Executive Summary

Mission Lake is an oligotrophic lake with very good water quality and good water clarity. Films of planktonic algae were common in the 0-1.5ft depth zone.

The aquatic plant community colonized more than three-quarters of the littoral zone to a maximum depth of 13 feet. The 0-1.5 ft. depth zone supported the most abundant aquatic plant growth.

The quality of the aquatic plant community is very high and is characterized by excellent species diversity and a high intolerance to disturbance. Mission Lake has one of the highest FQI Indices in the state and therefore, very close to an undisturbed condition.

Ceratophyllum demersum (coontail) and *Najas flexilis* (slender naiad) were the dominant species within the plant community of 57 species. *Chara* sp., muskgrass, and *Elodea canadensis,* common waterweed, were sub-dominant species. *Chara* spp. occurred at above average densities. Two species of special concern were recorded.

Management Recommendations

1) Lake property owner preserve the natural shoreline cover that is found around Mission Lake.
2) Lake residents begin monitoring the water quality through the Self-Help Volunteer Lake Monitoring Program. Monitor
3) DNR to designate sensitive areas within Mission Lake.

The Aquatic Plant Community in Mission Lake, Marathon County 2004

I. INTRODUCTION

A study of the aquatic macrophytes (plants) in Mission Lake was conducted during August 2004 by Water Resources staff of the West Central Region - Department of Natural Resources (DNR). This was the first quantitative vegetation study of Mission 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: Mission Lake is a 107-acre seepage lake in southeastern Marathon County, Wisconsin. Mission Lake has a maximum depth of 26 feet and an average depth is 12 feet.

A Sensitive Area Designation Study was conducted on Mission Lake in August 2004. The areas of the lake that are most important for fish and wildlife habitat and water quality preservation were delineated. A report describing the sensitive areas and putting forth recommendations for each area was compiled into a Sensitive Area Report.

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 18 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 sampling 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 the 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 (Appendix I).

The Aquatic Macrophyte Community Index (AMCI) developed by Nichols (2000) was applied to Mission 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 (FQI) 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 FQI 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.

August 2003 phosphorus concentration in Mission Lake was 9ug/l

This concentration of phosphorus in Mission Lake was indicative of an oligotrophic 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
Mission Lake - 2004	Good	9 ug/l	3.1 ug/l	10 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.
August 2003 chlorophyll a concentration in Mission Lake was 3.1 ug/l.
The chlorophyll a concentration in Mission Lake indicates that it was an oligotrophic lake (Table 1).

A film of planktonic algae occurred at 10% of the sample sites, in the near-shore area next to one of the bogs. This film of algae occurred at:

33% of the sites in the 0-1.5ft depth zone
6% of the sites in the 1.5-5ft depth zone
0% of the sites in the 5-10ft depth zone
0% of the sites in the 10-20ft depth zone

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.
August 2003 Secchi disc clarity in Mission Lake was 10 ft.

Water clarity indicates (Table 1) that Mission Lake was an oligotrophic lake with good water clarity.

The combination of phosphorus concentration, chlorophyll concentration and water clarity indicates that Mission Lake is an oligotrophic lake with very good water quality. This trophic state would favor less abundant plant growth and infrequent algae blooms.

Hardness

The hardness or mineral content of lake water can also influence the success of aquatic plant growth. The 2003 hardness value in Mission Lake was 55 mg/l CaCO3. Lakes with hardness values less than 60mg/l CaCO3 are considered soft water lakes. Soft water lakes tend to have less plant growth than hard water lakes.

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).

Mission Lake has a narrow basin that is shallow and gradually sloped in the west half (map, Appendix IV). The littoral zone in the east end has a slightly steeper slope. Areas of the lake with shallow depths and gradual slopes would favor plant growth.

SEDIMENT COMPOSITION – The dominant sediment in Mission Lake was sand, especially at depths less than 5ft and off shore from the wooded shorelines (Table 2). Peat sediments were common and dominant in the shallowest zone, especially off shore from the bog shorelines.

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**
Hard Sediments	Sand	31%	39%	18%	50%	34%
	Sand/Rock	6%				2%
Mixed Sediments	Sand/Silt	12%	11%	6%		8%
	Sand/Peat	15%		23%		6%
Soft Sediments	Peat	44%	17%	12%	25%	24%
	Silt			18%	25%	10%
	Silt/Peat	6%	33%	24%		16%

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.

Sand sediment was the dominant sediment found in Mission Lake and may limit plant growth due its high-density (Barko and Smart 1986). However, 78% of the sites with sand sediment were vegetated (Table 3) and those that were not vegetated were more commonly at deeper sites. All sediment types supported adequate vegetation and most unvegetated sites were found in the deepest depth zone. Light appears to be more of a limiting factor than sediment.

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 supported the lowest colonization of vegetation; 57% of these sites were vegetated. This was likely due to the occurrence of silt sediments in the deeper zones where light may be limiting.

Table 3. Sediment Influence

Sediment Type		Percent of all Sample Sites	Percent Vegetated
Hard Sediments	Sand	34%	78%
	Sand/Rock	2%	100%
Mixed Sediments	Sand/Silt	8%	100%
	Sand/Peat	6%	100%
Soft Sediments	Peat	24%	94%
	Silt	10%	57%
	Silt/Peat	16%	100%

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 4). Several sphagnum and tamarack bogs make up part of the shoreline of Mission Lake. Bog was found at 56% of the transects and had a mean coverage of 51%.

Table 4. Shoreline Land Use

Cover Type		Frequency of Occurrences at Transects	Mean % Coverage
Natural Shoreline	Native Herbaceous	78%	35%
	Shrub	67%	24%
	Wooded	61%	33%
Disturbed Shoreline	Cultivated Lawn	11%	4%
	Pavement	5%	2%
	Dirt Path	5%	2%
	Hard Structures	5%	1%

Some coverage of natural shoreline (wooded, shrub, native herbaceous, wetland) was found at all of the sites, with a mean coverage over the entire shore of approximately 92%.

Disturbed shoreline (cultivated lawn, hard structures, dirt paths and pavement) was found at 22% of the sites and had a mean coverage of 9% at the shoreline.

MACROPHYTE DATA

SPECIES PRESENT

Of the 57 species found in Mission Lake, 26 were emergent species, 5 were floating-leaf species and 26 were submergent species (Table 5). No non-native species were found.

2 Species of Special Concern were found:

Utricularia geminiscapa

Utricularia purpurea

Special Concern Species are species with which there some suspected 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 5. Mission Lake Aquatic Plant Species

Scientific Name	Common Name	I. D. Code
Emergent Species		
1) *Alnus incana* (L.) Moench.	tag alder	alnin
2) *Andromeda glaucophylla* Link.	bog rosemary	andgl
3) *Aronia melanocarpa* (Michx.) Ell.	black chokecherry	arome
4) *Asclepias incarnata* L.	swamp milkweed	ascin
5) *Calamagrostis canadensis* (Michx.) P.Beauv.	bluejoint grass	calca
6) *Campanula aparinoides* Pursh.	marsh bellflower	camap
7) *Carex comosa* Boott.	bristly sedge	carco
8) *Carex emoryi* Dew.	sedge	carem
9) *Chamaedaphne calyculata* (L.) Moench.	leatherleaf	chaca
10) *Cornus amomum* Mill.	silky dogwood	coram
11) *Eleocharis smallii* Britt.	creeping spikerush	elesm
12) *Equisetum fluviatile* L.	water horsetail l	equfl
13) *Ilex verticillata* (L.) Gray.	winterberry	ileve
14) *Impatiens capensis* Meerb.	spotted jewelweed	impca
15) *Iris versicolor* L.	northern blue flag	irive
16) *Oncolea sensibilis* L.	sensitive fern	onose
17) *Pontederia cordata* L.	pickerelweed	ponco
18) *Potentilla palustris* (L.) Scop.	marsh cinquefoil	potpa
19) *Sagittaria latifolia* Willd.	common arrowhead	sagla
20) *Sagittaria* spp.	arrowhead	sagsp
21) *Sarracenia purpurea* L.	pitcher plant	sarpu
22) *Scirpus validus* Vahl.	softstem bulrush	sciva
23) *Thelypteris palustris* Schott.	marsh fern	thepa
24) *Triadenum fraseri* (Spach) Gleason	marsh St. John's-wort	trifr
25) *Typha latifolia* L.	common cattail	typla
26) *Vaccinium oxycoccos*	small cranberry	vacox
Floating-leaf Species		
27) *Brasenia schreberi* J. F. Gmelin.	watershield	brasc
28) *Nuphar variegata* Durand.	bull-head pond lily	nupva
29) *Nymphaea odorata* Aiton.	white water lily	nymod
30) *Polygonum amphibium* L.	smartweed	polam
31) *Spirodela polyrhiza* (L.) Schleiden.	great duckweed	spipo
Submergent Species		
32) *Bidens beckii* Torr.	water marigold	bidbe
33) *Ceratophyllum demersum* L.	coontail	cerde
34) *Chara* sp.	muskgrass	chasp
35) *Eleocharis acicularis* (L.) Roemer & Schultes.	needle spikerush	eleac
36) *Elodea canadensis* Michx.	common waterweed	eloca
37) *Isoetes echinospora* Durieu.	spiny-spored quillwort	isoec
38) *Juncus pelocarpus* E. Meyer.	brown-fruited rush	junpe
39) *Myriophyllum sibiricum* Komarov.	common water milfoil	myrsi
40) *Najas flexilis* (Willd.) Rostkov and Schmidt	slender water-nymph	najfl
41) *Najas guadalupensis* (Spreng.) magnus.	common water-nymph	najgu
42) *Nitella* sp.	nitella	nitsp
43) *Potamogeton foliosus* Raf.	leafy pondweed	potfo
44) *Potamogeton gramineus* L.	variable-leaf pondweed	potgr
45) *Potamogeton illinoensis* Morong.	Illinois pondweed	potil
46) *Potamogeton natans* L.	floating-leaf pondweed	potna
47) *Potamogeton pusillus* L.	small pondweed	potpu
48) *Potamogeton richardsonii* (Ar. Benn.) Rydb.	clasping-leaf pondweed	potri

49) *Potamogeton strictifolius* Ar. Benn.	pondweed	potst
50) *Potamogeton zosteriformis* Fern.	flatstem pondweed	potzo
51) *Utricularia geminiscapa* Benj.	twin-stemmed bladderwort	utrge
52) *Utricularia gibba* L.	small bladderwort	utrgi
53) *Utricularia intermedia* Hayne	bladderwort	utrin
54) *Utricularia purpurea* Walt.	purple bladderwort	utrpu
55) *Utricularia vulgaris* L.	great bladderwort	utrvu
56) *Vallisneria americana* L.	water celery	valam
57) *Zosterella dubia* (Jacq.) Small	water stargrass	zosdu

FREQUENCY OF OCCURRENCE

Najas flexilis (a rooted submerged species) and *Ceratophyllum demersum* (a free-floating species) were the most frequently occurring species in Mission Lake in 2004, (50% of sample sites) (Figure 1, 2). *Brasenia scherberi, Chara* sp., *Elodea canadensis, Myriophyllum sibiricum, Nuphar variegata, Nymphaea odorata, Potamogeton richardsonii, P. zosteriformis* and *Vallisneria americana* were also a commonly occurring species, (21%, 34%, 46%, 33%, 26%, 28%, 21%, 31%, 27%) (Figures 1, 2, 3).

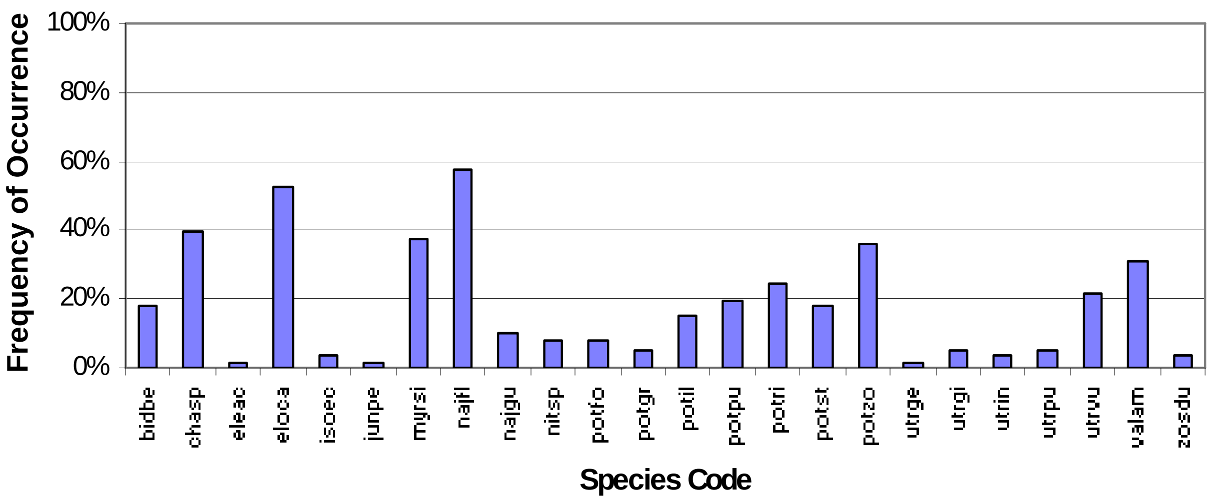


Figure 1. Frequency of aquatic plant species in Mission Lake, 2004, submergent species.

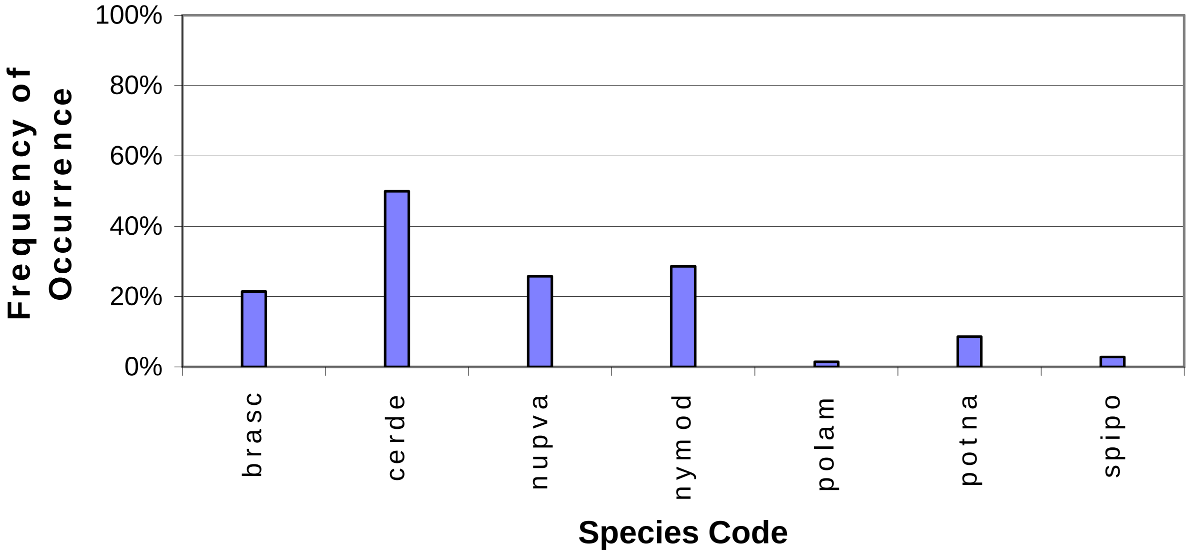


Figure 2. Aquatic plant frequencies in Mission Lake, floating-leaf species.

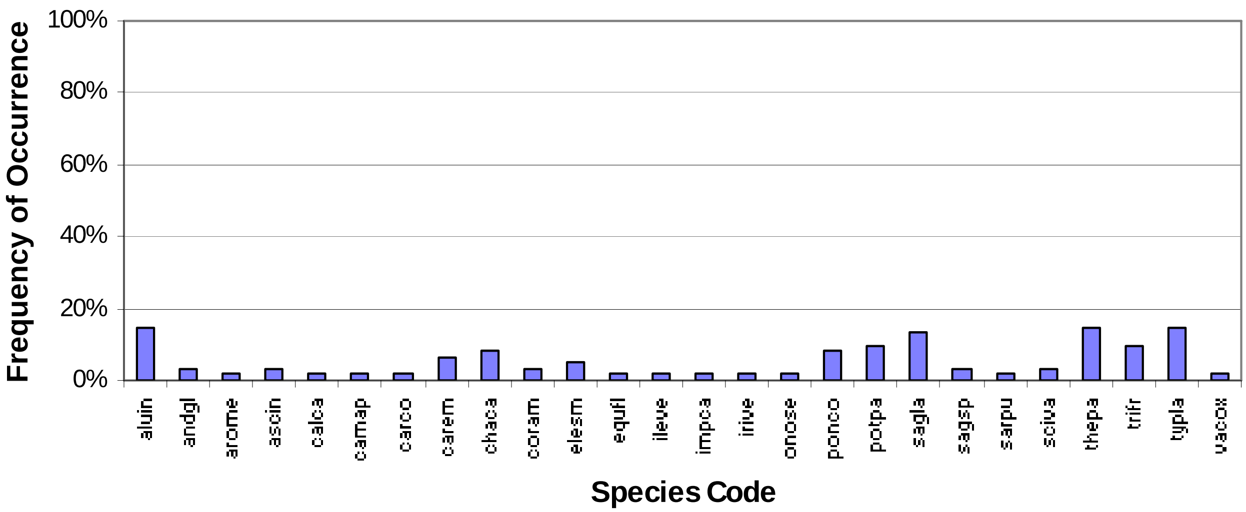


Figure 3. Aquatic plant frequencies in Mission Lake, emergent species.

DENSITY

Najas flexilis had the highest mean density (1.14 on a density scale of 1-4) in Mission Lake (Figure 4).

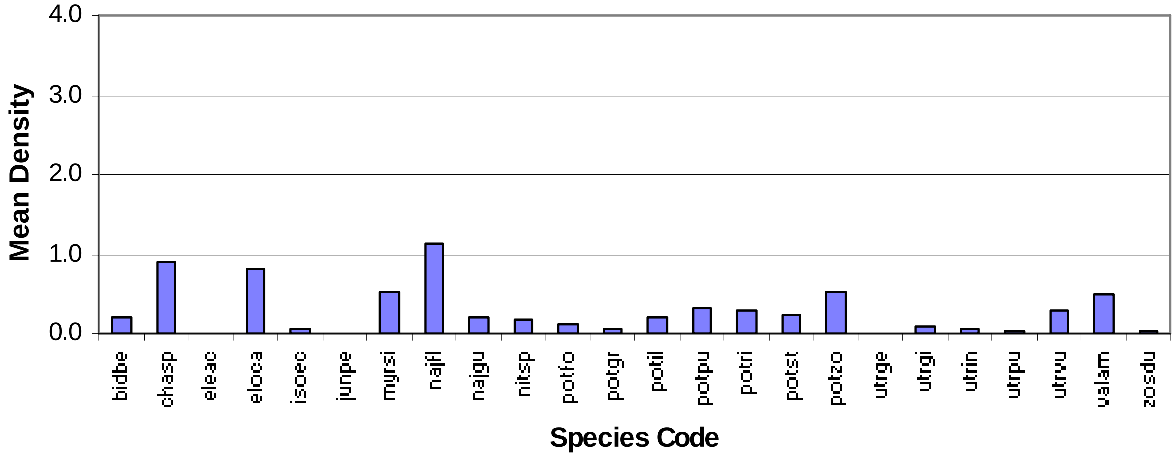


Figure 4. Densities of aquatic plant species in Mission Lake, 2004: rooted submergent species.

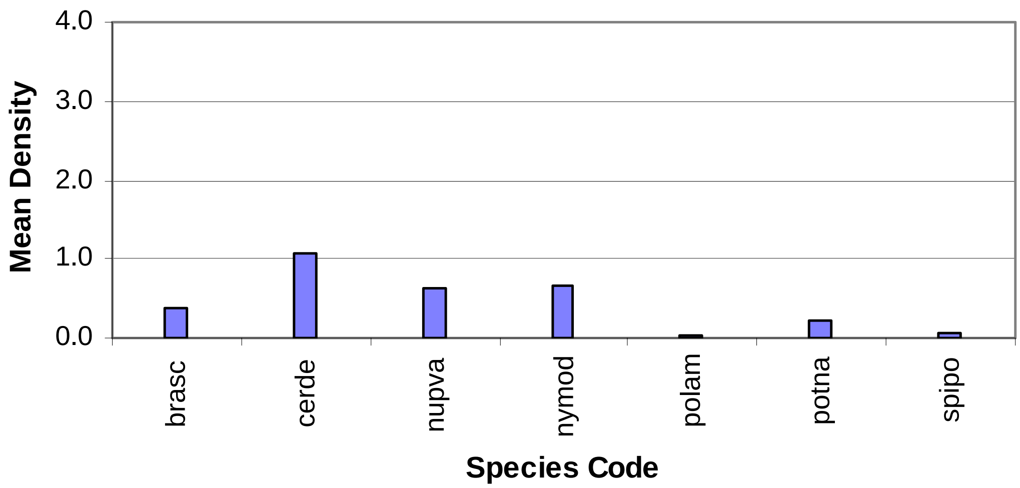


Figure 5. Densities of aquatic plant species in Mission Lake, 2004: floating-leaf species.

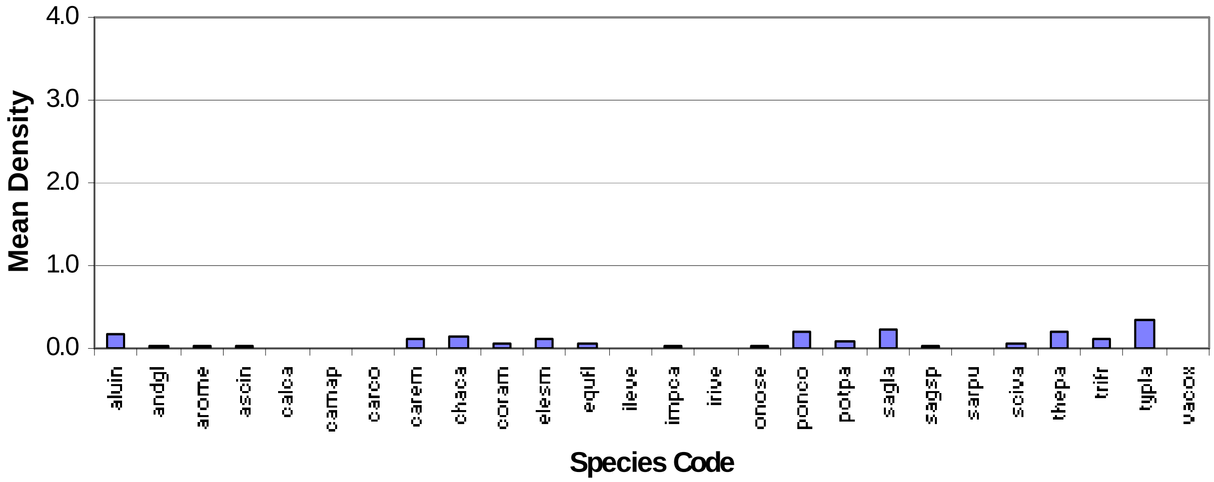


Figure 6. Densities of aquatic plant species in Mission Lake, 2004: emergent species.

Equisetum fluviatile had a "mean density where present" of (4.0). Its "mean density where present" indicates that, where *E. fluviatile* occurred, it exhibited a dense growth form in Mission Lake, even though it occurred at a limited number of sites (Appendix II). *Chara* sp., *Eleocharis smallii, Onoclea sensibilis, Polygonum amphibium, Pontederia cordata* and *Typha latifolia* were other species in Mission Lake that had "densities where present" of 2.5 or more, indicating that they exhibited a growth form of above average density (Appendix II).

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 demersum* and *Najas flexilis* were the dominant aquatic plant species in Mission Lake (Figure 7). *Elodea canadensis* and *Chara* sp. were sub-dominant.

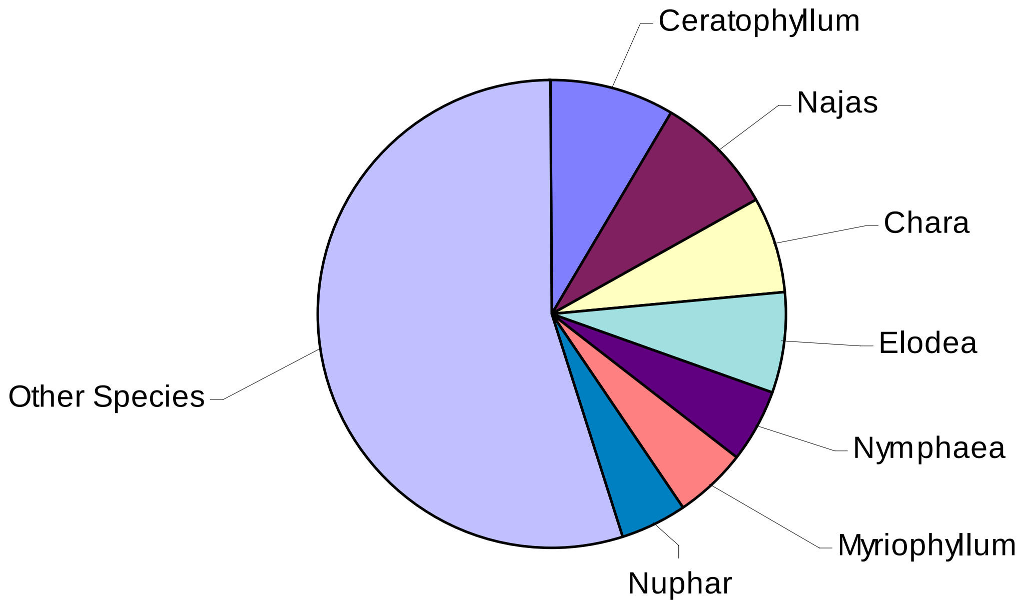


Figure 7. Dominance within the plant community, of the most prevalent species in Mission Lake, 2004.

Najas flexilis, the dominant species, and *Nymphaea odorata* dominated the 0-1.5ft depth zone (Appendices I, II) (Figure 8,9). *N. odorata* was found only in the 0-5ft depth zone.

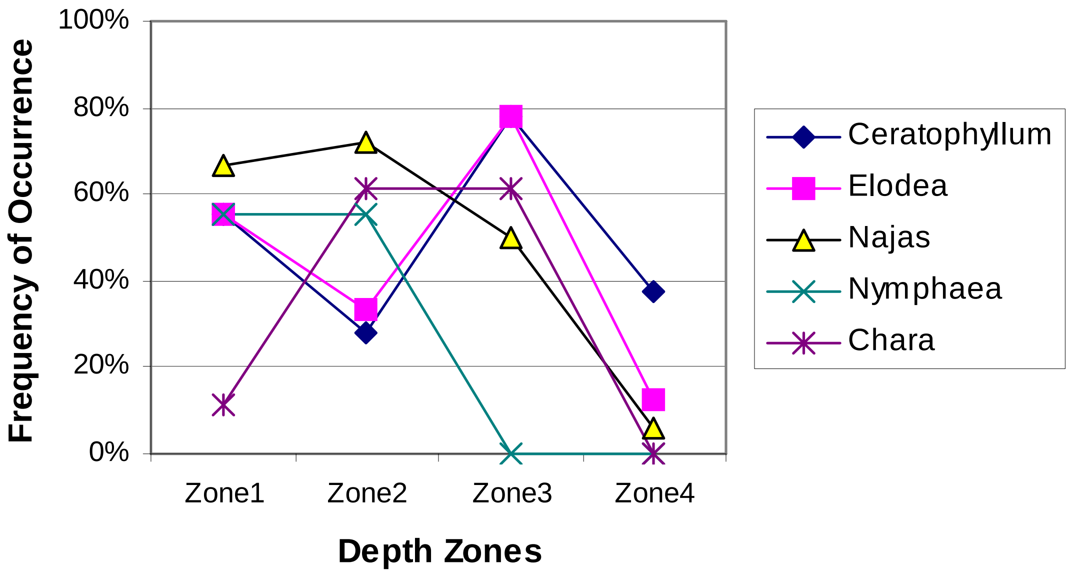


Figure 8. Frequency of most prevalent species in Mission Lake, by depth.

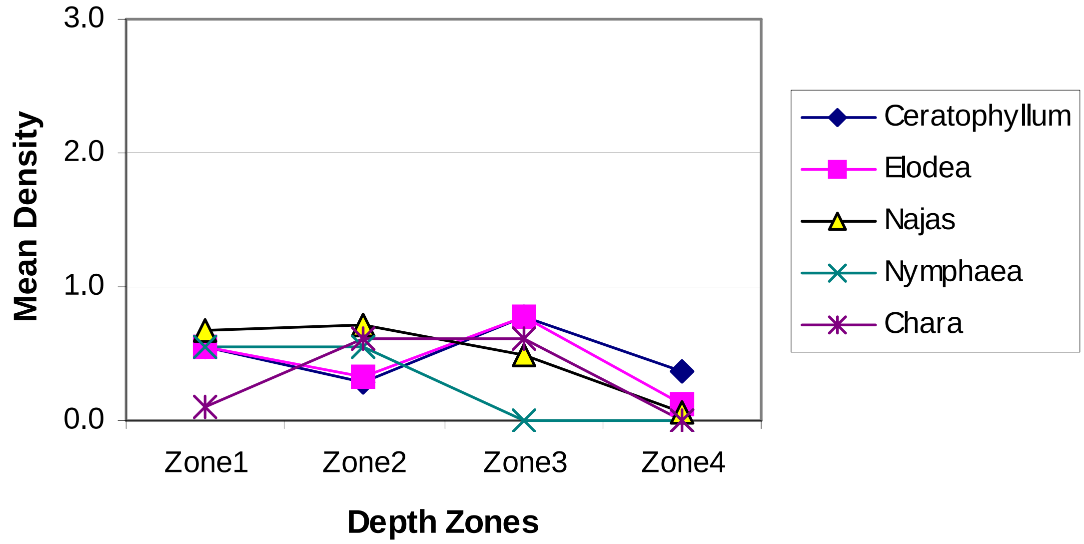


Figure 9. Density of the most prevalent plant species, by depth zone.

Najas flexilis also dominated the 1.5-5ft depth zone (Appendices I, II) and was found at its highest frequency and density in this depth zone (Figure 8, 9).

Ceratophyllum demersum, the other dominant species, dominated the 5-20ft depth zone (Figure 8, 9).

DISTRIBUTION

Aquatic macrophytes occurred throughout Mission Lake to a maximum rooting depth of 13 feet. *Najas guadalupensis* and *Potamogeton zosteriformis* were found at the maximum rooting depth. *Ceratophyllum demersum* was found at 14 feet, but is not a true rooted plant. The dominant and common species in Mission Lake were found throughout the lake.

Over the whole lake, 87% of the sampling sites were vegetated, 86% vegetated with rooted aquatic plants.

Secchi disc readings are used to calculate a predicted maximum rooting depth for plants in a lake (Dunst 1982).
Based on the August 2003 Secchi disc clarity (10ft), the predicted maximum rooting depth in Mission Lake would be 14.9 ft.
The maximum rooting depth of 13 feet is close to the predicted maximum rooting depth based on water clarity.

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 10).

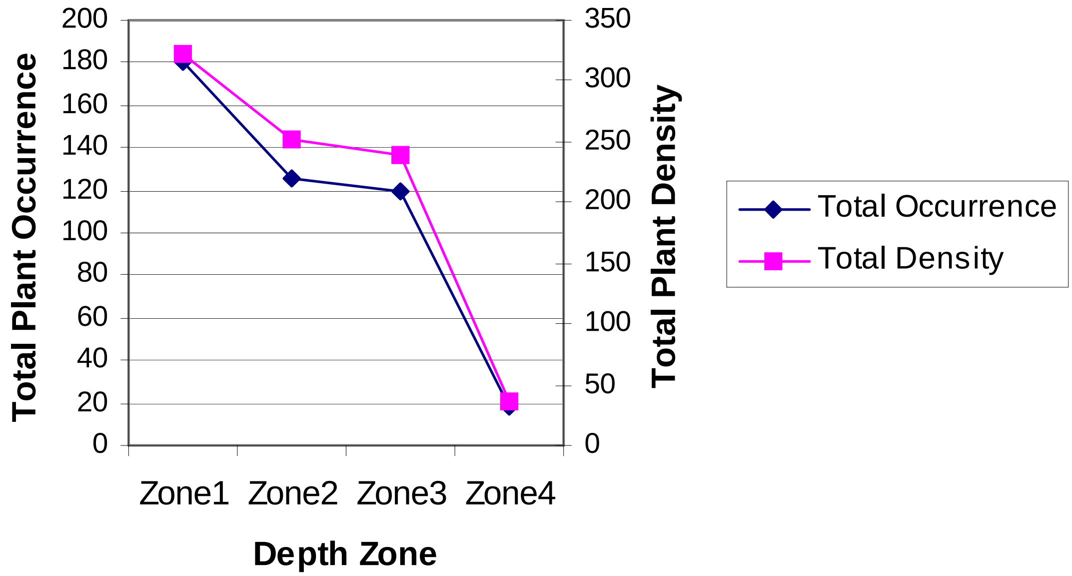


Figure 10. Total occurrence and density of plants by depth zone.

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 11).

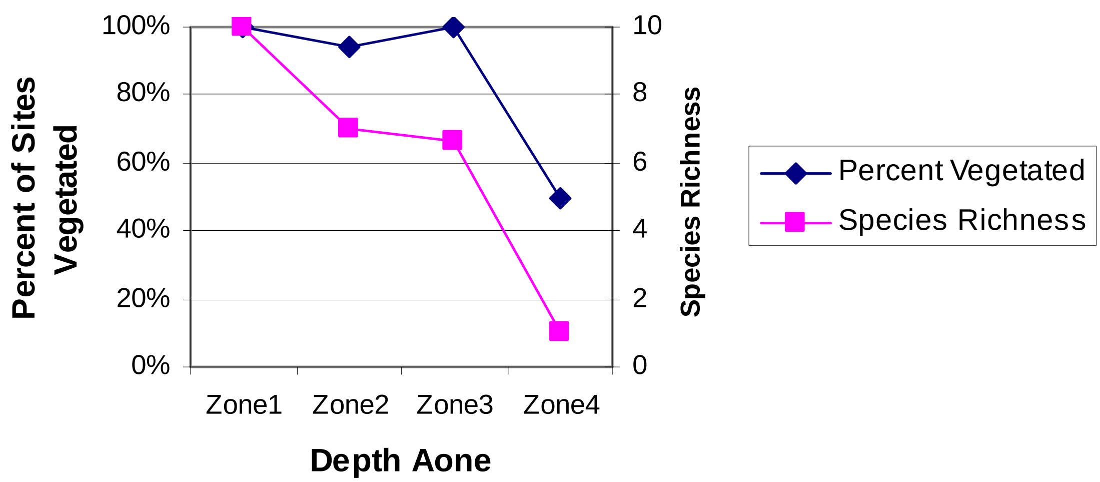


Figure 11. Percentage of vegetated site and mean number of species per site (Species Richness) in Mission Lake, by depth zone.

THE COMMUNITY

Simpson's Diversity Index was 0.96, indicating excellent 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 Mission Lake (Table 6) is 58, indicating a high quality plant community. This index places Mission 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. The highest value for this index is 70.

Table 6. Aquatic Macrophyte Community Index: Mission Lake

Category		Value
Maximum Rooting Depth	3.96 meters	7
% Littoral Zone Vegetated	87%	10
% Submergent Species	59% Rel. Freq.	5
# of Species	57	10
% Exotic species	0	10
Simpson's Diversity	0.96	10
% Sensitive Species	12% Relative Freq.	6
Totals		58

The Average Coefficient of Conservatism for Mission Lake was in the upper quartile for lakes in the North Central Hardwood Region lakes analyzed and above the mean for all Wisconsin lakes (Table 7). This suggests that the aquatic plant community in Mission Lake is among the group of lakes in Wisconsin least tolerant of disturbance and less tolerant of disturbance than the average lake in the North Central Hardwoods Region.

Table 7. Floristic Quality and Coefficient of Conservatism of Mission Lake, Compared to Wisconsin Lakes and Northern Wisconsin Lakes.

	(C)Average Coefficient of Conservatism †	Floristic Quality (FQI) ‡
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
Mission Lake 2004	6.34	47.44

***** - 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 of the plant community in Mission Lake was in the upper quartile of lakes in Wisconsin and the North Central Hardwood Lakes Region (Table 7). This suggests that the plant community in Mission Lake among the group of lakes in the state and region closest to an undisturbed condition. In addition, the Floristic Quality Index was higher than any lake analyzed in Nichols' (1998) statewide study of the Floristic Quality Index.

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, 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.

V. DISCUSSION

Based on water clarity, chlorophyll and phosphorus data, Mission Lake is an oligotrophic lake with good water clarity and very good water quality. Films of planktonic algae occurred at 10% of the sample sites, common in the 0-1.5ft depth zone.

The shallow depth and gradually sloped littoral zone in the west basin of Mission Lake would favor plant growth, while the greater depths and steeper slope of the littoral zone in the east basin of the lake could limit plant growth. The oligotrophic state of the lake, soft water and dominance of high-density sand sediments and very flocculent peat sediments in Mission Lake may limit plant growth. Favorable silt sediments are more common in the deeper water, below the photic zone.

Aquatic plants occurred throughout the lake at 87% of the sites, to a maximum depth of 13 feet. This maximum rooting depth is close to the predicted maximum rooting depth of 14.9 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.

Ceratophyllum demersum and *Najas flexilis* were the dominant plant species in Mission Lake, each occurring at half of the sample sites. *Najas flexilis* dominated the 0-5 ft depth zone and *Ceratophyllum demersum* dominated the 5-10ft depth zone. *Chara* sp. and *Elodea canadensis* were the sub-dominant plant species in Mission Lake. *Chara* sp. occurred at one-third of the sites and exhibited a growth form of above average density in Mission Lake. *Eleodea canadensis* occurred at nearly half of the sample sites. The other common species were found throughout the lake.

57 aquatic plant species were recorded in Mission Lake. Six emergent plant species exhibited a dense or aggregated growth form in Mission Lake, yet were not commonly occurring. Two Species of Special Concern were found, two rare bladderwort species. Special Concern Species are species with which there some suspected 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.

The Aquatic Macrophyte Community Index (AMCI) for Mission Lake was 58, indicating that Mission 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 (0.96) indicates that the aquatic plant community had excellent diversity of species.

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

Mission Lake is protected by natural shoreline cover (wooded, shrub, native herbaceous growth and tamarack bog); all natural cover types were commonly occurring. Approximately 92% of the shoreline is protected by some type of natural cover. Tamarack bog makes up half of the shoreline and is a very unique natural community. Preserving this natural shoreline is critical to maintaining water quality and wildlife habitat.

VI. CONCLUSIONS

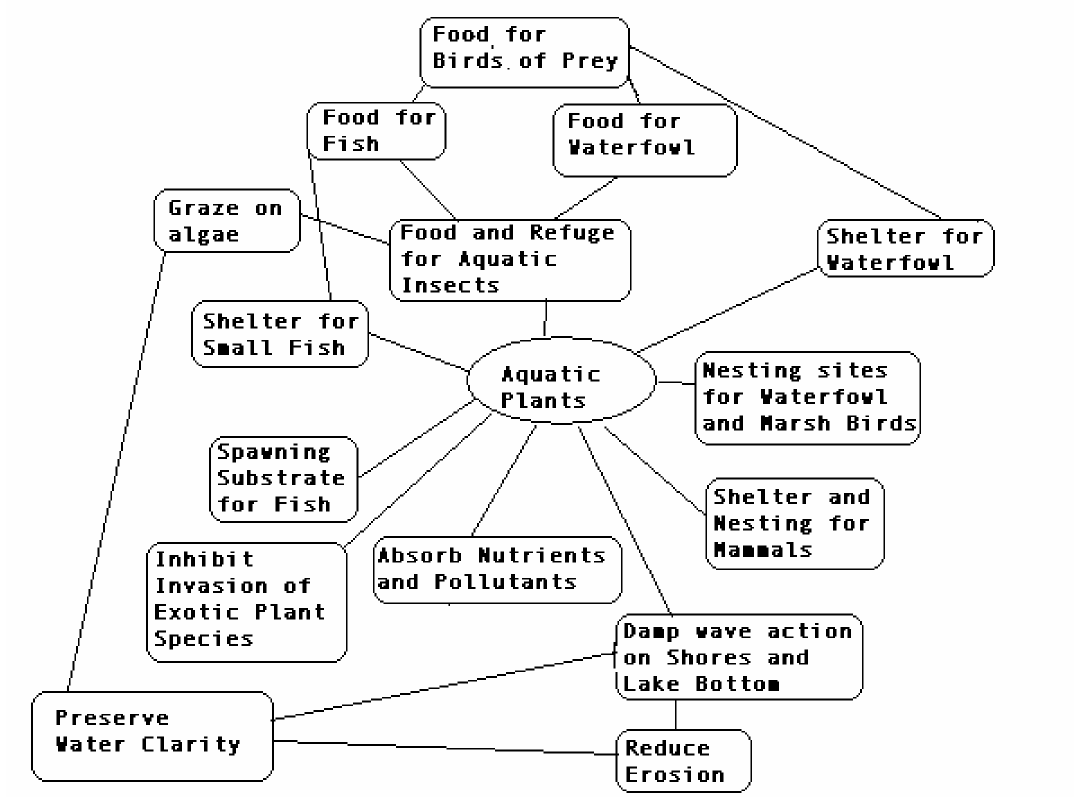
Mission Lake is an oligotrophic lake with good water clarity and very good water quality. Films of planktonic algae were common in the 0-1.5ft depth zone.

The AMCI Index indicates that aquatic plant community is of high quality and is characterized by excellent species diversity and intolerance to disturbance. The FQI Index ranks aquatic plant community in Mission Lake as one of a small number of lakes in the state and region, closest to an undisturbed condition.

Aquatic plant community colonized more than three-quarters of the littoral zone to a maximum depth of 13 feet. The 0-1.5 ft. depth zone supported the most abundant aquatic plant growth.

Fifty-seven (57) aquatic plant species were recorded in Mission Lake. *Ceratophyllum demersum* and *Najas flexilis* were the dominant species within the plant community, occurring at half of the sample sites and dominating all depth zones. *Chara* sp, and *Elodea canadensis* were sub-dominant species, *Chara* spp. occurring at above average densities. Two species of special concern were recorded.

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 10). Plant cover within the littoral zone of Mission Lake is 87% and 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 Mission Lake. Wooded cover, shrubs, native herbaceous growth and tamarack bog were commonly occurring and protected approximately 92% of the shoreline. A very unique natural community, Tamarack bog makes up half of the shoreline. Maintaining natural shoreline cover is critical to maintaining water quality and wildlife habitat.
2) Lake residents begin monitoring the water quality through the Self-Help Volunteer Lake Monitoring Program. Monitor water quality to pick up changes in the water quality before they become irreversible.
3) DNR to designate sensitive areas within Mission Lake. These are areas that are most important for habitat and maintaining water quality.