Gilbert Lake Aquatic Plant Management Plan 2006-2009

Prepared for:

The Gilbert Lake Advancement Association, Inc.

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Introduction

Gilbert Lake is a deep, clear lake of glacial origin located in northern Waushara County near the Village of Wild Rose. The lake is approximately one mile long and has 2.6 miles of shoreline. It covers 141 acres and has a maximum depth of 65 feet. Its steep, forested shorelines are predominantly upland and are heavily developed with year-around homes and summer cottages.

There are no inlets or outlets to the lake. Its primary water sources are groundwater seepage and surface runoff. Gilbert Lake tends to have very good water clarity, with Secchi disc readings averaging 16 feet. The waters of Gilbert Lake also tend to be very hard, with pH readings averaging 9.

The relatively large size of Gilbert Lake, along with its good water quality, scenic beauty, and adequate public access, attracts an abundance of power boaters, water skiers and swimmers. A quality fishery composed of largemouth bass, northern pike, walleye and panfish attracts a large number of anglers as well. Walleyes are present but are sustained through stocking. Trout were routinely stocked until the late 60's and then not again until 2004.

The Gilbert Lake Advancement Association represents the interests of riparian property owners and other lake users and assumes management responsibility for the lake. Since 1996, a primary management concern of this Lake Association has been the control of Eurasian watermilfoil (*Myriophyllum spicatum*), an exotic species that has invaded the lake.

This report summarizes recent management efforts directed at controlling Eurasian watermilfoil and provides recommendations for future management of aquatic plants in Gilbert Lake.

Recent Management Efforts

Herbicide treatments

An aquatic plant management plan was developed for Gilbert Lake in December 2000 (*Gilbert Lake Aquatic Plant Management Plan 2001-2005).* Recommendations that came about as a result of this management plan included, among other things, herbicide treatments for the control of Eurasian watermilfoil. Implementation of this plan began in May 2001, when 5.7 acres of the Eurasian watermilfoil in the lake was treated with Navigate® (granular 2,4-D) at a rate of 150 lbs/acre. A plant survey that was conducted the following September found that the treatment produced 100% control of Eurasian watermilfoil and had no negative impacts on native aquatic plants. In July 2002 a lake-wide plant survey likewise did not find Eurasian watermilfoil. In addition, no native species experienced declines. Native plants recolonized all areas where milfoil had been. Eurasian watermilfoil was not observed in Gilbert Lake again until September 2002, when several small plants were found. A June 2003 plant survey revealed Eurasian watermilfoil in 11 locations totaling 1.3 acres. Milfoil was not considered a nuisance, but was definitely expanding. In accordance with the management plan, all milfoil beds were treated with Navigate® at a rate of 100 lbs/acre. During a May 2004 survey, approximately 0.3 acre of Eurasian watermilfoil was found scattered along the shore of Gilbert Lake (**Figure 1**). However, no treatments were conducted in 2004. By May 2005, these areas had expanded to 3.3 acres (**Figure 2**). These areas were treated on May 24 with Navigate® at a rate of 100 lbs/acre.

Submergent Aquatic Plant Surveys
Beginning in 2000, annual submergent aquatic plant surveys were conducted. From 2000-2003 the surveys utilized a series of 18 transects (288 rake tosses) evenly spaced around the shore (Cason 2003). In 2004, DNR staff conducted a point intercept consisting of 224 points plotted across the lake, with one rake toss at each point (Provost 2004). Data collected during the aquatic plant surveys were used to determine species composition, percent frequency and relative abundance.

Exotic species mapping
A thorough Eurasian watermilfoil mapping effort was conducted on May 6, 2005. The location and extent of Eurasian watermilfoil and any other exotic species found were determined visually and by rake sampling. The dimensions of the beds, minimum and maximum depths, and distances from shore were measured and GPS coordinates of beds were recorded. GPS technology was then used to measure the area of the beds and plot their locations on a lake map.

Analysis of water quality data
Residents of Gilbert Lake have participated in volunteer water quality monitoring since 1986. For the past twenty years water transparency data have been collected on a monthly basis. In 1992 the collection of water samples for phosphorus and chlorophyll analyses began as well. And in 1993 volunteers began collecting dissolved oxygen and temperature data throughout the season. These data have been compiled in order to evaluate general water quality conditions in Gilbert Lake over the past 20 years.

Results and Discussion

Submergent Plant Community Characteristics

Since the 2004 aquatic plant survey utilized a different data collection method as the previous plant surveys, a direct statistical comparison of the data, as was performed in the 2003 management update (Cason, 2003), is not possible. However, the data do allow for useful comparisons. **Table 1** present the percent frequency of each species in the plant community. Results of this comparison show that musk grass (*Chara* spp.), slender naiad (*Najas flexilis*) and the native pondweeds (*Potamogeton* spp.) have long dominated the aquatic plant community. The data also show that since the lake-wide treatment of Eurasian watermilfoil began in 2000, milfoil has only been found at low occurrences. In

2004, the frequency of milfoil increased again. This is likely due to the lack of treatments in 2004, which allowed for the expansion of milfoil.

Table 1. Percent frequency calculated from aquatic plant survey data collected from 2000-2004.

		Percent Frequency				
Species	**Scientific name**	**2000**	**2001**	**2002**	**2003**	**2004**
Musk grass	*Chara spp.*	80.9	91.4	88.2	84.1	98.8
Slender Naiad	*Najas flexilis*	31.8	35.5	18.6	20.5	48.8
Illinois Pondweed/ Variable Pondweed	*Potamogeton illinoiensis/gramineus*	30.5	19.1	30	14.7	39.3
Floating-leaf Pondweed	*Potamogeton natans*	6.4	4.1	8.6	5.9	21.4
Variable-leaf Pondweed	*Potamogeton amplifolius*	--	--	--	--	19.1
Eurasian Milfoil	***Myriophyllum spicatum***	**20.9**	--	--	**1.4**	**11.9**
Sago Pondweed	*Stuckenia pectinatus*	3.6	6.4	4.5	--	11.9
Flat-stem Pondweed	*Potamogeton zosteriformis*	4.5	5.5	5.5	4	7.1
White Water Lily	*Nymphaea odorata*	0.5	0.9	1.8	--	7.1
Common Waterweed	*Elodea canadensis*		0.5	0.5	1.8	3.6
Northern Milfoil	*Myriophyllum sibiricum*	0.5	--	--	--	2.4
Large-leaf Pondweed	*Potamogeton amplifolius*	2.7	0.9	0.5	2.3	1.2
White-stem Pondweed	*Potamogeton praelongus*	--	--	--	--	1.2
Spatterdock	*Nuphar variegata*	0.5	--	--	5.9	1.2
Water Smartweed	*Polygonum amphibium*	1.8	0.9	1.4	0.9	--
Water Stargrass	*Zosterella dubia*	0.9	--	0.5	--	--
Filamentous algae	*Pithophora, Cladophora,* etc.	--	2.7	0.5	3.2	--
Wild Celery	*Vallisneria americana*	--	--	--	3.2	--

Eurasian watermilfoil distribution

Location	GPS Coordinates				Acreage
A	N44°	12.791'	W089°	09.503'	0.265
B	N44°	---	W089°	---	0.0006
C	N44°	---	W089°	---	0.0006
D	N44°	12.819'	W089°	09.691'	0.023
E	N44°	12.185'	W089°	09.775'	0.041
F	N44°	12.746'	W089°	09.929'	0.034
G	N44°	12.652'	W089°	10.305'	0.165
H	N44°	12.623'	W089°	10.340'	0.014
I	N44°	12.680'	W089°	10.587'	0.092
J	N44°	12.847'	W089°	10.565'	0.294
K	N44°	12.798'	W089°	10.302'	0.046
L	N44°	12.792'	W089°	10.234'	0.018
M	N44°	12.833'	W089°	10.051'	0.014
N	N44°	12.864'	W089°	09.597'	0.014
O	N44°	12.835'	W089°	09.521'	1.632

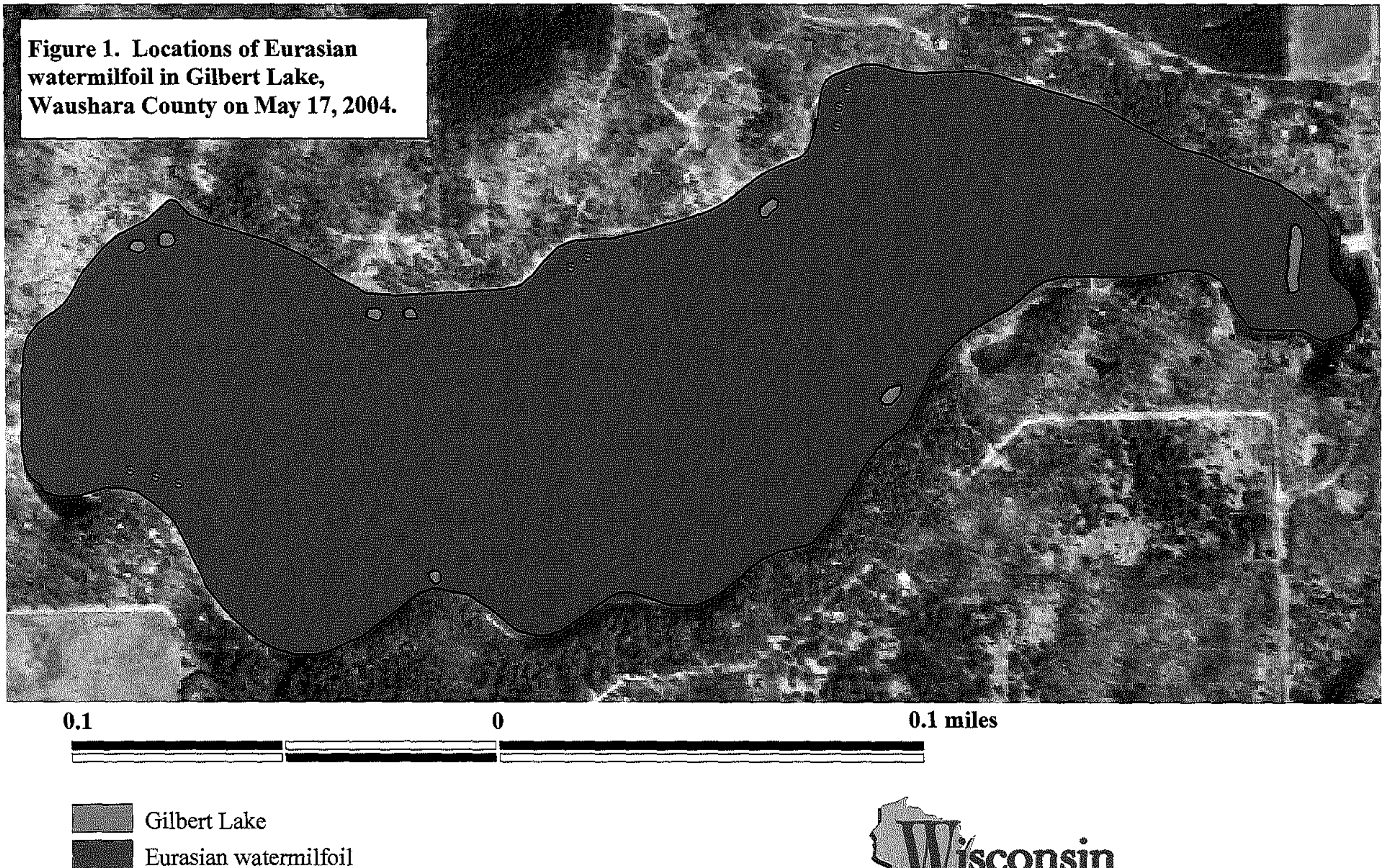

Figure 1. Locations of Eurasian watermilfoil in Gilbert Lake, Waushara County on May 17, 2004.

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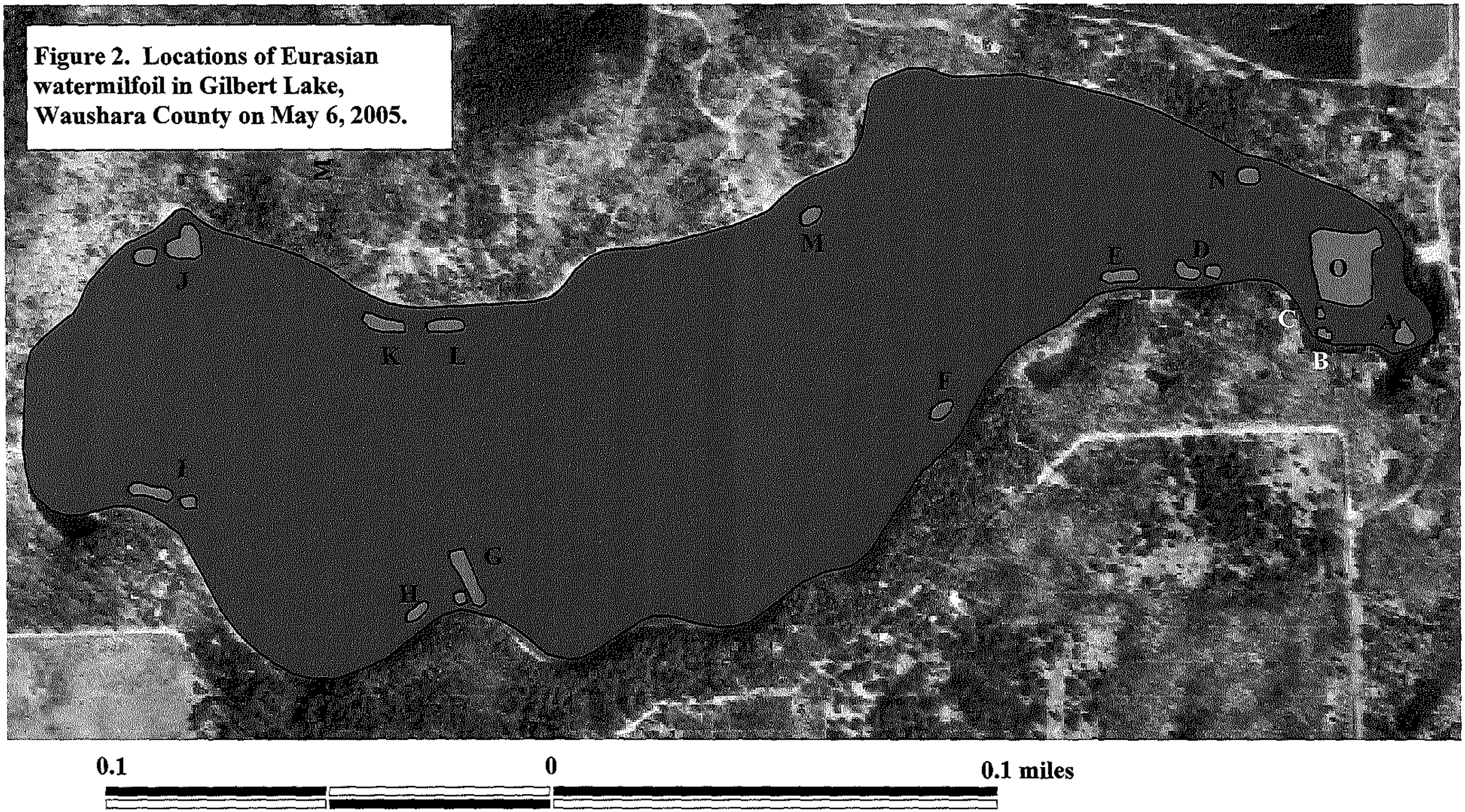


Figure 2. Locations of Eurasian watermilfoil in Gilbert Lake, Waushara County on May 6, 2005.

Gilbert Lake
Eurasian watermilfoil

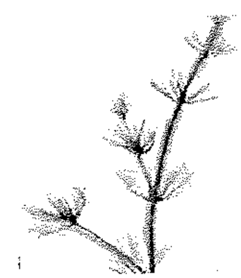
Wisconsin Lake & Pond Resource LLC

The Importance of Aquatic Plants

Aquatic plants serve an important purpose in the aquatic environment. They play an instrumental role in maintaining ecological balance in ponds, lakes, wetlands, rivers, and streams. Native aquatic plants have many values. They serve as important buffers against nutrient loading and toxic chemicals, they act as filters that capture runoff-borne sediments, they stabilize lakebed sediments, they protect shorelines from erosion, and they provide critical fish and wildlife habitat. Therefore, it is essential that the native aquatic plant community in Gilbert Lake be protected. The following is a list of common native aquatic plants that were found in Gilbert Lake. Ecological values and a description are given for each plant. Plant information was gathered from Borman et al. (1997), Eggers and Reed (1997), Fasset (1940), Fink (1994), Nichols and Vennie (1991), and Whitley et al. (1999). Images obtained from Schmidt and Kannenberg, 1998 and Borman et al., 1997.

Submersed Plants (Plants that tend to grow with their leaves under water.)

Musk grass (*Chara* spp.) is a complex form of algae that resemble a vascular plant. It is identified by its pungent, skunk-like odor and whorls of toothed branched leaves. Ecologically, this plant provides shelter for juvenile fish and is associated with black crappie spawning sites. Waterfowl love to feast on musk grass when the plant bears its seed-like oogonia. This species serves an important role in stabilizing bottom sediments, tying up nutrients in the water column, and maintaining water clarity.



Slender Naiad (*Najas flexilis*) also known as **bushy pondweed** has a finely branched stem that grows from a rootstock. Leaves are short (1-4 cm), pointed and grow in pairs. Slender naiad is an annual and must grow from seed each year. It tends to establish well in disturbed areas. Slender naiad is a one of waterfowl's favorite foods and considered very important. Waterfowl, marsh birds, and muskrats relish seeds, leaves and stems. Slender naiad stabilizes bottom sediment and offers cover for fish.

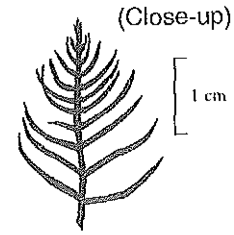
Illinois Pondweed (*Potamogeton illinoiensis*) and **Variable Pondweed** (*P. gramineus*) are very similar-looking perennial herbs that emerge from a rhizome. Their stout stems support lance-shaped leaves that come to a sharp point. Both of these pondweeds provide excellent cover for fish and invertebrates. Ducks, geese, muskrats, and beaver find most parts of these plants to be a tasty meal.

Elodea (*Elodea canadensis*) or **common waterweed** is made up of slender stems with small, lance-shaped leaves that attach directly to the stem. Leaves are found in whorls of two or three and are more crowded toward the stem tip. The branching stems of elodea provide valuable cover for fish and are home for many insects that fish feed upon. Elodea also provides food for muskrats and waterfowl.

Flat-stem Pondweed (*Potamogeton zosteriformis*) emerges from a rhizome, which has strongly flattened stems. The leaves are narrow and grow 4-8 inches long. Leaves contain a prominent mid-vein and many fine parallel veins. Ecologically, flat-stem pondweed provides a home for fish and invertebrates, and is grazed by waterfowl and muskrats.

Large-Leaf Pondweed (*Potamogeton amplifolius*) also referred to by fisherman as **cabbage weed**, is a perennial herb that emerges from a ridged black rhizome. This pondweed is the largest of all pondweeds. The sturdy stem supports large broad leaves that are numerously veined (25-37). Growing upright throughout most of the water column, large-leaf pondweed provides excellent shade, shelter, and foraging habitat for fish. Producing a large number of nutlets, cabbage weed is also valued by waterfowl.

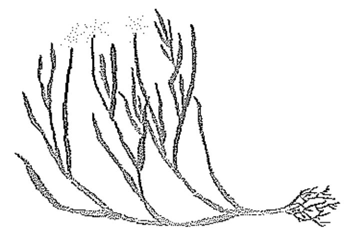
Northern Watermilfoil (*Myriophyllum sibiricum*) produces whorls of feather-like leaflets from a fairly stout stem. Northern watermilfoil is identified by its 5 to 12 pairs of leaflets that become progressively longer near the base of the leaf – giving the leaf a candelabra-like appearance. The leaves and fruit of this plant are eaten by a variety of waterfowl. Its finely divided leaves are habitat for numerous invertebrates that fish feed upon. Northern watermilfoil is an indicator of good water quality, as the plant seldom survives in more eutrophic environments



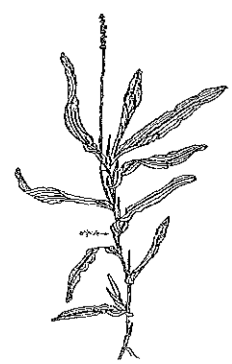
Floating Leaf Pondweed (*Potamogeton natans*) is a perennial that emerges from a red-spotted rhizome. Leaves that rest at the waters surface are heart shaped. Submerged leaves tend to be longer and skinnier than floating leaves. Fish find this pondweed to be useful for foraging opportunities and shelter. Growing upright in the water column, floating leaf pondweed attracts many aquatic invertebrates. Muskrats, ducks, and geese all graze on the plant.

Sago Pondweed (*Potamogeton pectinatus*) is a perennial herb that emerges from a slender rhizome that contains many starchy tubers. Leaves are sharp, thin, and resemble a pine needle. Reddish nutlets (seeds) that resemble beads on a string rise to the water surface in mid-summer. Sago pondweed produces a large crop of seeds and tubers that are valued by waterfowl. Juvenile fish and invertebrates utilize sago pondweed for cover.

Water Stargrass *(Heteranthera dubia)* resembles some of the narrow-leaved pondweeds. It is dark green to brown with thread-like leaves scattered on flexible stems. A close examination of the leaves will show that they have several veins but no obvious midvein. It reproduces from plant fragments. Water stargrass usually becomes abundant in late summer. It settles to the bottom in late autumn where it forms a decaying mat in the winter that provides habitat to many small aquatic animals. Water stargrass provides valuable habitat for fish and serves as a source of macroinvertebrates for fish.

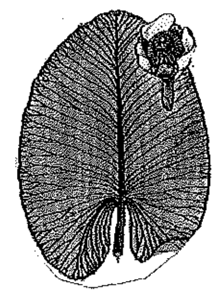


White-stem Pondweed (*Potamogeton praelongus*) has broad, wavy-edged leaves with stalkless leaf bases that wrap part way around the stem. The alternately arranged leaves have a distinctive boat-shaped tip. White-stem pondweed is often the first pondweed seen in early spring. No floating leaves are produced. White-stem pondweed provides good food and habitat for aquatic animals and waterfowl. It provides valuable food for trout and habitat for muskellunge in particular.

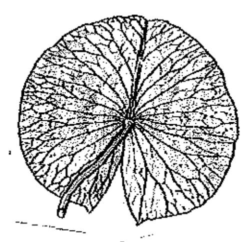


Wild Celery (*Vallisneria americana*) also known as eelgrass has long ribbon-like leaves that emerge in clusters. Leaves have a prominent central stripe and leaf tips tend to float gracefully at the water's surface. In the fall, a vegetative portion of the rhizome will break free and float to other locations. Wild celery is considered one of the best all natural waterfowl foods. The entire plant is relished by waterfowl, especially canvasbacks. Eelgrass beds serve as an important food source for sea ducks, marsh birds, and shore birds. Fish also find wild celery to be a popular hiding spot.

Floating Leaf Plants (Plants that are rooted in the bottom sediment and have leaves that float at the water's surface.)



Spatterdock (*Nuphar variegata*) is a perennial herb that produces yellow, rounded flowers. Large (4-10 inches) long, heart-shaped leaves float at the water's surface. Leaf stalks have flattened wings and emerge from a buried spongy rhizome. With large buried rhizomes, spatterdock helps stabilize bottom sediment. The large leaves also help buffer the impact of wave action on the shoreline. Like all lilies, spatterdock offers excellent fish habitat. Seeds are eaten by waterfowl; leaves, rhizomes, and flowers are relished by muskrats, beaver, and deer.



White Water Lily (*Nymphaea odorata*) emerges from a buried rhizome. Durable round stalks grow up from the rhizome. This perennial herb supports large round leaves (4-10 inches) wide that float at the water's surface. Leaves appear waxy green on top and reddish-purple on their undersides. By mid-summer, showy white flowers float at the water's surface. Lilies serve as important fish cover, especially for largemouth bass. White water lily seeds are eaten by waterfowl. Rhizomes, flowers, and leaves are consumed by muskrats, beaver, and deer. With large broad leaves, lilies also help prevent shoreline erosion by slowing wave action.

Exotic Aquatic Plants

The only invasive exotic plant identified in Gilbert Lake is Eurasian watermilfoil. The following description is given to promote awareness of this plant.

Eurasian Watermilfoil (*Myriophyllum spicatum*) produces long spaghetti-like stems that often grow up to the water's surface. Leaves are feather-like and resemble bones on a fish. 3-5 leaves are arranged in whorls around the stem, and each leaf contains 12-21 pairs of leaflets. At mid-summer small reddish flower spikes may emerge above the water's surface. Perhaps the most distinguishing characteristic though, is the plant's ability to form dense, impenetrable beds that inhibit boating, swimming, and fishing

Eurasian watermilfoil is native to Europe, Asia and Northern Africa. Of the eight milfoil (*Myriophyllum*) species found in Wisconsin, Eurasian watermilfoil is the only exotic. The plant was first introduced into U.S. waters in 1940. By 1960, it had reached Wisconsin's lakes. Since then, its expansion has been exponential (Brakken, 2000).

Eurasian watermilfoil begins growing earlier than native plants, giving it a competitive advantage. The dense surface mats formed by the plant block sunlight and have been found to displace nearly all native submergent plants. Over 200 studies link declines in native plants with increases in Eurasian watermilfoil (Madsen, 2001). The resultant loss of plant diversity degrades fishery habitat (Pullman, 1993), and reduces foraging opportunities for waterfowl and aquatic mammals. Eurasian watermilfoil has been found to reduce predatory success of fish such as largemouth bass (Engel, 1985), and spawning success for trout (*Salmonidae spp.*) (Newroth, 1985).

The continued spread of Eurasian watermilfoil can produce significant economic consequences. In the Truckee River Watershed below Lake Tahoe, located in western Nevada and northeastern California, economic damages caused by Eurasian watermilfoil to the recreation industry have been projected at $30 to $45 million annually (Eiswerth et al., 2003). In Tennessee Valley Authority Reservoirs, Eurasian watermilfoil was found to depress real estate values, stop recreational activities, clog municipal and industrial water intakes and increase mosquito breeding (Smith, 1971).

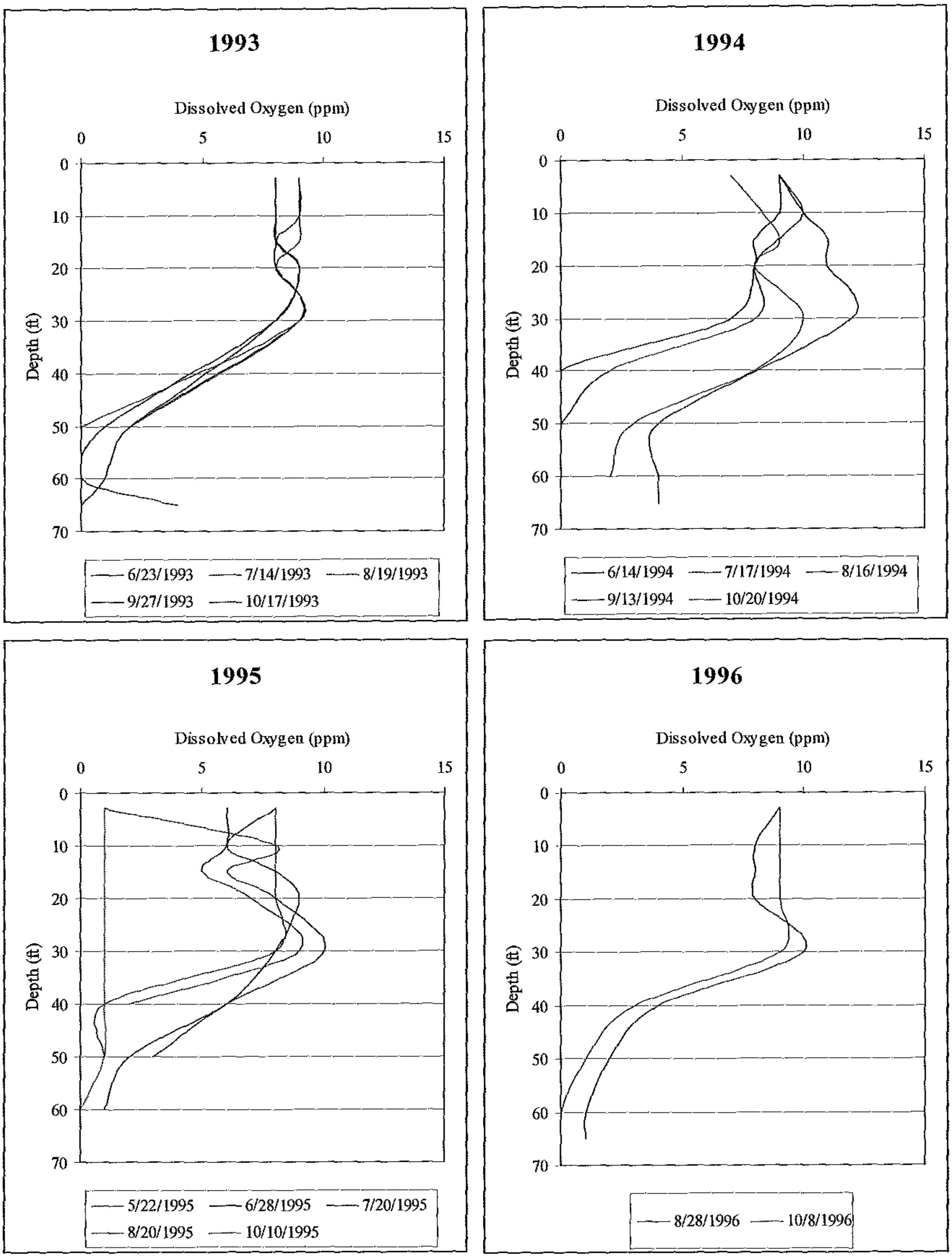
Eurasian watermilfoil has been found to reduce water quality in lakes by several means. Dense mats of Eurasian watermilfoil have been found to alter temperature and oxygen profiles – producing anoxic conditions in bottom water layers (Unmuth et al., 2000). These anoxic conditions can cause localized die-offs of mollusks and other invertebrates. Eurasian watermilfoil has also been found to increase phosphorus concentration in lakes through accelerated internal nutrient cycling (Smith and Adams, 1986). Increased phosphorus concentrations released by dead and dying Eurasian watermilfoil have been linked to algae blooms and reduced water clarity.

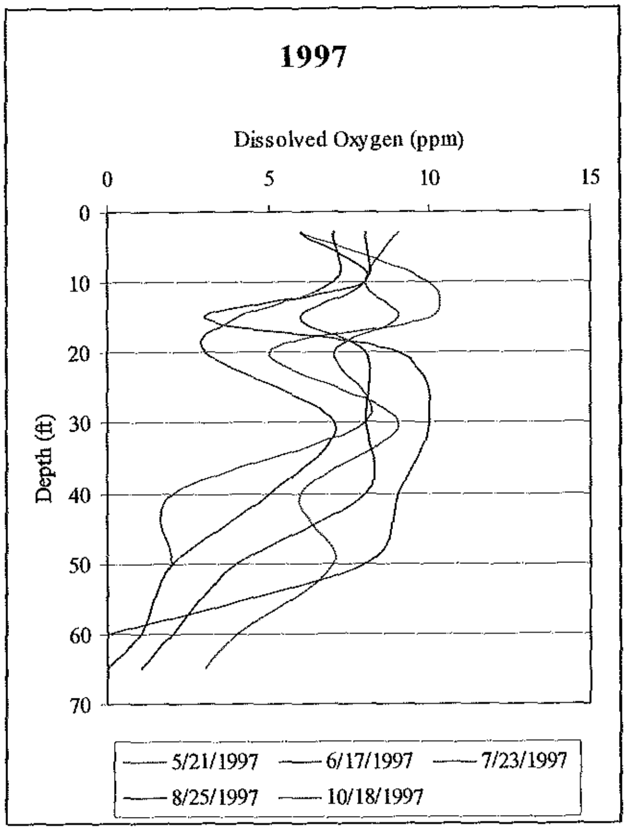
Water quality analysis

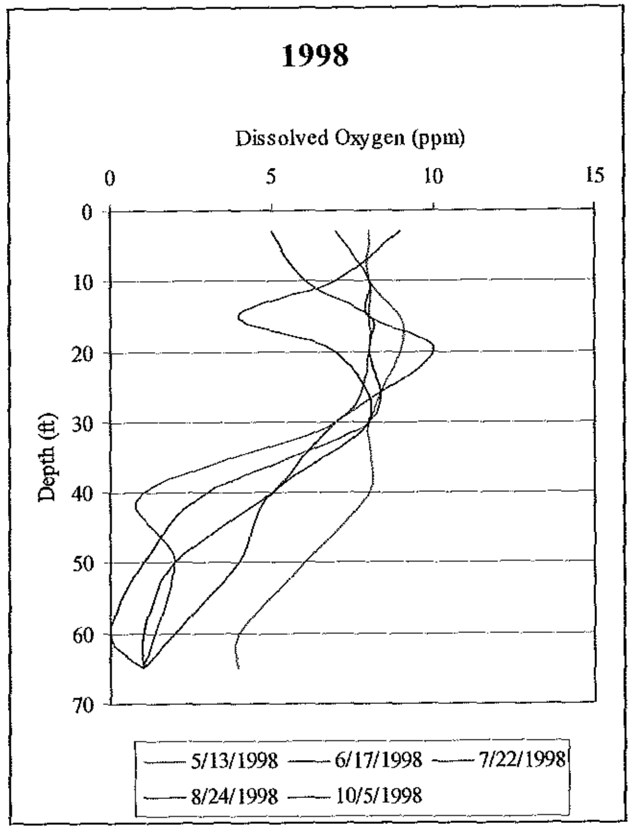
Dissolved Oxygen

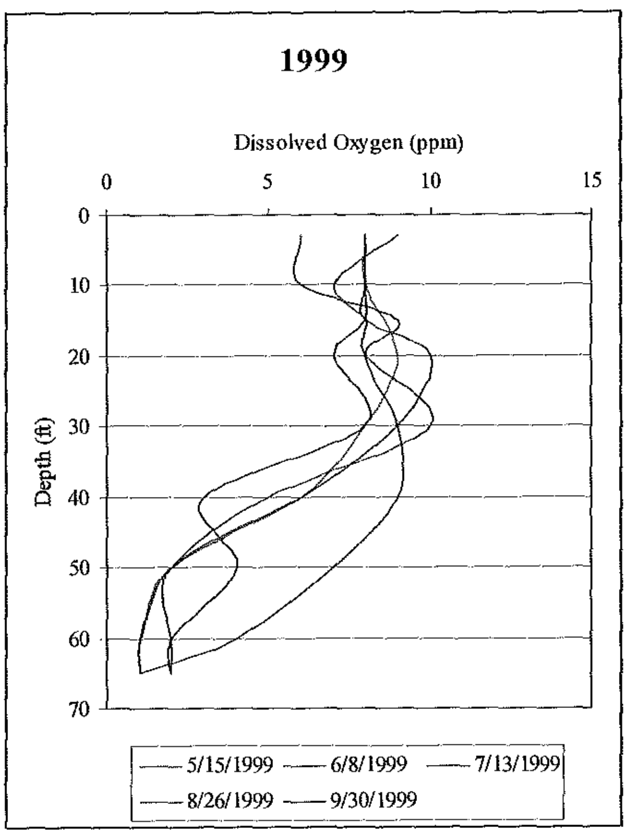
Dissolved oxygen data collected since 1993 for Gilbert Lake were used to develop annual profile graphs (**Figure 3**). Surface oxygen levels have been consistently between 5 and 10 ppm. As is evident in the profile graphs, the levels of oxygen start to decline at a depth of approximately 30 feet. This decline is often dramatic. This point, at which oxygen levels drop off, is referred to as the oxycline. Below the oxycline there is insufficient oxygen to support many fish species. The threshold level of oxygen needed for fish such as bass, perch, and sunfish to survive and grow is 5 mg/L. However, the lack of any significant fluctuations in oxygen content, both within a given year and from one year to the next, indicates a relatively stable lake environment.

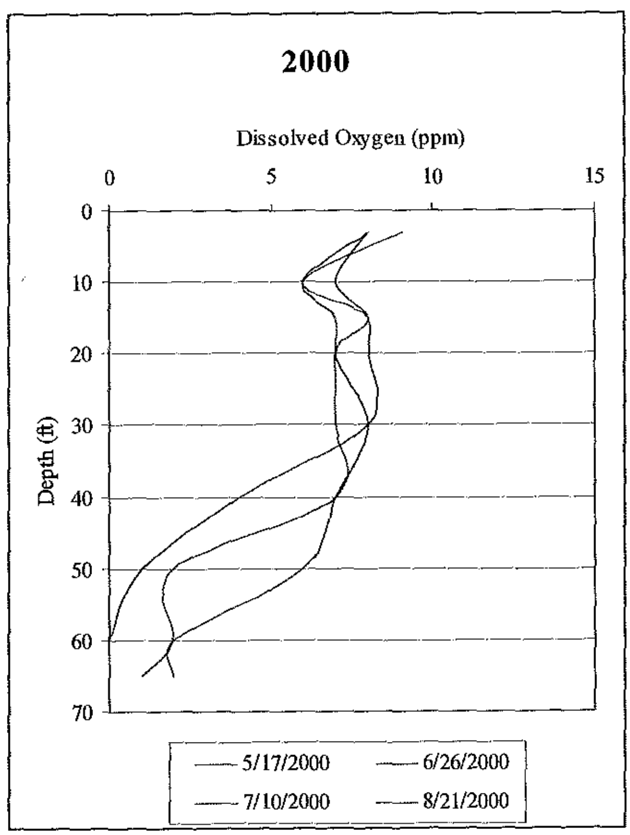
Figure 3. Dissolved oxygen concentrations found in Gilbert Lake.

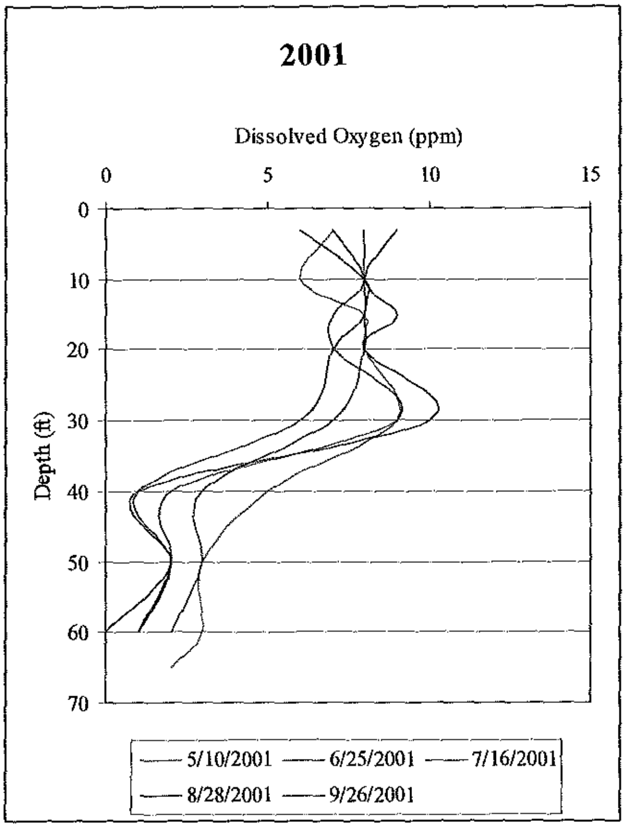


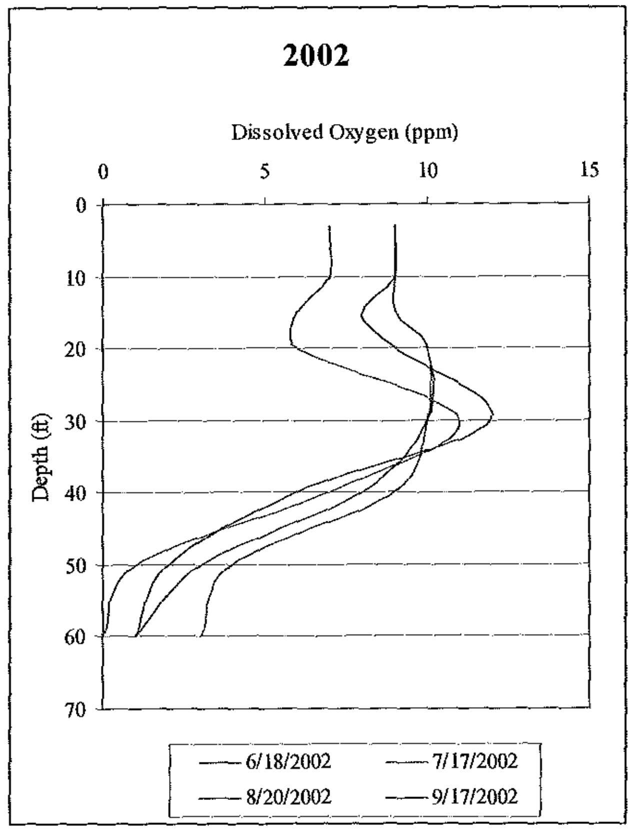

1997
Dissolved Oxygen (ppm)
0
5
10
15
0
10
20
30
40
50
60
70
Depth (ft)
5/21/1997
6/17/1997
7/23/1997
8/25/1997
10/18/1997

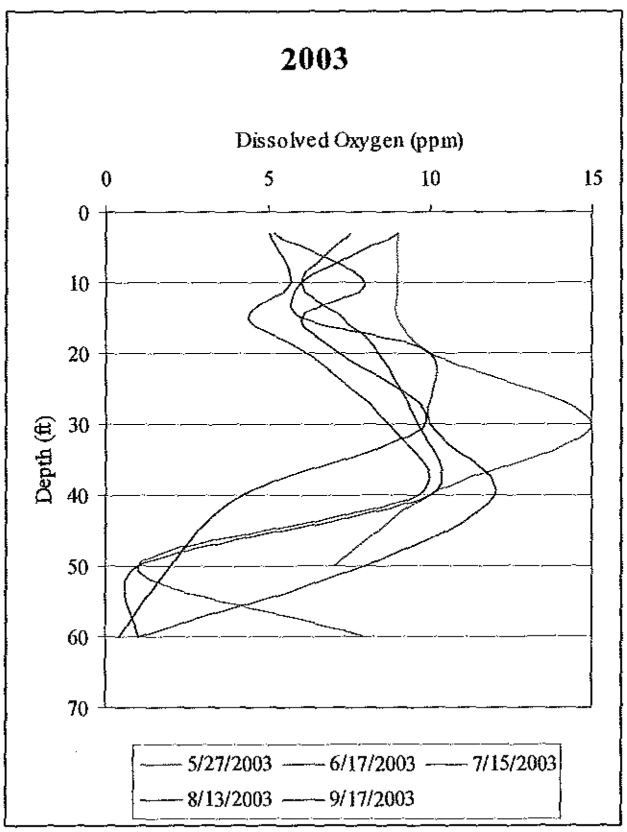

1998
Dissolved Oxygen (ppm)
0
5
10
15
0
10
20
30
40
50
60
70
Depth (ft)
5/13/1998
6/17/1998
7/22/1998
8/24/1998
10/5/1998

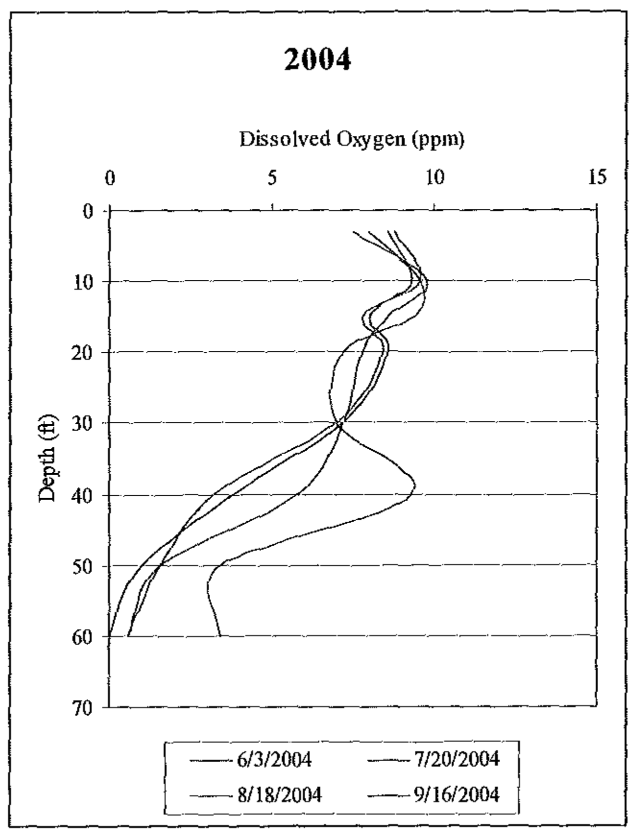

1999
Dissolved Oxygen (ppm)
0
5
10
15
0
10
20
30
40
50
60
70
Depth (ft)
5/15/1999
6/8/1999
7/13/1999
8/26/1999
9/30/1999


2000
Dissolved Oxygen (ppm)
0
5
10
15
0
10
20
30
40
50
60
70
Depth (ft)
5/17/2000
6/26/2000
7/10/2000
8/21/2000


2001
Dissolved Oxygen (ppm)
0 5 10 15
0 10 20 30 40 50 60 70
Depth (ft)
5/10/2001
6/25/2001
7/16/2001
8/28/2001
9/26/2001


2002
Dissolved Oxygen (ppm)
0 5 10 15
0 10 20 30 40 50 60 70
Depth (ft)
6/18/2002
7/17/2002
8/20/2002
9/17/2002


2003
Dissolved Oxygen (ppm)
0 5 10 15
0 10 20 30 40 50 60 70
Depth (ft)
5/27/2003
6/17/2003
7/15/2003
8/13/2003
9/17/2003


2004
Dissolved Oxygen (ppm)
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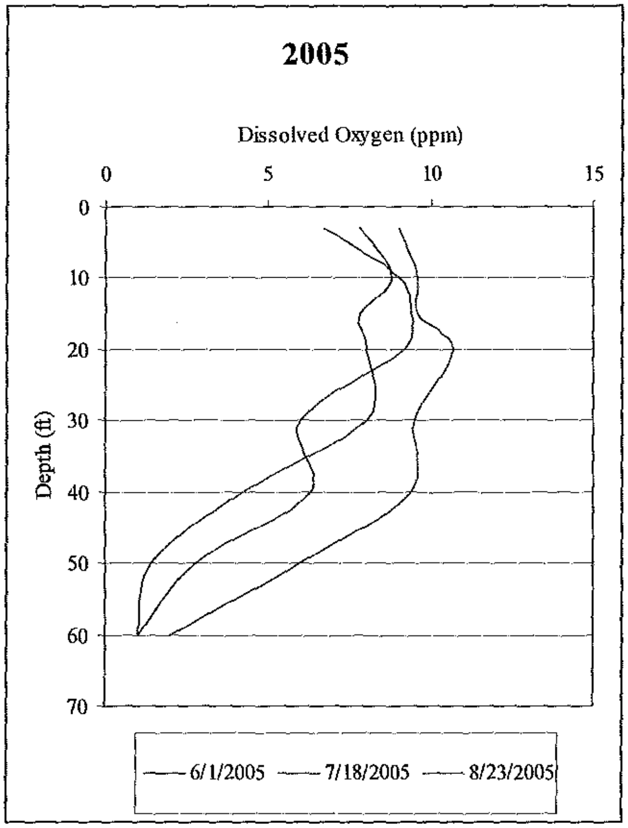
0 10 20 30 40 50 60 70
Depth (ft)
6/3/2004
7/20/2004
8/18/2004
9/16/2004



Trophic State

Lakes can be categorized by their productivity or trophic state. When productivity is discussed, it is normally a reflection of the amount of plant and animal biomass a lake produces or has the potential to produce. Many high productivity lakes are characterized by abundant algae growth. Therefore high productivity is often associated with poor water quality.

Lakes can be categorized into three trophic levels:

- oligotrophic - low productivity, high water quality
- mesotrophic - medium productivity and water quality
- eutrophic - high productivity, low water quality

Oligotrophic lakes are typically deep and clear with exposed rock bottoms and limited plant growth. Eutrophic lakes are often shallow and marsh-like, typically having heavy layers of organic silt and abundant plant growth. Mesotrophic lakes are typically deeper than eutrophic lakes with significant plant growth, and areas of exposed sand, gravel or cobble bottom substrates.

A lake's trophic state is a measure of its ability to support living things. Lakes can naturally become more eutrophic with time; however trophic state is more influenced by nutrient inputs than by time. When humans influence the trophic state of a lake the process is called *cultural eutrophication.* Although lakes can naturally evolve from oligotrophic conditions to eutrophic, this process is often highly influenced by human activity. Cultural eutrophication typically results in an accelerated change in trophic state. A sudden influx of available nutrients may cause a rapid change in a lake's ecology. Opportunistic plants such as algae may be able to out-compete macrophytes. The resultant appearance and odor is more typically considered poor water quality. Total phosphorus, chlorophyll *a* and Secchi depth are often used as trophic state indicators for lakes. Values measured for these parameters can be used to calculate Trophic State Index (TSI) values.

Total phosphorus is one of the most important water quality indicators. Phosphorus levels determine the amount of plant and algae growth in a lake. Phosphorus can come from the watershed (fertilizers, livestock) or to a lesser extent, from groundwater (septic systems). It can also come from within the lake as it is released from bottom sediments.

A Secchi disc is a weighted black and white disc that is used to visually measure the water clarity in a lake. Water clarity, or transparency, is often used as a quick and easy test for a lake's overall water quality, especially in relation to the amount of algae present.

Chlorophyll is the pigment found in all green plants, including algae, which gives them their green color. Chlorophyll absorbs sunlight which is used as the energy source for converting carbon dioxide and water to oxygen and sugars. Chlorophyll data is collected to estimate how much algal growth is occurring in a lake. Generally speaking, the more nutrients there are in the water and the warmer the water, the higher the production of algae (chlorophyll). This is reflected by higher calculated TSI values (**Figure 5**).

There is a strong relationship between phosphorus concentrations, transparency and chlorophyll *a* concentrations in lakes. As a response to rising levels of phosphorus, chlorophyll *a* levels increase and transparency values decrease. However phosphorus is the best estimate of trophic state early and late in the season, as levels of phosphorus are not as dependent upon temperature and weather as chlorophyll or transparency. In the spring and fall, water temperatures are lower and day lengths are shorter. As a result, algal abundance is less, which lowers chlorophyll concentrations and raises Secchi depths – reflecting trophic state values that very different from those found in mid-summer.

Figure 6 shows the Trophic State Indices (TSI) calculated from the Self-Help monitoring data collected from 1986 through 2005. Throughout this time period, TSI values have steadily increased – reflecting a steady decrease in Gilbert Lake's water quality. This relatively rapid decline in water quality is a result of cultural eutrophication, or accelerated nutrient loading due to human activities. If this trend is not reversed the declining water quality will result in changes to the fish community and changes to the aquatic plant community – specifically, a shift from rooted plants to algae.

Figure 5. The relationship of trophic state indices with transparency, chlorophyll *a* concentration and total phosphorus concentration.

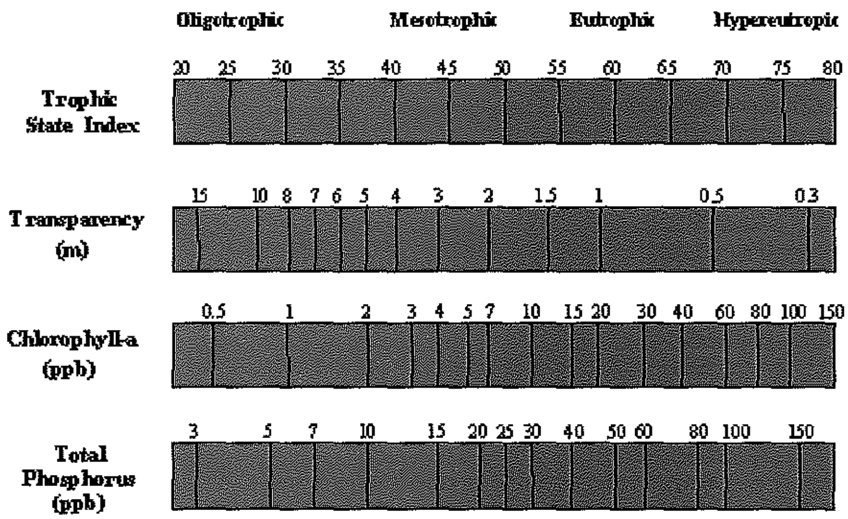
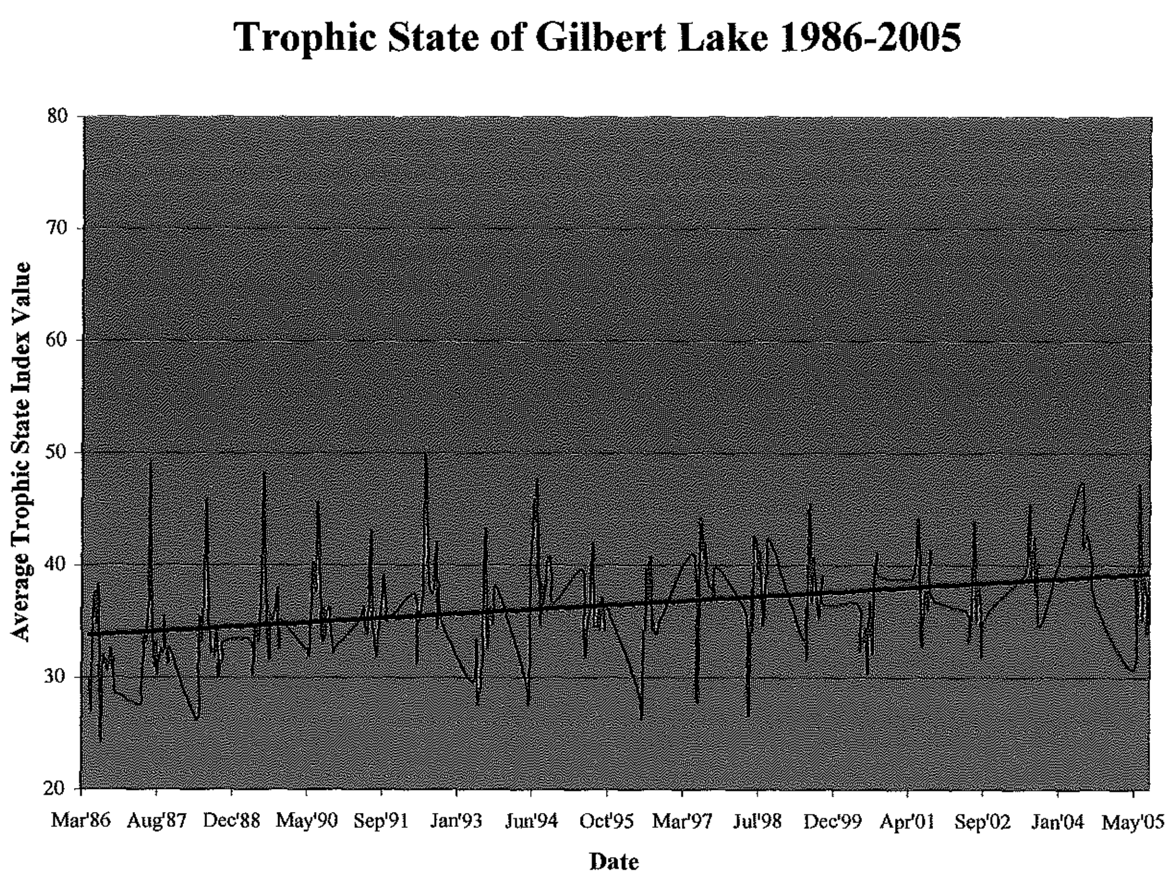


Figure 6. TSI values calculated from Self-Help monitoring data.



Conclusions and Management Recommendations

Eurasian Watermilfoil Control

Although past management efforts have been successful at controlling Eurasian watermilfoil and restoring native plants, the high level of boat traffic entering and leaving the lake at the public access makes re-infestation of Eurasian watermilfoil a constant threat for Gilbert Lake. Therefore it is recommended that the Gilbert Lake Advancement Association continue with the Eurasian watermilfoil control program established in 2000. Accordingly, the Association should conduct annual surveys of the lake to identify, plot and measure any beds of recurring milfoil. If found, milfoil should be treated as soon as possible with granular 2,4-D herbicide at rates of 100-200 lbs/acre, depending on bed size. The Association should be prepared to conduct such surveys and treatments with appropriate budgets and required permits.

Water Quality

The twenty-one years of Self-Help monitoring data presented in this report reveal a trend of declining water quality in Gilbert Lake. Although water quality is still good in Gilbert Lake, water quality issues may be the primary concern for the Gilbert Lake Advancement Association if this trend continues. This first step in remedying this situation will be to identify sources of nutrient loading, and then to determine which of those sources has increased in recent years. In order to answer these questions, the Lake Association is advised to commission a detailed water quality study of Gilbert Lake. Regardless of survey findings, individual property owners should adhere to the recommendations presented in **Appendix 1:** *Protecting Lake Water Quality.* The Lake Association should make this information available to all lakefront property owners.

Future Lake Monitoring

As stated earlier, Gilbert Lake should be annually surveyed for the presence of Eurasian watermilfoil and other invasive exotic species. Duplicating the mapping efforts conducted in May 2004 and May 2005 should suffice for accomplishing this task. Since the prescribed milfoil management activities have been shown to produce positive impacts to Gilbert Lake's native plant community, duplicating the point-intercept or transect plant surveys on an annual basis will not be necessary. Duplicating this type of detailed plant survey should be done every five years. Results of these surveys should be used to develop a five-year aquatic plant management plan for Gilbert Lake. The next aquatic plant survey / management plan update should be scheduled for 2009.

Volunteer Involvement

Lake Association members should continue to take an active role in the prevention of the spread of exotic species, namely Eurasian watermilfoil. This can be done by following the activities outlined in the 2005 grant proposal. These activities included, among others, conducting several public awareness activities. Volunteers can distribute DNR educational literature and Association-prepared literature to public lake users. As volunteers distribute literature they should also conduct watercraft inspections. Watercraft inspections should be tailored at preventing exotic species introductions and documenting potential watercraft infestations. The Wisconsin DNR has a program tailored to this level of involvement called Clean Boats/Clean Water (see **Appendix 2**). If the Lake Association has not utilized this resource, it is recommended that they do so.

Appendix 1. Protecting Lake Water Quality

Elevated nutrient inputs from human activities around Gilbert Lake can adversely affect both water clarity and water quality. This may directly affect the fishery, by reducing or eliminating conditions needed for survival of certain fish species. Further, many of the important plant and animal species found in Gilbert Lake could be adversely affected by decreases in water quality. A large-scale loss of species would negatively affect the lake's fishery. Therefore protecting lake water quality is essential to maintaining and enhancing the fishery of Gilbert Lake. The following paragraphs describe water quality enhancement activities that individual lakefront property owners can undertake to maintain water quality in Gilbert Lake.

Vegetative buffer zones

There are beneficial alternatives to the traditional mowed lawn. The best alternative is to protect the natural shoreline and leave it undisturbed. If clearing is necessary to access and view the lake, consider very selective removal of vegetation. Restoring a vegetative buffer zone is also an important alternative.

A recommended buffer zone consists of native vegetation that may extent from 25 – 100 feet or more from the water's edge onto land, and 25 – 50 feet into the water. A buffer should cover at least 50%, and preferably 75% of the shoreline frontage (Henderson et al., 1998). In most cases this still allows plenty of room for a dock, swimming area, and lawn. Buffer zones are made up of a mixture of native trees, shrubs, upland plants, and aquatic plants.

Shoreline vegetation serves as an important filter against nutrient and sediment loading. The buffer provides excellent fish and wildlife habitat, including nesting sites for birds, and spawning habitat for fish. Properly vegetated shorelines also play a key role in bank stabilization.

Lawn care practices

Mowed grass up to the water's edge is a poor choice for the well being of the lake. Studies show that a mowed lawn can cause 7 times the amount of phosphorus and 18 times the amount of sediment to enter a waterbody (Korth and Dudiak, 2003). Lawn grasses also tend to have shallow root systems that cannot protect the shoreline as well as deeper-rooted native vegetation (Henderson et al., 1998).

Landowners living in close proximity to the water should be discouraged from using lawn fertilizers. Fertilizers contain nutrients, including phosphorus and nitrogen, which can wash directly into the lake. While elevated levels of phosphorus can cause unsightly algae blooms, nitrogen inputs have been shown to increase weed growth. Landowners are encouraged to perform a soil test before fertilizing. A soil test will help determine if you need to fertilize, and give you direction on fertilizing. For assistance in having your soil tested, contact your county UW-Extension office. If there is a need to fertilize your lawn, use a fertilizer that does not include phosphorus. Most lawns in Wisconsin don't need additional phosphorus. The numbers on a bag of fertilizer are the percentages of available nitrogen, phosphorus and potassium found in the bag. Phosphorus free fertilizers will have a 0 for the middle number (e.g. 10-0-3).

To further reduce nutrient loading, avoid raking twigs, leaves, and grass clippings into the lake. They contain nitrogen and phosphorus. The best disposal for organic matter, such as leaves and grass clippings, is to compost them. Composted material can then be used for gardening.

Septic system maintenance

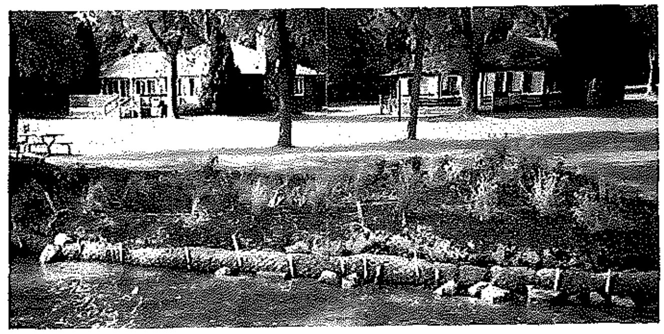
It is the responsibility of lakeshore property owners to ensure that septic systems are properly functioning. A failing septic system can contaminate both surface and ground water. If located in a groundwater discharge area, failing septic systems can be a major cause of nutrient loading in lakes. Systems should be professionally inspected every 3 years, and pumped every 2-5 years depending on operating circumstances (EPA, 2002). Avoid flushing toxic chemicals into the system. This can harm important bacteria that live in your tank and naturally break down wastes. Avoid planting trees in the drain field, compacting soil within the drain field, and directing additional surface runoff on top of the drain field.

Erosion control

Erosion is a natural process, but it's for the benefit of the landowner and health of the lake that erosion control practices be carried out to slow the process as much as possible. Sedimentation causes nutrient pollution, turbid water conditions, eliminates fish spawning habitat, and increases eutrophication. Shoreline owners are encouraged to leave existing vegetation, which is a great shore stabilizer. The placement of logs, brush mats, and rock riprap are also options for control of erosion. When riprap is used it is recommended that desirable shrubs and wetland plants be planted within the riprap. The plantings serve as nutrient filters and habitat. Before any shoreline stabilization project is initiated, it is recommended that property owners contact the local DNR office for guidance and to obtain any necessary permits.

Rainfall is one of the most powerful things on earth (Holdren et al., 2001). When a rain event occurs loose sediment can be washed directly into the lake or into inlets that drain into the lake. Disturbed areas with loose soil, including plowed farm fields, pastures, and construction sites, should all be areas of concern. Precautions in disturbed areas need to be addressed. The use of silt fencing is a popular tool designed to help control erosion on construction sites.

Emergent plant restoration



Shoreline vegetation can benefit lake ecology tremendously. A properly vegetated shoreline provides habitat for a variety of birds, furbearers, amphibians, and reptiles. Much of the shoreline and emergent vegetation in Gilbert Lake appears to have been destroyed by lakefront development. Benefits to lake water quality, fishery and wildlife could be achieved by restoring emergent plants in Gilbert Lake. Lakefront habitat improvement is often done on a property-by-property basis. In recent years many new techniques have been developed for restoring lakefronts. This type of work often incorporates many attractive flowering plants and adds a great deal of aesthetic appeal to lakefronts as well.

Informational resources for shoreline restoration

Lakescaping for Wildlife and Water Quality. This 180-page booklet contains numerous color photos and diagrams. Many consider it the bible of shoreline restoration. It is available from the Minnesota Bookstore (651-297-3000) for $19.95.

Woodworking for Wildlife: Homes for Birds and Mammals. by Carrol L. Henderson. 112 pages. Recommended for anyone wishing to construct homes to attract wildlife and enhance habitat. It is available from the Minnesota Bookstore (651-297-3000) for $9.95.

The Living Shore. This video describes buffer zone construction and gives information on selecting and establishing plants. May be available at local library, or order from the Wisconsin Association of Lakes (800-542-LAKE) for $17.00.

A Fresh Look at Shoreland Restoration. A four-page pamphlet that describes shoreland restorations options. Available from UW Extension (#GWQ027) or WDNR (#DNR-FH-055).

What is a Shoreland Buffer? A pamphlet that discusses both ecological and legal issues pertaining to riparian buffer zones. Available from UW Extension (#GWQ028) or WDNR (#DNR-FH-223).

Life on the Edge...Owning Waterfront Property. A guide to maintaining shorelands for lakefront property owners. Available from UW Extension-Lakes Program, College of Natural Resources, University of Wisconsin, Stevens Point, WI 54481, for $4.50.

The Water's Edge. A guide to improving fish and wildlife habitat on your waterfront property. Available from WDNR (#PUB-FH-428-00).

Appendix 2. Association Involvement

Improved public awareness is one of the most important aspects of an effective exotic plant species control program. By becoming knowledgeable about the condition of Gilbert Lake, Association members can learn what practices are necessary to restore the plant community and keep the lake healthy. There are number of activities that Lake Association members can carry out to improve lake users' awareness of the problems facing Gilbert Lake.

Several other prevention and educational awareness activities should be planned. This can include public notices regarding exotic species, distribution of WDNR educational literature to public lake users, and conducting watercraft inspections. These volunteer efforts should focus on preventing the spread of Eurasian watermilfoil and other exotic species. Watercraft inspections can also be used as a tool to document potential watercraft infestations that can be communicated to the WDNR.

Clean Boats, Clean Waters

The Wisconsin DNR in cooperation with the EW-Extension Lakes Program have developed a volunteer watercraft inspection program designed to educate motivated lake organizations in preventing the spread of exotic plant and animal species in Wisconsin lakes. Through the Clean Boats, Clean Waters program volunteers are trained to organize and conduct boater education programs.

For more information contact:
Laura Felda-Marquardt
Clean Boats, Clean Waters Program Coordinator
Wisconsin Invasive Species Program
Ph: 715-365-2659 (Rhinelander)
Ph: 715-346-3366 (Stevens Point)

To download a printable brochure regarding the Clean Boats, Clean Waters program go to http://www.uwsp.edu/cnr/uwexlakes/CBCW/Pubs/CBCW_brochure.pdf.

Association members should also take the opportunity to educate themselves and assist in identifying and mapping exotic species found in the lake. An ongoing effort should be initiated by numerous Association members to located and record the locations of invasive species throughout the lake. This information can then used to aid in lake management activities, and will serve as a foundation for a long-term monitoring program.

Lake Association members can also gain firsthand knowledge of Gilbert Lake's native aquatic plant community. This can be done by encouraging volunteer involvement during future plant survey field studies.

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