The Aquatic Plant Community of Lost Lake, Marathon County, Wisconsin

2005

Wisconsin Department of Natural Resources
Eau Claire, WI
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Submitted by:

Deborah Konkel
Wisconsin Department of Natural Resources
Eau Claire, WI
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Executive Summary

Lost Lake is a hypereutrophic lake with very good water clarity and very good water quality based on 1992 water quality data.

Aquatic plant community colonized more than three-quarters of the littoral zone, nearly half of the total lake area, to a maximum depth of 9 feet. The 0-1.5 ft. depth zone supported the most abundant aquatic plant growth.

Ceratophyllum echinatum was the dominant species within the plant community, especially in the 1.5-20ft depth zones, occurring at more than three-quarters of the sample sites and exhibiting a dense growth form. *Brasenia schreberi* and *Elodea canadensis* were sub-dominant species, both occurring at approximately half of the sites and at above average densities. *C. echinatum* is listed as a Special Concern Species, a species with which there is concern about its distribution and population.

The aquatic plant community in Lost Lake is characterized by high quality, very good species diversity, intolerance to disturbance and within the quartile of lakes in the state and region closest to an undisturbed condition.

A healthy aquatic plant community plays a vital role within the lake community. This is due to the role plants play in improving water quality, providing valuable habitat resources for fish and wildlife, resisting invasions of non-native species and checking excessive growth of tolerant species that could out-compete sensitive species, thus reducing diversity.

Management Recommendations

1) Lake property owner preserve the natural shoreline cover that is found around Lost Lake. Maintaining natural shoreline cover is critical to maintaining water quality and wildlife habitat.
2) Lakes residents use best management practices on shoreland property to prevent nutrient enrichment and stormwater run-off to the lake.
3) Lake residents begin monitoring the water quality through the Self-Help Volunteer Lake Monitoring Program.
4) DNR to designate sensitive areas within Lost Lake.
5) DNR conduct water quality monitoring in Lost Lake to determine if the high nutrient and algae concentrations have changed since 1992.
6) Maintain exotic species educational signs at the boat landing to prevent the spread of exotic species into Lost Lake.

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The Aquatic Plant Community in Lost Lake, Marathon County 2005

I. INTRODUCTION

A study of the aquatic macrophytes (plants) in Lost Lake was conducted during August 2005 by Water Resources staff of the West Central Region - Department of Natural Resources (DNR). This was the first quantitative vegetation study of Lost Lake by the DNR.

A study of the diversity, density, and distribution of aquatic plants is an essential component of understanding a lake due to the important ecological role of aquatic vegetation in the lake ecosystem 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 (including algae) - the beginning of the food chain. Aquatic plants provide food and shelter for fish, wildlife, and the invertebrates that in turn provide food for other organisms. Plants improve water quality, protect shorelines and lake bottoms, add to the aesthetic quality of the lake and impact recreation.

Characterize 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).

The present study will provide information that is important for effective management of the lake, including fish habitat improvement, protection of sensitive wildlife areas, aquatic plant management, and water resource regulations. The baseline data that it provides will be compared to future plant inventories and offer insight into any changes occurring in the lake.

Background and History: Lost Lake is a 42-acre lake in eastern Marathon County, Wisconsin. Lost Lake has a maximum depth of 22 feet.

II.METHODS

Field Methods

The study design was based on the rake-sampling method developed by Jessen and Lound (1962), using stratified random placement of the transect lines. The shoreline was divided into 12 equal segments and a transect, perpendicular to the shoreline, was randomly placed within each segment (Appendix IV), using a random numbers table.

One sampling site was randomly located in each depth zone (0-1.5ft, 1.5-5ft, 5-10ft and 10-20ft) along each transect. Using a long-handled, steel, thatching rake, four rake samples were taken at each sampling site, taken from each quarter of a 6-foot diameter quadrat. The aquatic plant species that were present on each rake sample were recorded. Each species was given a density rating (0-5) based on the number of rake samples on which it was present at each sampling site.

A rating of 1 indicates that a species was present on one rake sample
a rating of 2 indicates that a species was present on two rake samples
a rating of 3 indicates that it was present on three rake samples
a rating of 4 indicates that it was present on all four rake samples
a rating of 5 indicates that a species was abundantly present on all rake samples at that site.

Visual inspection and periodic samples were taken between transect lines to record the presence of any species that did not occur at the sampling sites. Specimens of all plant species present were collected and saved in a cooler for later preparation of voucher specimens. Nomenclature was according to Gleason and Cronquist (1991).

The type of shoreline cover was recorded at each transect. A section of shoreline, 50 feet on either side of the transect intercept with the shore and 30 feet deep was evaluated. The percentage of each cover type within this 100' x 30' rectangle was visually estimated and verified by a second researcher.

Data Analysis

The percent frequency of each species was calculated (number of sampling sites at which it occurred/total number of sampling sites) (Appendix I). Relative frequency was calculated (number of occurrences of a species/total occurrence of all species (Appendix I). The mean density was calculated for each species (sum of a species' density ratings/number of sampling sites) (Appendix II). Relative density was calculated (sum of a species density/total plant density). A "mean density where present" was calculated for each species (sum of a species' density ratings/number of sampling sites at which that species occurred) (Appendix II). The relative frequency and relative density of each species was summed to obtain a dominance value (Appendix III). Species diversity was measured by calculating Simpson's Diversity Index $1-(\sum(\text{Relative Frequency}^2))$ (Appendix I).

The Aquatic Macrophyte Community Index (AMCI) developed for Wisconsin Lakes by Nichols (2000) was applied to Lost Lake (Table 7). Values between 0 and 10 are given for each of seven categories that characterize a plant community and summed.

The Average Coefficient of Conservatism and Floristic Quality Index were calculated, as outlined by Nichols (1998), to determine 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 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 and clarity) 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 an indication of its water quality. Phosphorus concentration, chlorophyll a concentration, and water clarity data are collected and combined to determine the trophic state.

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.

Nutrients

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

1992 Mean summer phosphorus concentration in Lost Lake was 51.3ug/l

The concentration of phosphorus in Lost Lake was indicative of a eutrophic lake (Table 1).

Table 1. Trophic Status

	Quality Index	Phosphorus ug/l	Chlorophyll a ug/l	Secchi Disc ft.
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**
Lost Lake - 1992	Very Poor	51.3 ug/l	72.7 ug/l	2.67 ft.

After Lillie & Mason (1983) & Shaw et. al. (1993)

Algae

Chlorophyll a concentrations measure the amount of algae in lake water. Algae are natural and essential in lakes, but high algae populations can increase turbidity and

reduce the light available for plant growth.

1992 Mean summer chlorophyll a concentration in Lost Lake was 72.7 ug/l.

The chlorophyll a concentration in Lost Lake indicates that it was a hypereutrophic lake (Table 1).

Filamentous algae occurred at only one sample site, in the 1.5-5ft depth zone in the near-shore area next to the two homes on the lake.

Water Clarity

Water clarity is a critical factor for plants. When plants receive less than 1 - 2% of the surface illumination, they can not survive. 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.

1992 Mean summer Secchi disc water clarity in Lost Lake was 2.67 ft.

Water clarity indicates (Table 1) that Lost Lake was a hypereutrophic lake with very poor water clarity.

The combination of phosphorus concentration, chlorophyll concentration and water clarity indicates that Lost Lake is a hypereutrophic lake with very poor water quality. This trophic state would favor abundant plant growth and frequent and severe algae blooms.

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).

Lost Lake has an oval basin that has a gradually-sloped littoral zone (Appendix IV). The gentle slopes provide a more stable substrate for aquatic plant growth and a broader band of shallow waters favorable for plant growth.

SEDIMENT COMPOSITION – The dominant sediment in Lost Lake was peat, dominant at all depth zones (Table 2). Sand sediments were common in the shallowest zone (Figure 1).

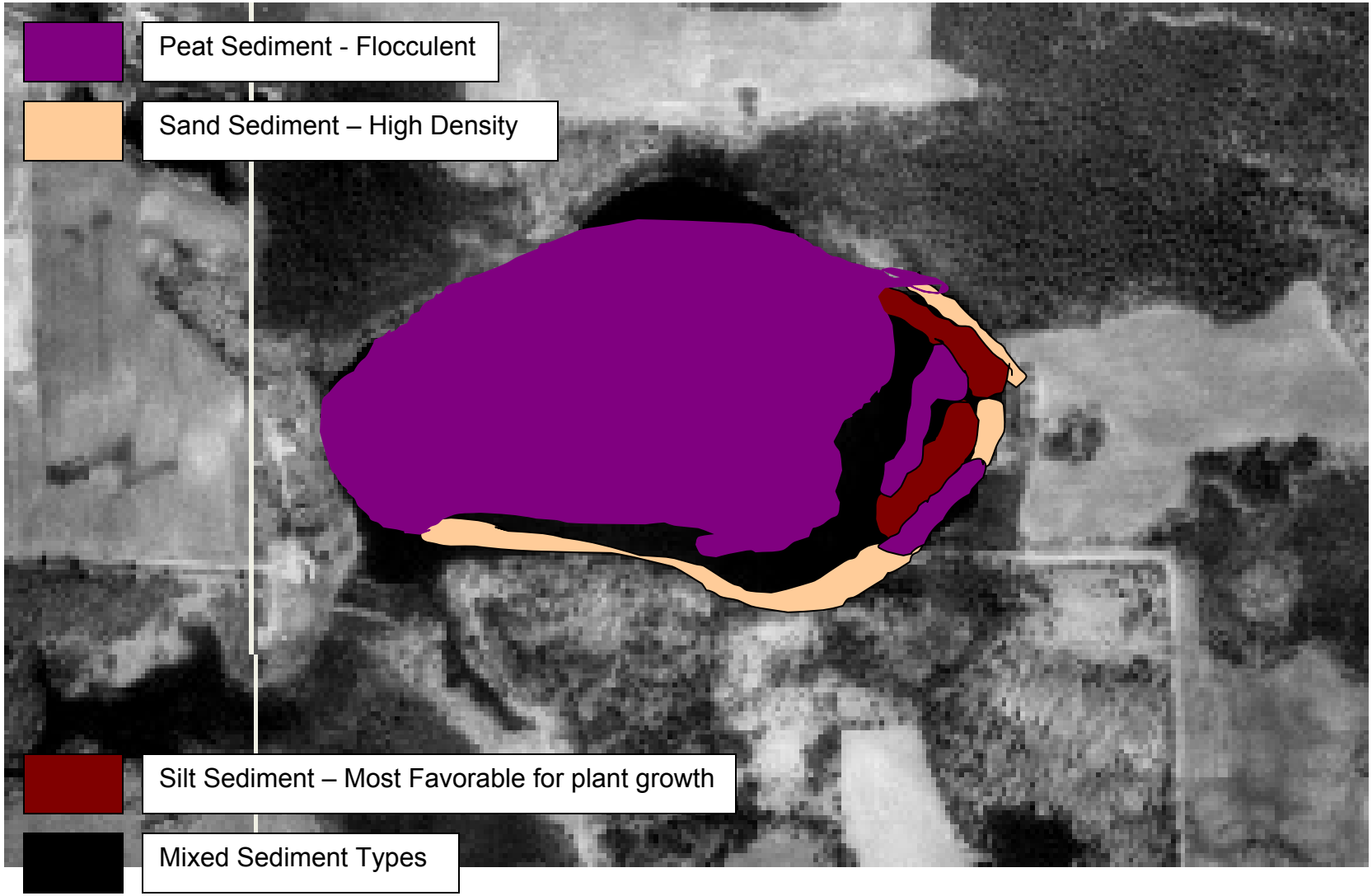


Figure 1. Sediment distribution in Lost Lake, 2005.

Table 2. Sediment Composition

Sediment Type		0-1.5' Depth	1.5-5' Depth	5-10' Depth	10-20' Depth	Percent of all Sample Sites
Soft Sediments	Peat	58%	75%	58%	100%	71%
	Silt/Peat		8%	25%		9%
	Silt		8%	17%		7%
Mixed Sediments	Sand/Silt	8%	8%			4%
Hard Sediments	Sand	33%				9%

INFLUENCE OF SEDIMENT - Some plants depend on the sediment in which they are rooted for their nutrients. The richness or sterility and texture of the sediment will determine the type and abundance of plant species that can survive in a location.

Peat sediment was the dominant sediment found in Lost Lake and may limit plant growth due its flocculent nature, resulting in an unstable rooting substrate. Sand sediment was common in the shallowest zone, but may also be limiting for plant growth due to its high-density (Barko and Smart 1986). Silt sediments are intermediate density sediments and considered most favorable for plant growth because of their intermediate density. The availability of mineral nutrients for growth is highest in sediments of intermediate density (Barko and Smart 1986). Silt sediments were not common in Lost Lake, and mixed with peat were common in the 5-10ft depth zone.

However, all sample sties less than 10 feet deep supported vegetation in Lost Lake. In Lost Lake, light appears to be a more important factor in determining plant distribution than sediment.

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 by 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 settings.

Native herbaceous plant growth was the most frequently encountered shoreline cover at the transects and had the highest mean coverage. The occurrence and coverage of wooded shoreline and shrub growth was also high (Table 3). Several sphagnum and tamarack bogs make up part of the shoreline of Lost Lake.

Table 3. Shoreline Land Use

Cover Type		Frequency of Occurrences at Transects	Mean % Coverage
Natural Shoreline	Native Herbaceous	100%	50%
	Wooded	75%	31%
	Shrub	67%	19%
Disturbed Shoreline	Cultivated Lawn	0	0
	Hard Structures	0	0

Disturbed shoreline (cultivated lawn, hard structures, etc.) were found in limited locations, but did not occur at the sample sites.

MACROPHYTE DATA

SPECIES PRESENT

Of the 29 species found in Lost Lake, 11 were emergent species, 3 were floating-leaf species and 15 were submergent species (Table 4).
No non-native species were found.
One Species of Special Concern was found:
Ceratophyllum echinatum
Special Concern Species are species with which there is some concern about their lack of abundance or distribution. The main purpose of this designation is to focus attention on these species before they become threatened or endangered.

Table 4. Lost Lake Aquatic Plant Species

Scientific Name	Common Name	I. D. Code
Emergent Species		
1) *Carex comosa* Boott.	bristly sedge	carco
2) *Carex* spp.	sedge	carsp
3) *Dulichium arundinaceum* (L.) Britton	three-way sedge	dular
4) *Eleocharis smallii* Britt.	creeping spikerush	elesm
5) *Equisetum fluviatile* L.	water horsetaill	equfl
6) *Glyceria borealis* (Nash) Batch.	northern manna grass	glybo
7) *Potentilla palustris* (L.) Scop.	marsh cinquefoil	potpa
8) *Sagittaria* spp.	arrowhead	sagsp
9) *Salix* spp.	willow	salsp
10) *Scirpus cyperinus* (L.) Kunth.	woolgrass	scicy
11) *Typha latifolia* L.	common cattail	typla
Floating-leaf Species		
12) *Brasenia schreberi* J. F. Gmelin.	watershield	brasc
13) *Nuphar variegata* Durand.	bull-head pond lily	nupva
14) *Nymphaea odorata* Aiton.	white water lily	nymod
Submergent Species		
15) *Ceratophyllum echinatum* A. Gray.	spiny coontail	cerec
16) *Chara* sp.	muskgrass	chasp
17) *Elodea canadensis* Michx.	common waterweed	eloca
18) *Myriophyllum heterophyllum* Michx.	variable-leaf water-milfoil	myrhe
19) *Myriophyllum sibiricum* Komarov.	common water milfoil	myrsi
20) *Najas flexilis* (Willd.) Rostkov and Schmidt	slender water-nymph	najfl
21) *Nitella* sp.	stonewort	nitsp
22) *Potamogeton amplifolius* Tuckerman.	large-leaf pondweed	potam
23) *Potamogeton foliosus* Raf.	leafy pondweed	potfo
24) *Potamogeton gramineus* L.	variable-leaf pondweed	potgr
25) *Potamogeton illinoensis* Morong.	Illinois pondweed	potil
26) *Potamogeton praelongus* Wulf.	white-stem pondweed	potpr
27) *Potamogeton pusillus* L.	small pondweed	potpu
28) *Potamogeton richardsonii* (Ar. Benn.) Rydb.	clasping-leaf pondweed	potri
29) *Potamogeton zosteriformis* Fern.	flatstem pondweed	potzo

FREQUENCY OF OCCURRENCE

Ceratophyllum echinatum was the most frequently occurring species in Lost Lake in 2005, (77% of sample sites) (Figure 1). *Brasenia scherberi, Elodea canadensis, Nuphar variegata,* and *Potamogeton amplifolius* were also commonly occurring species, (47%, 53%, 32%, 23%) (Figures 2).

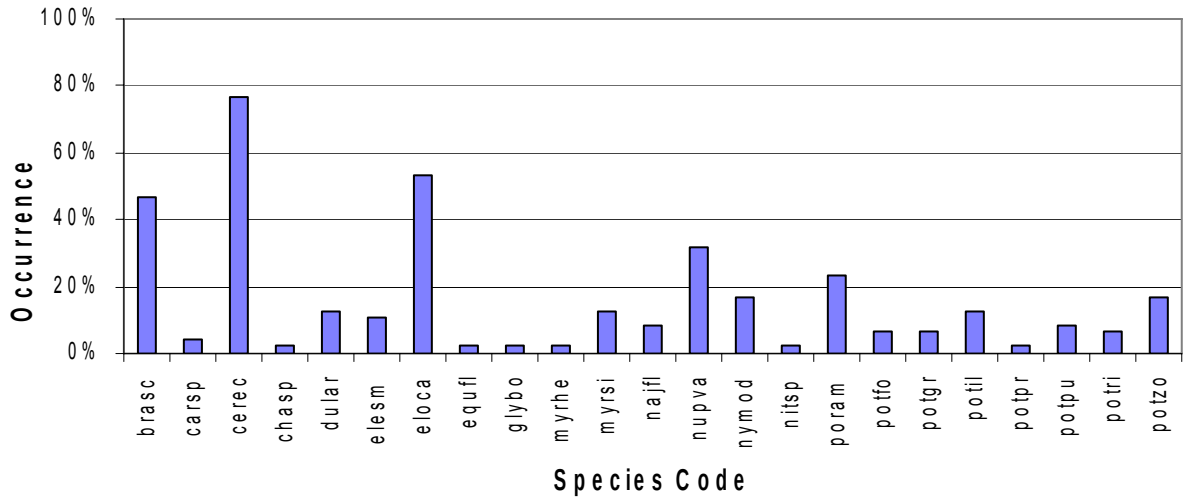


Figure 2. Frequency of aquatic plant species in Lost Lake, 2005.

DENSITY

Ceratophyllum echinatum was also the species with the highest mean density (2.51 on a density scale of 1-4) in Lost Lake (Figure 3).

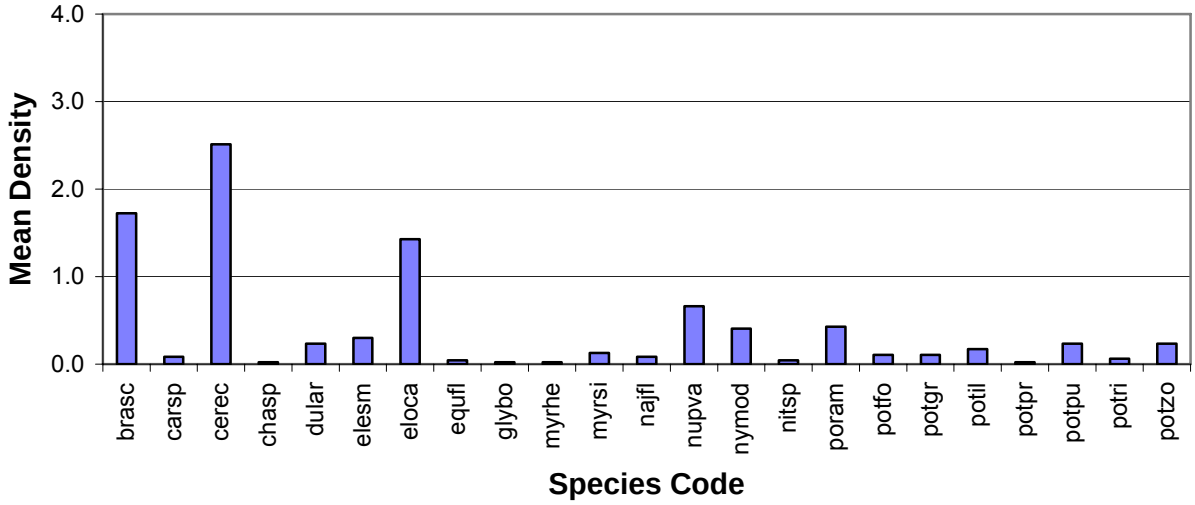


Figure 3. Densities of aquatic plant species in Lost Lake, 2005.

Ceratophyllum echinatum had a "mean density where present" of 3.28. Its "mean density where present" indicates that where *C. echinatum* occurred, it exhibited a dense growth form in Lost Lake (Appendix II). *Brasenia schreberi, Eleocharis smallii, Elodea canadensis,* and *Potamogeton pusillus* were other species in Lost Lake that had "densities where present" of 2.5 or more, indicating that they exhibited an aggregated

growth form or a growth form of above average density (Appendix II). However, two of the species were not commonly occurring and were aggregated in only a few locations.

DOMINANCE

Combining the relative frequency and relative density of a species into a Dominance Value illustrates how dominant a species is within the plant community (Appendix III). Based on the Dominance Value, *Ceratophyllum echinatum* was the dominant aquatic plant species in Lost Lake (Figure 4). *Brasenia schreberi* and *Elodea canadensis* were sub-dominant.

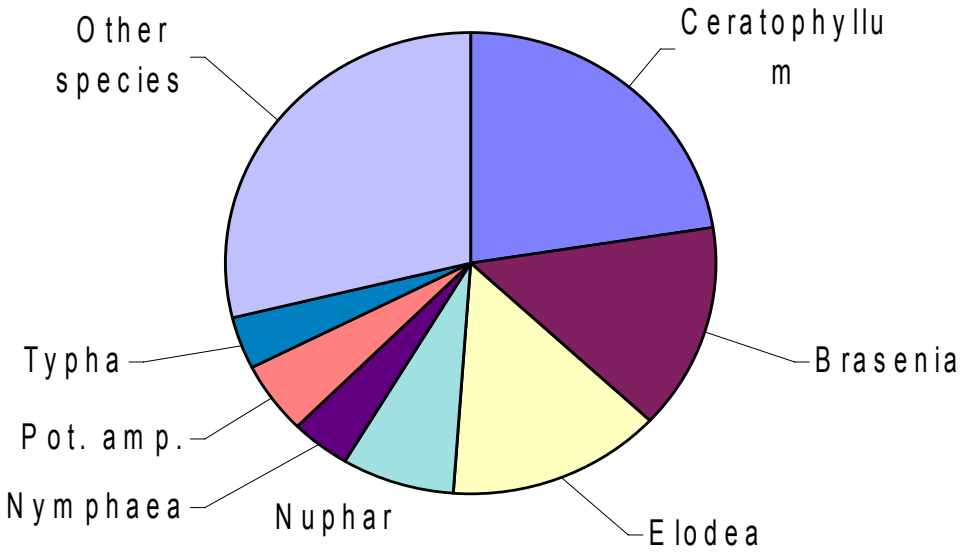


Figure 4. Dominance within the plant community, of the most prevalent species in Lost Lake, 2005.

Ceratophyllum echinatum, the dominant species, dominated the 1.5-20ft depth zones and occurred at its highest frequency and density in the 5-10ft depth zone (Appendices I, II) (Figure 5, 6). *Brasenia schreberi,* one of the sub-dominant species, dominated the 0-1.5ft depth zone and occurred at its highest frequency and density in this depth zone (Appendices I, II) (Figure 5, 6).

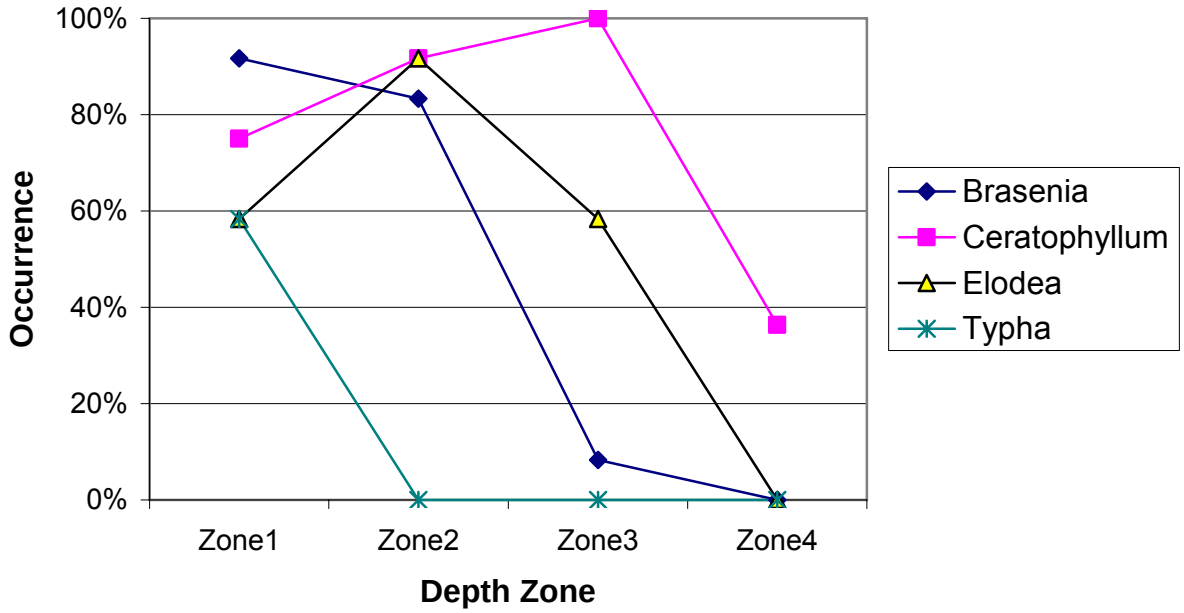


Figure 5. Frequency of most prevalent species in Lost Lake, by depth.

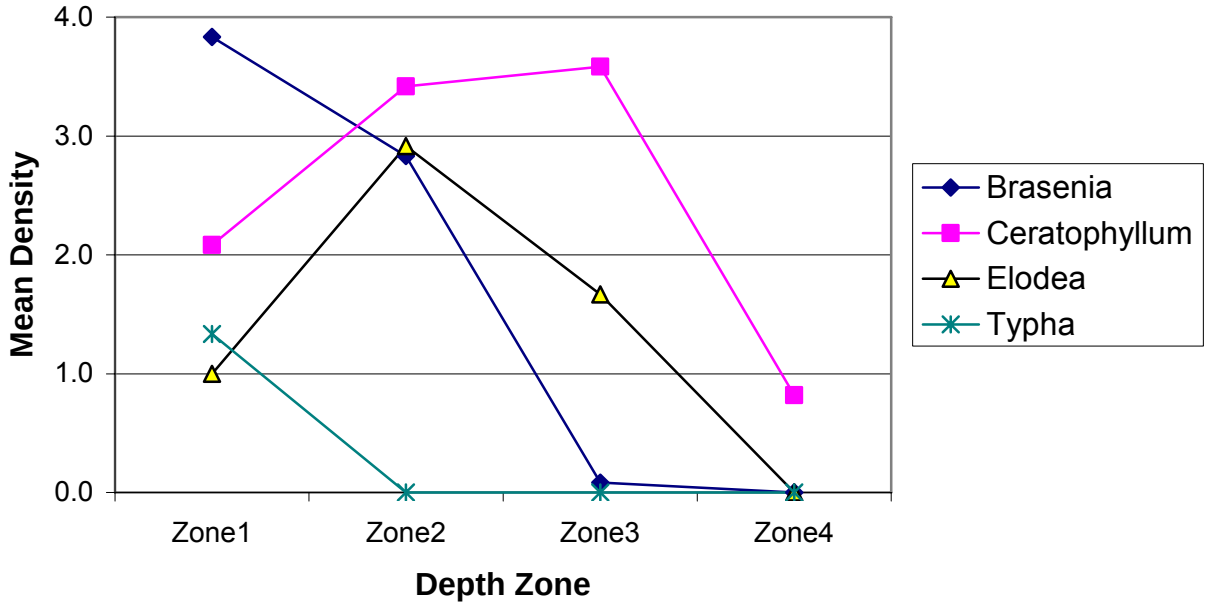


Figure 6. Density of the most prevalent plant species, by depth zone.

DISTRIBUTION

Aquatic plants occurred throughout Lost Lake to a maximum rooting depth of 9 feet. *Potamogeton amplifolius* was found at the maximum rooting depth. *Ceratophyllum echinatum* was found at 12 feet, but is not a true rooted plant.

Over the whole lake, 85% of the littoral zone (sampling sites) was vegetated; 72% vegetated with rooted aquatic plants. Approximately 46% (19 acres) of the entire lake was vegetated. Floating-leaf vegetation colonized about 8 acres (18%) and emergent vegetation colonized about 1 acre (2%) (Figure 7).

The dominant and common species in Lost Lake were found distributed throughout the littoral zone.

Secchi disc readings are used to calculate a predicted maximum rooting depth for plants in a lake (Dunst 1982).

Predicted Rooting Depth (ft.) = (Secchi Disc (ft.) * 1.22) + 2.73

Based on the 1992 mean summer Secchi disc water clarity (2.67ft), the predicted maximum rooting depth in Lost Lake would be 6 ft.

The maximum rooting depth of 9 feet is greater than the predicted maximum rooting depth based on water clarity. This may be due to better water clarity early in the spring or summer when aquatic plant growth if first starting. In addition, the predicted rooting depth was based on 1992 water clarity data and lake conditions may have changed since then.

The highest total occurrence and total density of plant growth was recorded in the 0-1.5ft depth zone and declined with increasing depth (Figure 8).

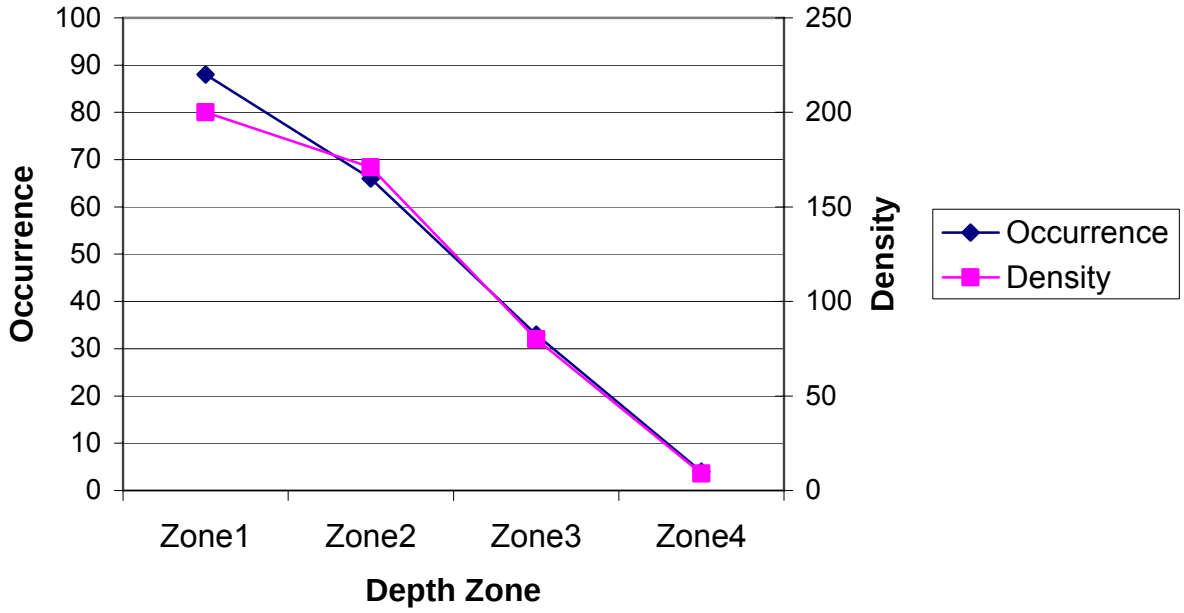


Figure 8. Total occurrence and total density of aquatic plants by depth zone in Lost Lake, 2005.

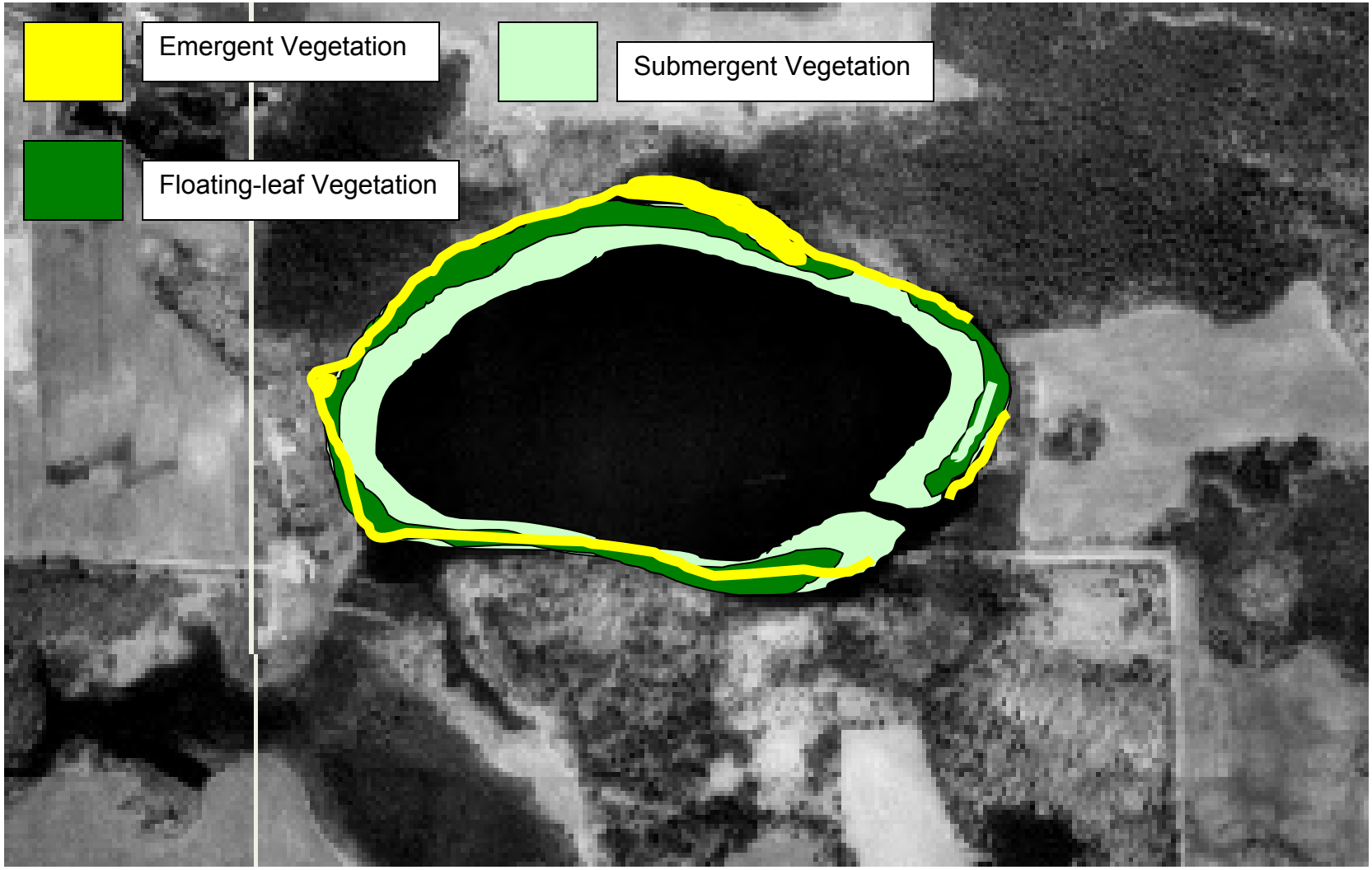


Figure 7. Distribution of aquatic plants in Lost Lake, Marathon County, 2005.

The highest percentage of vegetated sites was found in the 0-10ft depth zone and the greatest species richness (mean number of species per site) was found in the 0-1.5 ft. depth zone (Figure 9). Overall Species Richness in Lost Lake was 4.07.

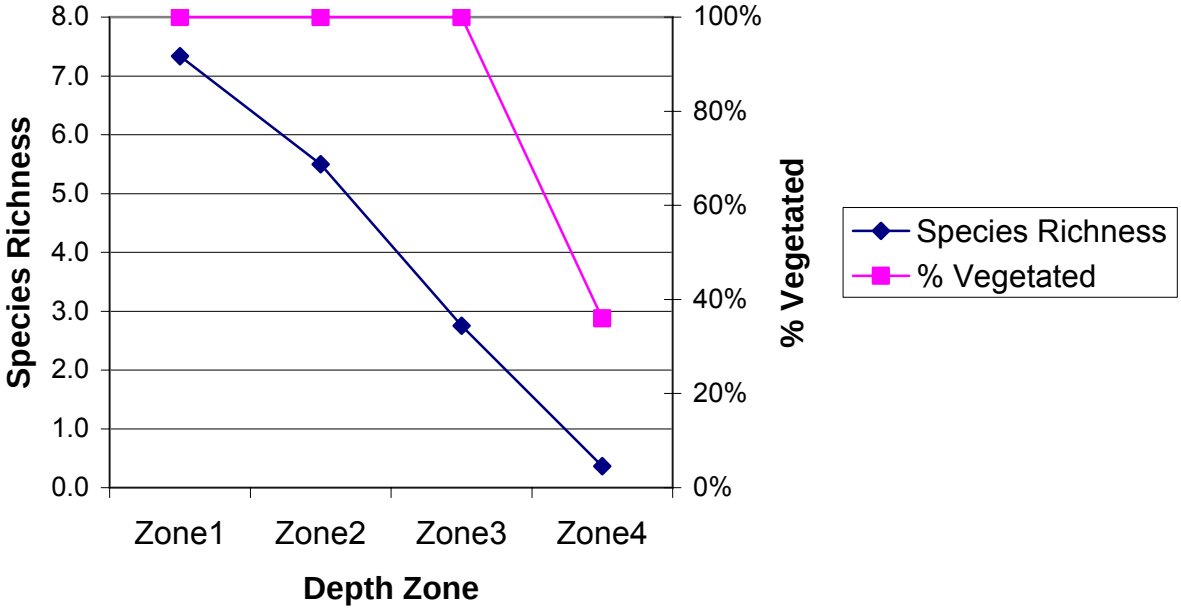


Figure 9. Percentage of vegetated site and mean number of species per site (Species Richness) in Lost Lake, by depth zone.

THE COMMUNITY

Simpson's Diversity Index was 0.91, indicating very good species diversity. A rating of 1.0 would mean that each plant in the lake would be a different species (the most diversity achievable).

The Aquatic Macrophyte Community Index (AMCI) for Lost Lake (Table 5) is 58, indicating a high quality plant community. This value places Lost Lake in the upper quartile of lakes in Wisconsin and the North Central Harwood Region of the state as far as quality of the aquatic plant community.

Table 5. Aquatic Macrophyte Community Index: Lost Lake

Category		Value
Maximum Rooting Depth	2.74 meters	4
% Littoral Zone Vegetated	85%	10
% Submergent Species	59% Rel. Freq.	5
# of Species	29	10
% Exotic species	0	10
Simpson's Diversity	0.91	9
% Sensitive Species	40% Relative Freq.	10
Totals		58

The highest value for this index is 70.

The Average Coefficient of Conservatism for Lost Lake was in the upper quartile for lakes in the North Central Hardwood Region lakes and above the mean for all Wisconsin lakes (Table 6). This suggests that the aquatic plant community in Lost Lake is among the group of lakes in the North Central Hardwoods Region least tolerant of disturbance and less tolerant of disturbance than the average lake in Wisconsin.

Table 6. Floristic Quality and Coefficient of Conservatism of Lost Lake, Compared to Wisconsin Lakes and Northern Wisconsin Lakes.

	Average Coefficient of Conservatism †	Floristic Quality ‡
Wisconsin Lakes *	5.5, 6.0, 6.9	16.9, 22.2, 27.5
NCH Region *	5.2, 5.6, 5.8	17.0, 20.9, 24.4
Lost Lake 2005	6.38	34.38

* - 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 of the plant community in Lost Lake was in the upper quartile of lakes in Wisconsin and the North Central Hardwood Lakes Region (Table 6). This suggests that the plant community in Lost Lake among the group of lakes in the state and region closest to an undisturbed condition.

Disturbances can be of many types:

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

IV. DISCUSSION

Lost Lake is a 42-acre lake with a maximum rooting depth of 22 feet. Based on 1992 water clarity, chlorophyll and phosphorus data, Lost Lake is a hypereutrophic lake with very poor water clarity and quality. Filamentous algae occurred at only one sample site, in the 1.5-5ft depth zone, in front of the homes on the west side.

The abundant nutrients, gradually-sloped littoral zone and shallow depths in most of Lost Lake would favor plant growth. The very poor water clarity and dominance of very flocculent peat sediments in Lost Lake may limit plant growth.

Aquatic plants colonized 46% of the lake surface, occurring throughout the lake at 85% of the sites, to a maximum depth of 9 feet. This maximum rooting depth is greater than the predicted maximum rooting depth of 6 feet, based on water clarity.

The greatest amount of plant growth occurred in the shallowest depth zone, 0-1.5ft. The highest total occurrence of plants, highest total density of plants, and the greatest species richness occurred in the shallowest depth zone (0-1.5ft). The greatest percentage of vegetated sites occurred in the 0-10ft depth zone.

Twenty-nine (29) aquatic plant species were recorded in Lost Lake. *Ceratophyllum echinatum,* a Special Concern Species, was the overall dominant plant species in Lost Lake, occurring at more than three-quarters of the sample sites and exhibiting a dense growth form. *C. echinatum* was especially dominant in the 1.5-20ft depth zone. *Brasenia schreberi* and *Elodea canadensis* were the sub-dominant plant species in Lost Lake. Both occurred at approximately one-half of the sites, exhibiting growth forms of above average density in Lost Lake. *B. schreberi* was dominant in the 0-1.5ft depth zone. Two (2) other species exhibited a dense or aggregated growth form in Lost Lake, yet two were not commonly occurring in Lost Lake. The dominant and common species were found throughout the lake.

The Aquatic Macrophyte Community Index (AMCI) for Lost Lake was 58, indicating that Lost Lake's aquatic plant community is of high quality compared to other Wisconsin lakes and lakes in the North Central Region. Simpson's Diversity Index (0.91) indicates that the aquatic plant community had very good diversity of species. Species Richness was 4.07 species per sample site.

The Average Coefficient of Conservatism and the Floristic Quality Index suggests that Lost Lake is intolerant of disturbance and is in the group of lakes in Wisconsin and in the North Central Hardwoods Region of Wisconsin closest to an undisturbed condition.

Lost Lake is protected by natural shoreline cover (wooded, shrub, native herbaceous growth and tamarack bog); all natural cover types were commonly occurring. Nearly all of the shoreline is protected by natural cover. Preserving this natural shoreline is critical to maintaining water quality and wildlife habitat.

V. CONCLUSIONS

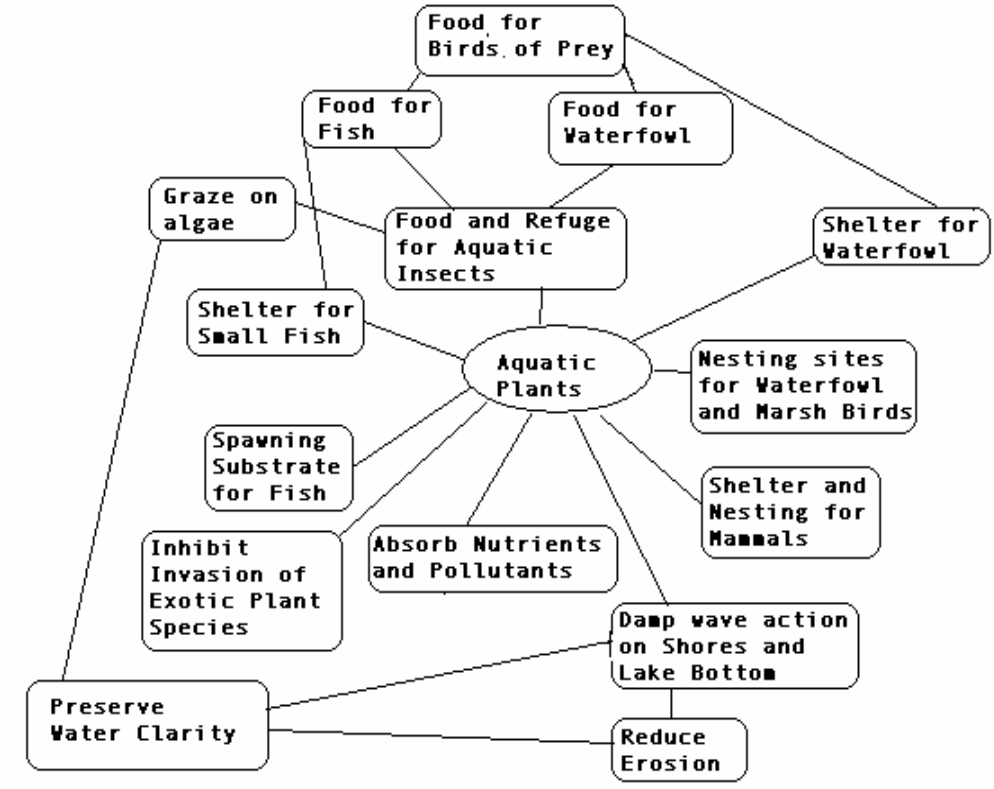
Lost Lake is a hypereutrophic lake with very good water clarity and very good water quality based on 1992 water quality data.

Aquatic plant community colonized more than three-quarters of the littoral zone, nearly half of the total lake area, to a maximum depth of 9 feet. The 0-1.5 ft. depth zone supported the most abundant aquatic plant growth.

Twenty-nine (29) aquatic plant species were recorded in Lost Lake. *Ceratophyllum echinatum* was the dominant species within the plant community, especially in the 1.5-20ft depth zones, occurring at more than three-quarters of the sample sites and exhibiting a dense growth form. *Brasenia schreberi* and *Elodea canadensis* were sub-dominant species, both occurring at approximately half of the sites and at above average densities. *C. echinatum* is listed as a Special Concern Species, a species with which there is concern about its distribution and population.

The aquatic plant community in Lost Lake is characterized by high quality, very good species diversity, an intolerance to disturbance and within the quartile of lakes in the state and region closest to an undisturbed condition.

A healthy aquatic plant community plays a vital role within the lake community. This is due to the role plants play in
1) improving water quality 2) providing valuable habitat resources for fish and wildlife 3) resisting invasions of non-native species and 4) checking excessive growth of tolerant species that could out compete sensitive species, thus reducing diversity.



1) Aquatic plant communities improve water quality in many ways:
they trap nutrients, debris, and pollutants entering a water body;
they absorb and break down some pollutants;
they reduce erosion by damping wave action and stabilizing shorelines and lake bottoms;
they remove nutrients that would otherwise be available for algae blooms (Engel 1985).

2) Aquatic plant communities provide important fishery and wildlife resources. Plants (including algae) start the food chain that supports many levels of wildlife, and at the same time produce oxygen needed by animals. Plants are used as food, cover and nesting/spawning sites by a variety of wildlife and fish (Table 7). Plant cover within the littoral zone of Lost Lake is 85% and over the entire lake is 46%. This is appropriate (25-85%) to support a balanced fishery.

Compared to non-vegetated lake bottoms, plant beds support larger, more diverse invertebrate populations that in turn will support larger and more diverse fish and wildlife populations (Engel 1985). Additionally, mixed stands of plants support 3-8 times as many invertebrates and fish as monocultural stands (Engel 1990). Diversity in the plant community creates more microhabitats for the preferences of more species. Plant beds of moderate density support adequate numbers of small fish without restricting the movement of predatory fish (Engel 1990).

Management Recommendations

1) Lake property owner preserve the natural shoreline cover that is found around Lost Lake. Wooded cover, shrubs and native herbaceous growth protected nearly all of the shoreline. Maintaining natural shoreline cover is critical to maintaining water quality and wildlife habitat.

2) Lakes residents use best management practices on shoreland property to prevent nutrient enrichment and stormwater run-off to the lake. The only filamentous algae found in the lake during the August 2005 survey was off shore from the two homes on the lake and could indicate that these properties are a nutrient source to the lake.

3) Lake residents begin monitoring the water quality through the Self-Help Volunteer Lake Monitoring Program. Monitor water quality to expand knowledge of water quality in Lost Lake.

4) DNR to designate sensitive areas within Lost Lake. These are areas that are most important for habitat and maintaining water quality.

5) DNR conduct water quality monitoring in Lost Lake to determine if the high nutrient and algae concentrations have changed since 1992.

6) Maintain exotic species educational signs at the boat landing to prevent the spread of exotic species into Lost Lake.

Table 7. Wildlife and Fish Uses of Aquatic Plants in Lost Lake

Aquatic Plants	Fish	Water Fowl	Song and Shore Birds	Upland Game Birds	Muskrat	Beaver	Deer
Submergent Plants							
Chara sp.	F*, S	F*, I*					
Elodea canadensis	C, F, I	F(Foliage) I					
Myriophyllum heterophyllum	I*, C	I* F(Seeds, Foliage)					
Myriophyllum sibiricum	F*, I*, S	F(Seeds, Foliage)	F(Seeds)		F		
Najas flexilis	F, C	F*(Seeds, Foliage)	F(Seeds)				
Nitella sp.		F, I*					
Potamogeton amplifolius	F, I, S*,C	F*(Seeds)			F*	F	F
Potamogeton foliosus	F, I, S*,C	F*(All)			F*	F	F
Potamogeton gramineus	F, I, S*,C	F*(Seeds, Tubers)			F*	F	F
Potamogeton illinoensis	F, I, S*,C	F*(Seeds)	F		F*	F	F
Potamogeton praelongus	F, I, S*,C	F*(All)			F*	F	F
Potamogeton pusillus	F, I, S*,C	F*(All)			F*	F	F
Potamogeton richardsonii	F, I, S*,C	F*(All)			F*	F	F
Potamogeton zosteriformis	F, I, S*,C	F*(Seeds)			F*	F	F
Floating-leaf Plants							
Brasenia schreberi	S, I, C	F(Seeds)			F	F	F

Aquatic Plants	Fish	Water Fowl	Song and Shore Birds	Upland Game Birds	Muskrat	Beaver	Deer
Nuphar variegata	F,C, I, S	F, I	F		F*	F	F*
Nymphaea odorata	F,I, S, C	F(Seeds)	F		F	F	F
Emergent Plants							
Carex comosa	S*	F*(Seeds), C	F*(Seeds)	F*(Seeds)	F	F	F
Eleocharis smallii (palustris)	I	F, C					
Equisetum fluviatile		F		F	F		
Glyceria spp.		F			F*		F*
Sagittaria sp.		F*, C	F(Seeds), C	F, C	F	F	
Scirpus cyperinus	F, S, C	F, C	F(Seeds, Tubers), C	F	F	F	F
Typha latifolia	I, C, S	F(Entire), C	F(Seeds), C, Nest	Nest	F* (Entire), C*, Lodge	F	

F=Food, I= Shelters Invertbrates, a valuble food source C=Cover, S=Spawning

***=Valuable Resource in this category**

*Current knowledge as to plant use. Other plants may have uses that have not been determined.

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Appendix IV. Transect Locations on Lost Lake, 2005 Aquatic Plant Survey