# Aquatic Plant Management Plan

For

# Beecher Lake


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January 2010

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# Beecher Lake Aquatic Plant Management Plan

Beecher Lake is located in Beecher Township (T36N, R20E, S28) in Marinette County, Wisconsin. As is common throughout Marinette County, references to Beecher Lake in this report actually refer to two separate lake basins, Beecher Lake and Upper Lake that are connected by a narrow channel (figure 1). Beecher Lake drains to the Pike River, an Outstanding Resource Water and State designated Wild River.

Beecher Lake is heavily developed with 68 private homes on the shore. One public boat launch with parking is maintained by the Town of Beecher along with a public park and swimming beach on the north shore of the lake.

The purpose of this report is to develop a long-term sustainable plan for the management of aquatic plants in Beecher Lake with an emphasis on the control of Eurasian watermilfoil (*Myriophyllum spicatum*), an invasive exotic species.

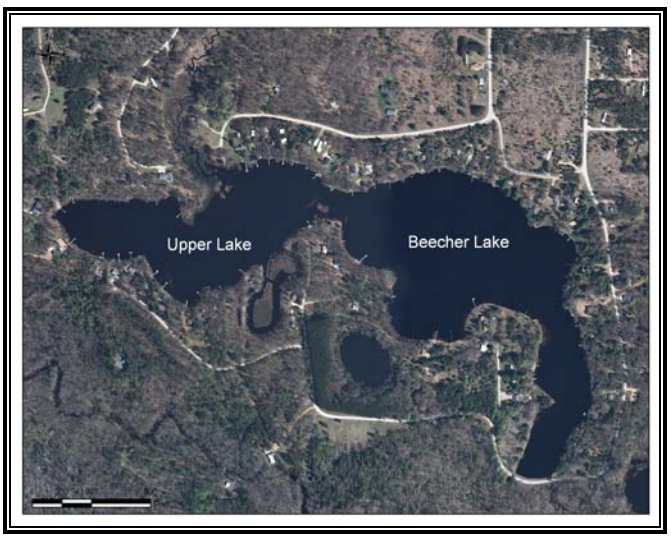



**Figure 1. Beecher & Upper Lakes**

## Beecher Lake Protection and Rehabilitation District

The Beecher Lake Protection and Rehabilitation District (Beecher Lake District) was formed by resolution of the Town of Beecher board of commissioners in 2000 to provide for the protection and improvement of Beecher and Upper Lakes. The Lake District includes all waterfront property owners on Beecher and Upper Lakes. The impetus for forming the Lake District was primarily to allow for the control of aquatic plants, which grow densely in the shallow waters (<5 feet) of Beecher Lake. Early efforts focused on hiring a private contractor to harvest plants. Since the discovery of Eurasian watermilfoil (EWM) the focus has shifted to controlling the exotic species.

## Overview of Physical & Chemical Characteristics of Beecher Lake

The Beecher Lake basin is 36.8 acres with a maximum depth of 47 feet. The Upper Lake basin is 21.5 acres with a maximum depth of 18 feet. A dam on the outlet of Beecher Lake maintains a head of approximately 6 feet.

Beecher is a drainage lake with a watershed of approximately 2,800 acres. Watershed land use is divided evenly between forest land (1,450 acres) and wetland (1,320 acres). Approximately 60 acres of residential development and roads drain to the lake.

Beecher Lake has moderately hard water (alkalinity 80 – 100 mg/l) with a neutral pH. The water is moderately stained with natural tannins and has an average Secchi disk depth of 9 feet. Historically water quality has been good. A lake management study conducted in 1995-96 revealed low to moderate levels of phosphorus and chlorophyll-a. Trophic state index calculations consistently placed the lake in the mesotrophic range, or moderately nutrient rich.

Monitoring data clearly indicates that both lake basins are dimictic, that is, they experience thermal stratification during the winter and summer months and only mix completely during spring and fall turnover. Stratification is relatively weak in the Upper Lake basin due to its shallow depth. Both lake basins experience oxygen depletion in the deeper waters (hypolimnion) during summer stratification. During these periods sampling shows there is a significant amount of internal phosphorus release from the sediment. As with most dimictic lakes, phosphorus is highest after spring turnover and falls throughout the summer as plants and algae take up nutrients.

## Public Access & Recreational Use

The town of Beecher maintains a public boat launch on Upper Lake with room for at least six vehicles with trailers. The launch is located in an area of very shallow water and is not hard-surfaced below the water line. The town of Beecher maintains a picnic area and swimming beach on the north side of Beecher Lake.

According to the user survey conducted in 1996 the primary recreational uses of Beecher Lake are enjoying the scenery, fishing and swimming. Although much of the near shore area has abundant aquatic plants the lake has sufficient deep water close to shore for swim rafts. Boating pressure is light and consists primarily of non-motorized craft and smaller fishing boats. Since neither lake basin is 50 acres in size Wisconsin law designates both as "slow-no-wake" lakes.

## Overview of Beecher Lake Fish Community

Beecher Lake supports a warm water fishery dominated by largemouth bass, bluegill and black crappie. Northern pike, yellow perch and bullheads can also be found in the lake.

The Wisconsin DNR conducted the most recent fish survey of the lake in 1989. According to WDNR Fisheries Technician Greg Kornely. Beecher Lake historically had a healthy fishery with excellent size structure for bass, bluegill and crappie. The well-developed aquatic plant community found in Beecher Lake and its many adjacent wetland areas provide excellent fish habitat. As in many lakes, large woody habitat is lacking. Also, being primarily sand, Beecher Lake lacks variability in sediment type.

## Aquatic Plant Community

Beecher Lake supports a diverse aquatic plant community. Prior to the invasion of EWM bushy pondweed (*Najas flexilis*), water marigold (*Bidens beckii*), coontail (*ceratophyllum demersum*), and a variety of small and large pondweeds (*Potamogeton sp.*) were the most dominant submersed aquatic plants. A transect survey of the lakes conducted in 1995 identified 23 native aquatic plants and no exotic species. A more thorough survey conducted in 2008 found 31 native species.

Due to moderately stained water the maximum rooting depth (photic zone) is approximately 10-12 feet and varies slightly as water clarity and water levels fluctuate. Rooted aquatic plant growth is typically dense throughout the photic zone.

Floating leaf plants are widespread and abundant in Beecher Lake. The population is dominated by water shield (*Brasenia schreberi*) and white water lily (*Nymphaea odorata*).

### Exotic Species

In June 2007 Eurasian watermilfoil (EWM) was found growing in Beecher and Upper Lakes. Plant samples were collected and verified by the Freckman herbarium at UW-Stevens Point. A cursory survey of the lake in October 2007 found EWM was widespread with dense stands covering more than 6.5 acres. While it is not know how long EWM had been in Beecher Lake the infestation appeared to be at least three or four years old. Currently the EWM population is still expanding and threatens to overtake the native plant population, greatly reducing plant diversity and ecosystem health.

### History of APM Efforts

Landowners on Beecher Lake have been managing aquatic plants for many years. The earliest organized effort entailed harvesting with a Hockney weed cutter. Although marginally successful the effort also created problems with escaped floating vegetation and maintenance of equipment. After it was formed the Beecher Lake

District began hiring a private contractor to harvest the lake, typically once each summer.

After the discovery of EWM in 2007 the Beecher Lake District applied for and received a permit to selectively treat areas of dense EWM growth. On June 11, 2008 a private contractor treated 14 acres of EWM with 2,4-D applied at a rate of 100 lbs/ac (Figure 2). At the time of treatment the EWM was rapidly growing and had already reached the lake's surface.

An aquatic plant survey was not completed prior to the herbicide application so quantitatively evaluating its effectiveness is difficult. In the summer of 2008 EWM was still abundant in the treatment areas, however density did appear lower and quite a bit of "herbicide damage" of EWM was noted. Despite the treatment EWM continued to spread to new areas of the lake during the summer of 2008.

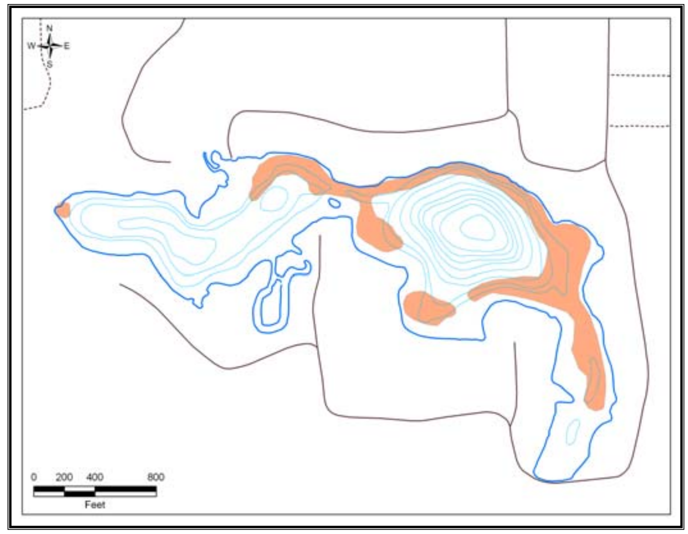



**Figure 2. 2008 herbicide treatment area.**

## Aquatic Plant Survey

The main focus of the Aquatic Invasive Species Planning and Education Grant is to plan for the long-term management of EWM in Beecher Lake for the protection of the native plant community. To this end, a detailed aquatic plant survey was completed during the summer of 2008.

**Survey Methodology**

Wisconsin DNR and Marinette County LWCD employees completed the aquatic plant survey of Beecher Lake on July 28, 2008. The survey of Upper Lake was completed on August 13, 2008 by the LWCD. The survey used the Wisconsin DNR point/intercept sampling protocol with a point spacing interval of 30 meters (98 feet). Coordinates for each of the 220 sample points were loaded onto a Garmin Vista handheld GPS unit for navigation in the field.

At each sample location a special double-headed garden rake on an extendable aluminum pole was used to determine the water depth and sediment type and to sample aquatic plants. Plants were collected for identification by dragging the rake across the bottom for approximately 0.75 meters and bringing it to the surface. For each species of plant found on the rake a relative abundance measurement was recorded. Abundance was also recorded for the total amount of plant material on the rake.

The field survey was completed using a team of three individuals, a "driver" a "sampler" and a "data recorder". The driver navigated to each sample point using the GPS receiver and recorded field data. When a sample point was reached the "sampler" would call out the depth, bottom type, and vegetation density at that location. Typically the sampler could sort and call out the vegetation data before the next sample point was reached. Sample points that were clearly in excess of the maximum depth of colonization were not sampled.

Data was entered and analysis was completed in Microsoft Excel and is reported in full in Appendix A. The location of each sample point was also recorded on a Trimble Geo XT for more accurate mapping. All sample location and associated data were mapped in the Marinette County Geographic Information Systems (GIS) database. Plant distribution maps for each species can be found in Appendix A.

# Sediment Type

Sediment type was determined at each sample location shallower than the maximum depth of plant growth by "feel" using the metal rake head attached to an aluminum pole. Data was recorded as muck, sand & gravel, or rock. Soft unconsolidated sediment was recorded as muck. Rock included everything from cobble size rock (2-3 inches) to boulders or limestone bedrock. Sand and gravel are often mixed and difficult to distinguish by feel so they were grouped together.

Analysis of the data shows that most of the sample points (77%) consisted of muck while 22% consisted of sand & gravel. Rock was found at only 1% of the sample points (Figure 3).

Sediment type is largely determined by local soils, wave action and aquatic vegetation. Soil surrounding the lake is primarily Menahga sand that typically contains less than 2% gravel by weight. In shallow near-shore areas wave and ice action tend to keep the sand clear. At greater depth accumulations of organic matter (muck) cover the sand to varying degrees. In most of the lake sand is limited to very shallow areas.

Sediment type is important because aquatic plants have differing sediment preferences. Muck

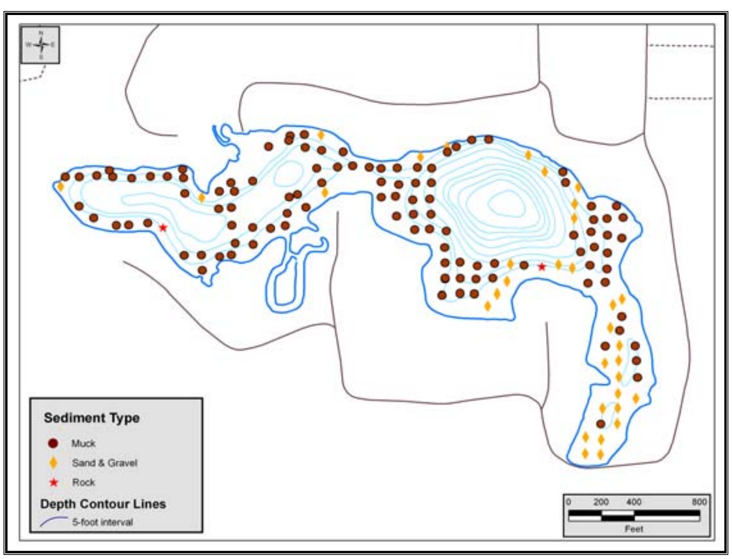



**Figure 3. Beecher Lake sediment type map.**

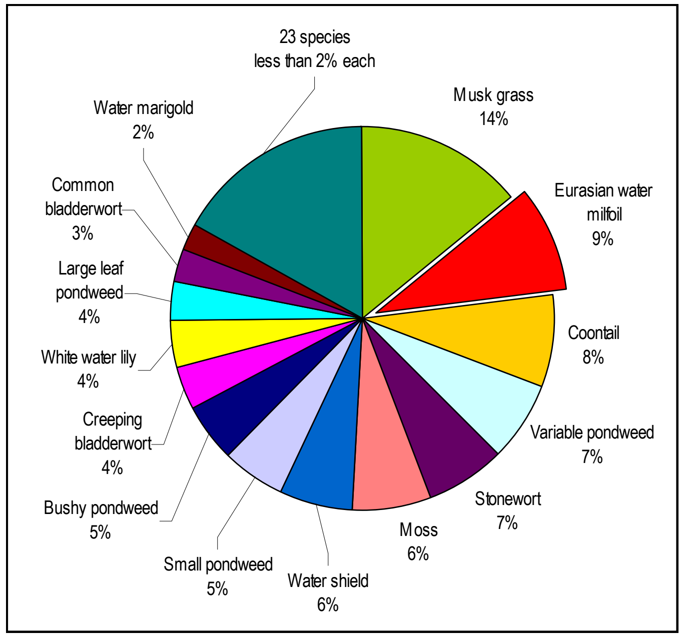



**Figure 4. Relative abundance of aquatic plants in Beecher Lake.**

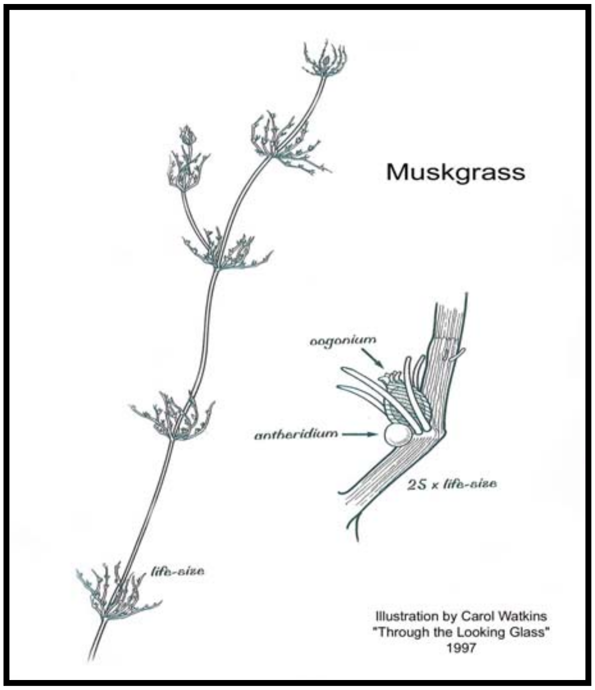
generally supports the greatest diversity of aquatic plants as seen in Beecher Lake.

# Aquatic Plant Community Structure

Beecher Lake supports an abundant and diverse aquatic plant population. 31 native species were identified during the survey along with the exotic Eurasian watermilfoil. Since the EWM infestation is relatively new, it does not yet dominate the aquatic plant community. Indeed, no one plant can be said to dominate in Beecher Lake. The thirteen most abundant species in the lake account for more than 80% of the population but no one species accounts for more than 14% by itself (figure 4). The following aquatic plants were found at more than 10% of vegetated sites and could be considered the dominant plants in Beecher Lake. Descriptions are taken from *Through the Looking Glass, a Field Guide to Aquatic Plants* (Boreman 1997), a publication of the Wisconsin Lakes Partnership. Distribution maps for each species can be found in Appendix A.

## Common Aquatic Plants

**Muskgrass**
Muskgrass (*Chara spp.*) is the most widely distributed aquatic plant in Beecher Lake. It was found growing at 61% of vegetated sites.




While outwardly appearing like many other aquatic plants, muskgrass is actually a type of colonial algae. Each "stem" and "leaf segment" is actually a separate algae cell. Muskgrass has branching slender "stems" with whorls of "leaves" at each joint. The main branches have ridges and the entire plant is often encrusted with calcium carbonate giving the plant a gritty or crusty feel. Muskgrass can be easily identified by its smell. When crushed the plant smells like skunk!

Muskgrass is found in hard water lakes and prefers firm sediment. In Beecher Lake muskgrass shows a strong preference for sand (87% of sites) but can be found in many mucky areas as well (52% of sites). Muskgrass also prefers shallow water. In Beecher Lake it is found most often in water less than five feet deep where it hugs the bottom, rarely growing more than two feet tall. Due to its short stature muskgrass is seldom viewed as a nuisance species.

Muskgrass is a favorite food of waterfowl and provides excellent fish habitat. In very shallow sandy areas used by newly hatched fry (juvenile fish), muskgrass is often the dominant plant.

**Eurasian watermilfoil (EWM)**
Eurasian watermilfoil (*Myriophyllum spicatum*), an invasive exotic species, was found at 39% of vegetated sites. EWM Has soft feather like leaves arranged in groups of four along a long thin stem. Depending on water clarity the plant can grow as tall as 15 feet. In shallow water the plants often reach the surface where they branch profusely and spread out to form a canopy that shades the water beneath. Eurasian watermilfoil is considered invasive since it has a habit of expanding rapidly and eliminating or drastically suppressing other plants.

EWM can overwinter green or survive as sprouts on the rootstock. The plant begins rapid growth at a low water temperature and quickly reaches the surface. EWM spreads primarily by fragmentation, a process where even small fragments of the plant separated by boats or wave action drift to a new place and take root. The rapid growth, ease of spread, and its canopy

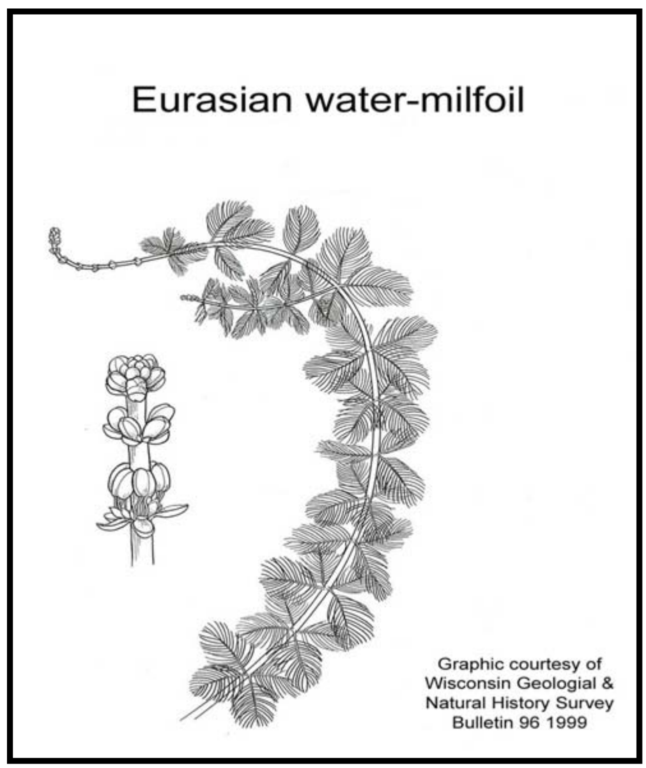



**Figure 5. EWM distribution in Beecher Lake.**

forming habit, allows EWM to out compete many of the slower growing native plants.

EWM shows a slight preference for water between five and eight feet of depth. It also shows a preference for muck sediment. In 2008 EWM could be found throughout the lake but was most dense on the east end of Beecher Lake and in a narrow band along the north shore. In the Upper Lake basin EWM was most dense between the boat landing and the channel.

The distribution of EWM in the lakes is rapidly expanding. When the plant was first discovered in 2007 it was uncommon in the Upper Lake basin and along the south shore of Beecher. Since then it has spread and can be easily found in all areas of the lake. The EWM map developed from the point/intercept survey (figure 5) does not accurately illustrate the true spread of EWM. This is most evident in the shallow arm of the lake near the dam. Here the clumps of EWM were robust with many stems but they were spread out and rarely showed up on the rake when sampling.

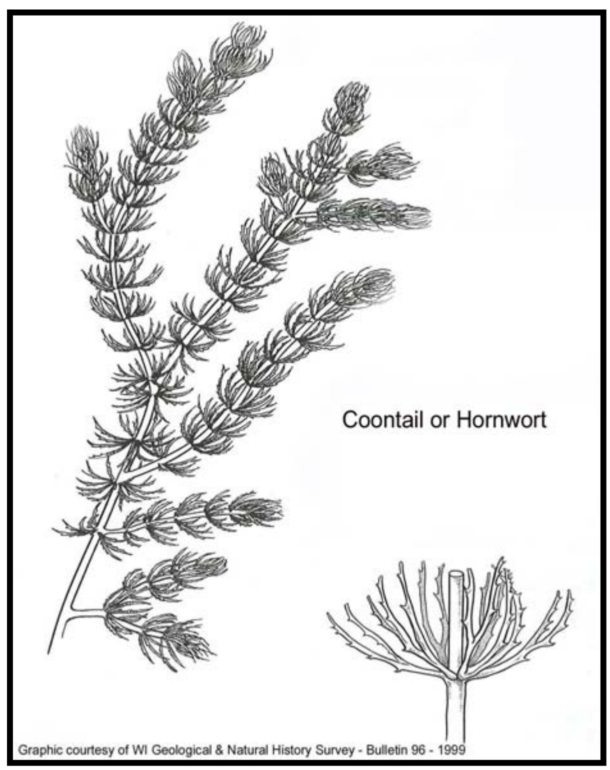
While Eurasian watermilfoil provides some fish and wildlife habitat, studies show that native pondweeds typically have more diversity and greater numbers of insects (Engel 1990).

**Coontail**

Coontail (*Ceratophyllum demersum*) is the most common aquatic plant in Wisconsin. In Beecher it was found at more than 34% of vegetated sites. Like milfoil, coontail has long stems with leaves arranged in whorls around the stem. Unlike milfoil the leaves of coontail are very stiff and have small "teeth". The leaves tend to be dense near the ends of the stem, giving them the appearance of a bushy raccoon tail. Coontail has no true roots but anchors to the sediment by modified stems wherever it touches the bottom. Due to its poor "rooting" ability, coontail prefers muck sediment. It rarely produces seed and spreads primarily by fragmentation.

Coontail is important for fish habitat since it is slow to decompose and often stays alive under the ice. This habit makes it excellent winter habitat, attracting aquatic insects and the fish that feed on them.

Like EWM, coontail in Beecher Lake shows a preference for deeper water (4-8 feet) and muck sediment. Because coontail often forms dense mats it is sometimes seen as a nuisance in shallow areas (< 3ft) where it can reach the surface.



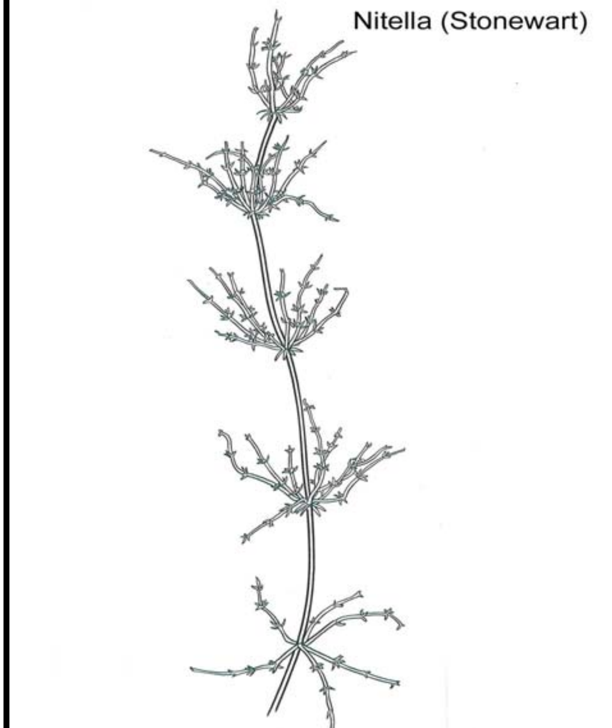
**Variable-leaf pondweed**
Variable-leaf pondweed (*Potamogeton gramineus*) was found at 29% of vegetated sites on the lake. As the name implies it varies greatly in growth form between lakes and even within a single lake depending on depth and sediment type. Typically the plant has lance shaped leaves 3-8 cm long and 3-10 mm wide. The plant branches repeatedly and the side braches are very bushy. In Beecher Lake variable pondweed tends toward smaller leaves.

Like most pondweeds variable-leaf is a perennial that dies back in the fall. It also spreads by seeds that are produced on stalks held above the water surface. When flowering it forms small floating leaves that are wider and more ellipse shaped than the submerged leaves.

Graphic courtesy of WI Geological & Natural History Survey - Bulletin 96 - 1999

Variable-leaf pondweed shows a distinct preference for muck bottom. In also shows a distinct preference for water less than five feet deep.

**Stonewort**
Stonewort (*Nitella spp.*) was also found at 29% of vegetated sites. Like chara, stonewort is actually a type of algae. It has slender branching "stems"



Graphic Courtesy of Through the Looking Glass

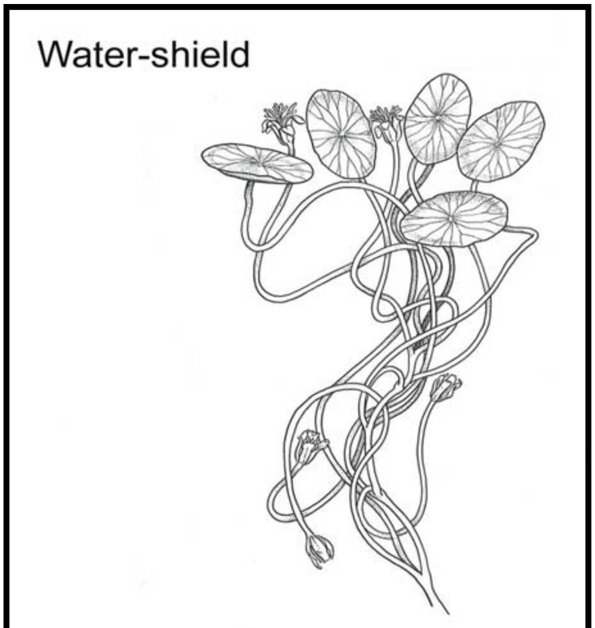
with whorls of "leaves". The entire plant is smooth and translucent green. While similar to chara, stonewort typically has longer "leaves" and lacks the gritty calcium carbonate deposits and skunk-like odor.

While stonewort typically prefers soft sediment and deep water, in Beecher Lake it showed no obvious sediment preference and was found most often in two to five feet of water.

Stonewort is used by waterfowl and offers foraging opportunities for fish. Since the plant rarely grows more than 2 feet tall it seldom becomes a nuisance.

**Moss**
While not actually an aquatic plant, mosses are an important part of many aquatic ecosystems. In Beecher Lake aquatic moss is widespread, being found at 28% of vegetated sites. In appearance most aquatic mosses look very much like their wetland counterparts.

Aquatic moss tends to be found in deep water, often growing well beyond the limit of higher plants. In Beecher Lake moss is found most




Graphic courtesy of WI Geological and Natural History Survey - Bulletin 96 1999

often in water deeper than five feet and is the only plant that could be called common beyond the depth of 10 feet where it often forms a thick carpet on the bottom. Moss seems to prefer muck, which is the dominant sediment in deep water.

Aquatic moss is an important part of the aquatic ecosystem since it is one of the few plants that do not die back during the winter months. It provides good winter habitat for aquatic invertebrates.

**Watershield**

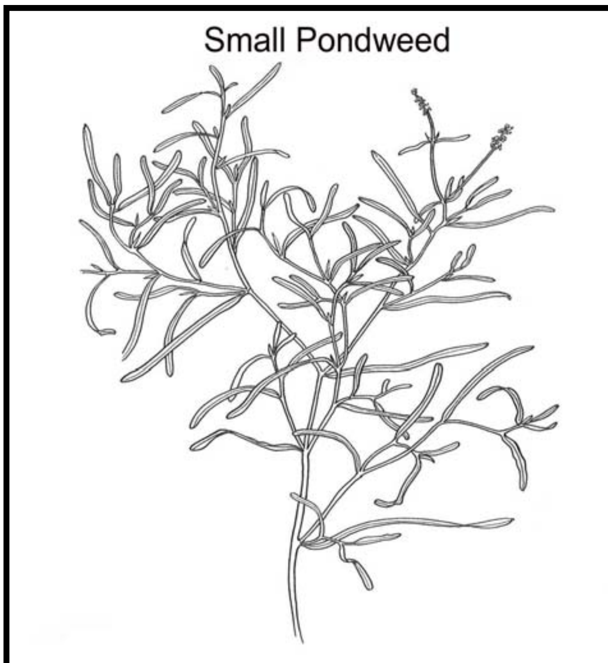
Watershield (*Brasenia schreberi*), found at 27% of vegetated sites, is the most abundant floating leaf plant in Beecher Lake. Watershield can be distinguished from the lilies by its small (2-5 in) football shaped leaves attached at the center to long spaghetti-like stems. The stems and underside of the leaves are typically covered with a thick clear jelly-like coating. Below the sediment surface watershield has an extensive system of rhizomes that anchor the plant and provide stored energy in the spring.

Like most floating leaf plants, watershield is restricted to shallow water areas. In Beecher Lake it is most abundant in two to three feet of water and absent from water more than 6 feet deep. While it is known to do well in very soft organic sediment, in Beecher it grows equally well in sand and muck. In shallow mucky areas watershield has a habit of spreading aggressively and becoming a nuisance. The main issue is their numerous, wiry, propeller-clogging stems. On this count Beecher Lake is no exception. Prior to the introduction of Eurasian watermilfoil it was probably the plant most in need of control.

Floating leaf plants in general provide important fish habitat, providing shade, escape cover for small fish and ambush cover for bass and other predators. While they appear dense from the surface, under the floating canopy the water is often quite open, especially when compared to milfoil or other submersed plant beds.

**Small pondweed**

Small pondweed (*Potamogeton pusillus*) is the most abundant of the narrow-leaved pondweeds found in Beecher Lake. It was found at nearly 23% of vegetated sites. It is the most common species in a large group of narrow-leaf pondweeds that are notoriously difficult to identify. They are differentiated based on floating leaves, winter buds, seed shape and other factors. Small pondweed has very fine stems that branch profusely as they rise towards the surface. The




Graphic courtesy of WI Geological & Natural History Survey - Bulletin 96 - 1999 leaves are typically much longer (3/8th –2 1/2 in) than they are wide (1/16th -1/8th in).

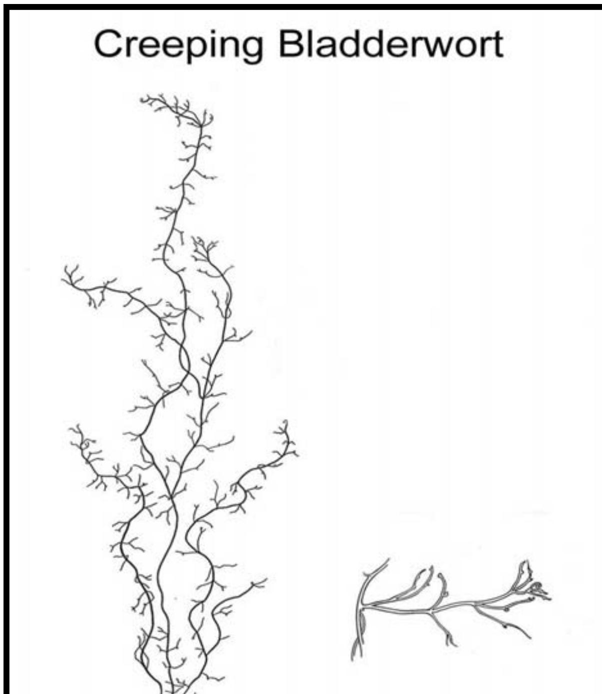
In Beecher Lake small pondweed seems to prefer water between four and eight feet deep. It is slightly more abundant in muck sediment than it is in sand.

Small pondweed appears to be particularly effected by Eurasian watermilfoil. Both plants have similar depth and sediment preferences but EWM is much more aggressive. Small pondweed was found primarily in areas where milfoil was absent or sparse.

**Bushy Pondweed**

Bushy pondweed (*Najas flexilis*) was found at 22% of vegetated sites in Beecher Lake. This plant varies greatly in growth form, compact and bushy in shallow water, long and wiry with widely scattered leaves in deep water. The leaves are very narrow (1/16th inch wide) with a broad base where they attach to the stem. Plants generally grow no more than 2 feet tall and prefer a firm substrate.


Graphic courtesy of WI Geological & Natural History Survey - Bulletin 96 - 1999

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Bushy pondweed is rather unique in that it's one of the few annual aquatic plants. It dies each winter and depends on seed to grow new plants each year. The plants and the seeds, which are produced in great number each year, are important food for waterfowl.

In Beecher Lake bushy pondweed can be found in water up to eight feet deep but is most abundant in one to four feet of water. Due to its short stature bushy pondweed is seldom reported as a nuisance plant.

**Creeping bladderwort** Creeping bladderwort (*Utricularia gibba)*, is fairly common, found at 16% of vegetated sites, but is all but invisible unless you look closely. It has extremely delicate free-floating green stems with tiny forked side branches holding occasional bladders. Occasionally it will form floating masses in shallow water that look like nets.s the bladders that make the Utricularia family unique. The bladders are hollow sacs that trap zooplankton size prey and slowly digest it. Most bladderworts are free-floating or only weakly anchored to the sediment.

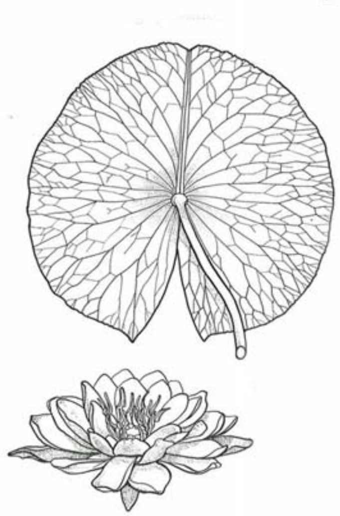
In Beecher Lake creeping bladderwort shows a strong preference for shallow water (<3ft). Since it is not anchored to the bottom it shows no sediment preference but tends to be more abundant in calm water in areas of dense vegetation.

**White water lily**
Of the two lily species found on Beecher Lake white water lily (*Nymphaea odorata*) is the most abundant. It was found at 16% of the sample locations.

White water lily has large (4-10 in) floating leaves attached to round flexible stalks. The leaves are fleshy, nearly round, and split to the center where the stalk is attached. In the summer it produces large white flowers on separate stalks that float on the surface of the lake. Like water shield it has large tuberous roots that store energy for growth.

White water lily is easily distinguished from the less common spatterdock (yellow) lily even when flowers are absent. Spatterdock has large oval leaves with a winged stalk attached to one side and rounded lobes in the leaf notch.

White water-lily



Graphic courtesy of Wisconsin Geological & Natural History Survey Bulletin 96 1999

Large-leaf Pondweed

Graphic courtesy of WI Geological & Natural History Survey - Bulletin 96 - 1999

While it is most abundant in water less than five feet deep, white water lily can be found in water up to 7 feet deep. It shows a strong association with muck sediment and is often found growing in conjunction with watershield.

**Large-leaf pondweed**
Large-leaf pondweed (*Potamogeton amplifolius)* is the largest of the pondweeds found in Beecher Lake. The plant, known to fishermen as "cabbage" or "musky-weed" was found at 15% of vegetated sites. This pondweed can be identified by its wide (1-2 in) arching leaves and by its thick seed stalk that is held above the surface.

In Beecher Lake large-leaf pondweed can be found throughout the lake in two to eight feet of water where it provides excellent fish habitat. No sediment preference was found although it is known to prefer firm sediment.

Like many of the pondweeds, large-leaf pondweed has the same habitat preference as EWM and is often displaced by the exotic species. Several other large pondweeds were found less frequently in the lake.

**Common bladderwort**
Common, or great bladderwort (*Utricularia vulgaris*), is the largest and most visible bladderwort in Beecher Lake. It was found at 11% of the vegetated sites.

Common bladderwort has long floating stems that are densely covered with fine leaf-like branches, each forked 3-7 times. The branches contain many bladders that are bright green when young and turn purple to black as they age. If you pull a plant from the water you can often hear it snapping like Rice Krispies as the bladders snap shut. In late summer common bladderwort forms dense winter buds on the ends of the stem that fall off and lie dormant on the sediment until the following spring.

Common bladderwort can be found in water from 1-8 feet deep. Since it is free floating it should show no actual sediment preference but is most common in shallow marshy areas where muck is the dominant sediment.

Graphic courtesy of WI Geological & Natural History Survey - Bulletin 96 - 1999

## Infrequent Aquatic Plants

The following aquatic plants were found at fewer than 10% of the Beecher Lake survey points. This does not necessarily mean they are rare. The survey methodology tends to under sample some plants due to their location or their growth form. As before, descriptions are taken from *Through the Looking Glass, a Field Guide to Aquatic Plants* (Boreman 1997).

**Other submersed plants**
Several other species of submersed plants can be found at low numbers in Beecher Lake. Many of these plants are common in Northeast Wisconsin lakes but seldom found in great number. These include several species of pondweeds and bladderworts.

**Other fine-leaved pondweeds**
In addition to "small pondweed" (*Potamogeton pusillus*) there were three other fine-leaved pondweeds found in Beecher Lake, Fries' pondweed (*P. fresii*), stiff pondweed (*P. strictifolius*) and sago pondweed (*Stuckenia pectinata*). Like small pondweed, these species have fine leaves and prefer moderate depths and muck sediment. The shape of the winter buds, glands, and leaf sheaths differentiate these species.

**Large pondweeds**
Several common large pondweeds were found in Beecher Lake. Anglers often group white-stem pondweed (*P. praelongus*), Illinois pondweed (*P. illinoensis*) and ribbon-leaf pondweed (*P. epihydrus*) together with large-leaf pondweed as "cabbage" or "musky weed". These pondweeds are typically the largest submersed plants in a lake and provide excellent deep-water fish habitat. Also found in the lake were flat stem pondweed (*P. zosteriformis*) and floating leaf pondweed (*P. natans*). The latter is often viewed as a floating leaf plant since it had no obvious underwater leaves.

All of these larger pondweeds are at risk from EWM since they have the same depth and sediment preferences. All of the pondweeds die back to the sediment each winter and begin growth later in the spring than EWM.

**Bladderworts**
Three species often confused with common bladderwort were found in Beecher Lake. These include flat leaf bladderwort (U. intermedia), small bladderwort (U. minor) and twin-stemmed bladderwort (U. gemniscapa). The latter is listed as a species of special concern in Wisconsin.

All of the bladderworts are carnivorous plants that trap and digest zooplankton, small aquatic insects and other organisms. They do this by sucking prey into the bladders where it is slowly digested.

**Native milfoil**
Prior to the introduction of EWM the native northern watermilfoil (*Myriophyllum sibericum*) was common in Beecher Lake. During this survey it was only found at two locations in the Upper Lake basin. Northern watermilfoil differs from EWM by the number of leaflets in each leaf. Northern has 5-12 pairs while EWM has 14-20 pairs. Northern watermilfoil develops winter buds and is stiffer when removed from the water. In some lakes northern watermilfoil has been known to hybridize with EWM. The resulting plant shares physical characteristics of both and the same invasive tendencies of EWM.

**Other submersed aquatic plants**
Several other submersed aquatic plants were identified in Beecher Lake. Water marigold (*Bidens beckii*) is often mistaken for a milfoil but can be distinguished by its branching instead of feather-like leaves.

Common waterweed (*Elodea canadensis*) is a dominant plant in many lakes but relatively infrequent in Beecher. It provides important habitat because it overwinters green and grows in colder water than most other native plants. It can grow to nuisance levels in shallow areas.

Water bulrush (*Schoenoplectus subterminalis*) and floating-leaf bur-reed (*Sparganium fluctuans*) are large grass-like plants with long flowing leaves. Hairgrass (*Eleocharis acicularis*) is similar, but as the name implies it is short and very fine.

# Floating-Leaf Plants

Floating-leaf plants include those with underwater stems and leaves that float on the surface. While many pondweeds also produce floating leaves when they flower, their primary leaves are under water. Floating leaf plants found in Beecher Lake include White pond lily (*Nymphaea odorata*), spatterdock lily (*Nuphar variegata*), and watershield (*Brasenia schreberi*).

While white water lily and watershield were found in a significant number of sample points, the survey methods still do a poor job of sampling the floating leaf community. The point grids tend to under-sample very shallow areas where they grow best. Also, due to their growth form and tough stems the sampling gear often fails to collect the plants. To better describe the community, areas containing floating leaf plants were mapped and described. Figure 6 shows the results of the floating leaf plant mapping effort.

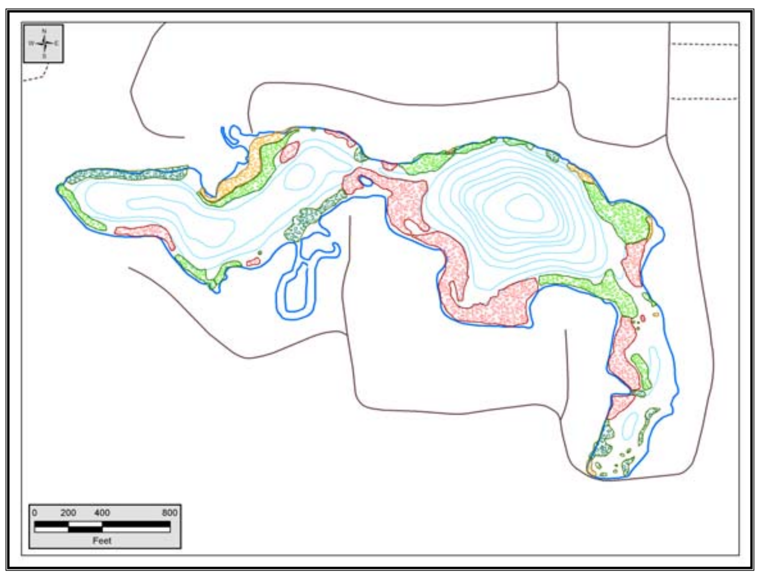



**Figure 6. Floating leaf plant coverage on Beecher Lake.**

Watershield is the most abundant floating leaf plant in Beecher Lake where it is limited to water less than 6 feet deep. Along the south shore of the lake it forms nearly pure stands in many broad shallow areas. Along the north shore of the lake where the water drops off quickly it is typically mixed with lilies. Water shield is often seen as a nuisance because of its wiry stems that bind up boat propellers.

Spatterdock is the least abundant floating leaf plant in the lake. It dominates near the inlet and is typically found in water less than 4 feet deep.

White water lily can tolerate deeper water than the other two and can be found growing in water up to eight feet deep. Throughout the lake white water lily can often be found growing on the outside edge of the watershield beds.
All of the floating leaf plants have large fleshy rhizomes that anchor the plants and store nutrients that allow new plant growth to reach the surface in the spring. In areas with very flocculent muck these rhizomes, which are filled with air, can break loose and float to the surface where they decay and become rather unsightly.

## Emergent Vegetation

Plants such as cattails, bulrushes and others that reach above the surface of the lake are known as emergent vegetation. Many of these plants grow in the lake or in saturated soil on the shoreline. Most are adapted to fluctuating water levels and are unharmed, or actually stimulated, by low water periods.

Due to their location on the shoreline emergents are under-sampled in grid surveys. Those found on the lake include broad-leaved cattail (*Typha lattifolia*), creeping spikerush (*Eleocharis palustris*), softstem bulrush (*Scirpus validus*), common rush (*Juncus effuses*), common arrowhead (*Sagittaria lattifolia*) and three-way sedge (*Dulichium arundinaceum*). A more intensive survey of shoreline vegetation would certainly show even more species including many sedges and other wetland vegetation.

In general the emergent plant community on Beecher Lake is healthy. The area around the boat landing, around the small island in the narrows, and the excavated channel across from the boat landing have especially diverse emergent plant communities. Throughout the lake emergent vegetation is most stressed where people maintain beaches by grading or mowing at the waters edge.

Emergent plants are important in the lake ecosystem because of the habitat they provide for fish and amphibians that spawn on and amongst their underwater stems. Invertebrates (insects) and amphibians living in the shoreline fringe form the base of the aquatic food web and are vital for a healthy lake.

## Floristic Quality Index

One measure of aquatic plant community "health" is the Floristic Quality Index (FQI). The FQI is based on the number of native species and their "coefficient of conservatism", a number assigned to every aquatic plant in the State representing how typical the plant is in pristine conditions. The FQI is based solely on the presence of a plant, not its abundance or dominance. Statewide, the average FQI for lakes is 22.2. The FQI for Beecher Lake was 38.1, indicating a high quality aquatic plant population. The high FQI also shows that early in the EWM infestation diversity remains high.

## Aquatic Plant Distribution

Each species of aquatic plant has habitat preferences that determine where it grows or potentially can grow. These include such factors as depth, light exposure and sediment type. A discussion of these factors and their effect on the plant community of Beecher Lake follows.

**Depth**
The area of a lake where aquatic plants can grow is called the littoral zone and is determined by water clarity and light penetration. Field investigation reveals that the maximum depth of plant colonization in Beecher is approximately 12 feet. In Beecher Lake the littoral zone covers approximately 38 acres, or 65% of the lakes surface area.

The extent of the littoral zone is determined by light penetration (water clarity), which is controlled by suspended sediment, algae, and color. In Beecher Lake color is primarily responsible for limiting light penetration. The water in Beecher Lake typically has a light brown color caused by tannins in the water. Tannins are naturally occurring dissolved organic compounds that come from decomposing plants. Spring runoff flushes the tannins from upstream wetlands each year turning the lake light brown. As the year progresses tannin rich water is flushed from the lake and water clarity improves.

Within the littoral zone each species has a depth preference and a maximum depth at which it can grow. In some cases the maximum depth is limited by growth form such as water lilies that have floating leaves attached at the end of long underwater stalks, or emergent plants that must stand above the surface. Submersed plants are limited by the amount of available light, which decreases rapidly as depth increases. Most aquatic plants are perennials that die back to the sediment surface each year. Others sprout anew from specialized plant fragments (winter buds) lying on the lake bottom. These plants use energy stored in the roots or winter buds to extend upward towards the light each year. They must grow high enough and fast enough to reach the sunlight then grow and export nutrients to the roots to start next year's growth. Different species vary in their ability to grow in low light conditions and fewer species are typically found at greater depth.

Of the dominant species found in Beecher Lake, creeping bladderwort showed the strongest preference for shallow water with more than half of the plants found in 2 feet of water or less. Musk grass, variable pondweed, water shield, white water lily, and large leaf pondweed are all found primarily in water less than 6 feet deep. Eurasian watermilfoil, coontail, moss, and small pondweed show a strong preference for deep water (5-8 feet). Common bladderwort and bushy pondweed show no distinct depth preference. Beyond 8 feet deep there is a sharp decline in the number of species found and none is found in any significant number beyond a depth of 7 feet.

**Sediment**

Sediment type also plays a major role in aquatic plant distribution and abundance. Sediment preference can be related to physical properties of the sediment (coarseness, grain size, compaction) or in the chemical properties of the sediment such as pH, or nutrient availability.

Most rooted aquatic plants get their nutrients from the sediment, not the overlying surface water. Because of this, even lakes with low to moderate nutrient levels in the water column can support abundant aquatic plants if sediment nutrient levels and water clarity is sufficient. Sediment that erodes from upland sources is typically high in nutrients. Impounded water such as Beecher typically has nutrient rich sediment in shallow areas that were historically upland or wetland areas.

Nutrient availability is closely tied to sediment coarseness. What most people refer to as muck is typically silt with a high percentage of organic particles from decomposing plant material. Organic sediment is typically high in nutrients. Sand, by itself can be very nutrient poor, however there is typically sufficient fine silt and organic matter mixed in to provide good growing medium for plants. Rock by itself will not support plant growth but it is often found mixed with sediment that will.

Of the dominant species only musk grass and water shield showed a significant (more than 10%) preference for sandy sediment. Many species show a significant preference for muck including Eurasian watermilfoil, common bladderwort, coontail, variable pondweed, moss, small pondweed, and white water lily. Creeping bladderwort and bushy pondweed showed no significant sediment preference.

## Aquatic Plant Abundance

In addition to describing patterns of aquatic plant distribution in Beecher Lake, the survey was designed to determine plant abundance (figure 7). At each sample point a rake "fullness" measure of 1 (sparse) to 4 (abundant) was used to estimate aquatic plant abundance. Abundance was recorded for each species independently and for all plants in aggregate at each site.

Overall plant abundance averaged 2.3 at sties shallower than the maximum rooting depth (12 ft). However, abundance varied considerably by depth. From 1 to 4 feet deep the average density was more than 2.7. Between 4 and 7 feet the density decreased to 2.2. Beyond 7 feet the density dropped to 1.5 or less.

Abundance did not vary by sediment type. Plants were equally abundant at mucky sites (average 2.2) as they were at sandy sites (average 2.3).

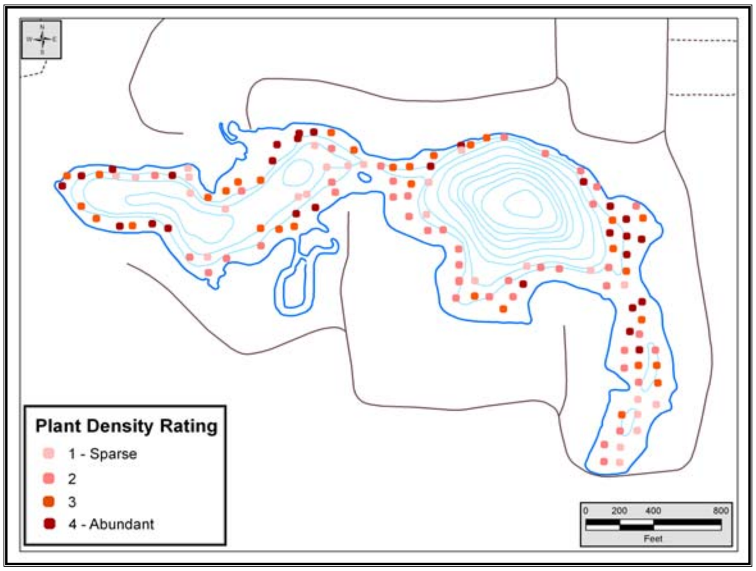



**Figure 7. Beecher Lake aquatic plant density rating.**

The submersed plant with the highest average abundance is muskgrass (1.9), which has a sprawling growth form that tends to dominate the community in shallow sandy areas. Eurasian watermilfoil, coontail and variable pondweed all had an average abundance of 1.4. It is notable that no species dominates the aquatic plant community. This is typical of highly diverse communities that are in balance. It is unlikely this condition will continue without intervention as EWM expands its range and abundance in Beecher Lake.

# Changes in the Aquatic Plant Community

One-time aquatic plant surveys are useful for describing the aquatic plant community but by themselves do not describe changes in the community. To identify changes the community needs to be tracked over time. The only other aquatic survey of Beecher Lake was conducted in 1996 as part of a lake management planning process. Unfortunately the 1996 survey was a transect survey where data is collected along a line instead of a grid. In the survey transects were laid out by anchoring a line perpendicular to shore. A diver swam along a line taking note of all species within 0.5 meters of the line in each of three depth ranges 0-0.5 meters, 0.5 – 1.5 meters and 1.5 – 3.0 meters. An abundance ranking of 1 to 5 was assigned for each species. While not directly comparable to the grid survey, the earlier transect survey does provide some basic information that can be used to make qualitative assessments of changes in the plant community over the last 12 years.

In 1996 ten randomly spaced transects were surveyed. Each transect contained three depth ranges for 30 total sample "points". In the survey 23 species of aquatic plants were identified compared to 31 species in 2008. The difference is likely due to survey methodology rather than an increase in diversity during the period. The relatively small number of sample points in the original survey would under-sample many habitats on the lake, making it likely that uncommon plants would be missed.

Many of the same plants that dominated the lake in the 2008 survey were also dominant in 1996 including bushy pondweed, muskgrass, large-leaf pondweed, and white water lily. Notable changes in plant dominance include water marigold, flat stem pondweed, and northern watermilfoil. All of which were dominant in 1996 but relatively uncommon today (figure 8).

Two common aquatic plants, water celery (*Vallisneria americana*) and water stargrass (*Zosterella dubia*), were found in 1996 but not in 2008. Neither was very abundant in the original survey

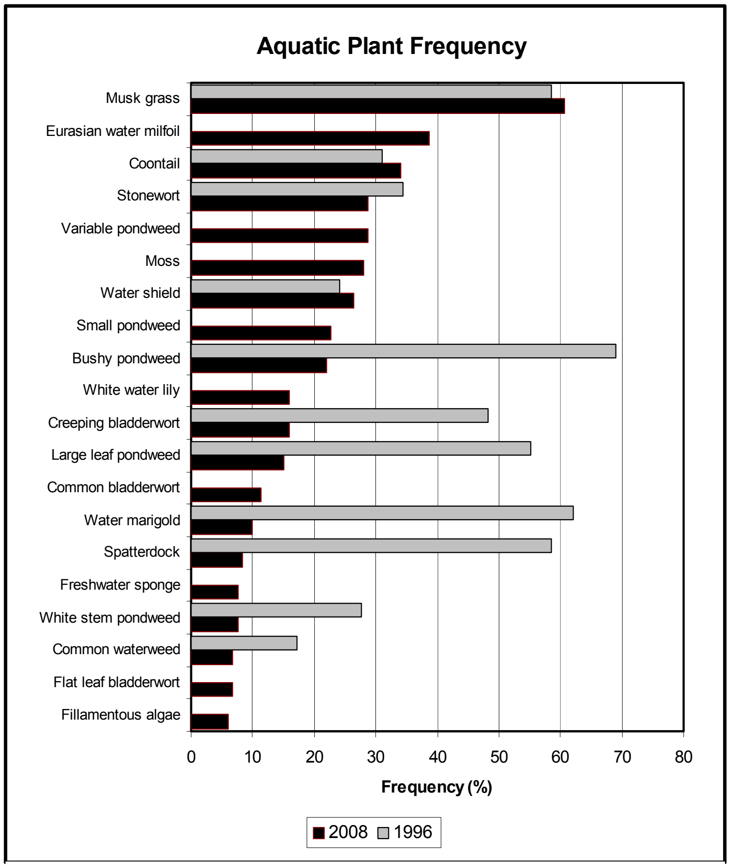



**Figure 8. Beecher Lake plant frequency changes between 1996 and 2008.**

but both are relatively easy to identify and would not likely be missed by the more intensive grid sampling effort.

In 1996 spatterdock lily dominated the floating leaf community followed by white water lily and watershield. Today the list has been reversed and watershield dominates the community while spatterdock is much less common. While there is little data to point to, it appears that watershield is increasing in other area lakes as well. This may be due to more frequent summer draughts and low water levels or changes in water temperatures or clarity.

## Effects of EWM on the aquatic plant community

Many of the observed changes in the aquatic plant community of Beecher Lake can be attributed to the recent EWM invasion. In 1996 EWM was not present and the native northern watermilfoil was abundant. Today northern watermilfoil is rare. Since the two plants share almost identical habitat preferences the native milfoil is almost always the first casualty of a EWM invasion. EWM is also likely responsible for the decrease in many of the large pondweeds, water marigold, and bushy pondweed. All have similar habitat preferences.

## Predicted impacts of EWM expansion in Beecher Lake

Many of the observed changes in the aquatic plant community follow a pattern commonly seen in EWM invasions. After introduction EWM often remains relatively sparse for a few years then expands rapidly into all areas of suitable habitat. The speed of the expansion depends in large part on the health of the native community and disturbances that help spread the EWM. Where conditions are favorable EWM eventually forms nearly monotypic stands.

While it's not known when EWM was introduced into Beecher Lake it is now rapidly expanding. In the fall of 2007 there were 9.7 acres of moderate to dense EWM growth, primarily on the east and north shores of the Beecher Lake basin as seen in figure 9. By the fall of 2008 EWM coverage expanded to 13.6 acres, making significant inroads into Upper Lake. By the fall of 2009 EWM covered 15.7 acres, a 61% increase from 2007.

Although EWM is widely distributed throughout both lake basins it has not yet expanded into all suitable areas. Based on EWM growth habits in Beecher Lake and other lakes where it is well established almost the entire Beecher Lake littoral zone will provide suitable habitat. Experience also suggests EWM has not yet reached its maximum abundance in Beecher Lake. As mentioned, the native plant community remains relatively healthy at this time and in many places is persisting in the face of the EWM invasion. Without intervention to manage EWM it will likely increase greatly in abundance, further restricting navigation and negatively impacting recreational uses of Beecher Lake.

The potential impact on fish and wildlife from an expanding EWM population are more difficult to predict. However, simplification of the aquatic

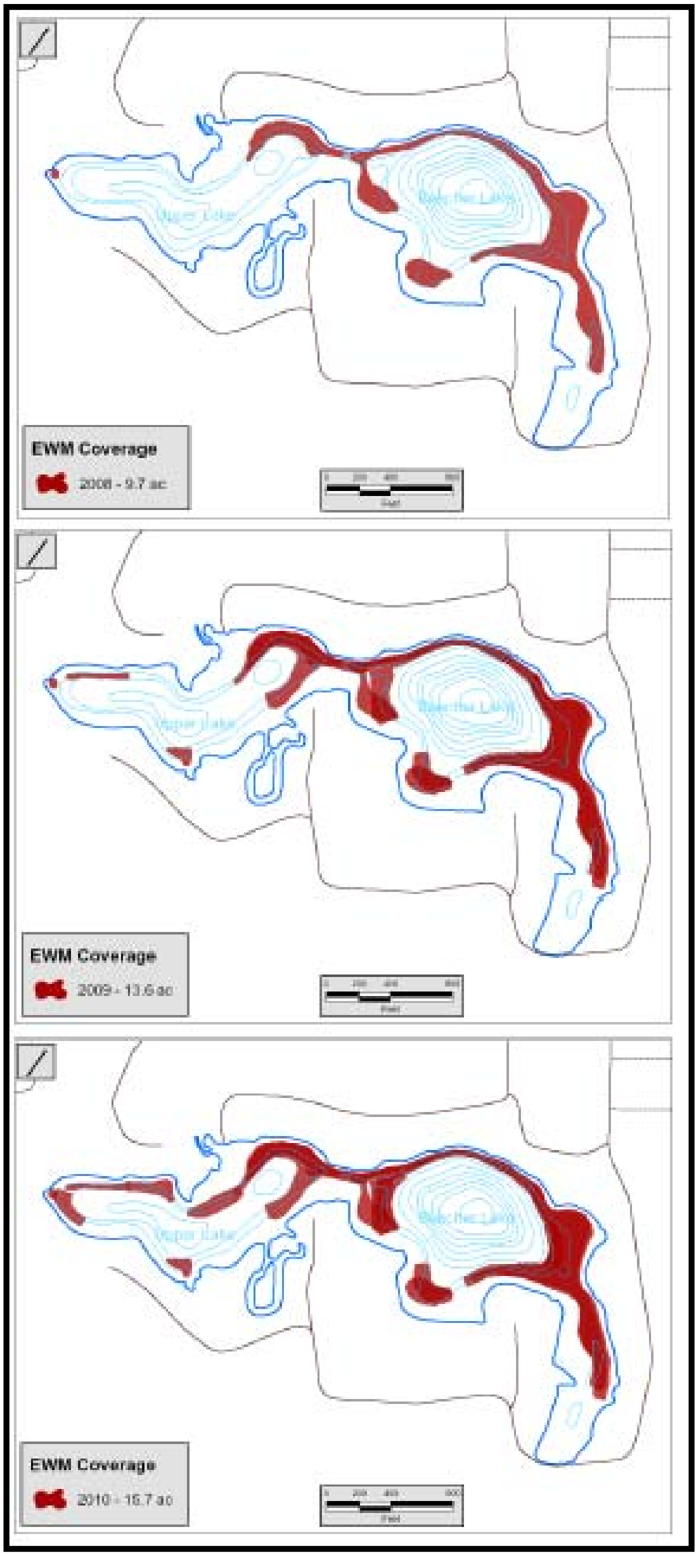



**Figure 9. EWM expansion over a three-year period in Beecher Lake (2008 is at the top followed by 2009 and 2010 on the bottom).**

plant community surely will not benefit local fish and wildlife communities. There is some evidence suggesting that extensive EWM beds can harm bass/bluegill fisheries by restricting the feeding opportunities of large predator fish, thereby causing a shift in the panfish population to favor smaller, less desirable fish.

## Identification of Problems and Threats to Beecher Lake

### Eurasian watermilfoil

The most pressing issue confronting Beecher Lake is obviously the recent EWM infestation and the threat it poses to the native plant community, navigability, and recreational potential of the lake. However, problems with excessive aquatic plant growth preceded the exotic species invasion. In 1997 Beecher Lake property owners identified excessive aquatic plant growth, excessive sediment buildup, and poor fishing as the most serious problems affecting the lake. Since the EWM invasion the primary focus has shifted to managing EWM.

### Other aquatic invasive species

Future threats to Beecher Lake include new introductions of aquatic invasive species. Currently several nearby waters are infested with zebra mussels (*Dreissena polymorpha*) and the Bay of Green Bay is home to numerous invasive aquatic species, all of which have the potential to impact Beecher Lake. The recent discovery of hydrilla (*Hydrilla verticillata*) in Marinette County illustrates this problem. Once thought to be incapable of surviving in our northern climate, hydrilla was well established, and even expanding, when it was discovered in a private pond near Athelstane. The plant apparently traveled to Marinette County by mail, attached to ornamental water garden plants. While the infestation appears to have been successfully eradicated, its discovery underscores the continuing threat of invasive species.

### Nutrient enrichment and declining lake levels

The triple threat of increasing nutrient enrichment, falling water levels and longer growing season is one shared by most area lakes. As the shoreline of any lake is developed the volume of runoff increases, as does the amount of phosphorus in that runoff. Many studies have shown that phosphorus loading is directly correlated to the amount of development in a watershed and that phosphorus loading from lawns was eight times higher than from forested areas (WDNR 2003).

The effect of increased phosphorus loading is compounded by long-term climate trends. The Wisconsin Initiative on Climate Change Impacts predicts slightly warmer summers, a continuing trend of less precipitation during the summer months and slightly warmer winters. Annual precipitation is not predicted to change greatly but the distribution is. The prediction is for a wetter spring and winter but a drier summer.

The net effect of these changes on lakes is a shorter period of ice cover, a longer and warmer growing season, and declining summer water levels. All favoring increased aquatic plant and/or algae production.

# Aquatic Plant Management Goals & Objectives

The goal of the Beecher Lake District is to: **Develop and implement a sustainable aquatic plant management program for Beecher and Upper Lakes to prevent EWM dominance, benefit the existing native aquatic plant community and restore beneficial uses of the lakes.** To achieve this goal specific management objectives have been identified and targets have been set to gauge success and guide selection of management options.

**Goal: Develop a sustainable aquatic plant management program.**

A sustainable aquatic plant management program will be cost-effective and should, as much as possible, be relatively easy to repeat as needed. In determining cost effectiveness the District needs to consider both management cost and duration of EWM control. In the final analysis management efforts that cost more may be preferable if they provide multi-year control. Permitting requirements should also be considered and figured into the management "cost".

***Objective:*** *Place emphasis on aquatic plant management methods that provide multi-year control and reduce annual management costs.*

An aquatic plant management program that is sustainable over the long-term also needs to adapt as environmental conditions and aquatic plant populations change. To make the required adjustments those responsible for making management decisions need current information upon which to base their decisions.

***Objective:*** *Track changes in the aquatic plant population so changes can be documented and past management efforts evaluated.*

Using an easily repeatable method like the point/intercept monitoring protocol used in the 2008 plant survey is the best way to track changes in the aquatic plant population. With some training in aquatic plant ID and a handheld GPS, lake residents are capable of collecting usable aquatic plant data.

***Target*** *– Provide for two or three District volunteers to be trained in aquatic plant ID and survey methods. Purchase equipment needed to conduct aquatic plant surveys.*

The recommended frequency of plant surveys depends on the frequency of changes in management methods. When new management methods are adopted surveys should be completed to track changes and determine management effectiveness. If, however management is routine the amount of time between plant surveys can be lengthened. Even in the absence of formal point/intercept surveys landowners should be routinely monitoring the lake for early detection of new invasive species.

***Target*** *- Conduct pre and post management aquatic plant surveys to evaluate effectiveness of new management tools.*

***Target*** *- Conduct annual surveys of the lake for new aquatic invasive species according to DNR AIS monitoring protocol.*

***Target*** *- Conduct a full point/intercept survey of the lakes every 5 years unless management conditions call for more frequent surveys.*

For any management program to be sustainable District members need to understand and take ownership of the program. Good communication is essential so District members are realistic about the expected outcomes and understand what they as landowners can do to help.

***Objective:*** *Communicate effectively with District members.*

While important, effective communication will require more than reports at the annual meeting. The District should use other avenues to communicate information, goals and outcomes to its members.

***Target*** *- Publish a regular newsletter to keep members informed about management practices and outcomes, and to share success stories.*

***Target*** *- Provide aquatic invasive species educational materials to members.*

**Goal: Prevent EWM dominance in Beecher and Upper Lakes.**

There are no management tools currently available that will allow for the eradication of EWM once it is established in a lake. The most realistic objective is to minimize its nuisance potential.

***Objective:*** *Reduce the frequency and abundance of EWM so that it does not dominate the aquatic plant community.*

Since EWM has many competitive advantages that allow it to quickly exploit disturbed areas or suppressed plant communities, control methods that cause widespread disturbance in the aquatic plant community may be counterproductive. Therefore, control methods must be carefully chosen to selectively control EWM. Currently a diverse native community exists even within EWM infested areas. Selective control of EWM in these areas will allow the native community to thrive. A healthy native community resists EWM invasion better than a disturbed plant community.

While EWM has made fairly serious inroads into the lake it still does not dominate the aquatic plant community. In 2008 EWM was found at 39% of survey sites (frequency of occurrence) and had an average rake fullness of 1.4 (abundance). An appropriate target is to:

***Target*** *- Reduce EWM frequency of occurrence to less than 25% of sample locations.*

***Target*** *- Reduce the abundance of EWM so that it's not the dominant submersed plant in the lakes as measured by average rake fullness.*

**Goal: Manage aquatic plants to restore beneficial uses of Beecher and Upper Lakes.**

The need to manage aquatic plants on Beecher and Upper Lakes predates the discovery of EWM. Many of the areas where EWM is dense have experienced nuisance levels of native aquatic plant growth for many years. Prior to the discovery of EWM floating leaf plants were the most troublesome species along with coontail and a mix of larger pondweeds. Restoring beneficial uses of the lake requires reducing aquatic plant density in these areas.

Unfortunately, since a healthy native plant community is required to combat EWM, the desire to reduce the abundance of all aquatic plants may run counter to the goal of reducing EWM dominance. In some instances certain types of native vegetation can be narrowly targeted for control without promoting EWM.

***Objective:*** *Selectively control nuisance native species where it does not promote EWM growth.*

In high use areas such as swimming beaches and around docks where intensive physical removal is possible all plants can be controlled. Manual removal with specialized weed cutters and weed rakes is common. Regular maintenance cutting is required to prevent re-colonization. Care must be taken to remove cut plant fragments (especially EWM) from the water to prevent their spread.

Some native species can also be selectively controlled with herbicides. Floating leaf plants (lilies and watershield) can be controlled with low doses of 2,4-D. However, unlike EWM the herbicide must be applied later in the year after the floating leaves have reached the surface. Watershield is also susceptible to winter drawdown.

***Target*** *- Reduce aquatic plant abundance around docks and swim areas without promoting EWM in these areas.*

In limited cases the growth of native species that do not typically produce nuisance conditions can be promoted.

***Objective:*** *Choose control methods which will promote the growth of low-growing native plants.*

Submersed aquatic plants that are common in Beecher Lake but seldom grow to nuisance levels include stonewort and bushy pondweed.

***Target*** *- Increase the frequency and abundance of stonewort, bushy pondweed and other species where experience shows them to be beneficial (or at least less of a nuisance).*

# Aquatic Plant Management Alternatives

A successful aquatic plant management strategy must be tailored to the plants and water body in question and will typically utilize multiple control methods as appropriate. A comprehensive review of aquatic plant management alternatives follows. While each of the alternatives may be beneficial in certain situations, not all are currently applicable to managing aquatic plants in Beecher Lake.

**Do Nothing**

Doing nothing is inexpensive, easy to do, and relatively uncontroversial. However, it is rarely effective. Lakes are complicated ecosystems and aquatic plant populations fluctuate within them due to a variety of factors. Large-scale climactic conditions and local weather cycles can impact water levels, temperature, and clarity, all of which effect aquatic plant growth. Plant populations also vary because of disease, species introduction, competition and other internal processes. Left to its own devices the plant community in Beecher Lake will continue to change over time.

In the case of Eurasian watermilfoil, doing nothing typically leads to EWM domination of the aquatic plant community. While the EWM dominance is often thought to be permanent, the history of EWM in Wisconsin shows this is not always the case. Carpenter (1980) reported that the duration of peak abundance in some lakes is approximately 10 years after which EWM may experience a significant decline. While the reason for these "natural" EWM declines is poorly understood some attribute it to a native milfoil weevil (*Euhrychiopsis lecontei*). Unfortunately this natural decline has not been seen everywhere and is not always permanent. In some lakes EWM populations experience quite a bit of natural variability with periodic declines and subsequent increases without any active management.
The downside to doing nothing is that the result may be nothing. This option will only result in a continuation of the problem and in the short term will surely lead to a worsening of the situation.

**Chemical Control**

When properly planned and executed, chemical control of aquatic plants can be effective. However, if care is not taken in the selection timing, and application of aquatic herbicides the results can be less than desirable, or worse, have unintended consequences.

There are several herbicides approved for aquatic use in Wisconsin and each differs in its mode of action and in the species it controls. Contact herbicides kill exposed plant material but can leave the root system intact, allowing for more rapid recovery and plant growth. Systemic herbicides are transported to the roots and kill the entire plant. Systemic herbicides provide longer-term control but may act slower than contact herbicides.

Herbicides can also be grouped into two general groups, "broad-spectrum" and "selective". Broad-spectrum herbicides control a broad range of plants. Selective herbicides, as the name implies, are more-or-less selective and control fewer species while leaving many others unharmed. Often selectivity is a function of timing of application or concentration of the herbicide.

Eurasian watermilfoil (EWM) is very susceptible to several common aquatic herbicides. The plant is especially susceptible to formulations of 2,4-D, a systemic herbicide. Since most pondweeds and other native aquatic plants are resistant or only slightly susceptible to 2,4-D the chemical can be used to selectively control milfoil while protecting native species (Parsons, 2001). Chemical control of EWM is a popular and effective control measure where the goal is to shift the plant community to a more natural mix of native species.

When used in a selective manner it is possible to get multi-year control from herbicides. This is most likely to be achieved when the native community is relatively vigorous and can resist EWM reestablishment. Eventually EWM will return so even selective management will have to be repeated on a regular basis.

Improper or excessive use of aquatic herbicides can have unintended consequences. Widespread use of broad-spectrum herbicides can leave large areas of suitable habitat exposed to colonization by nuisance species. Many of the more common nuisance plants, such as EWM, are aggressive pioneer species that can quickly invade disturbed areas. The decomposition of tons of aquatic plants also releases large amounts of nutrients to the water column. These nutrients can trigger algae blooms and fuel additional aquatic plant growth

Chemical treatment cost depends primarily on the chemical formulation and application rate, the distance a certified applicator has to travel, and the time and equipment involved. Currently (2010) EWM treatment with Navigate granular 2,4-D could be expected to cost between $500.00 and $900.00 per acre depending on the application rate and size of the treatment area. In some instances the State of Wisconsin can provide funding for chemical treatment of Eurasian watermilfoil or other lake restoration activities recommended in a lake management plan approved by the DNR.

Chemical treatment of aquatic plants in Wisconsin always requires a permit from the Wisconsin DNR. This is to ensure that the proposed chemical treatment will use appropriate chemical(s), at the correct concentration and at the proper time of the year. In almost all situations the chemical applicator must be certified by the Wisconsin Department of Agriculture Trade and Consumer Protection.

**Benthic Barriers**

Benthic, or sediment barriers cover the sediment and prevent the growth of aquatic plants. The barriers work by physically disrupting plant growth or eliminating light at the sediment surface. When installed properly benthic barriers are very effective at eliminating all plant growth. However the difficulty of installing and maintaining these barriers prevent their widespread use.

Benthic barriers can be made of naturally occurring materials (sand and gravel) or artificial (synthetic plastic sheeting). Sand or pea gravel is commonly used to create weed free swim areas. However, there are several common problems with sand and gravel benthic barriers. If deposited on soft sediment it can sink in and mix with the native sediment. Also, over time new sediment is deposited on top of the barrier. All of these factors will lead to failure of the barrier.

Artificial barriers typically consist of sheets of polypropylene, polyethylene, fiberglass or nylon (Wagner 2004). All must be weighted to hold them in place against water currents, waves, and boat wake. If constructed of non-porous material benthic barriers will be subject to billowing and may float free of the sediment as gasses from decomposition build up beneath them. Porous barriers are less subject to billowing but plant fragments that settle on top are better able to root through them. Both types of barriers require annual maintenance since sediment accumulation on top of the barriers will build up and support new aquatic plant growth.

Artificial benthic barriers are also relatively expensive and difficult to install and maintain. Maintenance consists primarily of annually removing accumulated sediment, which typically requires removal and replacement of the barrier.

The use of any type of benthic barrier requires a DNR permit.

**Dyes and Floating Covers**

Dyes are liquid chemicals that are applied to change the color of the water. Covers physically cover the water surface. Both control aquatic plants by reducing the amount of light reaching the sediment.

Dyes typically color the water a deep blue or even black. For small ponds they are relatively inexpensive, long lasting, and effective. Effectiveness is limited in shallow water (2 feet or less) where the light reduction is seldom enough to prevent plant growth. Dyes must stay in the water throughout much of the growing season. Because of their dark color, dyes increase light absorption and can result in higher water temperatures. The increase water temperature can in-turn result in stronger stratification, lower dissolved oxygen and widespread changes in the aquatic community (Wagner 2004). Dyes are not an option in larger lakes and those with significant outflow.

Floating covers also disrupt plant growth by reducing light levels at the sediment surface. However, unlike dyes the floating covers prevent virtually all water use while they are in place. Floating covers can be difficult to install and effectively anchor.

Both dyes and floating covers require DNR permits. The main permitting issue with floating covers is the disruption of public water rights (fishing and navigation) that they cause while installed.

**Harvesting**

Aquatic plant harvesting is a widely accepted aquatic plant management alternative that can be effective on a large or small scale. Individual landowners often manually clear small areas around their dock or swim area. Typically this is accomplished by using one of several specially designed aquatic plant rakes and/or hand-held cutting implements. Under current Wisconsin Law landowners can manually harvest plants without a permit if the plant removal is not in a DNR designated sensitive area and is limited to a 30-foot wide area (measured parallel to shore). There is no limit on how far out into the lake a landowner can harvest by hand if they stay within the 30-foot wide corridor. The control area must be around existing piers, boat lifts, and swim rafts and the cut plants must be removed from the water.

Large scale harvesting is typically accomplished using specially designed aquatic plant harvesters that cut and collect aquatic plants in one operation. The size and capacity of these harvesters varies greatly but the largest can cut a 10-foot wide swath up to 6 feet deep and holds more than 16,000lbs of cut plants.

Like most aquatic plant management alternatives harvesting seldom eliminates plants. Much like cutting your lawn, harvesting leaves the root system intact and plants will re-grow. In some cases repeated harvesting close to the sediment surface can stress plants enough to cause mortality. Species that depend on seed production for their spread may be partially controlled by harvesting if seeds are repeatedly removed. Plants that spread by fragmentation such as EWM and coontail can actually be spread through harvesting when cut fragments escape the harvester and drift to other areas of the lake.

Repeated harvesting can have impacts on the aquatic plant community that go beyond the initial cutting. In Lake Noquebay repeated harvesting has led to measurable shifts in the aquatic plant community. When harvesting began in 1978 the lake was dominated by a variable watermilfoil, a native milfoil with growth habits similar to the Eurasian variety. After 28 years of harvesting the plant community has changed noticeably. Harvesting tonnage has gone down and the new dominant species in Lake Noquebay is bushy pondweed, a low growing native that typically stays below the maximum cutter depth of 5.5 feet.

As a management method harvesting is not selective and is best used where invasive or nuisance species dominate. Plant re-growth depends on the species present, timing of harvest, and cutting depth. Studies have shown that very deep cutting with specialized harvesters can even have multiple year effects on milfoil and other aquatic plants.

Large Scale mechanical harvesting can be an expensive proposition. Commercial harvesting is available in Wisconsin and can range from $300 to $500 per acre plus travel costs. As with many services the unit cost is typically lower when the harvest area is larger. The Wisconsin Association of Lakes website has information regarding private commercial harvesting vendors.

Typically when a lake undertakes a long term harvesting program they purchase and operate their own equipment. Initial costs for a new harvester can range from $50,000 to $100,000 depending on the size of machine. Typically a truck is also required to transport plants to a disposal site and a shoreline conveyor to transfer cut plants from the harvester to the truck. Wisconsin does provide financial assistance for harvester and related equipment purchases through the Wisconsin Waterways Commission. Grants are awarded on a competitive basis and cover 50% of equipment purchase price. Operating and maintenance costs vary depending on the amount of use and the labor source. While volunteer operators are of course free, in the long run it may be best for the equipment and for the harvesting program to hire a dedicated harvesting crew to operate and maintain such expensive and complicated equipment.

Any mechanical harvesting requires a Wisconsin DNR approved aquatic plant management plan and permit. The approved management plan is also a requirement for receiving a Waterways Commission grant for equipment purchase.

Harvesting should only be used as a tool for managing EWM if the plant has already taken over a lake. With early infestations harvesting will speed the spread of EWM within the lake since it causes increased fragmentation. If harvesting is used it will have to be repeated multiple times during the season to provide nuisance relief, especially in shallow water areas since EWM can grow a foot or more per week.

**Dredging**

Typically a practice known for increasing depth to aid in navigation, dredging can also be an effective aquatic plant control technique. As a plant control measure dredging has two primary modes of action: changing sediment type, and increasing the depth to sediment.

Where a layer of nutrient rich organic sediment overlies a nutrient poor layer of mineral soil the organic layer can be removed to expose the sand or gravel layer that is less capable of supporting plant growth. Typically such removal will change the plant community structure, not eliminate all plant growth. Removing the upper layers of sediment also eliminates plant roots and most viable seeds. Unfortunately, the result of organic sediment removal is seldom long lived since many plants will colonize mineral soil where they quickly begin the process of building new organic matter. Very little organic matter is needed to support dense plant growth.

Eliminating all submersed aquatic plants requires dredging the lake to a depth where light availability limits plant growth. In Beecher Lake the lower limit of aquatic plant growth is about 12 feet with sparse plant growth beyond the 9-foot depth.

There are two major types of dredging, hydraulic and mechanical. Hydraulic dredging is accomplished by pumping a sediment/water slurry out of the lake to a disposal/dewatering area. Hydraulic dredging is best suited to loose organic sediment. Mechanical dredging employs heavy equipment deployed on barge or shore to dig out the sediment and transfer it to trucks for removal. Mechanical dredging can be simplified if done in conjunction with a drawdown since less water is moved and conventional dry land excavating equipment can be used.

It should come as no surprise that dredging is typically a very expensive alternative. Rough estimates for mechanical dredging range from $8.00 to $25.00 for each cubic yard (Wagner 2004). Much depends on the type of sediment, accessibility and disposal costs.

As a practical matter, large scale dredging to reduce EWM growth on Beecher Lake would not be feasible. While EWM grows best in muck it can grow in any firm sediment. As a management tool in very limited areas it may be of some benefit but, as mentioned, in shallow areas the benefit is not long lasting.

Any type of dredging requires, at a minimum, a Wisconsin DNR and US Army Cops of Engineers permit. Permits must describe in detail the scope of the proposed dredging, dewatering and disposal of spoils, and the effects the project will have on fish, wildlife, and public water rights.

**Drawdown**

In impounded waters temporary drawdown can be a valuable aquatic plant management tool. Its effectiveness depends on the season and duration of the drawdown. Summer drawdown can kill some species of plants through desiccation of the root system. This is often difficult in organic sediments since they retain moisture, requiring long periods of dewatering. Many plants are stimulated by changing water levels and can increase with summer drawdown. Winter drawdown controls plants by exposing their root systems to freezing conditions. In winter the duration of the drawdown is less important than the timing. It is important that frost penetrates to the root zone before snow insulates the lakebed.

The response of aquatic plants to drawdown is well known for some species but not for others. To complicate matters, accounts in the scientific literature do not always agree. Table 1 lists the species found in Beecher Lake and their reported susceptibility to winter drawdown according to Cooke (2005) and local experience. As the table indicates, some aquatic plants are stimulated by winter drawdown.

The use of winter drawdown for EWM control in Wisconsin is very promising. The Wisconsin Public Service Corporation (WPS) conducted a drawdown of High Falls Flowage during the winter of 2001 specifically for the purpose of Eurasian watermilfoil control. In a plant survey conducted in 2002 no EWM was observed in 14 test plots that previously contained the plant. By 2005 the milfoil had re-colonized 5 of the plots but was still much reduced (Shawn Puzen, pers. comm.). The duration of EWM control achieved by a single winter drawdown varies but has been reported as lasting 3 – 5 years. Besides EWM control, a winter drawdown of Beecher Lake shows promise for controlling watershield and other floating leaf plants. Species that might be expected to increase include bushy pondweed, water marigold, and coontail.

The primary drawbacks to drawdown include loss of recreational use during the low water period (minimal with a winter drawdown) and potentially lowering water levels in shallow wells adjacent to the lake. Other impacts may include unintended effects on fish and aquatic life. Since Beecher Lake has ample deep water a limited drawdown should have little direct impact on fish but may temporarily reduce the population of some aquatic insects and snails.

Based on literature reviews and local experience it appears that winter drawdown may be a viable EWM management tool for Beecher Lake. At full-pool the Beecher Lake dam impounds 6 feet of water. Based on the updated hydrographic map of Beecher Lake a 5-foot drawdown would

| Decrease | Variable/Unknown | Increase |
|---|---|---|
| Eurasian watermilfoil | Muskgrass (V) | Coontail |
| Water shield | Variable-leaf pondweed (V) | Water marigold |
| White water lily | Stonewort (U) | Bushy pondweed |
| Spatterdock lily | Small pondweed (V) | Floating-leaf pondweed |
| Common bladderwort | Creeping bladderwort (U) | |
| Hairgrass | Large-leaf pondweed (V) | |
| | White-stem pondweed (U) | |
| | Flat-leaf bladderwort (U) | |
| | Common waterweed (V) | |
| | Water bulrush (U) | |
| | Flat-stem pondweed (V) | |
| | Fries pondweed (U) | |
| | Stiff pondweed (U) | |
| | Ribbon-leaf pondweed (V) | |
| | Northern watermilfoil (V) | |
| | Sago Pondweed (V) | |

**Table 1. Response of common aquatic plants to winter drawdown.**

expose approximately 29 acres of lakebed (figure 10). A 6-foot drawdown would expose approximately 31 acres. Depending on the severity of the winter it may be possible to get some control beyond the 6-foot depth. Since EWM can be found growing in water up to 11 feet deep the drawdown would not impact all areas of EWM growth but it would impact the areas where EWM is most dense. As an added benefit a winter drawdown would also provide some control of watershield over most of its range in the lake.

If drawdown is to be used as a management tool it's important to understand the hydrology of Beecher Lake. Although the dam sets the maximum water level, history shows there is not always enough water flowing into the lake to keep it full. This was apparent during the last few years' when lake levels dropped below the spillway crest by late summer. Despite the occasional shortage of water seen during the summer months spring runoff will be more than sufficient to refill the lake even after the maximum possible drawdown.

The volume of water in the upper 6 feet of Beecher Lake is approximately 254 acre-feet (83 million gallons). Between April 21 and June 25, 2008 the water level in Beecher Lake was recorded daily. Outflow was also measured at several lake stages to develop a stage-discharge relationship. Based on the data it would have taken only 7 days to refill the lake in 2008. To provide some scale for the amount of water flowing through Beecher Lake it's estimated that during the two-month monitoring period 293 million gallons, nearly the entire volume of the lake, had passed over the dam.

Unfortunately the Beecher Lake dam has a fixed spillway without a low level drain or any means of controlling water levels. Conducting a drawdown of the lake would require pumping, siphoning, or installing a low level drain in the dam. An analysis of each method follows.

<u>Pumping</u> – While possible, pumping 83 million gallons of water from the lake would be a very expensive undertaking. For example, in


**Figure 10. Area of sediment exposed by a 5-foot water level drawdown in Beecher Lake.**

dewatering a local pond it cost $6,000.00 to pump about 2 million gallons of water. At this rate, pumping 83 million gallons from Beecher Lake would cost almost $250,000.00!

<u>Siphoning</u> – Siphoning is not as fast or efficient as pumping but is much more economical. Siphon tubes can be made from readily available PVC pipes and fixtures and primed with a small water pump (sump pump). Given the low cost it would be possible to use several of them in series to increase the rate of flow.

Since siphons are more efficient if the intake leg is as short as possible a deeper sump area close to the dam from which to draw water might improve efficiency. Siphons also work best when the difference in head between the intake and receiving water is greatest. As the lake level falls the siphons would not work as efficiently and would eventually stop so it will not be possible to effect the full drawdown with siphons alone.

<u>Modify the Dam</u> – While modifying the dam will surely be an expensive proposition it may be the best option if winter drawdown is to be used as a routine management tool. After some study it appears the simplest, and least expensive, modification would be to bore a hole through the bottom of the spillway wall and install a drainpipe and valve. Once installed the valve simply needs

to be opened in the fall and closed when the sediment freezes.

The Beecher Lake Dam is owned by the Town of Beecher and licensed by the Wisconsin DNR. Structural modifications to the dam would have to be approved by the Town and DNR Dam Safety engineers. The District and/or Town of Beecher would be required to submit detailed engineering plans for DNR review.

Regardless of the method employed, any drawdown will require a permit from the DNR. The drawdown option has already been discussed with local DNR staff and they appear open to trying this alternative for EWM control.

**Control/Reduce Nutrient Inputs**
Aquatic plant response to nutrient input varies by species and source of nutrients. For the most part, rooted aquatic plants absorb their nutrients through the root system so nutrient additions to the sediment are more important than dissolved nutrients in the water column. Dissolved nutrients do not stay dissolved for long however since they are so biologically available. Algae in particular quickly take up dissolved phosphorus. When the algae dies a portion of the phosphorus sinks to the lakebed as particulate phosphorus, available for rooted plant growth.

Studies have shown that many aquatic plants are particularly stimulated by nitrogen additions to the sediment. Rogers (1995) reported that nitrogen additions to sediment significantly increased wild celery growth. Nitrogen is a water-soluble nutrient. Septic systems intensive irrigation and excessive nitrogen fertilizer use have all been shown to cause increased nitrogen concentrations in groundwater.

Increasingly the amount of fertilizer used in urban settings is seen as a major contributor of phosphorus and nitrogen to our surface waters. Recently the State of Wisconsin severely restricted the use of phosphorus in lawn and garden fertilizer and recommended reductions in the use of nitrogen fertilizer to protect surface waters. Restricting fertilizer use is especially important near the lake since nutrient rich runoff from these areas is more likely to be delivered directly to the lake.

Reducing runoff volume is also important in controlling nutrient inputs to the lake. Since most of the increase in nutrient load is a result of increased runoff volume, it stands to reason that decreasing the amount of impervious surface and taking steps to increase the amount of infiltration will protect water quality. Many of the practices designed to decrease runoff volume also remove nutrients from the runoff.

**Biological Plant Control**
Biological control (biocontrol) typically utilizes bacteria, fungi, or insects to control an unwanted plant. Biocontrol of exotic species often involves finding the natural control mechanism in the exotic plants country of origin and importing it to the US. Since there is always a risk that introducing a new organism may lead to unintended impacts to non-target species a lot of study is required to approve the use of new biocontrol agents.

In a rather unusual twist, one of the most promising biocontrol agents for Eurasian watermilfoil is a native insect. The milfoil weevil (*Euhrychiopsis lecontei*) is a native species that normally feeds on northern water milfoil. The adult weevil lays its eggs on the growing tips of milfoil where the larvae feed and weaken the plant. Older larvae also burrow into the stems, often causing enough damage to cause the plants to loose buoyancy and sink. The stout stems and shoots of northern water milfoil typically show little damage from this feeding activity. Eurasian water milfoil however has relatively weak stems that are readily damaged by the feeding activity. Studies have shown that milfoil weevils actually prefer EWM and increase in population when EWM is the dominant food source (Lillie, 1997). It's believed that the natural decline in EWM infestations in some lakes may be due to the native milfoil weevil that has been found to be widespread in Wisconsin lakes (Jester, 1998).

Since its discovery as a control agent "stocking" milfoil weevils to control Eurasian watermilfoil has been used with mixed results. In Wisconsin it was found that in twelve lakes where weevils were stocked a few experienced large-scale milfoil declines while others saw little or no change (Jester 1999). Several factors seem to affect the success of EWM biocontrol. Jester found better results when EWM had already reached its maximum distribution. The study also found that weevil density was positively correlated with increasing water temperature, distance of plant beds from shore (closer was better), and the percent of natural shoreline. The amount of natural shoreline is important because the adult weevils overwinter in leaf litter on the forest floor along the waters edge. Other studies have found that sunfish species (bluegill, pumpkinseed etc.) are very efficient predators of milfoil weevils and play a major role in reducing their effectiveness (Newman 2004, Ward 2006). Environmental factors such as winter severity, disease, etc. can also affect weevil abundance and may play a role in variable biocontrol results.

Where successful, biocontrol can reduce the abundance of EWM and allow the native species to better compete. However, the expense ($1.00 per weevil) and highly variable results make it hard to recommend weevil stocking as a control measure. Also, even in lakes were biocontrol has been effective the declines in EWM biomass have often been temporary. This may be due to natural cycles in weevil abundance or other natural environmental factors.

Given the widespread distribution of the milfoil weevil in Wisconsin, and since Beecher Lake historically contained northern watermilfoil, it's likely that milfoil weevils are already in the lake. A survey of the EWM beds in Beecher Lake should reveal the presence/abundance of milfoil weevils. If found they could be incorporated into a comprehensive EWM control strategy.

**Exotic Species Monitoring and Prevention**

As is often the case, an ounce of prevention is worth a pound of cure. With exotic species this is doubly true. In most lakes, and for most exotic species the primary mode of introduction is by boat, boat trailer, or bait bucket. While public access points are particularly susceptible, many exotic have been introduced on lakes without any public access.

Once established in a water body it is extremely difficult to eradicate an exotic species. In the few cases where eradication has been successful the introduction was detected early. For this reason routine monitoring to detect new invasive species is an important step in any aquatic plant management effort. The Wisconsin DNR and University of Wisconsin Extension have many good publications and websites to help the layperson identify exotic species. Periodically these agencies also offer exotic species identification and control training to landowners.

# Aquatic Plant Management Recommendations

Since the EWM invasion of Beecher Lake is still in an early stage and the native plant community is still in relatively good condition it makes sense to aggressively attack the EWM as soon as possible to prevent it from taking over. At the same time, the District needs to explore all available options for the long-term control of EWM.

**Recommendation #1 – Conduct an early season 2,4-D treatment in 2010 targeting all areas of heavy EWM growth.** Research shows that 2,4-D can selectively control EWM at relatively low application rates if applied early in the growing season. The application should occur before many of the native pondweeds are actively growing and before EWM biomass is excessive. Herbicide treatments have been effective in water temperatures as low as 40 to 50 degrees F.

In early May 2009 nearly 14 acres of the lake were treated with Navigate 2,4-D at a rate of 150 lbs/acre with excellent results. By the fall of 2009 the area supporting heavy EWM growth was reduced to approximately 3.5 acres. The District should continue this effort and treat areas of heavy EWM growth in the spring of 2010 as shown in figure 10.

**Figure 11. Proposed 2010 EWM herbicide treatment area.**

**Recommendation #2 – Conduct a drawdown of the lake for EWM control in 2010 and/or 2011 using siphons**. The use of periodic winter drawdown for the long-term control of EWM shows promise and should be explored as an option for Beecher Lake. Prior to investing thousands of dollars to modify the dam it makes sense to test the option using siphons to lower the water level. Several 4" siphon tubes could be installed at the dam for about $150.00 each. The siphons are primed with a sump pump. To increase the siphon efficiency a sump area should be dredged closer to the dam if it can be done without compromising the structure.

The drawdown should be scheduled for the winter of 2010/11 if EWM growth is moderate to dense in a significant portion of the lake as determined by a late summer plant survey. If EWM growth is sparse or limited in its spread the drawdown should be postponed until EWM growth rebounds somewhat. The goal is to have well-established EWM growth at least in some areas so the effects of the drawdown can be judged.

**Recommendation #3 – Conduct early season 2,4-D treatments as needed based on drawdown results.** Based on the depth of EWM colonization and physical limitations of the dam, it is unlikely a drawdown will control all areas of dense EWM growth. Future herbicide use should be based on drawdown effectiveness. In the event that EWM growth remains dense beyond the 6-foot depth the District should consider early season spot treatments to provide relief in these areas.

**Recommendation #4 –Consider modifying the Beecher Lake dam to allow for periodic winter drawdown**. Based on the effectiveness of the test drawdown the District may want to explore making permanent modifications to the dam as described in the management alternatives. These modifications would greatly simplify the drawdown process and potentially allow for a more complete drawdown.

**Recommendation #5 – Survey the lake for milfoil weevils and establish control plots to test the use of biocontrol agents as a long-term EWM management tool.** The District should survey the lake for the presence of milfoil weevils. If found in significant numbers, or if grazing damage is noted on EWM, test plots should be established where other treatment measures are not used for a time to evaluate the potential for biocontrol of EWM.

**Recommendation #6 – Reduce nutrient loading to the lake from developed shoreline properties.** The Wisconsin Legislature recently banned the use of lawn fertilizer containing phosphorus except where soil tests show it is in short supply. Still the District should promote the wise use of fertilizer (if any) on lakeshore properties. It is recommended that applications of nitrogen be limited to 3-4 lbs of nitrogen per 1000 square feet annually.
The District should also promote the restoration of natural shorelines. These "shoreline buffers" reduce pollutant loading primarily by increasing infiltration. Additional benefits include improved shoreline habitat and less time spent mowing! The Marinette County LWCD has cost-share funds available to defray the cost of shoreline restoration.

## Monitoring and Evaluation Plan

In order to evaluate and make changes to the management program the District needs to track changes in the aquatic plant community. The management plan also needs to be evaluated on a regular basis and changed to meet shifting needs and address new challenges.

**Recommendation #1 – Conduct aquatic plant surveys to evaluate management effectiveness and track changes to the lakes aquatic plant community.** Surveys of the aquatic plant community should be completed with the application of any new management tool. For herbicide use, aquatic plant surveys should be completed before and after the treatment in and around areas to be treated. Pre and post-treatment surveys of the entire lake, or at least in representative areas, should be completed to evaluate the effect of winter drawdown on the plant community.

Periodically the entire lake should be surveyed to evaluate lake-wide changes to the plant community. These routine surveys should be completed approximately every 5 years. Sooner if sudden changes in the plant community are noticed. All plant surveys should be completed using the same DNR point/intercept aquatic plant sampling protocol used in the 2008 plant survey. The floating leaf plant community should also be mapped using GPS and described.

Where grants are obtained to assist in aquatic plant management the cost of professional aquatic plant surveys can be included in the grant. Eventually however the District should develop this capability from within its own ranks. The DNR and Wisconsin Lakes Partnership have many aquatic plant ID resources and offer periodic aquatic plant identification training. The Marinette County Land & Water Conservation Division can also assist.

**Recommendation #2 – Appoint a committee to annually evaluate the aquatic plant management program and recommend changes to the Board.** The Beecher Lake District should appoint an aquatic plant committee to coordinate management activities, oversee data collection, and preserve aquatic plant management data. The committee should evaluate the management program and recommend changes to the District Board.

## Information & Education Plan

With aquatic invasive species (AIS) an ounce of prevention truly is worth a pound of cure. A strong information and education effort is an important part of any AIS prevention program. It is also important to effectively communicate with district members when trying to implement a flexible aquatic plant management plan.

**Recommendation #1 – Maintain signage at the boat landing and provide educational materials to visitors to Beecher Lake.** Maintain educational signage at the boat landing to inform visitors to Beecher Lake about the danger of AIS and how they can help prevent the spread. Signage should be clear and uncluttered. Handouts should be provided through the "Clean Boats, Clean Waters" program during busy periods. Signage and educational materials can be obtained from the Peshtigo DNR office or on line at Wisconsin Lakes Partnership or UW Extension Lakes Program websites.

**Recommendation #2 – Publish a regular newsletter, provide educational materials, and update lake residents about AIS management efforts.** The District should publish a regular newsletter as a way of distributing educational materials and keeping members abreast of lake management issues. E-newsletters can be a cost effective alternative or supplement. The District should also sign members up to receive the Lake Tides Newsletter, a free quarterly publication by the Wisconsin Lakes Partnership.

**Recommendation #3 – Continue as a member of the Wisconsin Association of Lakes and take advantage of their resources.** The Wisconsin Association of Lakes (WAL) is a statewide lake organization that promotes sound lake policy and provides training opportunities for lake groups throughout the state. The District should send a few members each year to the annul lakes convention, a three day event featuring numerous speakers, workshops and presentations concerning lake management, operating effective lake organizations, and other current issues affecting Wisconsin Lakes.

# Aquatic Invasive Species Prevention, Monitoring and Rapid Response Plan

Unfortunately, Eurasian watermilfoil is not the only invasive aquatic species threatening out lakes. South of Marinette County curly-leaf pondweed (*Potamogeton crispus*) is an emerging problem. Other species including Hydrilla (*Hydrilla verticillata*), Brazilian waterweed (*Egaria densa*) and yellow floating heart (*Nymphoides peltata*) have been spreading north and may threaten our lakes in the future. Beyond the plant world we have Zebras mussels (*Drissena polymorpha*), Rusty crayfish (*Orconenctes rusticus*), exotic zooplankton, and fish diseases such as VHS to worry about. The best way to deal with these invaders is to be proactive and prevent their introduction. The Beecher Lake District should also adopt an exotic species monitoring plan to detect early invasions and a rapid response plan to deal with new invasive species if they are found.

## Prevention

An effective AIS prevention plan should focus on the most common routes of AIS invasion, boats, and water gardens. Boats traveling between lakes can carry plant fragments or zebras mussels attached to the boat or trailer. Water in the boat or bait buckets can carry plants, zebra mussels, zooplankton, algae, and disease causing organisms. While the information and education program can provide valuable information regarding the spread of AIS a more effective case can be made when delivering the message face-to-face.

**Recommendation #1 – The District should continue with the "Clean Boats, Clean Waters" watercraft inspection and information campaign.** Additional volunteers should be trained to conduct watercraft inspections and talk to boaters about the danger of spreading invasive species. This is a good project in which to get youth involved. The CBCW program is sponsored by the Wisconsin Lakes Partnership.

**Recommendation #2 – Education efforts should focus on the dangers of water gardening and the unintentional releases associated with the hobby.** Mail order water garden plants are believed to be the likely source of hydrilla, an invasive exotic that was recently found growing in a Marinette County pond. It had been believed hydrilla could not survive this far north but it was well established and expanding in the pond when discovered. On a positive note, the hydrilla was aggressively attacked and it appears to have been eliminated. A recent investigation of the water garden industry found that plants known to be invasive are available and routinely shipped around the country. Contamination of orders with other species, including invasive species, is also rampant (Maki, 2004).

## Monitoring

Effective management of AIS is much easier when the invader is detected early. In some cases it may even be possible to eradicate an invasive species if it is discovered early enough.

**Recommendation #1 – The District should join the Citizen Lake Monitoring Network and train several members in AIS monitoring procedures.** While the information & education program should equip all District members with a basic knowledge of invasive species, several should be trained specifically for AIS monitoring. The Citizen Lake Monitoring Network holds training workshops to train volunteers in AIS monitoring protocol. They also provide a monitoring manual and laminated AIS identification sheets along with reconnaissance and reporting forms. The County LWCD can assist in AIS identification and monitoring.

**Recommendation #2 – Volunteer AIS monitors should conduct annual AIS surveys of the lakes.** Aquatic plant surveys, although very beneficial, are not designed to find many types of aquatic invaders and may even miss pioneer plant invasions. A better method is to look specifically for different invasive species at the optimal time and in the most likely habitats. The ideal monitoring time varies by species but can typically be covered with one early and one late season survey.

Trained volunteers should conduct annual invasive species surveys. Findings should be reported to the District and the Citizen Lake Monitoring Network.

**Recommendation #3 – Report any suspected aquatic invasive species to local resource professionals.** If any suspected exotic species are found report it immediately to the Peshtigo DNR office or the County LWCD. Collect a sample of any suspected exotic species and keep it refrigerated in a zip-lock bag until it can be positively identified.

## Rapid Response

When a new invasive species is positively identified the District needs to act quickly. Depending on the species found, length of time since invasion, and where the pioneer colony is found, there may be a possibility for eradication. The following steps should be followed:

**Step #1 – Notify District board and local resource agencies and explore grant funding opportunities.** The District Board should immediately notify the Wisconsin DNR, arrange a meeting to explore control measures, and determine if and AIS Rapid Response grant is advisable. These grants were designed to deal with pioneer AIS infestations. The typical grant application process is bypassed so grant funds can be made available for quick action in hopes of eradication.

**Step #2 – Notify membership of the discovery and what the Board plans to do about it**. Notify Lake District members of the discovery and measures they can take to prevent its further spread within the lake or to other waters. Let them know how the Board plans on dealing with the invasion.

**Step #3 – Conduct a thorough survey of the lake to determine the extent of the AIS infestation.** Working with County or DNR staff, conduct a thorough survey of the lake. Map location of the invasive species and record its density as well as any other physical data that may be important such as water depth, sediment type etc.

**Step #4 – Determine if eradication is a possibility or if management is the only option.** Work with local resource agencies and outside experts where necessary to determine if eradication is possible. Where eradication is not feasible begin revising the lake management plan to deal with the new species.

**Step #5 - Develop an action plan based on species and extent of invasion.** Work closely with the experts to develop a customized plan aimed at eradication or control.

If outside consultants are needed for things like herbicide treatment or scuba diving bring them into the process early. Many consultants can also help with things like mapping and planning.

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