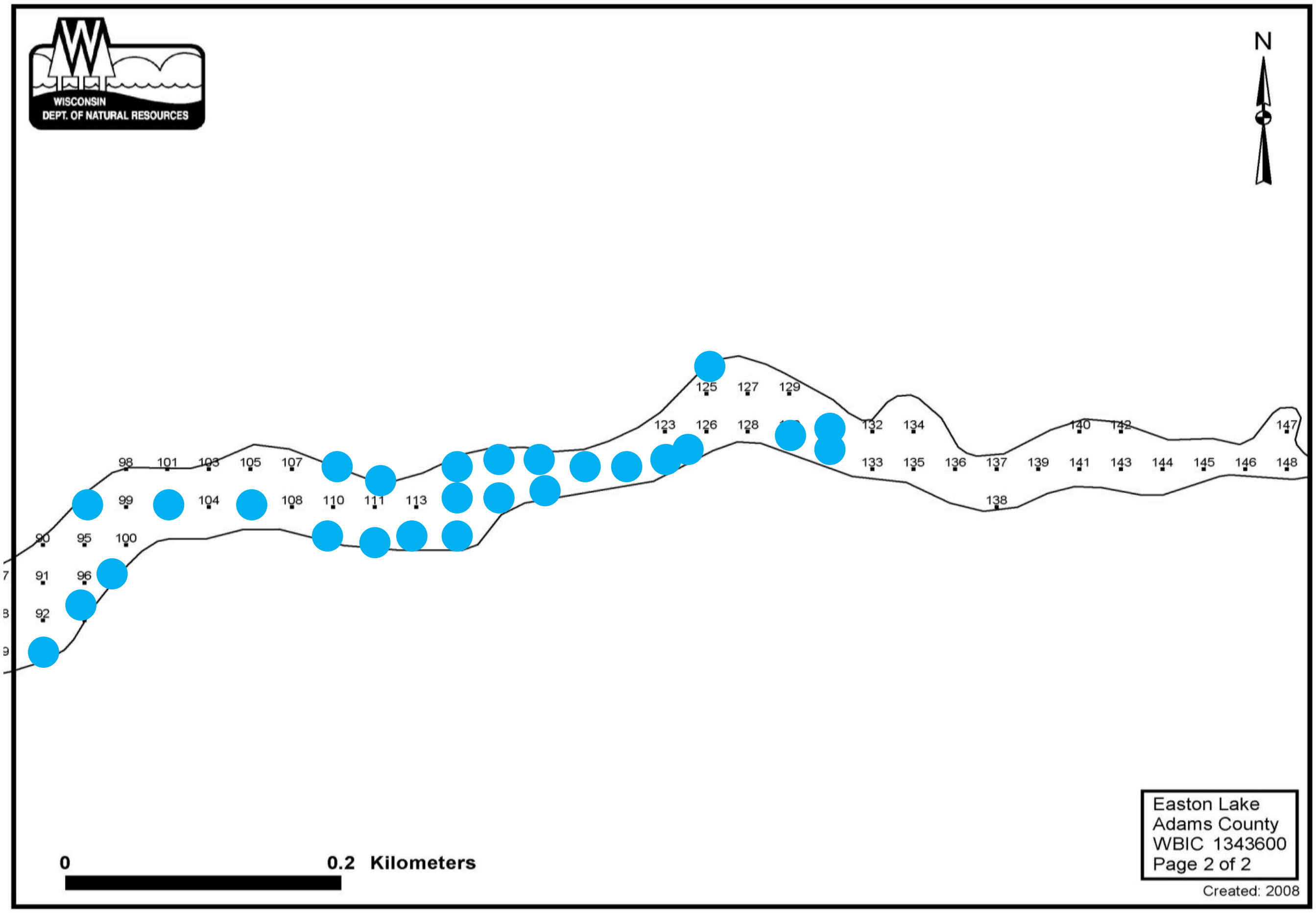


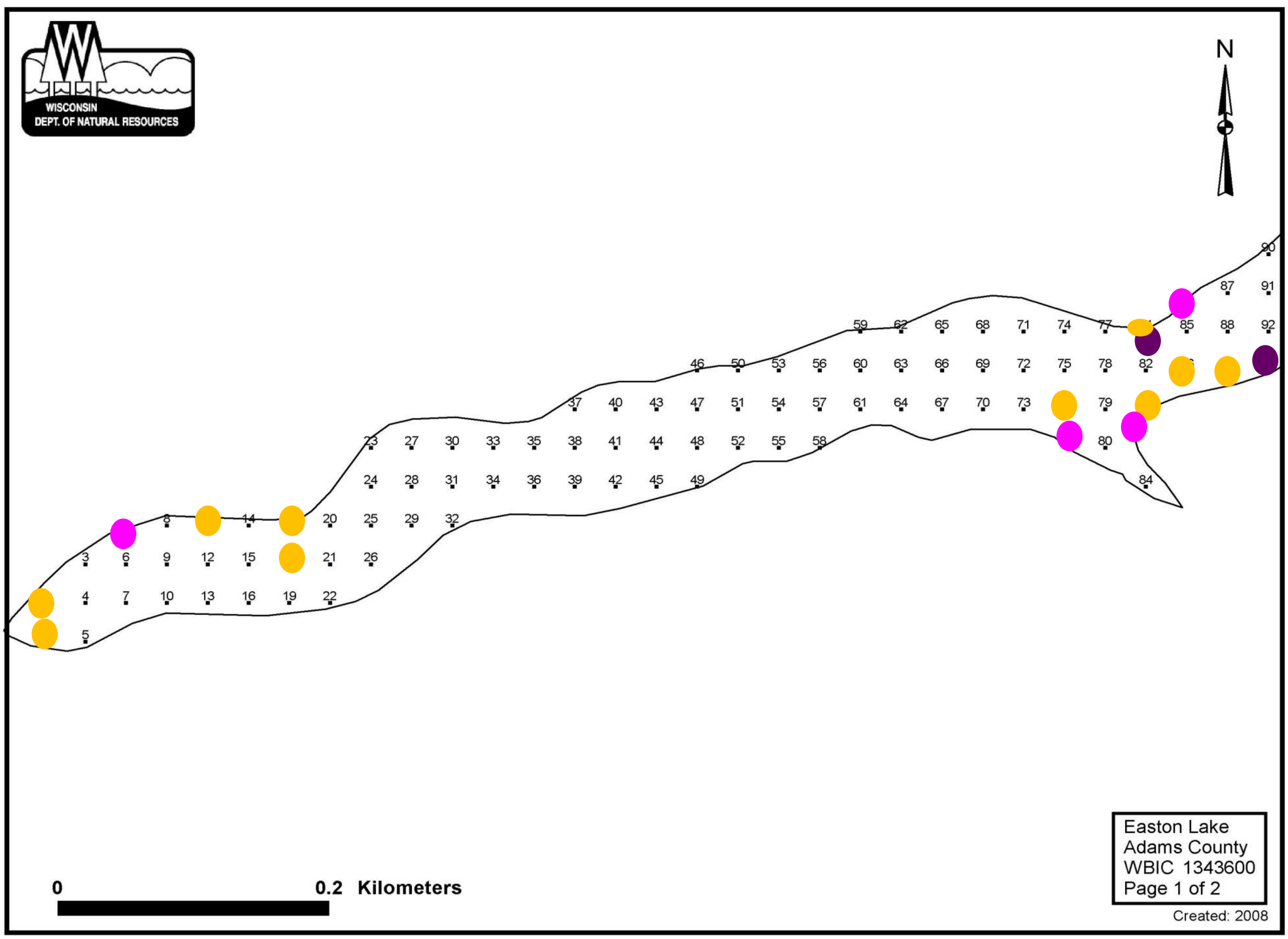
Figure 11b: Free-Floating Plants—East End



The discovery of *Myosotis scorpioides* (Aquatic Forget-Me-Not), which is not native to Wisconsin, is troubling. Since Easton Lake is in the process of rebuilding its aquatic plant community, there are many gaps. This plant now has an opportunity to move in with little native aquatic plant competition. It had a 15% occurrence frequency in 2012 and was prevalent along much of the shore, clearly visible even when there wasn't a sample point there.

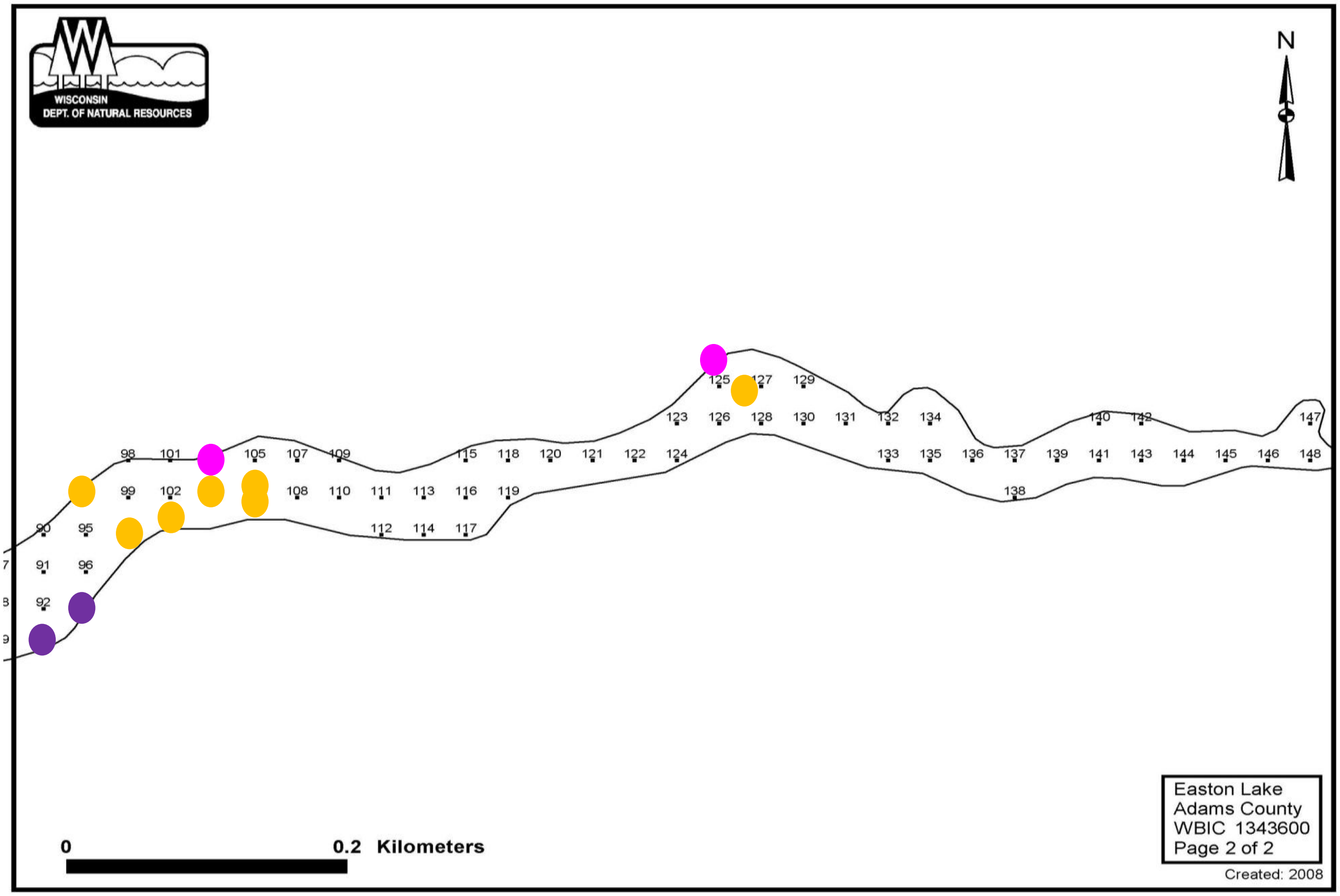
Phalaris arundinacea (Reed Canary Grass) has been at Easton Lake for several years. In 2006, it had only a 2.6% occurrence frequency and was only .5% of the aquatic plant community. However, its occurrence frequency in 2012 jumped up to over 20%, and it made up 6.5% of the overall aquatic plant community. Like the aquatic-forget-me-not, reed canary grass is an opportunistic invasive. If there continues to be a delay in the return of native aquatic plants to Easton Lake, reed canarygrass may establish a stronghold of big patches along the shore, becoming an even larger part of the aquatic plant community.

Figure 12a: Distribution of Aquatic Invasives—West End



Myosotis scorpioides *Phalaris arundinacea* *Both Plants Found*

Figure 12b: Distribution of Aquatic Invasives—East End



THE COMMUNITY

The Simpson's Diversity Index Easton Lake was .91, suggesting good species diversity. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable). This places it in the average range for Simpson's Diversity Index readings for both North Central Hardwood Forest and Wisconsin Lakes overall.

The 2012 Aquatic Macrophyte Community Index (AMCI) for Easton Lake was 33. In 2006, before the lake was drawn down, it was 46. Reductions in scores included a loss of four points because of a shallower rooting depth, a loss of two points because less of the littoral zone is vegetated, a loss of two points because of the greater presence of invasives, and a loss of four points because of the lack of "sensitive" plants. This is in the far below the average range for North Central Wisconsin Hardwood Lakes (48 to 57) and also below the average range for all Wisconsin lakes (45 to 57).

Figure 13: Aquatic Macrophyte Community Index

Aquatic Macrophyte Community Index for Easton Lake		**2012**
Category	Easton Lake results	Value
Maximum rooting depth	6.7	2
% littoral area vegetated	44.4	8
%submersed plants	20%	1
% sensitive plants	0	1
# taxa found	18 (2 exotic)	8
exotic species frequency	12%	4
Simpson's Diversity	.91	9
total		**33**

Because the lake has only been filled for two years, it is too early to sound alarm bells about the poor health of the Easton Lake aquatic plant community, but the increased presence of invasives and the lack of native littoral zone vegetation make the lake vulnerable to increased spread of the invasives already present and to the introduction of new invasives. Species richness (number of plant species per sight) was only 1.4 in 2012, while it was 4.5 in 2006.

A Coefficient of Conservatism and a Floristic Index calculation were performed on the field results. Technically, the average Coefficient of Conservatism measures the community's sensitivity to disturbance, while the Floristic Index measures the community's closeness to an undisturbed condition. Indirectly, they measure past and/or current disturbance to the particular community.

Previously, a value was assigned to all plants known in Wisconsin to categorize their probability of occurring in an undisturbed habitat. This value is called the plant's Coefficient of Conservatism. A score of 0 indicates a native or alien opportunistic invasive plant. Plants with a value of 1 to 3 are widespread native plants. Values of 4 to 6 describe native plants found most commonly in early successional ecosystem. Plants scoring 6 to 8 are native plants found in stable climax conditions. Finally, plants with a value of 9 or 10 are native plants found in areas of high quality and are often endangered or threatened. In other words, the lower the numerical value a plant has, the more likely it is to be found in disturbed areas.

The Average Coefficient of Conservatism Easton Lake was 3.44. This puts it in the lowest quartile for Wisconsin Lakes (average 6.0) and for lakes in the North Central Hardwood Region (average 5.6). The aquatic plant community in Easton Lake is in the category of those very tolerant of disturbance, probably due to the total draw down of the lake. However, it is worth noting that the Average Coefficient of Conservatism in 2006, before the lake was drawn down, was only 3.68, still below average. Easton Lake has long been a lake plagued by various disturbances, which has been reflected in the health of its aquatic plant community.

The Floristic Quality Index of the 2012 aquatic plant community in Easton Lake of 13.75 is below average for Wisconsin Lakes (22.2) and the North Central Hardwood Region (20.9). Even before the drawdown, it was only 16.06, still below average. This is a further indication that the plant community in Easton Lake is farther from an undisturbed condition than the average lake in Wisconsin overall and in the North Central Hardwood Region. In other words, the aquatic plant community in Easton Lake been impacted by an above average amount of disturbance and tolerates higher than average disturbance.

"Disturbance" is a term that covers many disruptions to a natural community. It includes physical disturbances to plant beds such as boat traffic, plant harvesting, chemical treatments, dock and other structure placements, shoreline development and fluctuating water levels. Indirect disturbances like sedimentation, erosion, increased algal growth, and other water quality impacts will also negatively affect an aquatic plant community. Biological disturbances such as the introduction of non-native and/or invasive species (such as the Aquatic Forget-Me-Not, Curly-Leaf Pondweed, and Reed Canarygrass found here), destruction of plant beds, or changes in aquatic wildlife can also negatively impact an aquatic plant community. Shore development and sediment deposition can also reduce the quality of the aquatic plant community.

DISCUSSION

Based on water clarity, chlorophyll-al and phosphorus data, Easton Lake is mostly an eutrophic impoundment with decreasing water clarity and decreasing water quality. This trophic state should support fairly dense aquatic plant growth and frequent algal blooms. Right now, Easton Lake does not have dense aquatic plant growth. Like many of the lakes in Adams County in the summer of 2012, it did suffer from some substantial algae blooms along its shores.

In the past, sufficient nutrients (trophic state), good water clarity, shallow lake, and soft sediments at Easton Lake favored plant growth. Currently, the water clarity has been reduced by over ½, and total phosphorus and chlorophyll-a levels seem to be creeping up.

During the time the lake was drawn down, a there were densely-growing wetland/terrestrial plants that grew in on areas usually covered by the lake. Although at one time there was a plan to burn this growth to clear it before the lake was refilled, that never occurred. Instead, the lake was filled over the plants. It is likely these plants, as they died, added to the nutrient levels in Easton Lake, and they may also reduce plant growth through their debris until they have decayed enough for plants to grow through. During the 2012 survey, there were still dying stalks of these plants pulled up, although not as many as in the summer of 2011.

Some mechanical harvesting of aquatic plants in Easton Lake occurred before the lake was drawn, but without a regular schedule or pattern. Currently, the only plant growth dense enough to harvest in along the shores occurs where it is too shallow to harvest. Should a sufficient aquatic plant community develop to the point where machine harvesting can resume, it is important that there be a regular schedule and pattern of machine harvesting. Keeping track of the amount harvested by getting the cut plants regularly tested for phosphorus could help reduce total phosphorus and other nutrients in the lake.

The lake is currently dominated by free-floating and emergent plants, with little vegetation at all occurring in waters over 5 feet deep. Of the 18 species found in Easton Lake in 2012, 16 were native and 2 were exotic invasives. In the native plant category, 10 were emergent, 3 were free-floating plants, and 3 were submergent types. Both the invasives present--*Myosotis scorpioides* and *Phalaris arundinacea*—are emergent plants.

The most developed shore—that along the north side of the lake—has many "grandfathered" buildings that are close to the shore, suggesting that runoff from impervious surfaces such as decks or rooftops could be adding to the pollutant load in the lake. Installation of as much buffer (native) vegetation as possible between the buildings and the ordinary high water mark could filter pollutants and nutrients and help keep them out of the lake water.

Along the south shore, there is a large parking lot, County Road A and a supper club all very close to the lake, creating significant stormwater runoff and soil erosion potential. Installation of runoff diversion practices and some shore protection here would help protect water quality. There are areas of wooded and wetland shores on the southeast part of the lake that should be preserved as they are to maintain habitat and to serve as a buffer for that area. Studies have suggested that runoff from establish wooded land is substantially less than that of developed areas.

Some kind of native vegetation was the dominant shore cover in Easton Lake. However, disturbed sites (buildings close to the shore, cultivated lawns, hard structures, rock/riprap and pavement) were also common. Of vegetated shorelines, wooded vegetation had the most coverage. Some type of disturbed shoreline was found at over 71% of the sites in 2006. These conditions offer little protection for water quality and have significant potential to negatively impact Easton Lake's water by increased runoff (including lawn fertilizers, pet waste, pesticides) and shore erosion. Expanding the amount of vegetation and/or runoff catch at these shorelines would help prevent erosion and reduce runoff into the lake that contributes to algal growth, increased sedimentation, and reduced water quality.

IV. CONCLUSIONS

Easton Lake is mostly an eutrophic impoundment with decreasing water clarity and decreasing water quality. This trophic state should support fairly dense aquatic plant growth and frequent algal blooms. Right now, Easton Lake does not have dense aquatic plant growth. Like many of the lakes in Adams County in the summer of 2012, it did suffer from some substantial algae blooms along its shores.

The quality of the aquatic plant community in Easton Lake is below average for Wisconsin lakes and for lakes in the North Central Hardwood region, as measured by Floristic Quality Index, AMCI, and Coefficient of Conservatism. Structurally, it contains emergent plants, free-floating plants, but few submergents overall and almost no submergents in depths over 3 feet.

Although only a little over 44% of the lake was vegetated in 2012, the potential for plant growth at all depths of the lake is present. In the past, the east end of the lake had particularly dense plant growth, mostly of the native *Elodea canadensis*, which grew thickly enough to block boat passage. Even though less than ½ of the lake is vegetated, *Elodea canadensis* comprises 12% of the aquatic plant community already, mostly on the shallow east end of the lake.

Wolffia columbiana was the most frequently-occurring plant in Easton Lake in 2012 (this was true in the past as well), followed by *Lemna minor*, *Elodea canadensis*, and *Spirodea polyrhiza*. Thus, three of the four most frequently-occurring plants in Easton Lake in 2012 were free-floating plants. Based on dominance value, *Wolffia columbiana* and *Lemna minor* were the dominant aquatic plant species in Easton Lake in 2012. Sub-dominant were *Elodea canadensis*, *Typha* spp, and *Spirodela polyrhiza*, in that order.

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.

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.

At this point, the aquatic plant community of Easton Lake cannot be categorized as “healthy”.

MANAGEMENT RECOMMENDATIONS

(1) Natural shoreline restoration and stormwater runoff control is needed. Disturbed shorelines cover too much of the current shoreline, especially with many buildings less than 50 feet from the ordinary high water mark. A buffer area of native plants should be restored around the lake, especially on those sites that now have traditional lawns mowed to the water’s edge or buildings very close to the water’s edge. Stormwater management of these impervious surfaces is essential to maintain the high quality of the lake water.

(2) No lawn chemicals, especially lawn chemicals with phosphorus, should be used on properties around the lake. If they must be used, they should be used no closer than 50 feet to the shore.

(3) An aquatic plant management plan should be developed with a regular schedule of activities. Such plans will be required by the Wisconsin DNR for aquatic plant permits and grants and will also assist in reducing the frequency and density of the plants in Easton Lake.

(4) Mechanical harvesting should not be resumed until an aquatic plant survey establishes that there is significant aquatic plant growth in waters over three feet deep. Until then, only monitoring should occur.

(5) Handpulling can be instituted for the two invasives, if possible. If the areas are not reachable by boat or wading, consultation with the WDNR Aquatic Plant specialist should occur.

(6) If mechanical harvesting resumes, there should be a regular schedule for harvesting, as well as a map developed annually for approval by the WDNR Aquatic Plant specialist.

(7) The Easton Lake Association may want to apply for grants from the Wisconsin Department of Natural Resources to help defray the cost of aquatic plant management.

(8) No broad-scale chemical treatments of aquatic plant growth are recommended due to the undesirable side-effects of such treatments, including increased nutrients from decaying plant material and decreased dissolved oxygen and opening up more areas to the invasion of invasives.

(9) Fallen trees should be left at the shoreline.

(10) In 2011, several Easton Lake citizens were trained to do water quality sampling and invasive species sampling. However, it does not appear that they continued their sampling activities into 2012. These activities need to resume and occur regularly in order to maintain a measurement of the lake's return.

(11) Easton Lake residents should identify, cooperate with and participate in watershed programs that will reduce nutrient and sediment inputs.

(12) Sensitive vegetation, emergent vegetation and lily pad beds should be protected if they recur. These not only provide habitat, but also help stabilize the sandy shores.

(13) The areas where there is undisturbed wooded shore should be maintained and left undisturbed.

(14) The Easton Lake District should make sure that its lake management plan that takes into account all inputs from both the surface and ground watersheds and addresses the concerns of this lake community.

(15) Because the lake is still rebuilding, it is recommended that that an aquatic plant survey occur every 2 to 3 years, rather than the generally recommended 5 to 6. This frequency would permit more intensive monitoring of aquatic plant re-establishment.

LITERATURE CITED

Dennison, W., R. Orth, K. Moore, J. Stevenson, V. Carter, S. Kollar, P. Bergstrom and R. Batuik. 1993. Assessing water quality with submersed vegetation. BioScience 43(2):86-94.

Duarte, Carlos M. and Jacob Kalff. 1986. Littoral slope as a predictor of the maximum biomass of submerged macrophyte communities. Limnol.Oceanogr. 31(5):1072-1080.

Dunst, R.C. 1982. Sediment problems and lake restoration in Wisconsin. Environmental International 7:87-92.

Engel, Sandy. 1985. Aquatic community interactions of submerged macrophytes. Wisconsin Department of Natural Resources, Technical Bulletin #156. Madison, WI.

Gleason, H, and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada (2nd Edition). New York Botanical Gardens, N.Y.

Jessen, Robert, and Richard Lound. 1962. An evaluation of a survey technique for submerged aquatic plants. Minnesota Department of Conservatism. Game Investigational Report No. 6.

Nichols, Stanley. 1998. Floristic quality assessment of Wisconsin lake plant communities with example applications. Journal of Lake and Reservoir Management 15(2):133-141.

Nichols, S., S. Weber and B. Shaw. 2000. A proposed aquatic plant community biotic index for Wisconsin lakes. Environmental Management 26(5):491-502.

Shaw, B., C. Mechenich and L. Klessig. 1993. Understanding Lake Data. University of Wisconsin-Extension. Madison, WI.