The Aquatic Plant Community

of

Adams Lake,

Portage County, Wisconsin

2006

Submitted by:

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Executive Summary

Adams Lake is a mesotrophic lake with fair-to-good water clarity and good water quality. Water clarity appears to have decreased slightly since 1999. Filamentous algae occurred, but was not common in Adams Lake in 2006.

The aquatic plant community colonized the entire littoral zone, a little more than half of the total lake area, to a maximum depth of 14 feet. The 0-1.5 ft. depth zone supported the most abundant aquatic plant growth.

Fourteen (14) aquatic plant species were recorded in Adams Lake. *Chara* spp., a macrophytic algae, was the dominant species within the plant community, dominating all depth zones, occurring at nearly all of the sample sites and exhibiting a dense growth form. *Potamogeton illinoensis* (Illinois pondweed) was the sub-dominant species, occurring at approximately one-third of the sites.

The aquatic plant community in Adams Lake is characterized by high quality, very poor species diversity, an above average tolerance to disturbance and a condition farther from an undisturbed condition than the average lake in the state or region.

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 owners preserve the natural shoreline cover that is found around more than three-quarters Adams Lake. Maintaining natural shoreline cover is critical to maintaining water quality and wildlife habitat.
2) Lake residents restore natural shoreline buffer in cleared areas. Aquatic plant communities at disturbed shorelines were more tolerant of disturbance and farther from an undisturbed condition than communities at natural shoreline as measured by Floristic Quality Indices and Average Coefficients of Conservatism. Sensitive species had a lower occurrence and tolerant species had a higher occurrence at disturbed shoreline sites
3) Lakes residents use best management practices on shoreland property to prevent nutrient enrichment and stormwater run-off to the lake.
4) 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 Adams Lake.
5) DNR to designate sensitive areas within Adams Lake.
6) Maintain exotic species educational signs at the boat landing to prevent the spread of exotic species into Adams Lake.

The Aquatic Plant Community in Adams Lake, Portage County 2006

I. INTRODUCTION

A study of the aquatic macrophytes (plants) in Adams Lake was conducted during July 2006 by Water Resources staff of the West Central Region - Department of Natural Resources (DNR). This was the first quantitative vegetation study of Adams 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: Adams Lake is a 30-acre drainage lake in central Portage County, Wisconsin with a maximum depth of 51 feet and a mean depth of 17 feet. Adams Lake is a hard water lake.

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 10 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 shore 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 for each species (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 Adams Lake (Table 5) to quantify the quality of the plant community. 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 Index is calculated from the Average 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 the majority 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.

2002-03 Mean summer phosphorus concentration in Adams Lake was 19ug/l

The concentration of phosphorus in Adams Lake was indicative of a mesotrophic 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
Adams Lake – 2002/03	**Good**	**19 ug/l**		**6.0ft.**

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. No chlorophyll data has been found for Adams Lake

Filamentous algae occurred at one sample site, (3% of the littoral zone) in Adams Lake. Filamentous algae occurred only in the shallow depth zones, a 10% occurrence in the 0-1.5ft 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 can be estimated from satellite images.

August 2001 Satellite water clarity in Adams Lake was 6.0 ft.

Water clarity indicates (Table 1) that Adams Lake was a mesotrophic lake with fair-to-good water clarity.

Water clarity appears to be declining as measured in 1999-2001 (Figure 1).

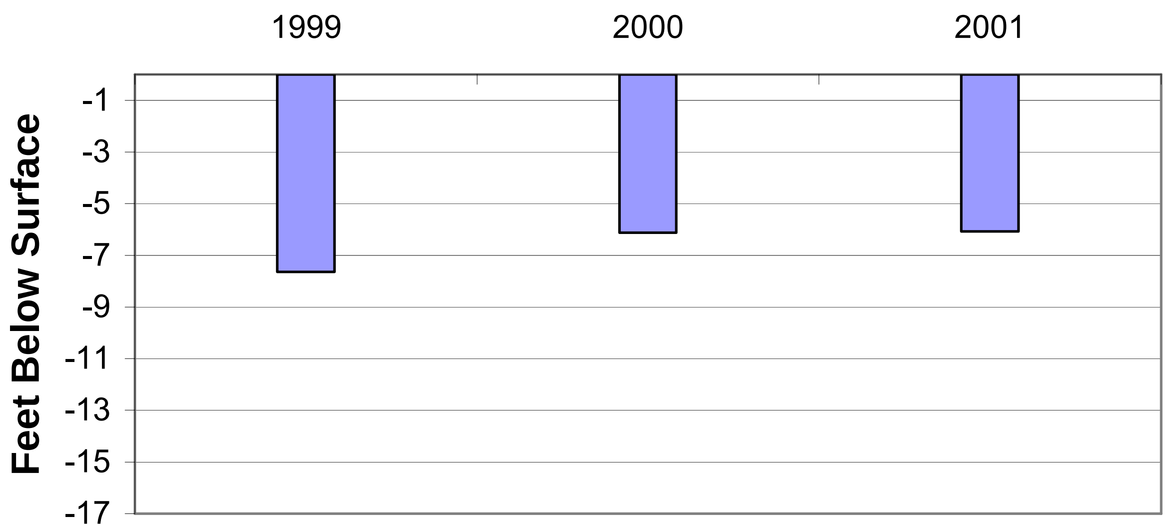


Figure 1. Change in water clarity as measured by satellite images, 1999-2001.

The combination of phosphorus concentration and water clarity indicates that Adams Lake is a mesotrophic lake with good water quality. This trophic state would favor moderate plant growth and occasional 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).

Adams Lake has a roughly oval basin. No bathymetric map could be found, but the small size and deep maximum depths of Adams Lake suggests that much of the littoral zone would be steeply-sloped. Steep slopes provide a less stable substrate for rooting and a narrow band of water shallow enough for plant growth.

SEDIMENT COMPOSITION – Soft sediments dominate Adams Lake. The dominant sediment in Adams Lake was marl (Table 2). A mixture of peat and marl was common, dominant in the deepest zone. Peat was common in the shallowest zone; a silt/marl mixture was abundant in the 1.5-5ft depth zone (Figure 2).

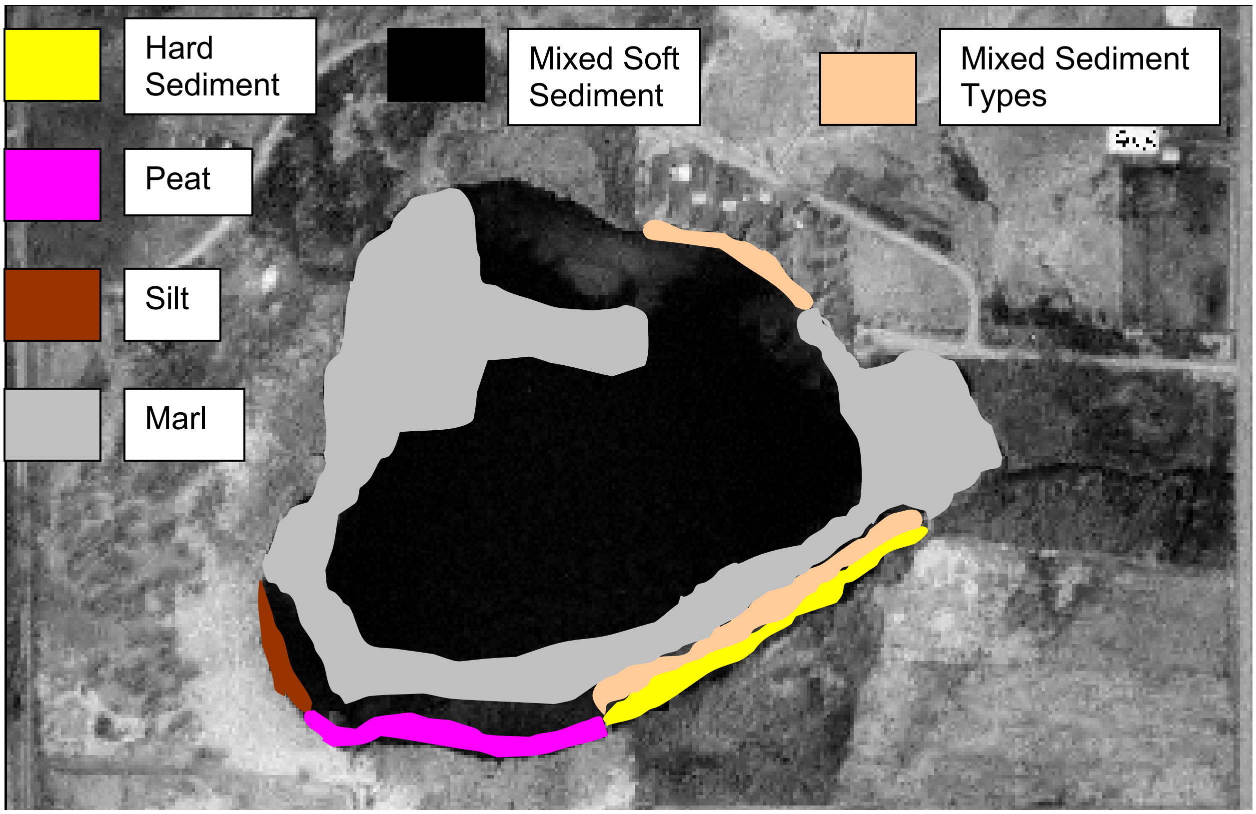


Figure 2. Sediment distribution in Adams Lake, 2006.

Table 2. Sediment Composition, 2006

Sediment Type		0-1.5' Depth	1.5-5' Depth	5-10' Depth	10-20' Depth	Percent of all Sample Sites
Soft Sediment	Marl	40%	20%	67%	33%	41%
	Peat/Marl		20%	33%	67%	22%
	Silt/Marl	10%	40%			16%
	Peat	20%				6%
	Silt	10%				3%
	Silt/Peat	10%				3%
Mixed Sediment	Sand/Marl	10%	10%			6%
Hard Sediment	Sand/Gravel	10%				3%

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.

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 was not common in Adams Lake. Marl sediment was the dominant sediment in Adams Lake and peat/marl mixtures were common, especially at increased depths. All sample sites supported vegetation in Adams Lake, irregardless of sediment type.

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.

Shrub growth was the most frequently encountered shoreline cover at the transects and had the highest mean coverage. The occurrence of herbaceous cover and wooded cover was also high at the shoreline (Table 3).

However, disturbed shoreline cover was common, cultivated lawn and hard structures (Table 3). Run-off is increased on cultivated lawn and hard structures without filtering of the run-off. Run-off from lawn can carry pesticides, pet wastes and nutrients and both can carry toxics into the lake.

Some type of natural shoreline occurred at all sites and covered approximately 81% of the shore. Disturbed shoreline (lawn, structures) was found at 40% of the sites and covered 19% of the shore (Table 3).

Table 3. Shoreline Land Use, 2006

Cover Type		**Frequency of Occurrences at Transects**	**Mean % Coverage**
Natural Shoreline	Shrub	90%	48%
	Native Herbaceous	80%	18%
	Wooded	60%	15%
Total Natural			81%
Disturbed Shoreline	Cultivated Lawn	20%	12%
	Hard Structure	20%	2.5%
	Pavement	10%	4.5%
Total Disturbed			19%

MACROPHYTE DATA

SPECIES PRESENT

Of the 14 aquatic plant species found in Adams Lake, 5 were emergent species, 2 were floating-leaf species and 7 were submergent species (Table 4). Three of the submergent species and 2 of the emergent species are known to be intolerant of water clarity. Eight species (5 submergent) are known to grow to nuisance levels with nutrient addition to the waterbody.

No non-native species were found. No Threatened or Endangered species were found.

Table 4. Adams Lake Aquatic Plant Species, 2006

Scientific Name	Common Name	I. D. Code
Emergent Species		
1) *Betula pumila* L.	bog birch	betpu
2) *Carex aquatilis* Wahlenb.	lake sedge	caraq
3) *Eleocharis smallii* Britt.	creeping spikerush	elesm
4) *Scirpus validus* Vahl.	softstem bulrush	sciva
5) *Typha latifolia* L.	common cattail	typla
Floating-leaf Species		
6) *Lemna minor* L.	small duckweed	lemmi
7) *Spirodela polyrhiza* (L.) Schleiden.	great duckweed	spipo
Submergent Species		
8) *Chara* sp.	muskgrass	chasp
9) *Myriophyllum sibiricum* Komarov.	common water milfoil	myrsi
10) *Najas flexilis* (Willd.) Rostkov and Schmidt	slender water-nymph	najfl
11) *Potamogeton illinoensis* Morong.	Illinois pondweed	potil
12) *Potamogeton natans* L.	floating-leaf pondweed	potna
13) *Potamogeton pectinatus* L.	sago pondweed	potpe
14) *Potamogeton strictifolius* Ar. Benn.	narrow-leaf pondweed	potst

FREQUENCY OF OCCURRENCE

Chara spp., a macrophytic algae, was the most frequently occurring species in Adams Lake in 2006, (95% of sample sites) (Figure 3). *Najas flexilis, Potamogeton illinoensis,* and *P. strictifolius,* were commonly occurring species, (24%, 37%, 24%) (Figure 3).

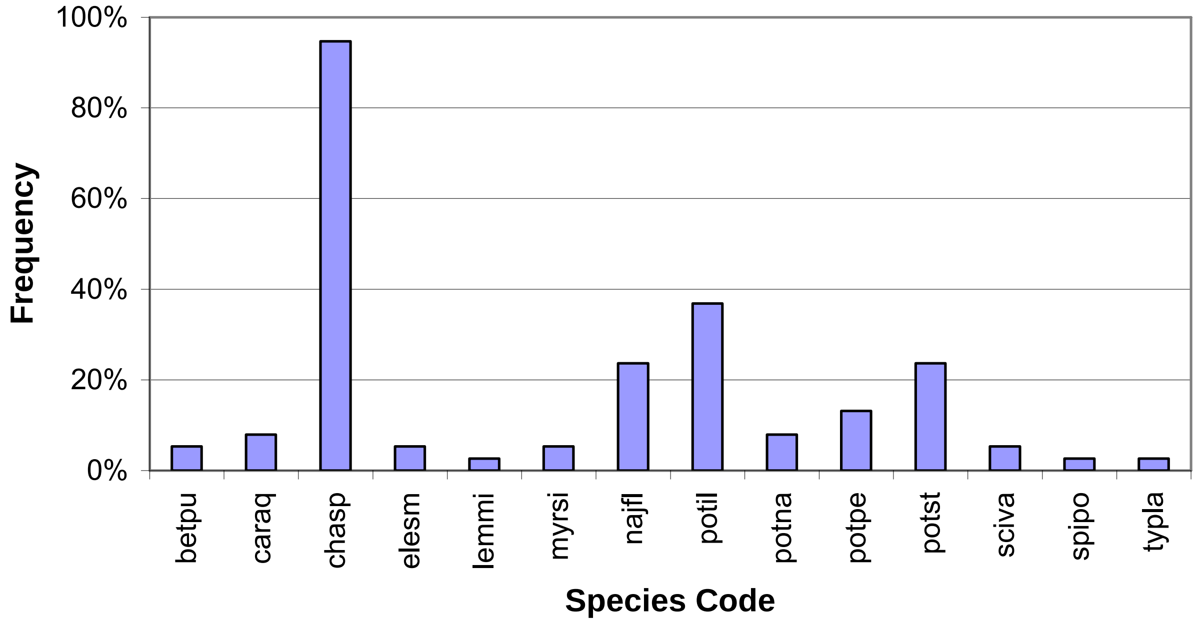


Figure 3. Frequency of aquatic plant species in Adams Lake, 2006.

DENSITY

Chara spp., a macrophytic algae, was also the species with the highest mean density (3.61 on a density scale of 0-4) in Adams Lake (Figure 4). All other species were found at very low densities, overall in Adams Lake.

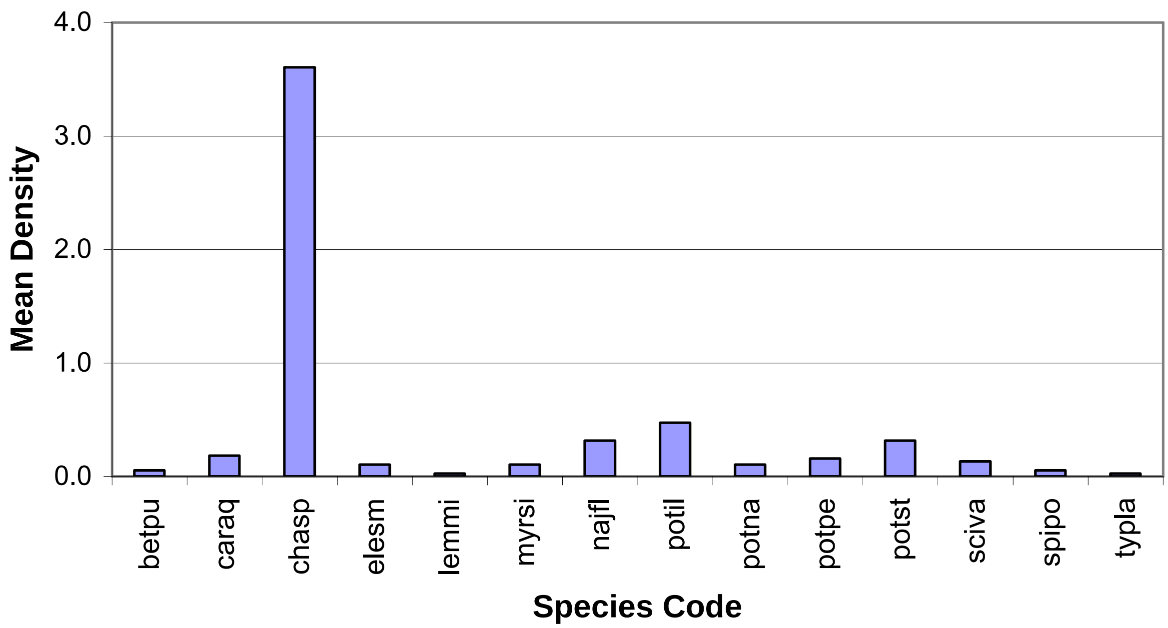


Figure 4. Densities of aquatic plant species in Adams Lake, 2006.

Chara spp. had a “mean density where present” of 3.81 (Figure 5). Its “mean density where present” indicates that where *Chara* occurred, it exhibited a dense growth form in Adams Lake (Figure 5). No other species in Adams Lake had a “mean density where present” of 2.5 or more, indicating no other species exhibited a dense growth form in Adams Lake (Appendix II).

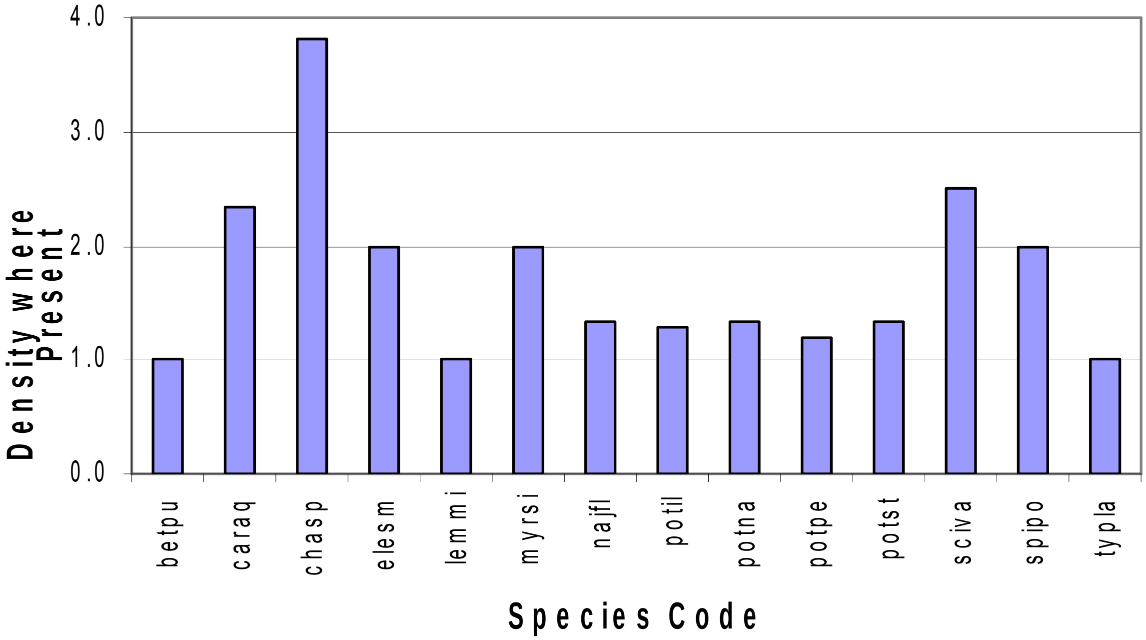


Figure 5. “Density where present”, density of growth form in Adams Lake, 2006.

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, *Chara,* a macrophytic algae, was the dominant aquatic plant species in Adams Lake, making up half of the plant community (Figure 6). *Potamogeton illinoensis* (Illinois pondweed) was sub-dominant.

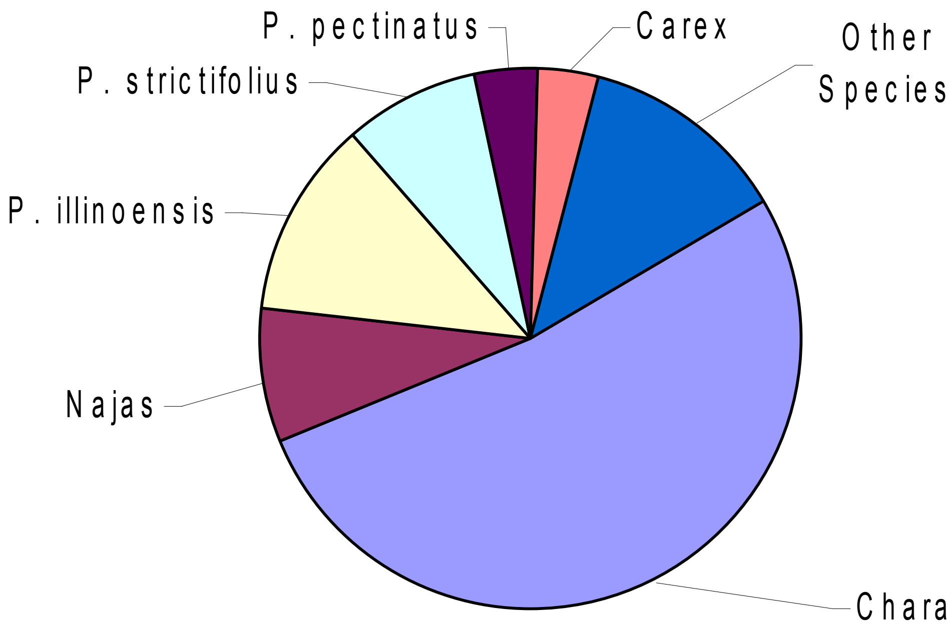


Figure 6. Dominance within the plant community, of the most prevalent species in Adams Lake, 2006.

Chara, the dominant species, dominated all depth zones and occurred at its highest frequency and density in the 1.5-20ft depth zones (Appendices I, II) (Figure 7, 8).

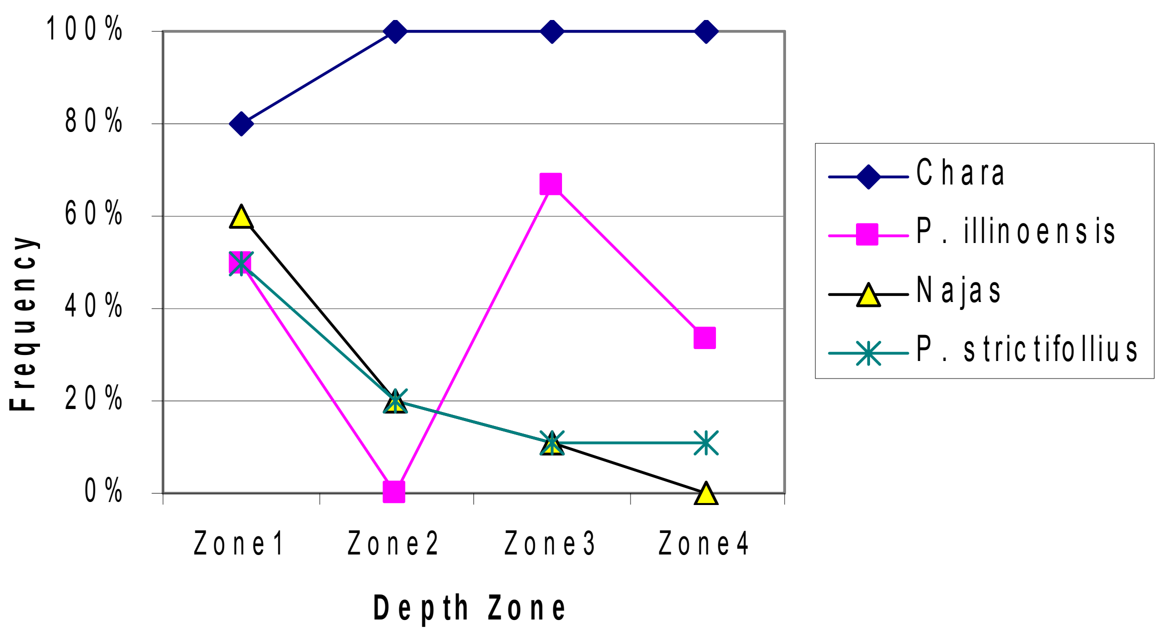


Figure 7. Frequency of most prevalent species in Adams Lake, by depth, 2006.

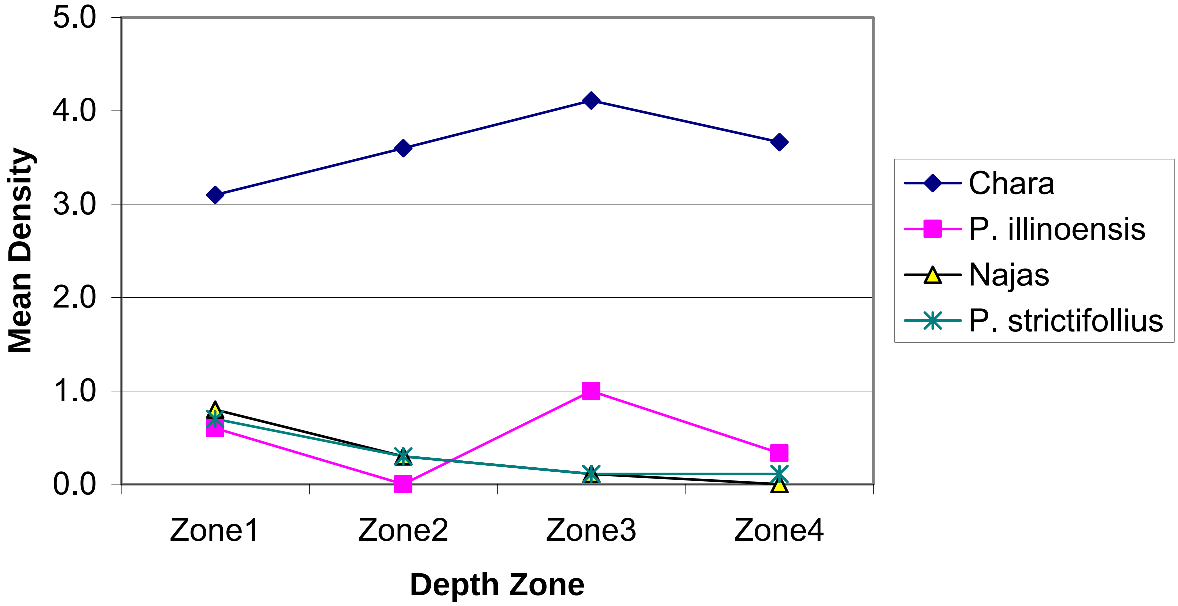


Figure 8. Density of the most prevalent plant species, by depth zone.

DISTRIBUTION

Aquatic plants occurred throughout Adams Lake to a maximum rooting depth of 14 feet. *Chara* spp., *Potamogeton pectinatus* (sago pondweed) and *P. strictifolius* (narrow-leaf pondweed) were found at the maximum rooting depth. *Chara* spp. was found deeper, at 19 feet, but is not a rooted plant.

The entire littoral zone (sampling sites) was vegetated. In 2006, approximately 18 acres (61% of the lake surface, 100% of the littoral zone) was vegetated with submergent vegetation. Emergent vegetation colonized about 1 acre (3% of the lake surface, 24% of the littoral zone) (Figure 9).

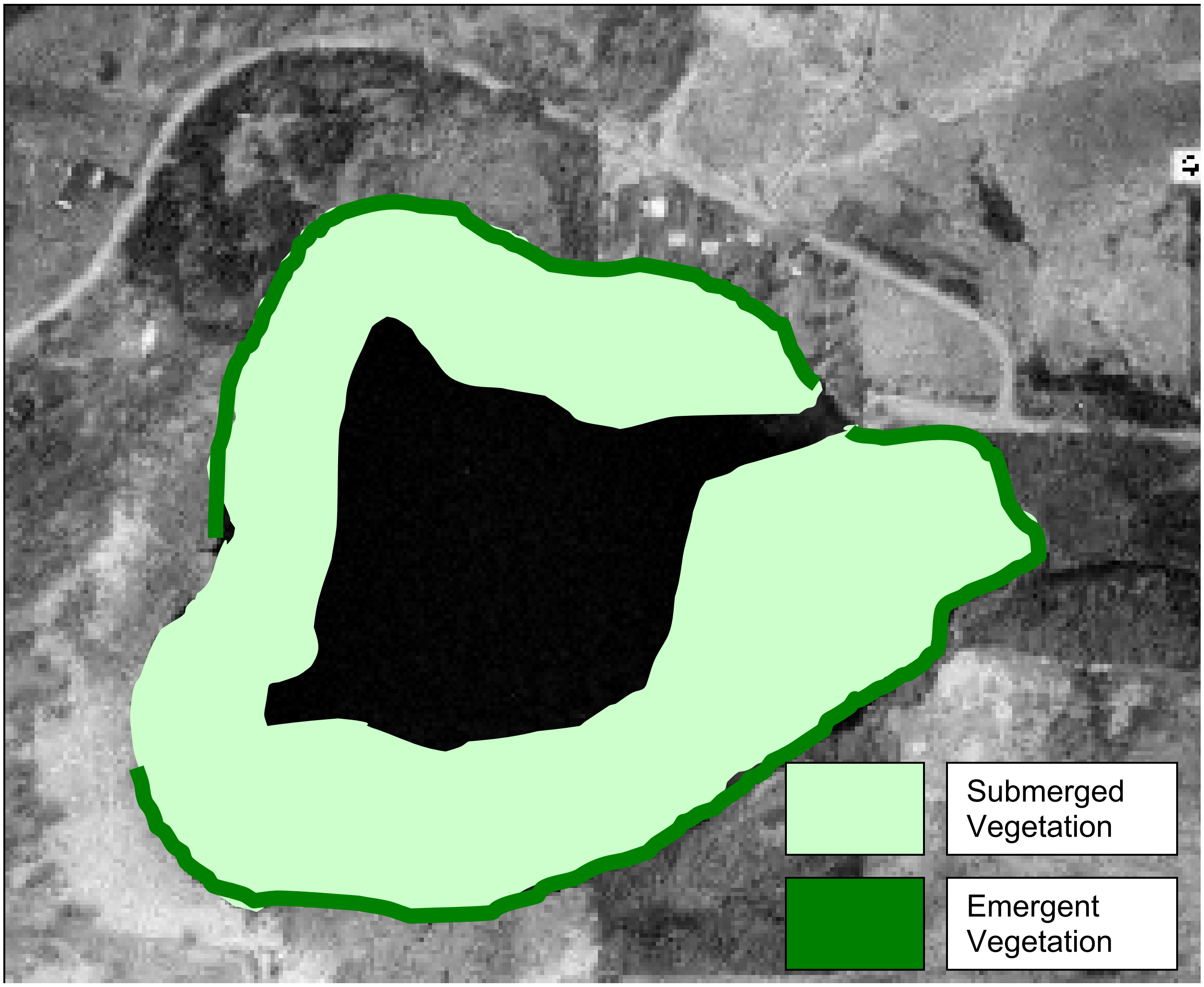


Figure 9. Distribution of aquatic plants in Adams Lake, Portage County, 2006.

The dominant and common species in Adams Lake were found distributed throughout the littoral zone, except *Potamogeton strictifolius* (narrow-leaf pondweed) was found only in the northwest half of the lake.

Water clarity data can be used to calculate a predicted maximum rooting depth for plants in a lake (Dunst 1982).

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

Based on the 2001 summer satellite water clarity (6ft), the predicted maximum rooting depth in Adams Lake would be 10 ft.

The maximum rooting depth of 14 feet is greater than the predicted maximum rooting depth based on water clarity (Figure 10). This may be due to either using clarity data from a different year than the plant study was conducted, less reliable estimates with satellite data or aquatic plant growth starting early in the year when water clarity is generally greater.

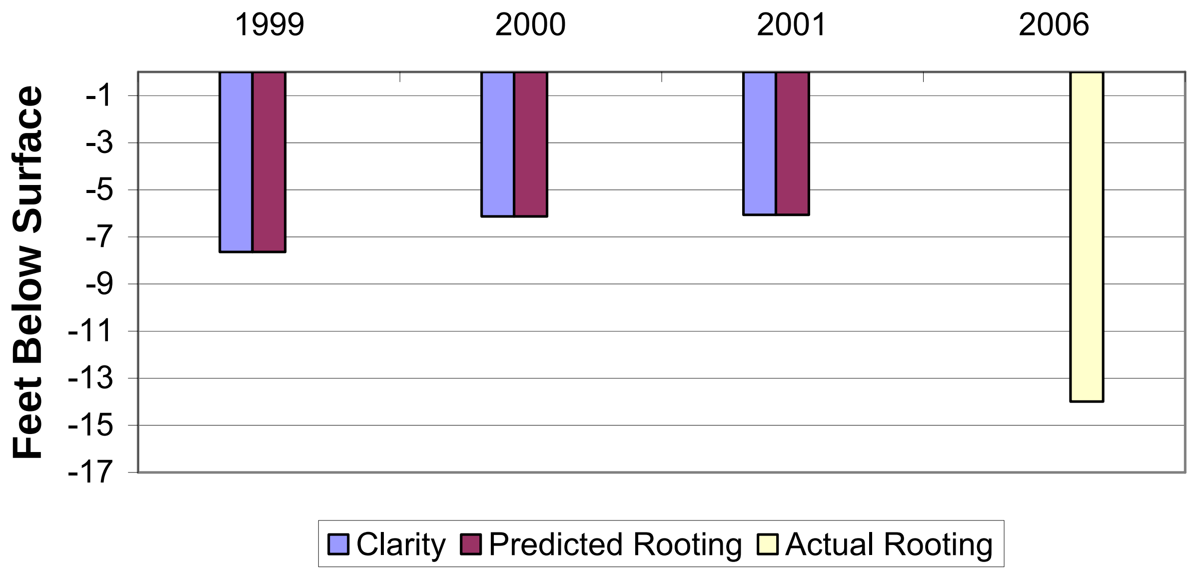


Figure 10. Predicted and Actual Maximum Rooting Depth of aquatic plant growth in Adams Lake, 1999-2006.

The highest total occurrence of plants, total density of plant growth and greatest species richness (mean number of species per site) were recorded in the 0-1.5ft depth zone, decreased in the 1.5-5ft depth zone, increased somewhat in the 5-10ft zone and declined at greater depths (Figure 11, 12). Overall Species Richness in Adams Lake was 2.37.

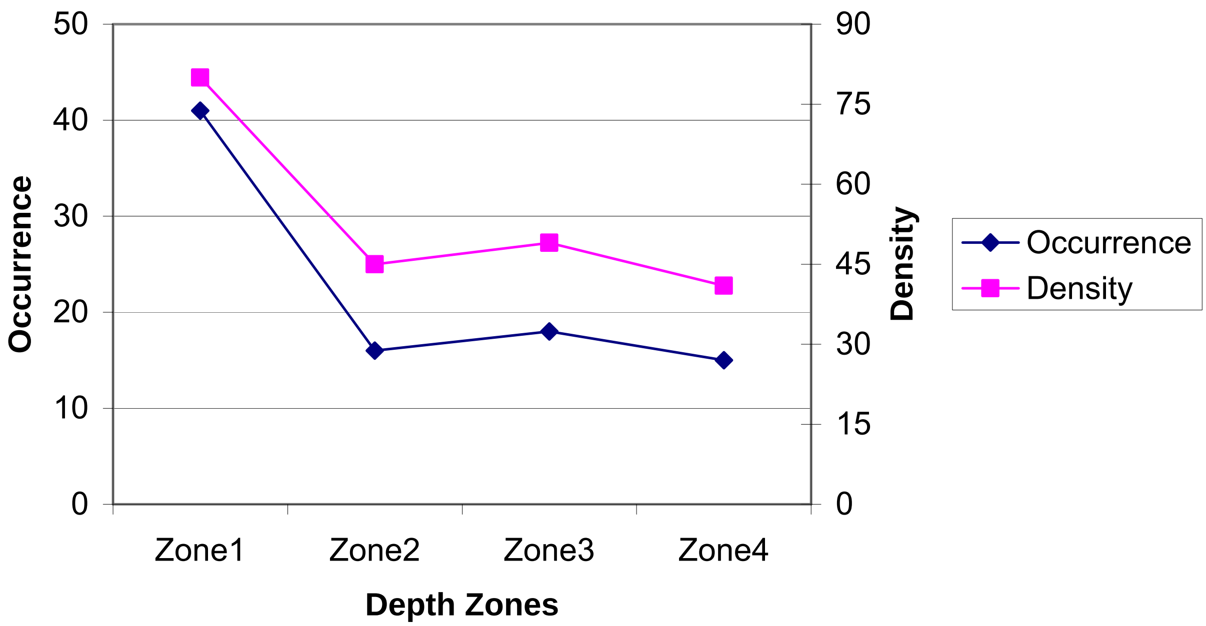


Figure 11. Total occurrence and total density of aquatic plants by depth zone in Adams Lake, 2006.

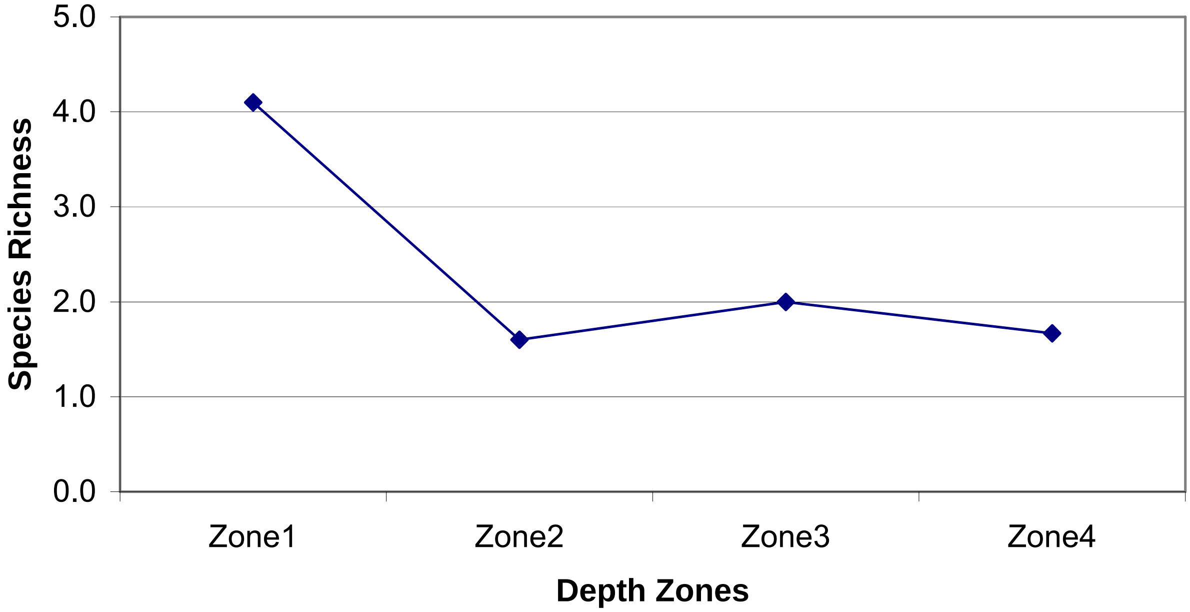


Figure 12. Species Richness (mean number of species per sample site) by depth zone in Adams Lake, 2006.

THE COMMUNITY

Simpson's Diversity Index was 0.79, indicating very poor 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 Adams Lake (Table 5) is 57, indicating a high quality plant community. This value places Adams 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: Adams Lake 2006

Category		Value
Maximum Rooting Depth	4.27 meters	8
% Littoral Zone Vegetated	100%	10
% Submergent Species	87% Rel. Freq.	9
# of Species	15	7
% Exotic species	0	10
Simpson's Diversity	0.79	4
% Sensitive Species	26% Relative Freq.	9
Totals		57

The highest value for this index is 70.

The Average Coefficient of Conservatism for Adams Lake was below average for lakes in the North Central Hardwood Region lakes and Wisconsin lakes (Table 6). This suggests that the aquatic plant community in Adams Lake is more tolerant of disturbance than the average lake in Wisconsin or the region. This has likely resulted from an above average amount of disturbance.

Table 6. Floristic Quality and Coefficient of Conservatism of Adams 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
Adams Lake 2006	5.50	20.58

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

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

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

The Floristic Quality Index of the plant community in Adams Lake was below average for lakes in the North Central Hardwood Lakes Region and Wisconsin lakes (Table 6). This suggests that the plant community in Adams Lake is farther from an undisturbed condition than the average lake in the state or region and has likely had an above average amount of disturbance.

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.

Disturbance in Adams Lake is likely due to shoreline development and factors that have not been recorded in the history of the lake.

IV. DISCUSSION

Adams Lake is a 30-acre hardwater lake with a maximum depth of 51 feet. Based on 2002-03 water clarity and phosphorus data, Adams Lake is a mesotrophic lake with fair-to-good water clarity and good water quality. Satellite data suggests that water clarity has decreased slightly since 1999. Filamentous algae occurred at 3% of sample sites, 10% of the sites in the 0-1.5ft depth zone.

The adequate nutrients (trophic state), good water clarity and hard water in Adams Lake would favor plant growth. Aquatic plants colonized 100% of the littoral zone (60% of the lake surface), to a maximum depth of 14 feet.

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).

Fourteen (14) aquatic plant species were recorded in Adams Lake in 2006. *Chara* spp., a macrophytic algae, was the dominant plant species in Adams Lake, occurring at nearly all of the sample sites, dominating all depth zones and exhibiting a dense growth form in Adams Lake. *Potamogeton illinoensis,* Illinois pondweed, was the sub-dominant plant species in Adams Lake, occurring at approximately one-third of the sites.

The Aquatic Macrophyte Community Index (AMCI) for Adams Lake was 57, indicating that Adams Lake's aquatic plant community is of high quality compared to other Wisconsin lakes and lakes in the North Central Region. The Simpson's Diversity Index (0.79) for Adams Lake indicates that the aquatic plant community had very poor diversity of species. Species Richness was 2.37 species per sample site.

The Average Coefficient of Conservatism and the Floristic Quality Index suggests that Adams Lake has been impacted by disturbance at the shore. The aquatic plant community in the lake is more tolerant of disturbance than the average lake in the state or region and is farther from an undisturbed condition than the average lake. This is likely the result of an above average amount of disturbance to the lake. Shoreline development is likely the major disturbance.

Adams Lake is protected by natural shoreline cover (wooded, shrub, native herbaceous growth) at 81% of the shore; all natural cover types were commonly occurring. However, disturbed shoreline was common (lawns and hard structures) and covered 19% of the shore. Run-off is increased on cultivated lawn and hard structures without filtering of the run-off. Run-off from lawn can carry pesticides, pet wastes and nutrients and both can carry toxics into the lake. Preserving and restoring the natural shoreline is critical to maintaining water quality and wildlife habitat.

Shoreline development may be impacting the aquatic plant community in Adams Lake. When transects at shoreline with 100% natural cover were separated from transects that had any amount of disturbed cover (Appendices V-VI), some measures of the aquatic plant community were different (Table 7).

The Average Coefficient of Conservatism indicates that disturbance has impacted the plant community. The coefficient was lower at disturbed shore transects. The natural shoreline sites were above average, more sensitive to disturbance than the average lake in the Northern Central Hardwoods Region or state. The disturbed sites were in the lowest quartile, within the group of lakes in the state and region most tolerant of disturbance (Table 7). This is likely due to selection by past disturbance.

An additional clue that disturbance has impacted the lake community was the reduction of sensitive species and an increase in tolerant species at disturbed shoreline (Table 7).

The maximum rooting depth was greater at natural shoreline sites. This results in a broader littoral zone, providing more habitat (Figure 7).

Table 7. Comparison of the Adams Lake Aquatic Plant Community at Natural and Disturbed Shorelines

	Natural	**Disturbed**
Average Coefficient of Conservatism	6.00	5.38
Relative Frequency of Sensitive Species (Potamogeton strictifolius)	12%	7%
Most likely occur in disturbed areas (Typha latifolia)	0%	2%
Maximum rooting depth	14 feet	11 feet

V. CONCLUSIONS

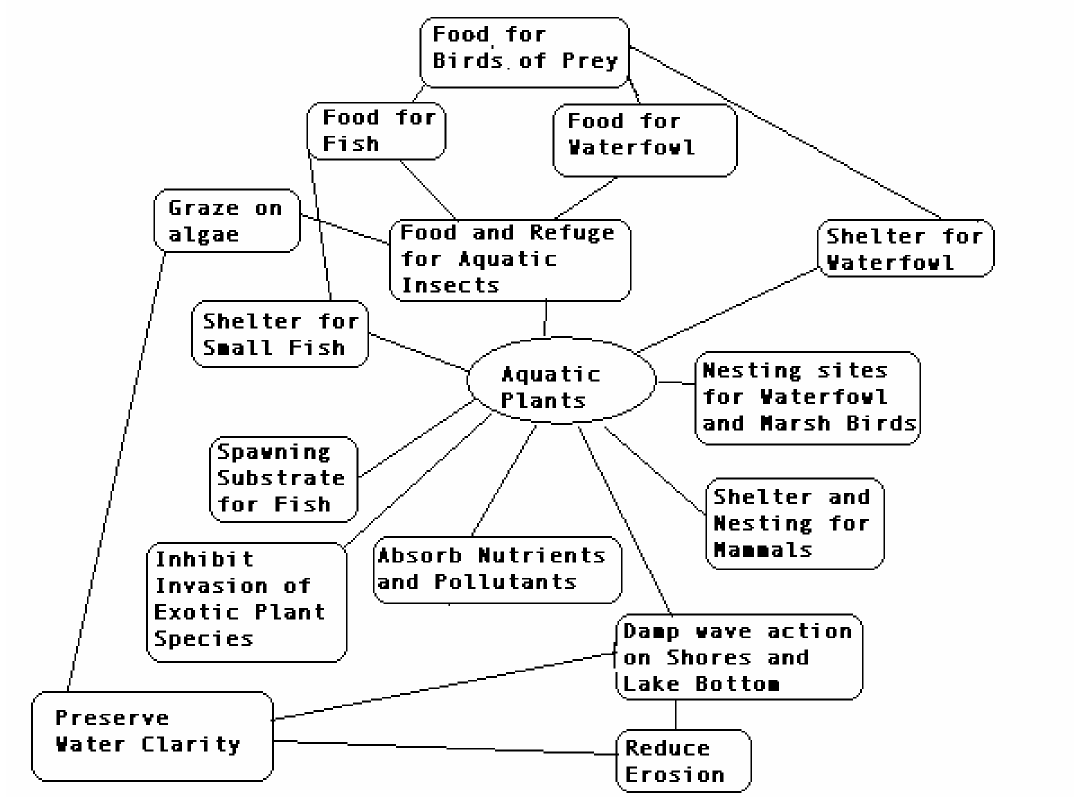
Adams Lake is a mesotrophic lake with fair-to-good water clarity and good water quality. Water clarity appears to have decreased slightly since 1999. Filamentous algae occurred, but was not common in Adams Lake in 2006.

The aquatic plant community colonized all of the littoral zone, a little more than half of the total lake area, to a maximum depth of 14 feet. The 0-1.5 ft. depth zone supported the most abundant aquatic plant growth.

Fourteen (14) aquatic plant species were recorded in Adams Lake. *Chara* spp., a macrophytic algae, was the dominant species within the plant community, dominating all depth zones, occurring at nearly all of the sample sites and exhibiting a dense growth form. *Potamogeton illinoensis*, Illinois pondweed, was the sub-dominant species, occurring at approximately one-third of the sites.

The aquatic plant community in Adams Lake is characterized by high quality, very poor species diversity, an above average tolerance to disturbance and a condition farther from an undisturbed condition than the average lake in the state or region.

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 8). Plant cover within the littoral zone of Adams Lake is 100% and over the entire lake is 60%. 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 Adams Lake. Wooded cover, shrubs and native herbaceous growth protected 80% of the shoreline. Maintaining natural shoreline cover is critical to maintaining water quality and wildlife habitat.
2) Lake residents restore natural shoreline buffer in cleared areas. Disturbance may have already impacted the aquatic plant community. Aquatic plant communities at disturbed shorelines were more tolerant of disturbance and farther from an undisturbed condition than communities at natural shoreline as measured by Floristic Quality Indices and Average Coefficients of Conservatism. Sensitive species had a lower occurrence and tolerant species had a higher occurrence at disturbed shoreline sites
3) Lakes residents use best management practices on shoreland property to prevent nutrient enrichment and stormwater run-off to the lake. Water clarity has decreased since 1999. Nutrient enrichment in Adams Lake must be prevented to preserve water clarity and to prevent overabundance of aquatic plant growth. More than half of the submergent plant species in Adams Lake are known to grow to nuisance levels with increased nutrients.
4) 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 Adams Lake.
5) DNR to designate sensitive areas within Adams Lake. These are areas that are

most important for habitat and maintaining water quality.

6) Maintain exotic species educational signs at the boat landing to prevent the spread of exotic species into Adams Lake. No exotic species were found in Adams Lake in 2006.