# EXECUTIVE SUMMARY

Jersey Valley Lake is a hardwater, mesotrophic lake. The aquatic plant community is characterized by below average quality, good species diversity and 100% coverage of plants within the littoral zone, with the most abundant plant growth in the 0-1.5 ft. depth zone. Jersey Valley Lake has been more impacted by disturbance than the average lake in the region.

There has been a significant change in the aquatic plant community in Jersey Valley Lake between1994 and 2003.

1) Eurasian watermilfoil invaded between 1994 and 2003. By 2003, Eurasian watermilfoil was found throughout the lake, to a maximum depth of 13 feet, at more than half of the sites. This invasion may be a major factor in the other changes tht have occurred in the lake.
2) The dominant species in the plant community has changed from *Elodea canadensis* in 1994 *Ceratophyllum demersum* in 2003.
3) The occurrence of filamentous algae increased dramatically.
4) The maximum rooting depth increased
5) The mean density of all native aquatic plant species declined
6) The greatest density of plant growth shifted from the 0-1.5ft depth zone into the 1.5-5ft depth zone.
7) The quality of the plant community declined from average quality to below average quality for Wisconsin lakes.
8) The species diversity of the aquatic plant community declined from very good diversity to good diversity.
9) The aquatic plant community moved closer to a disturbed condition.

**Management Recommendations**

1) Preserve the natural buffer zone of native vegetation around the lake
2) Monitor water quality in Jersey Valley Lake
3) Manage nutrient inputs from watershed
4) Implement management of Eurasian watermilfoil within Jersey Valley Lake. Investigate using a combination of various methods
   a) **Chemical control with a selective chemical:** Only in combination with another method or in high-use areas in which the milfoil is preventing a recreational use.
   b) **Cutting and/or Pulling by hand**: In combination with another method and in high-use areas in which the milfoil is preventing a recreational use.
   c) **Mechanical harvesting:** Only feasible in deeper water when combined with a winter drawdown. Combine with another control method to be used in the deeper zones.
   d) **Winter drawdown**
   e) **Stock milfoil weevils**

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# The Aquatic Plant Community in Jersey Valley Lake
# 1994-2003
# (MWBC 1191600)

**Deb Konkel**

## I. INTRODUCTION

A study of the aquatic macrophytes (plants) in Jersey Valley Lake was conducted during August of 1994 and 2003 by Water staff in the West Central Region - Department of Natural Resources (DNR).

A study of the diversity, density, and distribution of aquatic plants is an essential component of understanding a lake ecosystem due to the important ecological role of aquatic vegetation and the ability of the vegetation to characterize the water quality (Dennison et al. 1994).

**Ecological Role:** All other life in the lake depends on the plant life - the beginning of the food chain. Aquatic plants and algae provide food and oxygen. Aquatic plants provide shelter and habitat for fish, wildlife, and the invertebrates that in turn provide food for other organisms.

**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. 1994). In addition, plants can improve water quality, protect shorelines and the lake bottom, add to the aesthetic quality of the lake and impact recreation.

The present study was conducted to determine the extent of the colonization and growth of Eurasian watermilfoil, an exotic plant species recently introduced to Jersey Valley Lake. The information this study provides will be important for effective management of the lake, including: fish habitat improvement, protection of sensitive wildlife areas, aquatic plant management, exotic species management and water resource regulations. The added data that it provides will be compared to past and future plant inventories to track any changes occurring in the lake.

**Background:** Jersey Valley Lake is a 51-acre impoundment on a tributary of the West Fork of the Kickapoo River in Vernon County, Wisconsin. The maximum depth of Jersey Valley Lake is 18 feet. The Jersey Valley watershed drains 4865 acres of land. This is a watershed to lake ratio of size of 95:1. Lakes with drainage area/lake size ratios greater than 10:1 tend to have water quality problems (Field 1994). As part of the county park, Jersey Valley Lake is an important recreational resource for the area.

## II.METHODS

Field Methods

The 1994 and 2003 study design was based on the rake-sampling method developed by Jessen and Lound (1962). Transects (10) were place along the shoreline, using a random numbers table for stratified random sampling. The transects were recorded on a map and used for both the 1994 and 2003 studies (Appendix IX). 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. The four samples were 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); the number of rake samples on which it was present at each sampling site.

1 indicates that a species was present on one rake sample
2 indicates that the species was present on two rake samples
3 indicates that the species was present on three rake samples
4 indicates that the species was present on all four rake samples
5 indicates that the species was abundantly present on all rake samples.

The exact depth and sediment type at each sampling site was also recorded. Visual inspection and periodic samples were taken between transect lines in order to record additional species. 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 back from the shore, was evaluated. The percent coverage of each land use type within this 100' x 30' rectangle was estimated.

Data Analysis

Data from each survey (1994 and 2003) were analyzed separately and compared. The percent frequency of each species was calculated (number of sampling sites at which it occurred / total number of sampling sites) (Appendix I, II). Relative frequency was calculated (the number of occurrences of a species / total occurrence of all species) (Appendix I, II). The mean density was calculated for each species (sum of a species' density ratings / number of sampling sites) (Appendix III, IV). Relative density was calculated (species density / total plant densities). 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 III, IV). The relative frequency and relative density were summed to obtain a dominance value (Appendix V, VI). Simpson's Diversity Index was calculated (Appendix I, II).

The Aquatic Macrophyte Community Index (AMCI) developed by Weber et. al. (1995) to evaluate the quality of an aquatic plant community, was applied to Jersey Valley Lake. Values between 0 and 10 are given for each of six important measures of a plant community and summed.

The Average Coefficients of Conservatism and Floristic Quality Index (Nichols 1998) were calculated for Jersey Valley Lake to measure the disturbance tolerance of the plant community and its closeness to an undisturbed condition. The Coefficient of Conservatism is an assigned value, 0-10, based on the probability that a species will occur in a relatively undisturbed habitat. Floristic Quality is calculated from the average coefficient.

## III. RESULTS

### PHYSICAL DATA

Many physical parameters are important determinants of the type of macrophyte community that will ultimately inhabit a lake. Water quality (nutrients, algae concentration, clarity, hardness) impact the plant community as the plant community can in turn modify these parameters. Other physical factors, such as lake morphology, sediment composition and shoreline use, also impact the macrophyte community.

**WATER QUALITY** - The trophic state of a lake is a classification of its water quality.
**Eutrophic lakes** are high in nutrients and support a large biomass.
**Oligotrophic lakes** are low in nutrients and support limited plant growth and smaller fish populations.
**Mesotrophic** lakes have intermediate levels of nutrients and biomass.

Results of water quality monitoring indicate that Jersey Valley is a hard-water, mesotrophic lake (Konkel 1995). This trophic state and the hard water would favor plant growth and result in 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).

Jersey Valley Lake is an impoundment with two narrow arms sheltered by steep forested hills. The narrow sheltered arms may produce a more protected area for plant growth. However, the littoral zone is fairly steep throughout most of the basin and may be less favorable for plant growth.

**SEDIMENT COMPOSITION** - Silt, a soft low-density sediment, was the dominant sediment in Jersey Valley Lake, especially at depths greater than 1.5ft (Table 1).

Silt mixed with sand was dominant in the 0-1.5 ft. depth zone. Organic muck occurred only at the inlet from the river.

**Table 1. 2003 Jersey Valley Lake Sediment Composition**

| | | 0-1.5 ft. | 1.5-5 ft. | 5-10 ft. | 10-20 ft. | Overall |
|---|---|---|---|---|---|---|
| **Soft Sediments** | Silt | 10% | 50% | 70% | 100% | 58% |
| | Muck | | 10% | | | 2% |
| **Mixed Sediments** | Sand/Silt | 50% | 10% | 10% | | 18% |
| | Silt/Rock | 20% | 10% | | | 8% |
| **Hard Sediments** | Sand/Rock | 20% | 20% | | | 10% |
| | Sand | | | 20% | | 5% |

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

The availability of mineral nutrients for growth is highest in sediments of intermediate density, such as silt (Barko and Smart 1986). Highly organic muck sediments are low-density; sand, gravel and rock are high density sediments.

All types of sediments had high percentages of vegetation (Table 2). Sediment type does not appear to be an important determinant of plant growth in Jersey Valley Lake.

**Table 2. Sediment Influence in Jersey Valley Lake**

| | | Percent Occurrence | Percent Vegetated |
|---|---|---|---|
| **Soft Sediments** | Silt | 58% | 83% |
| | Muck | 2% | 100% |
| **Mixed Sediments** | Sand/Silt | 18% | 100% |
| | Silt/Rock | 8% | 100% |
| **Hard Sediments** | Sand/Rock | 10% | 100% |
| | Sand | 5% | 100% |

**SHORELINE LAND USE** - Land use practices strongly impact the aquatic plant community and, therefore, the entire aquatic community. Practices on shore can directly impact the plant community through increased sedimentation from erosion, increased nutrients from fertilizer run-off and soil erosion and increased toxics from farmland, suburban and urban run-off.

Wooded cover and native herbaceous cover were the most frequently encountered shoreline cover at the transects (Table 3). Shrub cover was also commonly encountered.

Wooded cover had the highest mean coverage at the shoreline, more than half of the shoreline. Herbaceous growth covered nearly one-fourth of the shoreline.

**Table 3. Shoreline Land Use on Jersey Valley Lake, 2003**

| | Cover Type | Frequency of Occurrences at Transects | Mean % Coverage |
|---|---|---|---|
| Natural Shoreline | Wooded | 80% | 54% |
| | Native Herbaceous | 90% | 20% |
| | Shrub | 50% | 14% |
| Disturbed Shoreline | Cultivated Lawn | 10% | 8% |
| | Dirt Road | 10% | 2% |

Some type of natural shoreline (wooded, native herbaceous, shrub) was found at all of the sites and covered 88% of the shoreline (Table 3).
Disturbed shoreline (mowed lawn and roads) covered 10% of the shoreline.

**MACROPHYTE DATA**

**SPECIES PRESENT**

Twenty-one (21) plant species were found in Jersey Valley Lake. Of the 21 species, 4 were emergent species, 3 were floating-leaf species, 14 were submergent species (Table 4).

No endangered or threatened species were found.

Two non-native species were found: *Potamogeton crispus* and *Myriophyllum spicatum*.

**Table 4. Jersey Valley Lake Aquatic Plant Species, 1994-2003**

| Scientific Name | Common Name | I. D. Code |
|---|---|---|
| Emergent Species | | |
| 1) *Leersia oryzoides* (L.) Sw. | rice-cut grass | leeor |
| 2) *Phalaris arundinacea* L. | reed canary grass | phaar |
| 3) *Scirpus validus* Vahl. | softstem bulrush | sciva |
| 4) *Typha latifolia* L. | broadleaf cattail | typla |
| Floating-leaf Species | | |
| 5) *Lemna minor* L. | small duckweed | lemmi |
| 6) *Spirodela polyrhiza* (L.) Schleiden. | greater duckweed | spipo |
| 7) *Wolffia columbiana* Karsten. | common watermeal | wolco |
| Submergent Species | | |
| 8) *Ceratophyllum demersum* L. | coontail | cerde |
| 9) *Chara* sp. | muskgrass | chasp |
| 10) *Elodea canadensis* Michx. | common water-weed | eloca |
| 11) *Myriophyllum spicatum* L. | Eurasain watermilfoi | myrsp |
| 12) *Najas flexilis* (Willd.) R. & S. | northern water-nymph | najfl |
| 13) *Potamogeton crispus* L. | curly-leaf pondweed | potcr |
| 14) *Potamogeton foliosus* Raf. | leafy pondweed | potfo |
| 15) *Potamogeton natans* L. | floating-leaf pondweed | potna |
| 16) *Potamogeton nodosus* Poiret. | long-leaf pondweed | potno |
| 17) *Potamogeton pectinatus* L. | sago pondweed | potpe |
| 18) *Potamogeton pusillus* L. | slender pondweed | potpu |
| 19) *Potamogeton zosteriformis* Fern. | flatstem pondweed | potzo |
| 20) *Ranunculus longirostris* Godron. | stiff water crowfoot | ranlo |
| 21) *Zosterella dubia* (Jacq.) Small | water stargrass | zosdu |

Not all species occurred at the sample sites in both years. In 1994, 18 species occurred at the transect sites and in 2003, 13 species occurred at the transect sites.

**FREQUENCY OF OCCURRENCE**

The species with the highest frequency of occurrence in 1994 was *Elodea canadensis* (97%), yet *E. canadensis* disappeared from Jersey Valley Lake in 2003 (Figure 1). *Ceratophyllum demersum* occurred at a high frequency of sample sites in 1994 (92%)

and increased in 2003 to 95%, becoming the species with the highest frequency of occurrence in Jersey Valley Lake.

*Potamogeton pectinatus* also occurred at a high frequency in 1994; *Potamogeton foliosus* and *P. zosteriformis* were commonly occurring in 1994 (Figure 1). In 2003, *P. foliosus* had disappeared, *P. pectinatus* decreased dramatically and *P. zosteriformis* increased. *Lemna minor* and *Zosterella dubia* also increased in frequency, becoming common species in 2003. The exotic species *Myriophyllum spicatum* invaded Jersey Valley Lake between 1994 and 2003, becoming very abundant (68% of the sites) by 2003 (Figure 1).

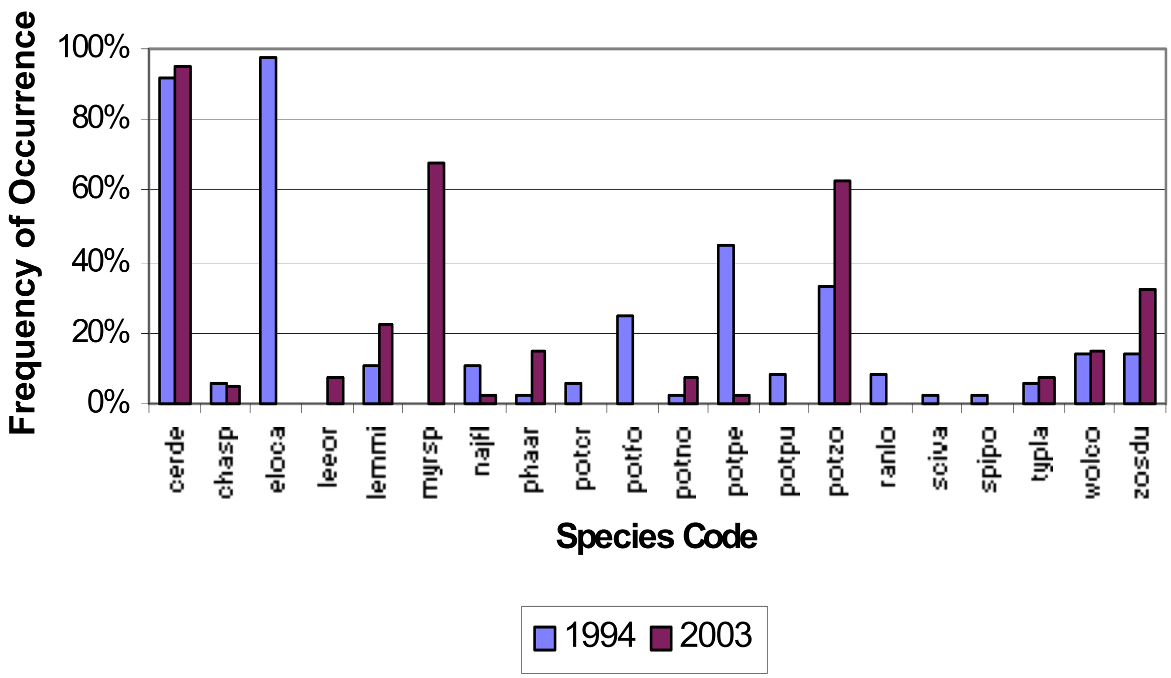


**Figure 1. Frequency of macrophyte species in Jersey Valley Lake, 1994-2003.**

Filamentous algae was not found during the survey of Jersey Valley Lake in 1994, but in 2003 occurred at 55% of the sample sites:

- 100% of the sites in the 0-1.5 ft. depth zone
- 70% of the sites in the 1.5-5 ft. depth zone.
- 50% of the sites in the 5-10 ft. depth zone.

Many lakes in the driftless region of Wisconsin exhibited increased growth of filamentous algae during the summer of 2003. This may have been the result of drought conditions during the summer of 2003, reducing fresh water inputs that may have flushed nutrients and algae from the lakes (Koperski, pers. comm.).

**DENSITY**

*Elodea canadensis* was the species with the highest mean density (3.36 on a density scale of 1-4) in 1994 in Jersey Valley Lake. *Elodea canadensis* was not found in 2003. *Ceratophyllum demersum* had the highest mean density (0.86) of any species in 2003, although its density had decreased since 1994 (2.50) (Figure 2). The mean density of all species, except *Myriophyllum spicatum,* decreased from 1994-2003*.* The mean density of this exotic species was 0.45 in 2003.

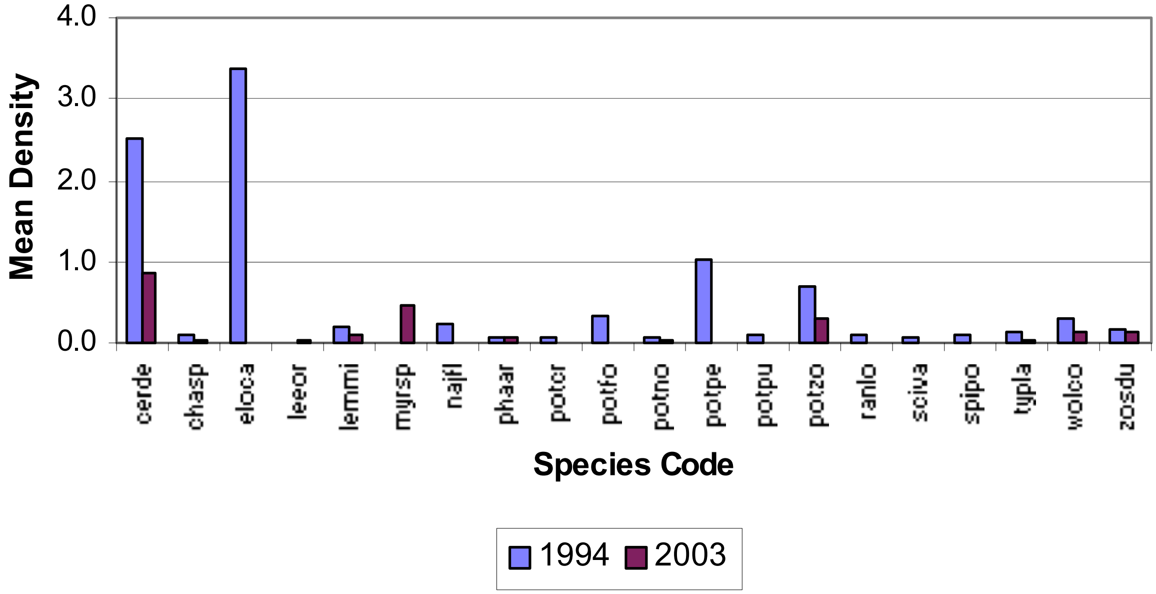


**Figure 2. Mean density of macrophytes in Jersey Valley Lake, 1994-2003.**

Species with a high "mean density where present" are those species with a more aggregated, or more dense growth form. Species with an above average aggregation in Jersey Valley in 1994 were *Ceratophyllum demersum, Elodea canadensis* and *Spirodela polyrhiza* (2.73-4.0)*.* In 2003, only *Ceratophyllum demersum* had an above average "mean density where present" (3.61) (Appendices III, IV).

**DOMINANCE**

Combining relative frequency and relative density into a dominance value indicates the dominance of species within the macrophyte community (Appendix V-VI). Based on the dominance values, in 1994, *Elodea canadensis* was the dominant species;*,* *Ceratophyllum demersum* was the sub-dominant within the aquatic plant community (Figure 3). *E. canadensis* disappeared in 2003. *Ceratophyllum demersum* increased in dominance in 2003, becoming the dominant species with *Myriophyllum spicatum* as the sub-dominant species. *Potamogeton pectinatus* decreased in dominance in 2003 and *P. zosteriformis* and *Zosterella dubia* increased in dominance. (Figure 3).

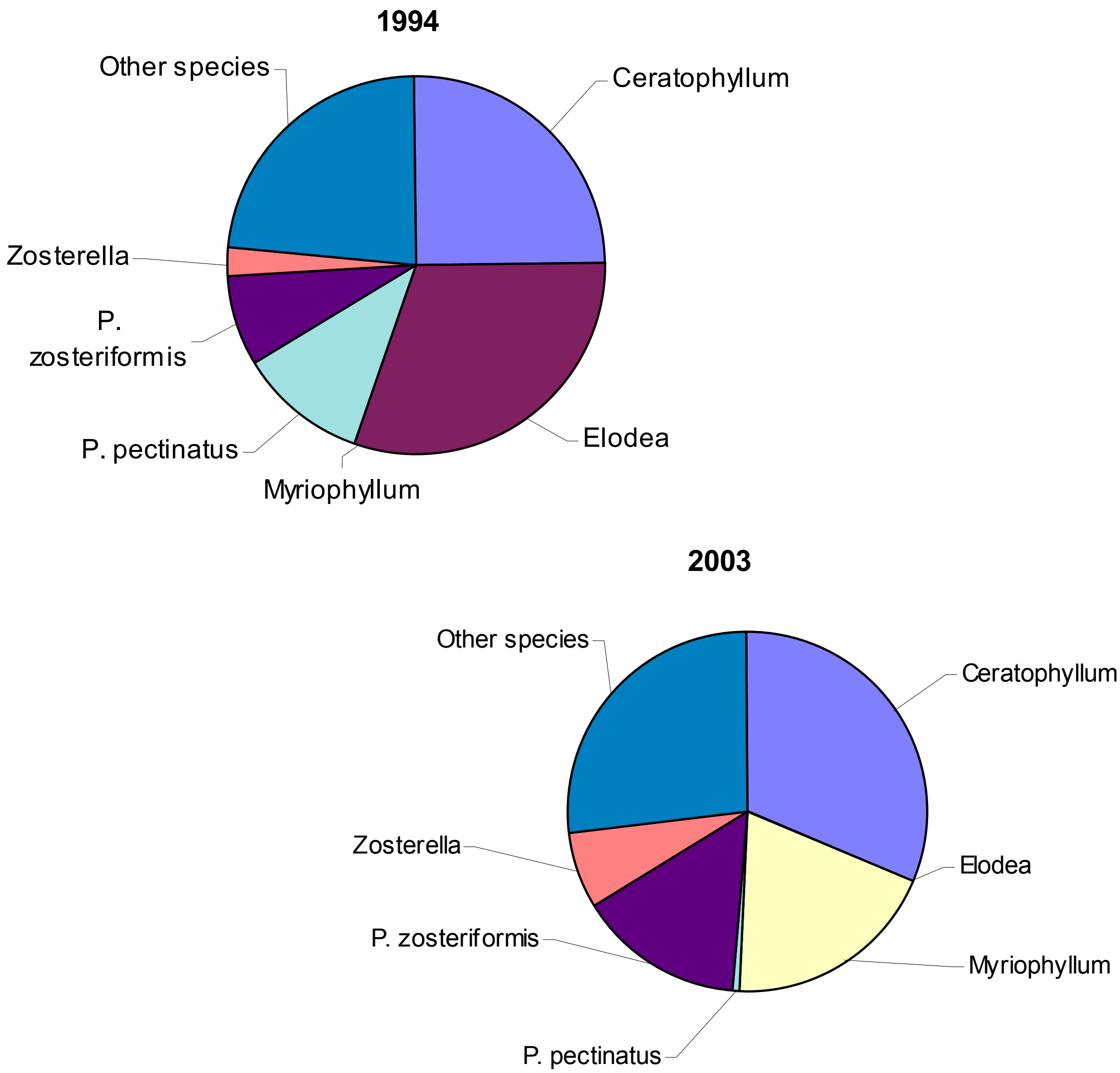


**Figure 3. Dominance within the macrophyte community, of the most prevalent species in Jersey Valley Lake, 1994-2003.**

*Elodea canadensis* dominated all depth zones in 1994 (Appendices I, III). *Ceratophyllum demersum* dominated all depth zones in 2003 (Appendices II, IV).

The frequency and density of *Myriophyllum spicatum* was highest in the 5-10ft depth zone and lowest in the shallowest and deepest depth zone (Figure 4).

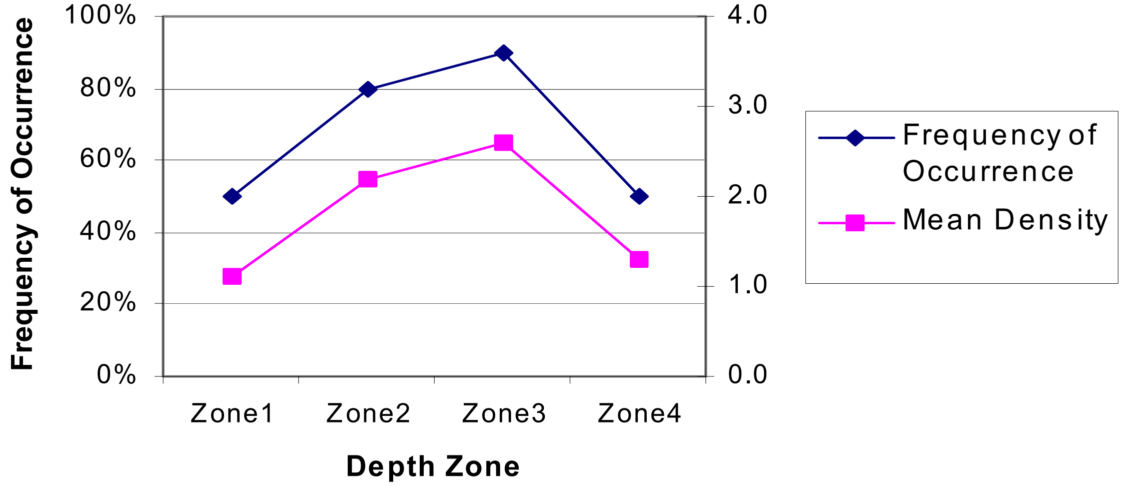


**Figure 4. Frequency and density of *Myriophyllum spicatum* by depth, 2003.**

**DISTRIBUTION**

Aquatic plant growth was found throughout Jersey Valley Lake. Vegetation colonized 97% of the sample sites in 1994 and 100% of the sample sites in 2003. Aquatic vegetation occurred to a maximum rooting depth of 11.5 feet in 1994 and 15 feet in 2003. *Elodea canadensis* occurred at the maximum depth in 1994; *Potamogeton zosterifornis* and *Zosterella dubia* occurred at the maximum depth in 2003.

The exotic species, *Myriophyllum spicatum*, was found throughout Jersey Valley Lake (Appendix VII). It colonized the entire littoral zone to a maximum depth of 13 feet.

*Ceratophyllum demersum*, which is not truly rooted and floats in the water column, occurred throughout the lake to a depth of 18 feet. Other floating species, the duckweeds, *Lemna minor* and *Wolffia columbiana*, occurred along the north shore and at the ends of the two branches of the lake, over water up to 5 ft deep. *Potamogeton zosteriformis* and *Zosterella dubia* were found throughout the lake to the maximum rooting depth of 15 feet.

The 0-1.5 ft. depth zone had the highest total occurrence of plants, highest total density of plants and greatest species richness (mean number of species per sample site) in 1994 (Figure 5, 6, 7). The total occurrence, total density and mean number of species decreased with increasing depth. In 2003, the 0-1.5ft depth zone still had the highest total occurrence and species richness, but total density was high in the entire 0-10ft depth zone and slightly higher in the 1.5-5ft depth zone (Figure 5, 6). Overall, species richness decreased in 2003 (Figure 7) from 3.89 species per site in 1994 to 3.42 species per site in 2003.

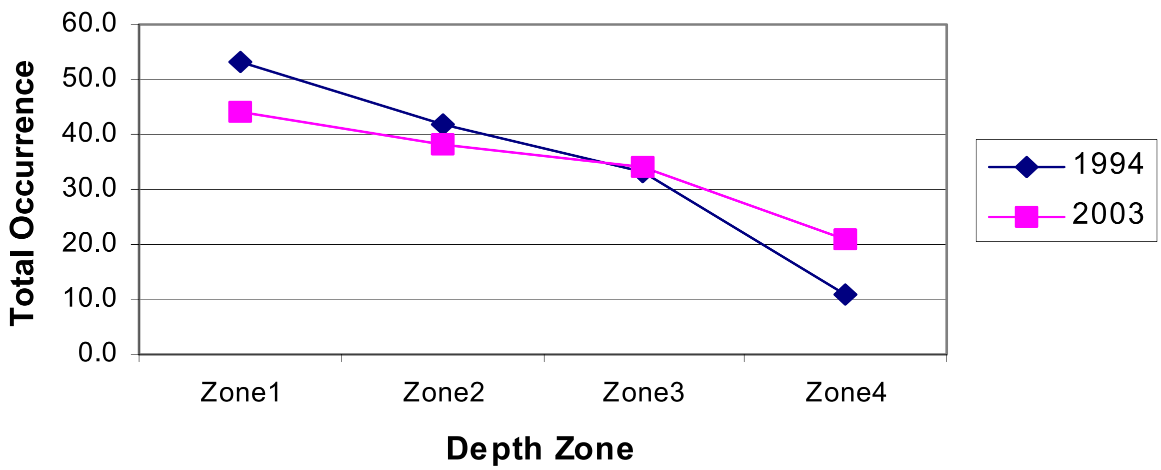


**Figure 5. Total occurrence of aquatic plants by depth zone**

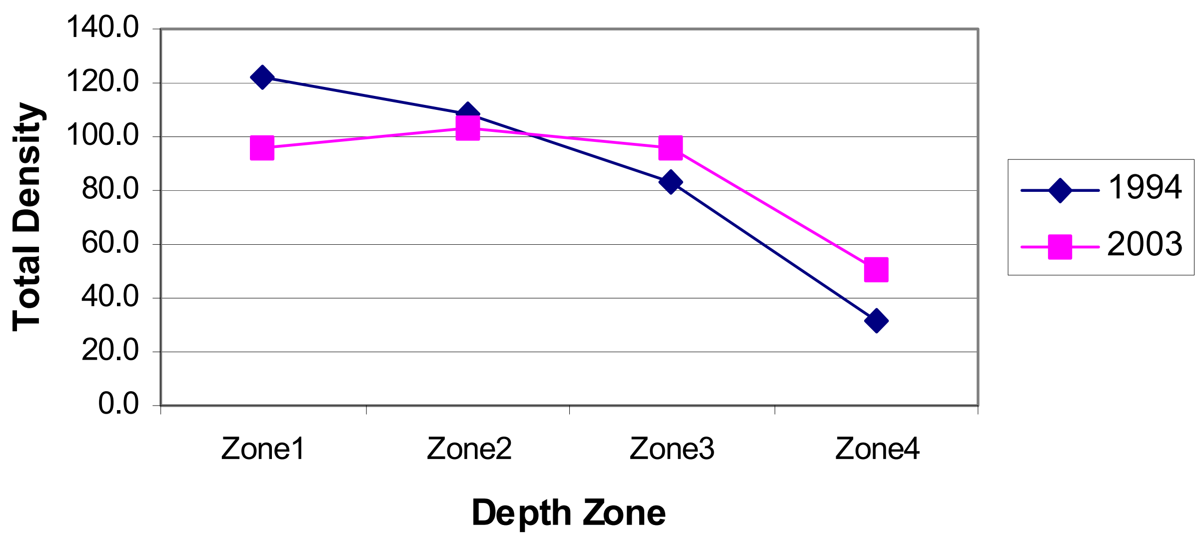


**Figure 6. Total density of aquatic plants by depth zone.**

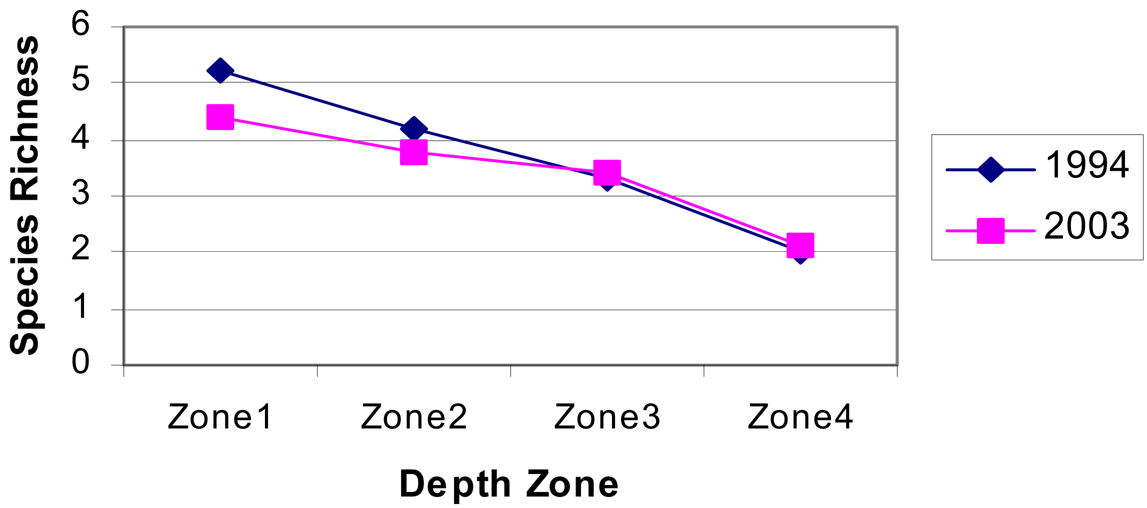


**Figure 7. Mean number of species per site, by depth zone.**

**THE COMMUNITY**

The plant community in Jersey Valley Lake changed significantly between 1994 and 2003. The Coefficient of Community Similarity indicates that the plant communities were only 48% similar (Table 5). Coefficients less than 0.75 are interpreted as a significant difference.

**Table 5. Coefficient of Similarity - Jersey Valley Lake, 1994-2003**

| | Coefficient | % Similar |
|---|---|---|
| 1994-2003 | 0.48222 | 48% |

Many indices and parameters can be used to determine changes in the plant community. A few small changes have occurred in the plant community of Jersey Valley Lake between 1994 and 2003 (Table 6).

The number of species has decreased, as has the diversity index the coverage of submerged species and the Floristic Quality and Aquatic Macrophyte Community Indices (which are discussed later). Diversity in the plant community decreased 2%, from very good diversity to good diversity. A Simpson's Diversity Index of 1.0 would mean that each individual plant in the lake was a different species (the most diversity achievable).
The biggest decrease was in the number of species.

The maximum rooting depth of aquatic plants increased, as did the percent of the littoral zone that is vegetated, the coverage of emergent vegetation and the coverage of free-floating vegetation (Table 6). The largest increase was in the maximum rooting depth; the largest percent increase was in the coverage of emergent species, which tripled.

**Table 6. Changes in the Aquatic Plant Community of Jersey Valley Lake, 1994-2003**

| | 1994 | 2003 | Change 1994-2003 | %Change 1994-2003 |
|---|---|---|---|---|
| Number of Species | 18 | 13 | -5 | -28% |
| Maximum Rooting Depth | 11.5 | 15.0 | 4 | 30% |
| % of Littoral Zone Vegetated | 97% | 100% | 3 | 3% |
| %Sites/Emergents | 8.3% | 25.0% | 0.17 | 200% |
| %Sites/Free-floating | 91.7% | 97.5% | 0.06 | 6% |
| %Sites/Submergents | 97.2% | 82.5% | -0.15 | -15% |
| %Sites/Floating-leaf | | | 0.0 | |
| Simpson's Diversity Index | 0.85 | 0.83 | -0.02 | -2% |
| Aquaitic Macrophyte Community Index | 38 | 34 | -4 | -10% |
| Floristic Quality | 18.86 | 16.36 | -2.50 | -13% |

The Aquatic Macrophyte Community Index (AMCI) developed by Weber et. al. (1995) to evaluate the quality of an aquatic plant community, was applied to Jersey Valley Lake (Table 7). The highest value for this index is 60. The quality of the Jersey Valley Lake Aquatic Plant Community was near the average of 40 for lakes in Wisconsin in 1994, but decreased to below average in 2003.

**Table 7. Aquatic Macrophyte Community Index**

| Category | 1994 | 2003 |
|---|---|---|
| Maximum Rooting Depth | 6 | 8 |
| % Littoral Zone Vegetated | 10 | 10 |
| Simpson's Diversity | 9 | 8 |
| # of Species | 5 | 2 |
| % Submersed Species | 8 | 6 |
| % Sensitive Species | 0 | 0 |
| Totals | 38 | 34 |

The Average Coefficient of Conservatism and Floristic Quality Index are a measure of plant community's disturbance tolerance and closeness to an undisturbed condition. The 1994 and 2003 Average Coefficient of Conservatism for Jersey Valley Lake were in the lowest quartile for all Wisconsin lakes and lakes in the Driftless Area/Mississippi Backwater Region (Table 8). This suggests that the plant community in Jersey Valley Lake is among those lakes most tolerant of disturbance, probably the result of being subjected to disturbance.

The Floristic Quality Index indicates that in 1994, Jersey Valley was below average for Wisconsin Lakes, yet in the upper quartile for lakes in the Driftless/Mississippi Backwater region. In 2003 the Floristic Quality decreased to the lowest quartile of Wisconsin lakes and above average for lakes in its region. This can be interpreted to mean the Jersey Valley moved further from an undisturbed condition between 1994 and 2003. It is among the group of lakes in the state furthest from an undisturbed condition and closest to a disturbed condition. Compared to other lakes in its region, Jersey Valley Lake was among the group of lakes closet to an undisturbed condition in 1994, but closer to a disturbed condition than the average lake in 2003 (Table 8).

**Table 8. Mean Coefficient of Conservatism and Floristic Quality of Jersey Valley Lake, Compared to Wisconsin Lakes and Region Lakes.**

| | Average Coefficient of Conservatism | Floristic Quality | Based on Relative Frequency | Based on Dominance Values |
|---|---|---|---|---|
| Wisconsin Lakes | 5.5, 6.0, 6.9* | 16.9, 22.2, 27.5* | | |
| DMR † | 4.6, 5.0, 5.5‡ | 10.2, 14.3, 18.1‡ | | |
| Jersey Valley Lake, 1994-2003 | | | | |
| 1994 | 4.44 | 18.86 | 16.73 | 16.11 |
| 2003 | 4.54 | 16.36 | 12.45 | 11.86 |

* The upper limit of the lowest quartile, the mean and the lower limit of upper quartile based on a sample of 554 lakes throughout Wisconsin

† Driftless Area/Mississippi Backwater Lakes, the region in which Jersey Valley Lake is located

‡ the upper limit of the lowest quartile, the mean and the lower limit of the upper quartile

These values were based only on the presence or absence of tolerant and intolerant species. The frequency or dominance of these species within the plant community was not taken into consideration. The Floristic Quality Index was recalculated by weighting a species coefficient with its relative frequency and dominance value. The resulting values indicate that Jersey Valley Lake was closer to an undisturbed condition than the average lake in its region in 1994 and moved closer to a disturbed condition in 2003, farther from an undisturbed condition than the average lake in its region (Figure 8).

Disturbances can be of many types:

1) Physical 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 can be the result of factors that impact water clarity and thus stress species that are more sensitive: resuspension of sediments, sedimentation from erosion, 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, destruction of plant beds by a fish or animal population.

The invasion of Eurasian watermilfoil may the major disturbance factor in Jersey Valley Lake.

Plant communities change due to changes in individual species. There were notable changes in the plant community in Jersey Valley Lake.
Possibly the biggest change was the invasion of *Myriophyllum spicatum.*
***Myriophyllum spicatum*** **did not occur in Jersey Valley in 1994, but by 2003 it was the second most dominant species, 67.5% frequency.**

Seven species disappeared from the sample sites, although they may still occur at low frequencies in the lake:
*Elodea canadensis, Potamogeton crispus P. foliosus, P. pusillus, Ranunculus*

*longirostris, Scirpus validus, Spirodela polyrhiza.*

Other than *Myriophyllum spicatum*, *Phalaris arundinacea* underwent the largest increase, from
**3% frequency and 0.06 mean density in 1994 to**
**15% frequency and 0.08 mean density in 2003** (Appendix VIII).
Other species that increased substantially from 1994-2003 were: *Lemna minor, Potamogeton nodosus* and *Zosterella dubi.* These species more than doubled in frequency of occurrence and dominance but decreased someone in density (Appendix VIII).

Other than species that were not found in 2003, *Potamogeton pectinatus* underwent the greatest decrease, decreasing 94-99% from
**44% frequency and 1.03 mean density in 1994 to**
**2% frequency and 0.01 mean density in 2003.**
*Najas flexilis* also decreased substantially, a 78-95% decrease in frequency, density and dominance (Appendix VIII).

**V. DISCUSSION**

Based on water quality data, Jersey Valley Lake is a hardwater, mesotrophic lake. The trophic state, hard water and high frequency of silt sediments would favor plant growth. The steeply sloped littoral zone over much of the lake could limit plant growth. The large watershed to lake ratio (95:1) could increase the probability of water quality problems due to run-off from the watershed (Fields 1994).

Drought conditions during the summer of 2003 appeared to have impacted algae growth in many lakes in the Driftless Region of Wisconsin. In Jersey Valley Lake, the frequency of filamentous algae increased from no sites in 1994 to 55% of the sites in 2003. Filamentous algae was more abundant at shallow depths.

The Coefficient of Similarity indicates that the aquatic plant community of Jersey Valley Lake changed significantly from 1994 to 2003. The two communities were only 48% similar.

Simpson's Diversity Index indicates that the species diversity of the plant community declined from a very good diversity (0.85) in 1994 to a good diversity (0.83) in 2003. The species richness declined also, as did the number of species from 18 in 1994 to 13 in 2003. The Aquatic Plant Community Index (AMCI) indicates that the quality of the aquatic plant community in Jersey Valley Lake decreased from nearly average in 1994 to below average in 2003.

The Floristic Quality in Jersey Valley Lake decreased during 1994-2003 from a lake closer to an undisturbed condition than the average lake in the Driftless Area/Mississippi Backwater Region to a lake farther from an undisturbed condition than the average lake in the region. This means that Jersey Valley Lake has likely been subjected to increased disturbance. The major disturbance factor is likely the invasion of the exotic plant species, Eurasian watermilfoil.

*Elodea canadensis* was the dominant plant species in 1994, dominating all depth zones, but disappeared in 2003. *Ceratophyllum demersum* became the dominant species in 2003, dominating all depth zones.

*Myriophyllum spicatum* invaded between 1994 to 2003 and in 2003 was found throughout the lake, at more than half the sites, to a maximum depth of 13 feet. The mean densities of all other species decreased from 1994 to 2003. Three species grew at above average densities in 1994, but only one species grew at high densities in 2003.

Besides the disappearance of *Elodea canadensis, Potamogeton foliosus* also disappeared and *P. pectinatus* declined. *Lemna minor, Potamogeton zosteriformis* and *Zosterella dubia* increased.

In 1994, the 0-1.5 foot depth zone supported the greatest vegetation growth: the highest total occurrence and total density of plants and the greatest species richness.

The highest total density of plants shifted into the 1.5-5ft depth zone in 2003, the zone in which Eurasian watermilfoil is found at its highest frequency and density.

The maximum rooting depth of aquatic plant growth increased form 11.5 feet in 1994 to 15 feet in 2003.

The occurrence and mean coverage of natural shoreline (wooded, shrub and native herbaceous growth) on Jersey Valley Lake was high.  Wooded cover protected more than half of the shoreline and native herbaceous growth covered one-fifth of the shoreline.  Preserving this buffer of natural vegetation along the shore will protect the water quality of the lake from erosion and nutrient/chemical run-off that could feed algae blooms and increase sedimentation.

## VI. CONCLUSIONS

Jersey Valley Lake is a hardwater, mesotrophic lake. The occurrence of filamentous algae increased dramatically from 1994 to 2003 as many lakes in the Driftless Region exhibited increased algae growth during the droughty summer of 2003.

There has been a significant change in the plant community in Jersey Valley Lake from 1994 to 2003 (Coefficients of Community Similarity).

The invasion of *Myriophyllum spicatum* between 1994 and 2003 is the most notable difference. *M. spicatum* was not found in the lake in 1994, but by 2003, it was found throughout the lake, to a maximum depth of 13 feet, at more than half of the sites. Along with the invasion of the invasion of *M. spicatum*, the mean density of all species declined and the greatest density of plant growth shifted from the 0-1.5ft depth zone into the 1.5-5ft depth zone where Eurasian watermilfoil is found at its highest frequency and density.

In 1994, *Elodea canadensis* was the dominant species within the plant community and *Ceratophyllum demersum* became dominant in 2003.

The quality of the plant community in Jersey Valley Lake is of below average quality for Wisconsin lakes and is characterized by good species diversity and most abundant plant growth in the 0-1.5 ft. depth zone. The aquatic plant community in Jersey Valley Lake is in the quartile of the lake with the most disturbance tolerant plant communities in Wisconsin and the Driftless Area/Mississippi Backwaters Region.

The change in the aquatic plant community has resulted in decreased quality of the plant community (AMCIndex), species diversity (measured by Simpson's Diversity Index, decreased species richness, decreased number of species) and increased disturbance tolerance (FQIndex). The invasion of Eurasian watermilfoil may be causing many of these changes.

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

1) 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

and 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 9).

Table 9. **Wildlife Uses of Aquatic Plants in Jersey Valley Lake**

| Aquatic Plants | Fish | Water Fowl | Shore Birds | Upland Birds | Muskrat |
|---|---|---|---|---|---|
| **Submergent Plants** | | | | | |
| *Ceratophyllum demersum* | F,I*, C, S | F(Seeds*), I, C | | | F |
| *Chara* sp. | F*, S | F*, I* | | | |
| *Elodea canadensis* | C, F, I | F(Foliage), I | | | |
| *Myriophyllum spicatum* | F, C | | | | |
| *Najas flexilis* | F, C | F*(Seeds, Foliage) | F(Seeds) | | |
| *Potamogeton crispus* | F, C, S | F(Seeds, Tubers) | | | |
| *Potamogeton foliosus* | F, I, S*,C | F*(All) | | | F* |
| *Potamogeton natans* | F, I, S*,C | F*(Seeds, Tubers) | | | F* |
| *Potamogeton nodosus* | F, I, S*,C | F*(Seeds) | | | F* |
| *Potamogeton pectinatus* | F, I, S*,C | F* | | | F* |
| *Potamogeton pusillus* | F, I, S*,C | F*(All) | | | F* |
| *Potamogeton zosteriformis* | F, I, S*,C | F*(Seeds) | | | F* |
| *Ranunculus longirostris* | F | F(Seeds, Foliage) | | F | |
| *Zosterella dubia* | F, C, S | F(Seeds) | | | |
| | | | | | |
| **Floating-leaf Plants** | | | | | |
| *Lemna minor* | F | F*, I | F | F | F |
| *Spirodela polyrhiza* | F | F | | F | |
| *Wolffia columbiana* | | F | | | F |
| | | | | | |
| **Emergent Plants** | | | | | |
| *Leersia oryzoides* | | F | | | F |
| *Scirpus validus* | F, C, I | F (Seeds)*, C | F(Seeds, Tubers), C | F (Seeds) | F |
| *Typha latifolia* | I, C, S | F(Entire), C | F(Seeds), C, Nest | Nest | F* (Entire C*, Lodg |

**F=Food, I= Shelters Invertbrates, a valuble food source C=Cover, S=Spawning**
***=Valuable Resource in this category**
**Species Name Highlighted - Occurred in 1994, but not found in 2003**
*Current knowledge as to plant use. Other plants may have uses that have not been determined.

After Fassett, N. C. 1957. A Manual of Aquatic Plants. University of Wisconsin Press. Madison, WI

Nichols, S. A. 1991. Attributes of Wisconsin Lake Plants. Wisconsin Geological and Natural History Survey. Info. Circ. #73

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). Jersey Valley Lake provided 100% cover within the littoral zone in 2003. This is greater than the ideal cover (about 25-85%) that supports a healthy fishery.

**Management Recommendations**

1) Preserve the natural buffer zone of native vegetation around the lake for the benefit of water quality and wildlife habitat.
2) Conduct water quality monitoring on Jersey Valley Lake to track any water quality impacts due to the invasion of Eurasian watermilfoil and its management.
3) Manage nutrient inputs from watershed sources by:
    a) reducing nutrient run-off from agricultural fertilizer applications
    b) reducing erosion in the watershed and around the lake
3) Implement management of Eurasian watermilfoil within Jersey Valley Lake. The colonization of Eurasian milfoil is too extensive to easily eliminate this species; therefore, management is the more feasible goal.
    **a) Chemical control with a selective chemical:** This option will likely be too expensive to maintain over the life of the lake and may result in controversy from park users. If chemical control is used, it should only be used in areas in which the milfoil is preventing a recreational use.
    **b) Cutting and/or Pulling by hand**: This option will likely be too time consuming for long term control. This option would likely only be feasible to maintain open water in the critical high-use areas e.g. the dock area and swimming area. Using divers to clip the mifloil at the sediment would fall in this category. Again, the milfoil is too extensive for this option unless divers are found that want to volunteer their services for dive practice.
    **c) Mechanical harvesting:** The closeness to shore of the milfoiil colonies precludes this option, unless combined with a winter drawdown.
    **d) Winter drawdown:** A drawdown before ice forms and that continues through at least 6 weeks of temperatures low enough to freeze the sediments will control Eurasian water milfoil will generally kill the milfoil in the area of the drawdown, plus 1.5-2 feet. A complete kill of the milfoil would require an 11-foot drawdown. However, a less extreme drawdown could be used in combination with another control method.

e) **Milfoil weevils:** These weevils are not likely in Jersey Valley Lake naturally because the lake does not have Northern mIlfoil (their native host plant). Weevils can be stocked, but they are expensive and if the panfish population is too high, they may end up as fish food. The weevils need abundant natural shoreline for winter hibernation, which Jersey Valley Lake can provide. Though expensive initially, they may be the best long-term control if the fish population is not a deterrent.

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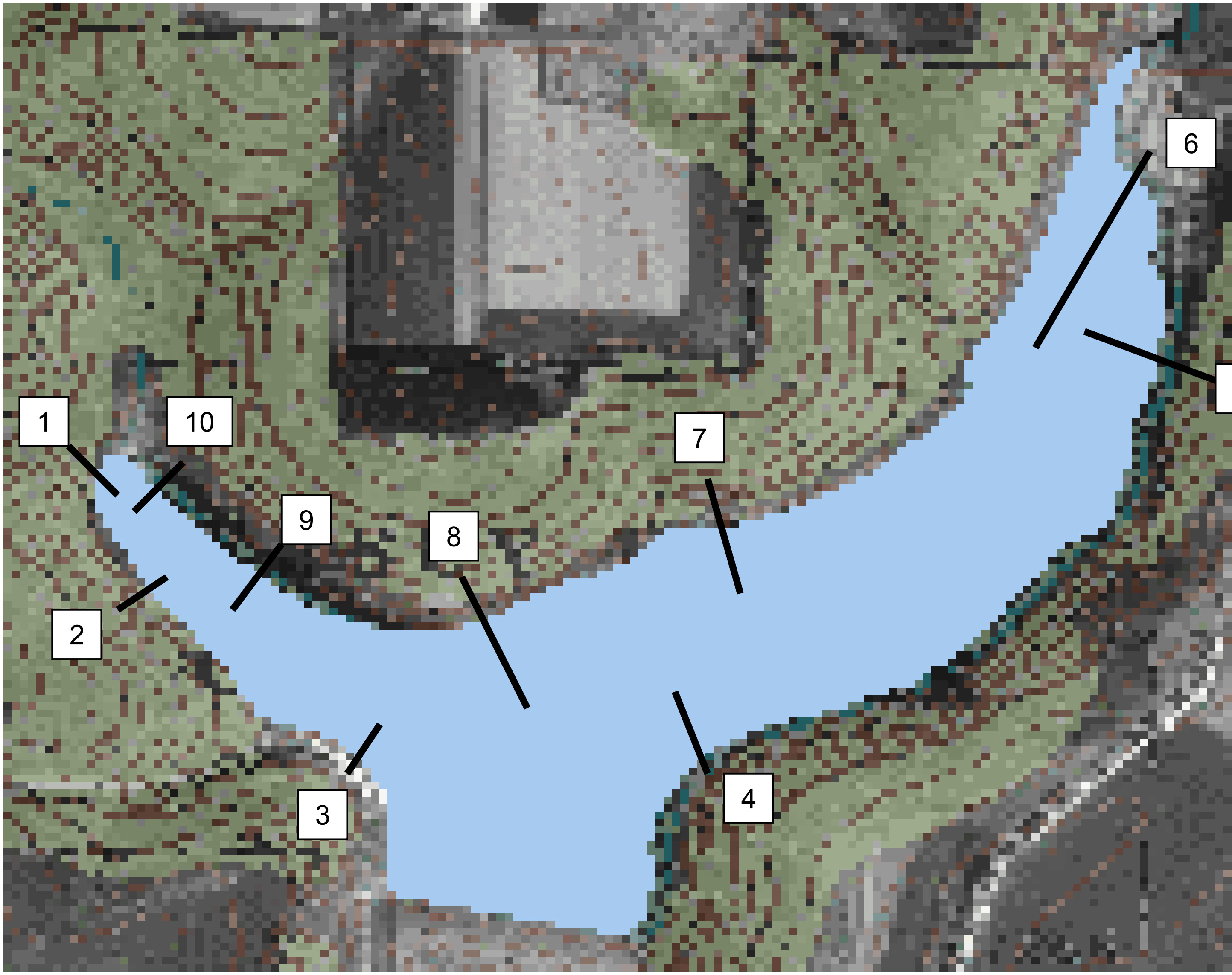
**Appendix VII. Distribution of Eurasian watermilfoil (*Myriophyllum spicatum)* in Jersey Valley Lake, 2003**




**Appendix IX. Location of study transects on Jersey Valley Lake, 1994-2003**