

		Estimated	Estimated		Total			
	Target	Per	Treatment	Treatment	Treatment	Treatment	Treatment	
	Species	Unit Cost	Area	Time	Events	Cost	Cost	
		USD (\$)	(acres)	(month)	(days)	USD (\$)	USD (\$)	
Plant Control Strategy								
Reward (Diquat Dibromide)	milfoil/curly	\$195		June	1	\$0		
Herbicide Combination	broad leaf	\$320		June or July	1	\$0		
Algaecide	fil-A	\$47		as needed	many	\$0		
Harvesting	pondweeds	n/a		July	10	n/a		
MI DEQ Permit Fee						\$800		
Estimated Total Cost of Program Implementation							\$800	
						Estimated	Estimated	
						Cost	Cost	
						USD (\$)	USD (\$)	
Lake Monitoring and Management Planning								
						\$6,182		
						\$2,000		
Estimated Total Cost of Monitoring, Planning, and Communications							\$8,182	
TOTAL ESTIMATED COST							\$17,164	

## 2006 Lake Ogemaw MANAGEMENT PLAN UPDATE

### Large Submersed Plant Management Overview

Conditions in Lake Ogemaw are considered to be very good relative to other Michigan inland lakes. The exotic, invasive species of milfoil has been suppressed and does not appear to impede the proliferation of more desirable species. The emergence of milfoil genotypes that exhibit differing responses to herbicides may compromise the long-term effect of the management programs. Management efforts will be required to provide adequate milfoil suppression through 2008.

Wild celery was the greatest nuisance plant in Lake Ogemaw in late summer 2007. It was considered to be a serious aesthetic and recreational nuisance. There are no consistent, effective treatments known for the management of this plant. Nearly every conceivable combination of herbicides have been used on Lake Ogemaw in the past for the control of this plant. New combinations will be used in 2008 in hopes of finding a more reliable management strategy for this weed.

Starry stonewort is beginning to spread in Lake Ogemaw. MI DEQ restrictions prevent lake communities from implementing effective management strategies for this plant, even though it is an exotic, invasive species that poses a real threat to the fishery. The MI DNR and industry professionals are seeking relief from the unreasonable policies of the MI DEQ in this regard.

### Invasive Plant Species Management:

The combination of contact herbicides, based on diquat dibromide, should be applied at a low dose for the selective control of milfoil and curly leaf pondweed as soon as water temperatures reach 60°F just above the bottom sediments in water that is 3' deep. Typically, these conditions are present in early June. A late season application of contact herbicides is also recommended for the management of wild celery in late July.

### Other Nuisance Plant Species Management:

There are several species of submersed plants that are generally considered to be preferred species in lakes, but that are also known to grow at nuisance levels. Sometimes, the production of these plants can be so great that they are considered to be invasive and crowd out other plants resulting in a loss of biodiversity. The reasons for this abnormal growth are not clearly understood; however, anecdotal evidence suggest that nuisance growth may be attributed to specific genotypes. When preferred species growth attains nuisance proportions, action must be taken to insure that lake management goals are not compromised. Unfortunately, many of these species are difficult to control and even more difficult to control selectively. Broad leaf pondweed or variable pondweed is likely to grow to nuisance levels in Lake Ogemaw in 2007. Unfortunately, highly selective vegetation management strategies are not available for these plants. Consequently, management initiatives must be restricted to as small an area as possible. Combinations of contact herbicides can be used to suppress the production nuisance pondweed, but these combinations of herbicides can also suppress the production of other preferred species. Still, these herbicide combinations are recommended. The Michigan DEQ does not usually issue permits for the control of either of nuisance pondweed species in off shore areas.

Filamentous algae is a common problem in most southeastern Michigan lakes. Nuisance production is usually isolated and restricted to shoreline areas. Several small treatments may be required during a season to prevent problems from developing near boat docks and swimming areas.

**AQUEST TIP:**

**Rationale for Managing Aquatic Vegetation**

The need to manage aquatic vegetation arises when vegetation cover and biomass become sufficiently high to disrupt the natural balance of a lake and interfere with recreation. This type of growth is often referred to as nuisance or invasive. Excessive growth of aquatic plants interferes with nearly all forms of recreation and causes many biological problems. Dense plant growth at the water surface impedes exchange of gases between the air and water, thereby contributing to nighttime dissolved oxygen depletion and large daily pH fluctuations, conditions which are detrimental to fish and other aquatic life. Production of desirable sport fish (e.g., largemouth bass) is maximized at intermediate levels of plant cover and biomass. Excessive plant cover makes it difficult for larger fish to capture smaller food fish, which can lead to reduced production of larger piscivorous fish and to stunted populations of small forage fish.

Invasive exotic aquatic plants (i.e., plants that do not naturally occur in the same geographical area) often produce particularly severe problems. Exotic species, such as Eurasian watermilfoil (*Myriophyllum spicatum* L.) and curly leaf pondweed (*Potamogeton crispus* L.), expand rapidly to supplant native vegetation and form dense monospecific beds. Compared with most native aquatic plants, these exotic species concentrate their stems and leaves at the water surface. Thus they interfere with recreation to a much greater degree than comparable quantities of native plants. Not all lakes are equally likely to be severely affected by invasive exotic plants. Generally lakes that are characterized by highly developed shorelines and lakes that are subjected to intense recreational use are most susceptible to invasive species problems.

At moderate density levels, aquatic plants provide important benefits to the lake, including sediment stabilization, invertebrate habitat and cover for small fish. Thus, management of problem aquatic plant growth should be carried in such a way as to preserve desirable aquatic vegetation or preferred plant species. Most preferred species are characteristic of stable, undisturbed ecosystems and are not usually considered to be nuisances. Effective aquatic plant management can preserve beneficial aquatic vegetation in a number of ways. Selective techniques control problem species with minimal effect on desirable ones. Desirable vegetation can also be preserved by limiting the application of control techniques to areas where they are needed. In general, some areas in every lake should be set aside for little or no management in order to preserve species that are sensitive even to selective controls.

## Broad Leaf Pondweed:

The pondweeds (except the exotic curly leaf pondweed and sago pondweed) are generally considered to be preferred species in Michigan inland lakes. Most pondweeds are considered to be conservative species with “c” values exceeding 5. They do not typically form large monotypic plant stands, grow at high densities, or contiguous distribution patterns as do many of the opportunistic, and invasive species. Broad leaf pondweed is usually considered to be a conservative species with a “c” value ranking of 7. However, broad leaf pondweed has been found to spread rapidly in some lakes where milfoil has been effectively suppressed. In some cases broad leaf pondweed has appeared to be far more invasive than expected and has formed large monotypic meadows where it has eliminated other plant species production. This growth pattern is inconsistent with the goals of the Lake Ogemaw management plan. Pondweed species are known to freely hybridize and is quite possible that a broad leaf pondweed hybrid or genotype is emerging as a new invasive species in Michigan lakes. Broad leaf pondweed (as variable pondweed) was observed at 78% of all BAS’s in Lake Ogemaw in 2006. Broad leaf pondweed production must be closely monitored in Lake Ogemaw and corrective actions would be indicated if it is found to negatively impact the biodiversity of the Lake Ogemaw flora.

## Nuisance Algae Production:

The bio-geochemistry of Lake Ogemaw does not appear to be predisposed to the production of nuisance phytoplankton populations. Phytoplankton production is strongly and positively correlated with fisheries production. Unfortunately, the production of toxic blue green algae (Cyanobacteria) is enhanced by the presence of zebra mussel. It is inevitable that Lake Ogemaw will be infested with zebra mussel and that the potential for nuisance blue green algae blooms will increase. These algae represent a health risk for swimmers and those who may be exposed to aerosols from irrigation systems that use water containing these noxious algae. Large-scale blue green algae blooms have been reported; however, the presence of zebra mussel suggests that the lake is at risk. Every effort must be taken to prevent the domination of the Lake Ogemaw planktonic flora by these noxious organisms. Aquest is a cooperator in a study of blue green algae selective suppression methods. Michigan DEQ road permitting blocks must be overcome before any of the proposed methods can be used in Michigan.

### ***AQUEST TIP:***

#### **Blue Green Algae Concerns**

Blue green algae are becoming an important issue for many riparian property owners. Recent studies have revealed disturbing findings regarding the toxicology of substances made and released into the water by these nuisance algae. These substances can seriously threaten the public health and poison pets and wildlife. Studies are in progress related to the potential risks that the lake users may encounter when exposed to blue green algae blooms. Riparian property owners are urged to not panic, but take some precautions. Until these studies are completed, it is recommended that persons not swim in waters where blue green algae blooms are evident. These conditions would include blooms where it appears that green latex paint has been spilled on the water, or that the water in enclosed bays is covered by an oil slick. Blue green algae blooms are usually temporal events and may disappear as rapidly as they appear. Riparian property owners should learn to recognize blooms and act accordingly.

### ***AQUEST TIP:***

#### **Water Quality Protection**

Nuisance algae blooms and suspended sediment problems can be abated by “slowing the flow” of water off of the landscape. When runoff is channeled through dense vegetation or structure, such as rocks or cobbles, sediments can settle out and phosphorus (an algae growth stimulant) can be extracted from the runoff water before it reaches the lake where it can degrade water quality. It is also a good idea to limit or ban the use of phosphorus containing fertilizers in areas that drain into lakes.

## Selected Plant Species and Other Considerations

### Nuisance Plant Production:

Nuisance plant production has been a persistent problem in Lake Ogemaw for decades, according to reports from lake side residents. Eurasian watermilfoil or a hybrid may have reached nuisance levels in the 1980's but has been effectively suppressed through the judicious use of aquatic herbicides. It was present in most parts of the lake throughout 2006 and nearly the entire lake in 2007. Despite being spread throughout the lake, it was not particularly conspicuous. Continued management will be required to prevent this plant from becoming a serious nuisance.

Aquest Corp. discovered the presence of a hybrid milfoil in Michigan in 2003. Studies are being conducted to identify the genotype of the milfoil found in Michigan Lakes. Some of the milfoil hybrids appear to be more tolerant of the common aquatic herbicides than other genotypes. The genetic identity of plants is now becoming an increasing concern for lake managers and lake communities. Preliminary data suggests that the milfoil in Lake Ogemaw is now a hybrid type.

Starry stonewort was discovered in the lake in late 2006. This plant has eliminated nearly all competing plant growth in some lakes where it is found in SE Michigan. Starry stonewort does not appear to exhibit the habits in Michigan that it manifests in other parts of the world. It is being closely monitored. In some lakes, it has been found to destroy spawning habitats. The unrestricted spread of this plant is expected to have a dramatic impact on the fishery of Lake Ogemaw.

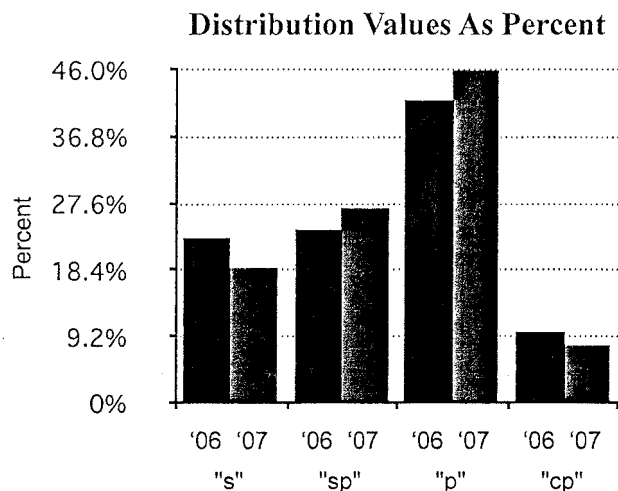
There are also some concerns regarding "native" Michigan species that are demonstrating an increasing propensity to grow at nuisance levels in Michigan inland lakes. A form of Broad leaf pondweed has demonstrated the ability to thrive in ecologically disturbed conditions, beyond all expectations. The spread of a "super" genotype or "super pondweed" hybrid could have negative impacts on the biodiversity and stability of Lake Ogemaw. This plant must be closely monitored.

### Milfoil:

Milfoil was found in nearly all BAS in 2006 and 2007, even after it was treated with selective agents. The last survey of the season suggested that the plant never really was killed or removed from the lake. It is expected that milfoil production will constitute a significant nuisance in 2008. The emergence of herbicide tolerance in milfoil populations provides a strong argument for the use of a wide variety of selective agents to prevent the emergence of a dominant biotype that is tolerant of a single herbicide. A combination of contact herbicides is recommended for 2008.

### Curly Leaf Pondweed:

The production of curly leaf pondweed can be as noxious as milfoil. Fortunately, it has been effectively managed in Lake Ogemaw. It was disturbing to find it in 11% of all BAS in September 2006; however, the plant was not considered to be a significant nuisance in 2007. It is difficult to determine how serious a nuisance it may be in 2008.

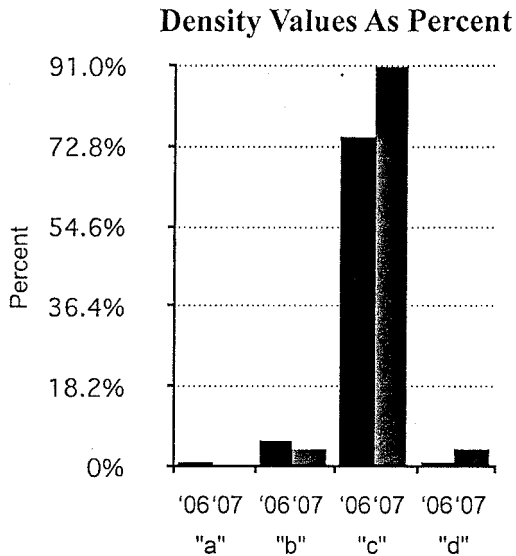


**Distribution:**

Open space is generally considered to be a desirable feature in plant communities because it can contribute to habitat complexity by creating more “edge”. Plant distributions must be considered within the context of plant height and the diversity of leaf type. Scattered “s” and scattered patch “sp” distributions are generally considered to be the most desirable distribution patterns for recreation and fisheries and wildlife considerations. Contiguous patches “cp” of vegetation are not necessarily negative if the plant are forming dense meadows of low-growing vegetation that carpets the bottom of the lake. Contiguous patch distribution is extremely undesirable when the plants are growing at the water surface.

Figure 5.1b The mean distribution value of the Lake Ogemaw submersed flora, expressed as percent of BAS's where the value was determined (see text for description of values).

Most of the plant species observed in Lake Ogemaw in 2006 and 2007 were found to have adopted a patchy distribution pattern. Still, the data set showed a good blend of different distribution types. These distribution values appear to be very good and provide good edge effect for the fishery.



**Density:**

It is generally preferred that most plant species be found at "b" or "c" level densities which indicate that most of the plant species present in the lake are capable of inhabiting many areas of the lake and that species richness numbers are not merely inflated by rare species confined to narrowly defined habitats.

Figure 5.1a The mean density value of the Lake Ogemaw submersed flora, expressed as percent of BAS's where the value was determined (see text for description of values).

**Plant Density**

It is important to note that plant mean density is based on how dense a plant stand is at the time of observation rather how dense plants are throughout the lake. Many species were found to be present in more than 50 % of the BAS's and many of these plants were found at a common or "c" level. This value should be considered to be very good. The potential spread of starry stonewort is disconcerting and may result in a shift toward more "d" level densities at more of the BASs.

# Plant Community Quality

## 5.1 Distribution and Density

### Plant Distribution and Density:

The quality of the plant community can also be considered from the perspective of density and distribution. Density and Distribution are subjective values that are used to describe how much vegetation is observed per unit area and how it distributed within the BAS. Field data are evaluated as follows:

#### Density Values

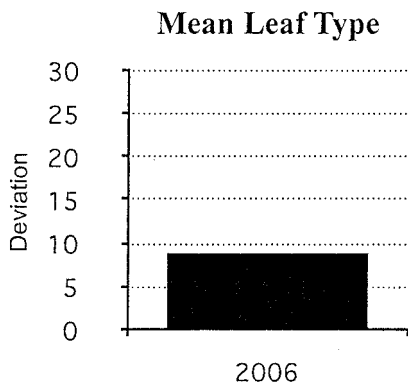
- Density "a" Rare: The plant species has been observed; however, it is unlikely that the plant could be found again if the observer were to return to the observation site.
- Density "b" Present: This designation is an artifact from methods used in the early 1990's and should not be used. It is listed here; however, because the term is still used by the MI DEQ. The "b" value is used instead of the "c-" value that is used in the field. This value is used to describe plants that could be found if the observer were to return the observation site, but the plant is not common or dominant in the observation zone.
- Density "c" Common: This term is used to describe plant species that are common throughout the observation site.
- Density "d" Dense: This term is used to describe the production of a species or perhaps several species that totally dominate the observation site where they form dense low-growing meadows or impenetrable surface mats of vegetation.

#### Distribution Values

- Distribution "s" Scattered: The plant is observed to be randomly scattered around the observation site, usually as a single plant or small clump of plants comprised of several stems.
- Distribution "sp" Scattered Patches: The plant is observed as clumps of several plants scattered around the observation site.
- Distribution "p" Patchy: The plant is observed to cover large patches or areas within the observation site; however, the plant does not cover more than 50% of the total area.
- Distribution "cp" Contiguous Patches: This term is used to describe plant growth that is usually dense and where places that are not occupied by the described species appear to be patches within the mass of vegetation produced by the described species.

# Plant Community Quality

## 4.3 Mean Leaf Type



### Leaf Type Variation

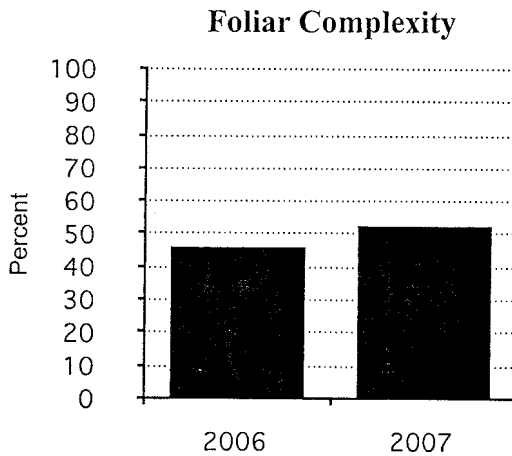
Variability in leaf type is probably another important plant community characteristic to consider from the perspective of fisheries and wildlife habitat values. Presumably, the greater the variation in leaf type, the better the plant community for the support of fisheries and wildlife values.

Figure 4.3. Lake Ogemaw submersed macrophyte community mean morphotype.

PLEASE NOTE: This matrix is currently being developed. It is not yet possible to characterize these data.

# Plant Community Quality

## 4.2 Vegetation Morphological Complexity



### Percent Leaf Type:

The variety of leaf type and morphometry of the plant species found in the plant community can also be used as a measure of plant community quality. Studies have shown that fisheries production and quality is greater where plant communities are considered diverse in terms of leaf type and plant morphology.

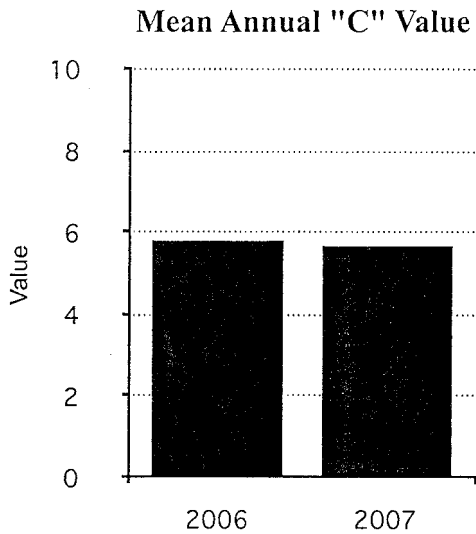
Figure 4.2. Submersed macrophyte community leaf complexity or morphotype is presented for Lake Ogemaw.

### Percent Leaf Type

The vegetation, leaf type complexity appears to be excellent in lake Ogemaw. This index has only recently been generated and it is difficult to compare the value to other lakes.

# Plant Community Quality

## 4.1 "C" Value



### "C" Values:

Submersed plant communities that are dominated by conservative, rather than opportunistic species are generally considered to be more desirable by persons who use lakes for a variety of purposes. Lakes that are dominated by opportunistic species are generally considered to be "too weedy". A "c" value (coefficient of conservatism), ranging from 1 to 10, is assigned to each species to describe how likely a plant is to be found in either disturbed or conservative (stable) ecosystems. Opportunistic plants, that are more tolerant of cultural disturbance are usually considered to be the worst weeds and are assigned lower "c" values. Plant species found in stable, less disturbed lakes are not usually considered to be "weedy" and are

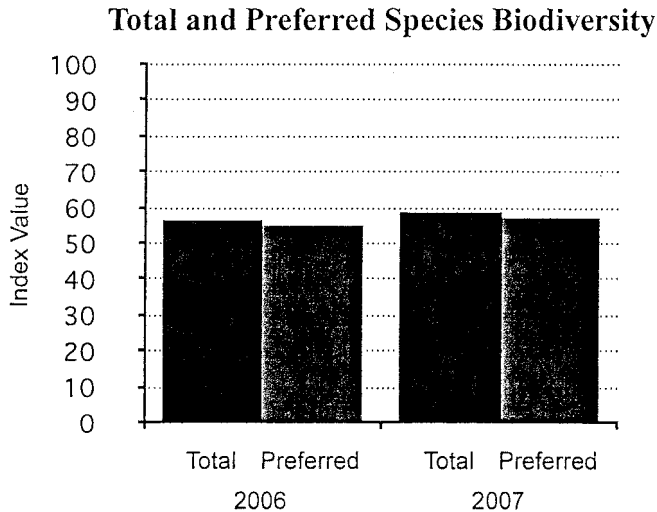
Figure 4. Lake Ogemaw macroflora mean annual "c" values.

### Plant Community Quality:

The quality of the plant community in Lake Ogemaw in terms of "c" value is considered to be excellent, relative to other lakes in the region. Higher "c" values suggest that the Lake Ogemaw ecosystem is also more stable than other regional lakes. The mean "c" value in Lake Ogemaw may decline in 2008 as preferred species are expected to cover less area than observed in previous years due to the spread of starry stonewort. Weedy broadleaf pondweed has been assigned a high "C" value that may not be merited. This plant will be closely monitored in 2008 and adjustments shall be made in the analysis if warranted.

# Plant Community Biodiversity

## 3.1 Total and Preferred Macrophyte Species Biodiversity



### Biodiversity Indices:

Biodiversity is a measure of the number of species present and the total number of BASs where the species are observed. This index is based on a widely accepted biodiversity index from the late 1950's. The higher the biodiversity value, the better. The lighter shaded bars represent the biodiversity calculated for desired species only and without nuisance species.

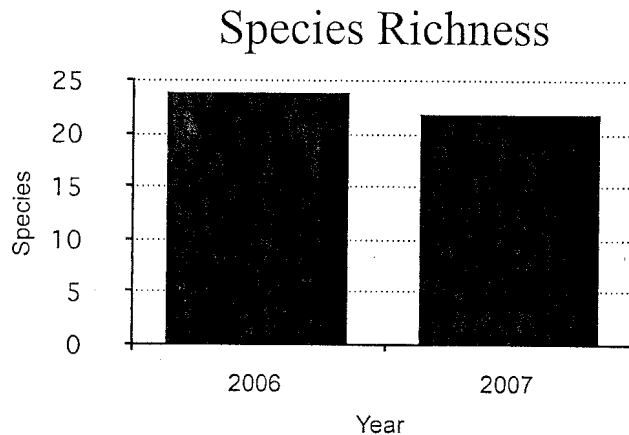
Figure 3.1 Total biodiversity and preferred species biodiversity (sans milfoil and curly leaf pondweed in dark black).

### Plant Community Biodiversity:

The relative biodiversity of Lake Ogemaw was high in 2006 and 2007 and is considered to be very good (Figure 3.). It is still expected that preferred species will not spread to more BAS's resulting in an increase in biodiversity in 2008 because starry stonewort is likely cause other species to decline.

# Plant Community Biodiversity

## 2.2 Total Macrophyte Species or Species Richness



### Plant Species Richness

The total number of plant species present in a lake is an important measurement when considered within the context of biodiversity estimates. The number of species may be high in a given lake but if this does not correspond with high biodiversity, it would indicate that there are species that are present, but at very low levels. Rarely are more than 20 macrophyte species found during a single survey event and it is rare that the total number of species found in an inland lake is greater than 25 during the course of the year.

Figure 2.2 The species richness (total number of species) in Lake

### Plant Species Richness (Total Species Present):

Twenty-four submersed aquatic plant species were found in Lake Ogemaw in 2006 and 22 were found in 2007. This value is considered to be incredibly high for a lake in the Michigan lower peninsula. A total of 28 species have been found in Lake Ogemaw, thus far. It appears that the plant community is very dynamic and species will change from year to year.

The species richness of tier 1 was slightly higher than tier 2 BAS's.

# Plant Community Biodiversity

## 2.1 Species Present and Percent Occurrence

SPECIES NAMES		% BAS WHERE PRESENT	
COMMON NAME	SCIENTIFIC NAME	2002	2007
1 Eurasian Watermilfoil	<i>Myriophyllum spicatum</i> L.		99
2 Green/Variable Milfoil	<i>Myriophyllum verticillatum</i> L. or <i>Myriophyllum heterophyllum</i> Michaux		31
3 Common Bladderwort	<i>Utricularia vulgaris</i> L.	99	40
4 White Water Crowsfoot	<i>Ranunculus</i> sp.		1
5 Mini-Bladderwort	<i>Utricularia</i> sp.	19	4
6 Coontail	<i>Ceratophyllum</i> sp.	1	0
7 Elodea	<i>Elodea</i> sp.	2	0
8 Chara/Nitella	<i>Nitella</i> sp.	82	47
9 Starry Stonewort	<i>Nitellopsis obtusa</i> L.		78
10 Tufted Nitella	<i>Nitella</i> sp.	28	
11 Water Moss	<i>Drepanocladus</i> sp. or <i>Fontinalis</i> sp.		33
12 Curly Leaf Pondweed	<i>Potamogeton crispus</i> L.	11	26
13 Flat Stem Pondweed	<i>Potamogeton zosteriformis</i> Fern.	1	4
14 Water Star Grass	<i>Zosterella dubia</i> (Jacq.) Small	1	
15 Robbins Pondweed	<i>Potamogeton robbinsii</i> Oakes	1	
16 White Stem Pondweed	<i>Potamogeton praelongus</i> Wulfen	73	54
17 American Pondweed	<i>Potamogeton nodosus</i> Poiret	11	
18 Variable Pondweed	<i>Potamogeton graminus</i> L.	78	3
19 Illinois Pondweed	<i>Potamogeton illinoensis</i> Morong	55	77
20 Broadleaf Pondweed	<i>Potamogeton amplifolius</i> Tuckerman	14	36
21 Weedy Broadleaf Pondweed	<i>Potamogeton</i> sp.		11
22 Floating Leaf Pondweed	<i>Potamogeton</i> sp.	1	1
23 Sago Pondweed	<i>Stuckenia</i> sp.	71	83
24 Wild Celery	<i>Vallisneria americana</i> Michaux	69	80
25 Waterlily	<i>Nymphaea</i> sp.	40	59
26 Spatterdock	<i>Nuphar</i> sp.	22	15
27 Water Shield	<i>Brasenia schreberi</i> J.F. Gmel.	2	1
28 Smartweed	<i>Polygonum</i> sp.	2	1

### Plant Species Occurrence

Table 2 is a listing of plants that were observed in the lake during the survey dates listed in the headings. The % of the total BAS where the plants were observed is listed. This percentage value is sometimes referred to as the percent occurrence for each species. This measurement can also be used for analysis of point intercept data and transected data sampled by a wide variety of means and methods. It is rare that the total number of species found in an inland lake is greater than 25.

Figure 1. Aquatic Vegetation Observations Sites (BAS) used to evaluate plant community matrices in Lake Ogemaw, Ogemaw County, MI.

## A SUMMARY OF CONDITIONS

### Results of the Aquest Aquatic Vegetation Community Assessment Method:

Aquatic vegetation grows in two distinct zones or Tiers in Lake Ogemaw that roughly correspond with increasing depth. Vegetation community observation sites were established in all three zones and are numbered to facilitate various analyses of plant community data by tier. The bioassessment sites (BAS) are depicted on Figure 1. By convention, the near shore BAS are considered collectively as part of the tier 1 zone and are referenced by numbers ranging from 1 to 228 on Figure 1. Some of the tier 1 BAS are very shallow, sandy, and plant-free because of wind, ice, and wave action and are strongly influenced by shoreline conditions and development. The tier 2 zone is characterized by deeper water and is generally more plant productive than the near-shore tier 1 BAS. The Tier 2 observation sites are numbered from 250 to 368 on Figure 1.

Observations were made at each of the observation sites depicted on Figure 1. Codes for species identification, density, distribution, and relative height are recorded in a manner to allow comprehensive data analysis. Each plant species is recorded by a specific number which assigned according to the plant morphotype. The position of the plant in the water column, density and distribution of plants are also noted on the survey map. A code form with descriptors is included in the appendix attached to this document.

### Total % Vegetation Cover of Aquatic Vegetation Observation Sites:

Aquest Method Vegetation Surveys were performed several times in 2007. The maximum area covered by any single plant species in each year was used to create a map of conditions that represent submersed plant growth for the entire year. All of the BAS's in all of the tiers supported plant growth in 2007 except for two BASs, located in tier 1. Milfoil was found to inhabit nearly every conceivable habitat and depth zone in Lake Ogemaw in 2006 and 2007 and was found in 93% and 99% of all BASs, respectively. The early season 2006 herbicide treatment did not appear to have killed the milfoil, but merely suppressed it's production throughout the remainder of the summer. Preferred pondweed species were found to inhabit nearly 3/4 of the total BASs in 2006 and 2007. The percent cover of most species varies tremendously from year to year. Preferred species cover was observed to be within acceptable limits.

Table 1. The total number of BASs assigned to each tier in Figure 1.

TIER	BAS TOTALS
Tier 1	228
Tier 2	95

algae production to support a reasonable fishery. Blue green algae blooms can be a public health concern. Efforts should be made to limit unnecessary nutrient loading in Lake Ogemaw because internal sources appear to be more than adequate to support a moderately productive freshwater fishery. Water quality conditions should be maintained or altered to favor the greatest degree of phytoplankton species diversity and if possible, restrict the production of harmful, blue green algae blooms.

### Other Considerations

The Lake Ogemaw fishery is an important resource for Lake Ogemaw residents. The vegetation and water quality management programs are intended to benefit all forms of recreation including fisheries production and angling opportunities by improving the quality of the flora and mitigating against conditions that may lead to the proliferation of blue green algae. The uncontained spread of starry stonewort will drastically reduce the utility of spawning areas and may result in a collapse of the fishery. This plant must be monitored closely and the fisheries protection program should be continued. Swimming and boating represent other key resource uses. The primary goal of the Lake Ogemaw Management Plan is consistent with the maintenance of conditions that will enhance opportunities for the pursuit of these recreational activities.

### Summary Management Opinion

#### *Primary Considerations*

- Lake Ogemaw is very plant productive; however, the distribution and density patterns of plants in Lake Ogemaw are considered to be very good. Milfoil, wild celery, and curly leaf pondweed require most of the management effort but other species also require some management in discrete areas of the lake. Starry stonewort and an emerging type of broad leaf pondweed are likely to require some effort to suppress nuisance populations in the shallow areas of the lake. Milfoil is also expected to be a very serious nuisance in 2008 and should be monitored and controlled.
- Select areas in the southern part of Lake Ogemaw received herbicide combination applications in 2006 for the containment of milfoil watermilfoil. These efforts were generally considered to be successful; however, they did not produce the same level of result in 2007. Milfoil continues to spread throughout the lake and was found in 99% of all observation sites in November 2007. Most plant community quality indices are expected to increase in 2007.
- Total planktonic primary production appears to be adequate to support a moderately productive fishery. There is an abundance of suitable spawning habitat to support a vibrant warm water fishery; however, the total spawning area is expected to decline sharply as starry stonewort spreads in the lake.
- Lake Ogemaw is considered to be susceptible to blue green algae blooms. Recent studies and anecdotal evidence indicate that the domination of plankton communities by blue green algae may be a result of filter feeding zebra mussel.

#### *Management Recommendations*

- Milfoil is expected to return to extreme nuisance levels in Lake Ogemaw in 2007. The milfoil in Lake Ogemaw may be a milfoil hybrid. It was discovered in 99% of all observation sites in 2007; however it was not a nuisance in every place it was observed. Starry stonewort management may be required to alleviate problems in fish spawning areas. The total area to be treated shall be determined in the Spring of 2007. Several preferred species exhibited a potential to grow at nuisance levels in 2007. Pondweeds may become a nuisance near boat docks where they can be managed with herbicides. Curly leaf pondweed, another exotic, opportunistic, invasive weed was not observed at nuisance levels in Lake Ogemaw in 2006 or 2007, but is expected to grow to nuisance levels in the coming years. Aggressive management effort is strongly recommended if this plant becomes significant nuisance in Lake Ogemaw. Some benthic algae (filamentous algae or chara) management may be required in 2007.
- Plant community monitoring must be continued in 2007 to monitor trends in ecosystem development. Most of the preferred species that dominated the lake in the late summer of 2006 are not expected to grow to extreme nuisance levels; however, a permit application for nuisance weed control should be submitted to the Michigan DEQ in case discrete treatment is required in areas of the lake.
- No opportunistic, nonnative, problem fish species were detected in the lake in 2006.

## Executive Summary

### Primary Goal of the Lake Ogemaw Management Plan

The primary goal of Lake Ogemaw Management Plan is to modify conditions within the lake to enhance species and habitat diversity and thereby stabilize the ecosystem by promoting the production of conservative species and inhibiting the production of those plants that are weedy or more opportunistic. The attainment of this goal is expected to foster conditions that will make Lake Ogemaw more resilient to the rapid proliferation and domination of the aquatic ecosystem by invasive nuisance species. Success will also enhance recreational opportunities, including the fishery and the cultural utility of the resource. Any applied management strategy will focus on mitigating against the effects of cultural disturbance and be applied in a manner to minimize further disturbance of the ecosystem.

### Proximal Management Goals

*Nuisance Plant Production Management:* The primary goal of the vegetation management plan is to mitigate against cultural and natural disturbances by modifying the quality of the Lake Ogemaw flora through the prescriptive use of selective plant management agents and strategies. In recent years, the submersed flora of Lake Ogemaw has been threatened by several invasive plant species. Selective plant management agents are used to suppress the production of opportunistic and invasive species that are prone to form monocultures and suppress the production of preferred, conservative plant species. Eurasian watermilfoil is currently present in the lake and has been a serious nuisance for many years. It has, however, been successfully suppressed. The density and distribution of Eurasian watermilfoil in Lake Ogemaw is being closely monitored. Wild celery is also invasive in Lake Ogemaw. Control efforts have yielded only modest results and MI DEQ restrictions on the total size of treatment zones make this plant the dominant nuisance in the lake in the later summer. A broad range of control strategies have been used for celery control in Ogemaw Lake. Starry stonewort is another invasive exotic plant (algae) species that was found in the lake in 2006. It appears to possess the ability to crowd out all other plant species found in Lake Ogemaw. It is also expected to have a dramatic impact on the fishery.

*Water Quality Management:* Water quality management is typically focused on matters related to lake fertility as they impact the production of suspended algae (phytoplankton) and the fishery. Lake Ogemaw is very shallow and water clarity can be impaired by storms that may suspend bottom sediments. The proliferation and production of zebra mussel is likely to play a significant role as a determinant of water transparency, plant nutrient dynamics, and ultimately, fisheries production. The spread of zebra mussels is typically accompanied by tremendous increases in water clarity and a shift to undesirable algae that are not consumed by the zebra mussel. The water clarity in Lake Ogemaw is already good and it does not appear that zebra mussel will cause the water to become noticeably clearer. A water quality study was performed by Aquest Corp. in 1999 and the results are appended to the end of this report.

Plant nutrient concentrations in the sediments are obviously capable of supporting luxuriant rooted plant production. Water column nutrient concentrations appear to be capable of supporting enough

#### **AQUEST TIP**

##### **Disturbed Aquatic Ecosystems**

##### Characteristics

- Noxious Plants and Algae
- Compromised recreational and utilitarian values
- Loss of aesthetic value
- Rapidly changing conditions, such as blooms of algae, plant monocultures, fish kills.

##### Common Disturbances

- Lake shore development,
- Watershed development,
- Pollution inputs (plant nutrients and sediments),
- Introduction of exotic organisms,
- Boating in shallow areas,
- Random, non-ecologically based management practices.

A Limnological Condition Assessment and Lake Management Plan Update for:

# Lake Ogemaw

Ogemaw County, MI

Plant and Water Quality Assessments Prepared by:

Dr. G. Douglas Pullman  
Aquest Corporation  
Flint, Michigan

November 2007