Lake Education and Planning Services, LLC
PO Box 26
Cameron, Wisconsin 54822

GILMORE LAKE, WASHBURN COUNTY

2024-2028 Aquatic Plant Management Plan
WDNR WBIC: 2695800

Prepared by: Dave Blumer, Lake Educator
December 2023

Gilmore Lake Association
Minong, WI 54859

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2024-2028 AQUATIC PLANT MANAGEMENT PLAN

GILMORE LAKE, WASHBURN COUNTY

PREPARED FOR THE GILMORE LAKE ASSOCIATION

INTRODUCTION

Gilmore Lake is in the northern portion of Washburn County, Wisconsin. It is approximately 371 acres in size and has a maximum depth of 36 feet and an average depth of 16 feet. In 2009, Eurasian watermilfoil (EWM) was discovered in Gilmore Lake and since that time the Gilmore Lake Association (GLA) has been managing it using diver removal, physical removal, and small-scale application of aquatic herbicides. An initial whole-lake, point-intercept, aquatic plant survey was completed in 2010, with no EWM being found at any of the surveyed points. In 2010, EWM was present in a small bed in the southwest portion of Gilmore Lake. In 2015, after 5 years of active management, the whole-lake, point-intercept survey had the same result – no EWM was found at any surveyed point. However, it was still present in the same location in Gilmore Lake, and at several locations in Little Gilmore Lake. In 2022, the plant survey was completed again. This time, EWM was found on the rake or as a visual at 23 points, most of which were in newly identified, large bed in the North Basin of the lake near the outlet.

The Wisconsin Department of Natural Resources (WDNR) recommends that Aquatic Plant Management Plans (APMP) be updated every five years when active management is occurring. The last APMP was completed in 2017 and guided EWM management from 2018 to 2023. This document serves as the update to that plan.

Except for the increase in EWM distribution and density, the condition of Gilmore Lake for the most part has remained unchanged since the 2010 and 2015 whole-lake, point-intercept surveys and the last APMP. Water quality is about the same with a potentially improving trend in place. Survey results from 2022 indicate that the native aquatic plant community is as healthy as or healthier than it was in 2010 or 2015. With the identification of the new, larger bed of EWM in the North Basin and the limited management alternatives that can be used to control, lake user and property owners' views and concerns related to EWM have increased.

The combined approach of physical removal and limited herbicide application has been successful at keeping EWM under control in the main basins of the lake and will likely continue to do so. However, the presence of the larger bed of EWM in the North Basin poses a greater threat to the rest of the lake and exacerbates management actions, likely making it much more difficult to maintain a very low frequency of occurrence of EWM in the lake. It is the intent of the GLA to modify both its management actions and expectations to maintain control of EWM in the main basins of the lake and to minimize the threat posed by the new bed in the North Basin.

The following seven goals were in place in the previous APMP and again will be the focus of the new APMP, although the individual objectives and actions associated with each goal have been modified.

1. Goal 1 - Protect and enhance the native aquatic plant community.

2. Goal 2 - Minimize the negative impact of EWM on the native aquatic plant community through the implementation of management actions.

3. Goal 3 - Reduce the threat that a new aquatic invasive species will be introduced and go undetected in Gilmore Lake and that existing AIS will be carried to other lakes.

4. Goal 4 - Improve the level of knowledge property owners and lake users have related to aquatic invasive species and how they can impact the lake.

5. Goal 5 - Improve the level of knowledge property owners and lake users have related to how their actions impact the aquatic plant community, lake community, and water quality.

6. Goal 6 - Complete APM Plan implementation and maintenance for a period of five years following adaptive management practices.

7. Goal 7 - Evaluate and summarize the results of management actions implemented during the entire 5-year timeframe of this plan.

GILMORE LAKE ASSOCIATION

The Gilmore Lake Association was formed in 1991 with the intent of protecting and improving Gilmore Lake. The GLA is a not-for-profit organization incorporated under Chapter 181 of the State of Wisconsin Department of Natural Resources as a "qualified lake association" which enables the GLA to apply for WDNR grants for the benefit of the lake. The GLA is a tax-exempt IRS 501(c) (3) organization. The GLA has no paid employees and relies totally on the volunteer efforts of its members, the lakeshore property owners and other area residents who are interested in preserving the quality of this important aquatic resource.

In 1992, a volunteer from the GLA began collecting water quality data through what is now referred to as the Citizen Lake Monitoring Network (CLMN). When the GLA was originally formed there were no invasive species present within the lake. Since then, two invasive species have been found in the waters of Gilmore Lake – EWM and Chinese Mystery Snails (CMS). AIS prevention efforts have been able to prevent any new invasive species from getting into the lake.

The GLA is involved in many other activities as well, including:

- Walleye stocking program
- Monthly water clarity and quality testing of the lake
- Daily water level measurements
- Monthly monitoring of lake shoreline to detect the presence of Eurasian Watermilfoil (EWM)
- Seasonal boat inspections to prevent introduction of EWM in cooperation with Minong Town Lake Committee
- Implementation of a rapid response plan for the control of EWM
- Newsletter, Up North updates, kiosk, and website to keep property owners informed.
- Ongoing research on issues relevant to the lake
- Representation on the Minong Town Lakes Committee
- Annual cleanup of area roadways
- Annual members' meeting, picnic, and boat parade

The GLA operates under a committee structure with the following active committees:

- Membership
- Eurasian Watermilfoil
- Website
- Town of Minong Lakes Committee Representatives
- Newsletter
- Lake Water Quality Testing
- Fundraising

The GLA has been providing watercraft inspection at the landing near Narrows Trail since about 2008. They have amassed thousands of hours and contacted ten thousand plus people. Most of this time has been completed by paid watercraft inspectors through the WDNR Clean Boats Clean Waters (CBCW) program.

For several years, the GLA also supported the "Milfoil Marauder" a special pontoon boat outfitted to help volunteers' complete physical removal of EWM in the larger basins of the lake. EWM found in Little Gilmore Lake created a problem as the Marauder was too big to travel to Little Gilmore Lake through the large culvert connecting the two lakes. Also, the Commercial Applicator used by the GLA could not travel between the two lakes with his regular boat. For the last few years, the GLA has used a smaller boat outfitted with a "spreader" that can travel through the culvert leading to Little Gilmore Lake to apply granular herbicide. For a number of years, a member of the GLA obtained a commercial applicators license and could apply herbicide. However, this is no longer the case.

PAST GRANTS

The GLA has been recipients of past WDNR surface water grant dollars, mostly for education and planning services, but also for management of EWM. Grants awarded and their statuses include:

1. AEPP-076-07 (complete)
2. AEPP-137-08 (complete)
3. AIRR-196-10 (complete, 1st management grant)
4. AEPP-071-10 (complete)
5. AEPP-755-11 (complete)
6. ACEI-127-13 (active, 2nd management grant)
7. AEPP-696-23 (active)

The goal of most of these projects has been to control the EWM infestation in Gilmore Lake and preserve the lake's ecological integrity, aesthetic experience, and recreational value. To that end, these projects had the following objectives:

1. Detection - To identify and map the full extent of EWM in Gilmore Lake and its response to control efforts.
2. Control - To use appropriate means to contain, reduce, and where possible eliminate EWM colonies.
3. Prevention - To prevent the introduction of other AIS and export of EWM from Gilmore Lake.
4. Education - To instill Gilmore Lake users with understanding and appreciation of our lake ecosystem.

PUBLIC PARTICIPATION AND STAKEHOLDER INPUT

The GLA has an ongoing program to inform, educate, and obtain public input on treatment of EWM. The GLA has published twice-yearly newsletters sent to all property owners which contain updates and information about the status of EWM in the lake, treatment programs, and how people can get involved. Their website includes a Newsletter Archive which allows the public to access past newsletters. The website also has a page devoted to EWM Updates which provides information to viewers and how to contact members of the Association for more information.

Each year at the Annual Meeting of the GLA, the Milfoil committee provides an update to members and responds to questions and gets input. At the 2023 Annual Meeting in July 2023, the consultant working with the GLA to update the APMP provided an educational presentation on EWM, explaining how residents can participate in control efforts. This session was attended by over 80 people, and there were many questions from residents on EWM control. The GLA also maintains an informational kiosk at the boat landing which has signage to educate the public on safe practices to stop the spread of invasive species. The kiosk also includes a map of known milfoil beds and specific information on how to clean and disinfect watercraft to prevent spread.

The process of updating the Gilmore Lake APMP began in 2022 when Endangered Resource Services (ERS) an aquatic plant surveyor was contracted to redo the whole-lake, point-intercept (PI), aquatic plant survey. The impetus for updating the old APMP was finding a dense, 8-acre bed of EWM in the North Basin in 2022. The existing APMP was not set up to deal with that large a bed of EWM. A consultant was contracted with late in 2022 to update the APMP in 2023.

A draft of the 2024-28 APMP was submitted to the Board of the GLA in early September 2023. After a short review by the Board, a draft of the APMP was posted on the GLA webpage for at least 21 days to give the constituency an opportunity to review and ask questions about the plan.

GLA WEBPAGE

The Gilmore Lake Association maintains a webpage https://gilmorelakeassociation.com/ where a great deal of information about the lake and what is happening on the lake is posted. The Public Use Survey was posted on this webpage. Newsletters are posted on the webpage as are other important documents. This plan was posted on the webpage for review by the constituency. They also have a Facebook group with over 300 members.

NEWSLETTERS AND MEETINGS

The GLA puts out at least two newsletters annually, one in the spring and one in the fall. In each newsletter updates on management actions planned and completed are made. The appropriate contacts for volunteers who are interested in helping with EWM control, water quality testing, and many other activities are provided. The GLA is active in the Minong Town Lakes Committee and the Washburn County Lakes and Rivers Association.

OVERALL MANAGEMENT GOAL

The overall goal for EWM management in Gilmore Lake remains the same as in 2010 and 2015 – to minimize the distribution and density of EWM in all basins of Gilmore Lake without negatively impacting the native aquatic plant community. To accomplish this goal, the GLA will continue to monitor the entire lake for EWM multiple times per season, complete physical removal (hand-pulling, rake removal, snorkel/diver removal, and diver-assisted suction harvest (DASH)) where appropriate and apply aquatic herbicides following current WDNR guidelines in areas too large for physical removal. Herbicide will be applied by commercial applicators and/or a GLA volunteer that completes the requirements to become a licensed applicator. Management planning will be completed by GLA representatives with assistance from a chosen herbicide applicator, the WDNR, and private consultants when necessary.

WATERSHED CHARACTERISTICS

The Gilmore Lake Watershed is one of many small watersheds within the larger Totagatic River Watershed (Figure 1). The Totagatic River Watershed spans over 372 square miles across Douglas, Bayfield, Sawyer, and Washburn Counties. Less than 1% of this area is the Gilmore Lake Watershed which only covers 3.42 square miles. Gilmore Lake has a small watershed because it does not have any tributaries coming into the lake, except in the event of flooding of the Totagatic River which backs up into the lake through the outlet, so the main sources of water for Gilmore Lake are groundwater and precipitation.

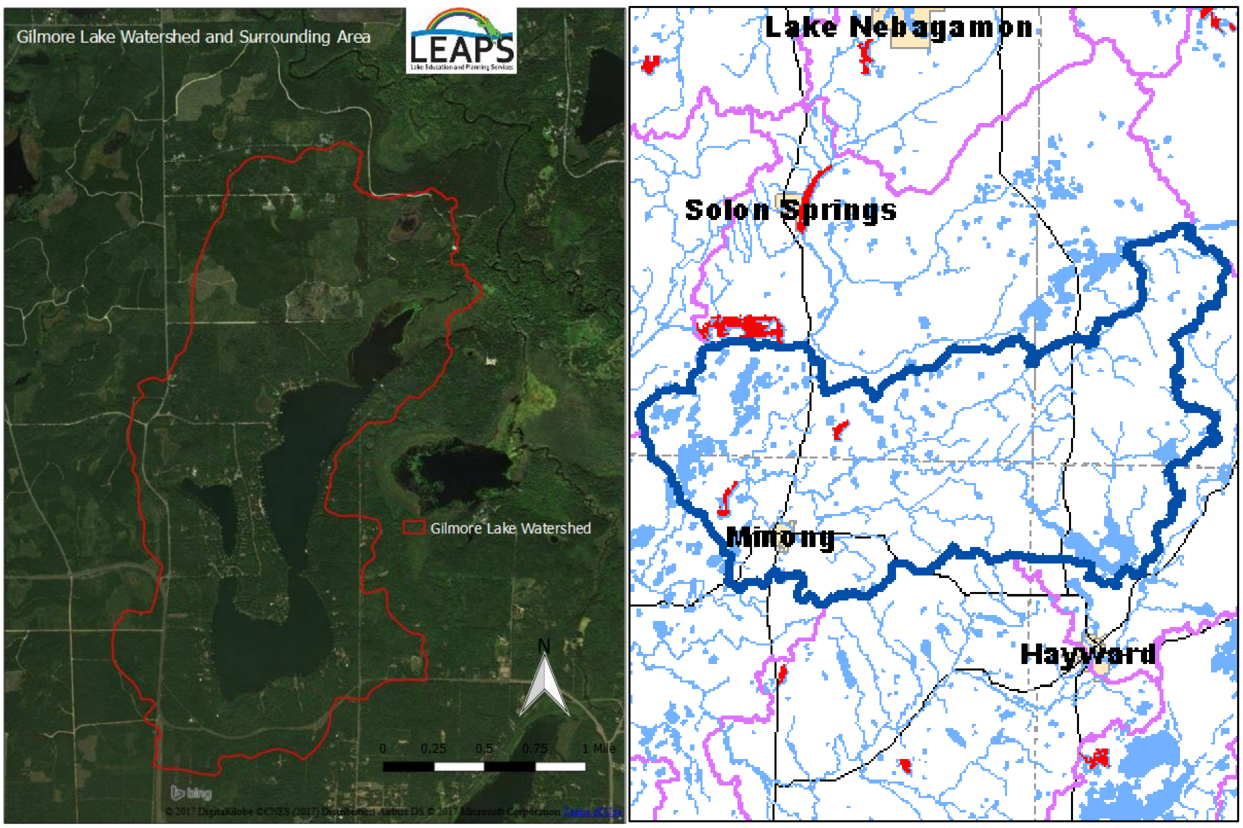

Figure 1: Gilmore Lake immediate Watershed (left) and Totagatic River Watershed (right)

Figure 2 and Table 1 reflect land use in the watershed. Much of the land within the Gilmore Lake Watershed is made up of forest (59%). The lake covers 19.2%. The rest of the land cover is comprised of wetlands (9.8%), developed areas (8.5%), and a mixture of barren areas, agriculture, and grasslands (3.6%).[1]

[1] WEx https://dnr-wisconsin.shinyapps.io/WaterExplorer/

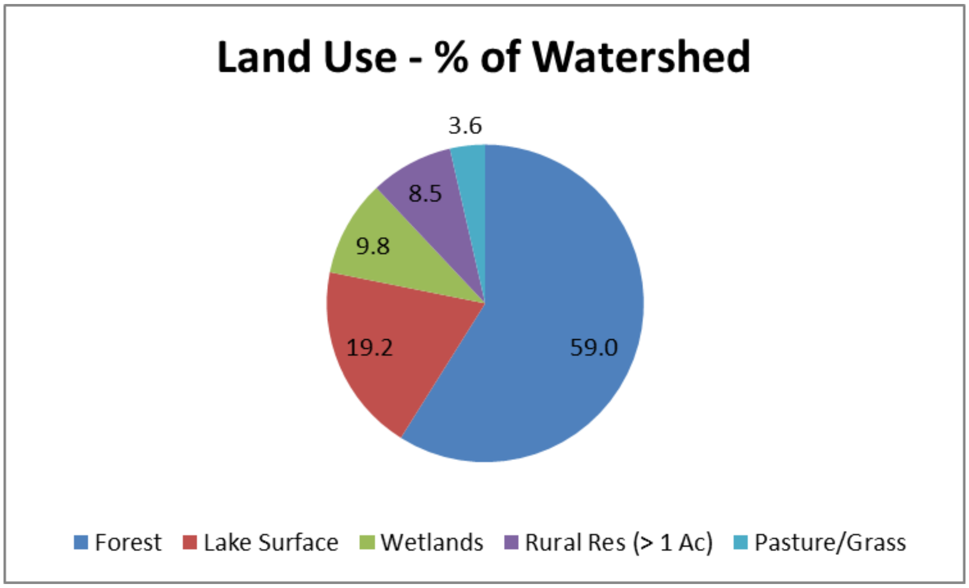

Figure 2: Land use in the Gilmore Lake watershed (WEx)

Table 1: Land use in the Gilmore Lake watershed (WEx)

Land Use	% of Watershed	Total Acres
Forest	59.0	1,291
Lake Surface	19.2	421
Wetlands	9.8	215
Rural Res (> 1 Ac)	8.5	185
Pasture/Grass	3.6	79
Totals	100.0	2,191

WETLANDS

A wetland is an area where water is at, near or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions. Wetlands have many functions which benefit the ecosystem surrounding lakes. Wetlands with a higher floral diversity of native species support a greater variety of native plants and are more likely to support regionally scarce plants and plant communities. Wetlands provide fish and wildlife habitat for feeding, breeding, resting, nesting, escape cover, travel corridors, spawning grounds, and nurseries for mammals and waterfowl.

Wetlands also provide flood protection within the landscape. Due to the dense vegetation and location within the landscape, wetlands are important for retaining stormwater from rain and melting snow moving towards surface waters and retaining floodwater from rising streams. This flood protection minimizes impacts to downstream areas. Wetlands provide water quality protection because wetland plants and soils have the capacity to store and filter pollutants ranging from pesticides to animal wastes.

Because they act as buffers between land and water, wetlands also provide shoreline protection for the lakes they surround. They protect against erosion by absorbing the force of waves and currents and by anchoring sediments. This shoreline protection is important in waterways where boat traffic, water current, and wave action cause substantial damage to the shore. Wetlands also provide groundwater recharge and discharge by allowing the surface water to move into and out of the groundwater system. The filtering capacity of wetland plants and substrates helps protect groundwater quality. Wetlands can also stabilize and maintain stream flows, especially during dry months. Aesthetics, recreation, education, and science are also all services wetlands provide. Wetlands contain a unique combination of terrestrial and aquatic life and physical and chemical processes.

There are very few wetland areas within the Gilmore Lake Watershed (Figure 3). This means there is very little protection around the lake, and if landowners become careless in the management of their property, lake conditions could deteriorate rapidly. The only substantially sized wetland within the Gilmore Lake Watershed is found surrounding the northern shoreline of Gilmore Lake. Because water is usually exiting Gilmore Lake, this wetland helps filter the outflowing water, but does little for the water that is entering the lake.

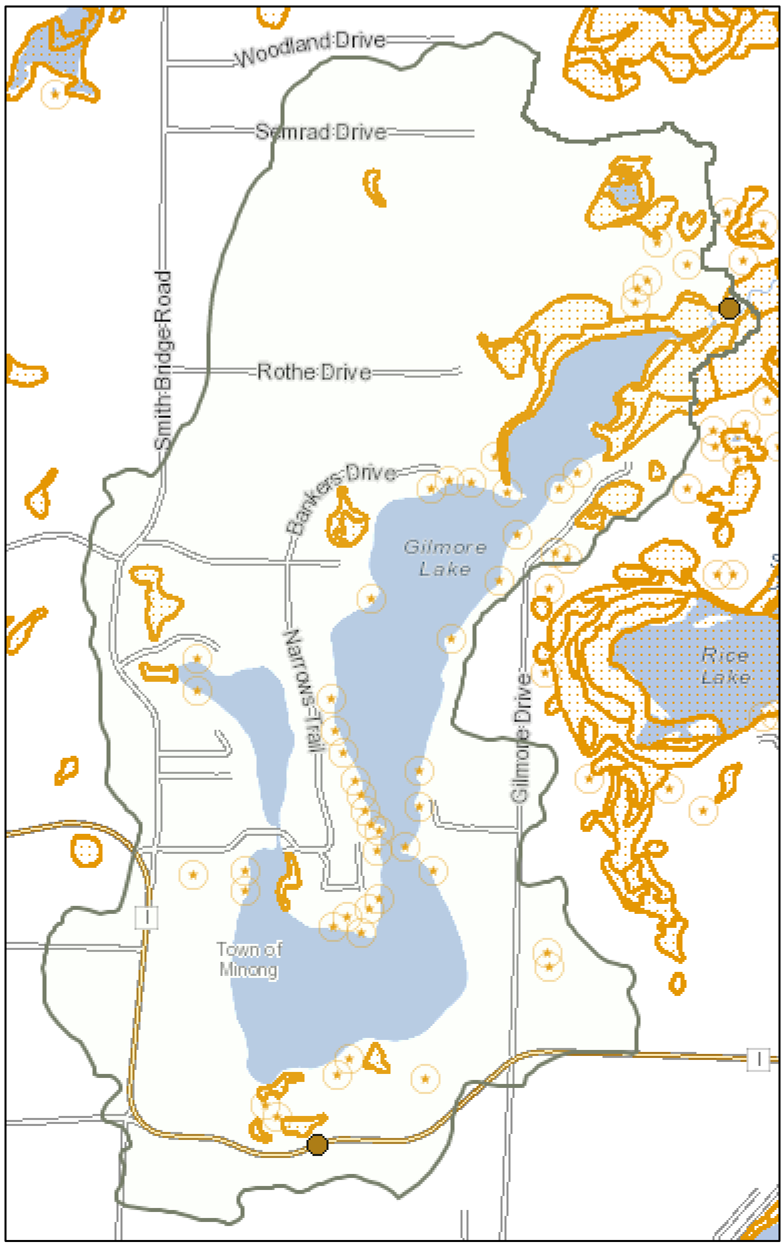

Figure 3: Gilmore Lake wetlands (Wisc. Wetlands Inventory December 11th, 2017)

LAKE INVENTORY

To make recommendations for aquatic plant and lake management, basic information about the water body of concern is necessary. A basic understanding of physical characteristics including size and depth, critical habitat, water quality, water level, fisheries and wildlife, wetlands and soils is needed to make appropriate recommendations for improvement.

PHYSICAL CHARACTERISTICS

Gilmore Lake, including Little Gilmore Lake, is a 371 acre stratified drainage lake in north central Washburn County (Figure 4). According to the results of the 2022 whole-lake, point-intercept (PI) survey completed by Endangered Resource Services (ERS) the lake reaches 36.5 feet deep in the central basin and has a mean depth of 16.4 feet. There are no surface water tributaries to Gilmore Lake, and a single outlet at the northern end of the lake. The south basin of Gilmore Lake has the most varied underwater topography with two sunken islands and an expansive shallow flat on the south side of the lake (Figure 5). The deep central basin is characterized by sharp drop-offs; especially on the east side. The shallow north basin slopes gently towards the lake outlet moving from southwest to northeast. Little Gilmore forms a deep bowl with steep sides and a narrow littoral zone (Figure 5).

Figure 4: Gilmore Lake aerial and identification of different basins (ERS, 2022)

In the most recent whole-lake plant survey, the bottom substrate was classified as 58.0% pure sand, 38.0% organic and sandy muck, and 3.60% rock. Thick nutrient-rich organic muck covered the north basin near the lake outlet and in the northwest bay in Little Gilmore, while sand and sandy muck covered the rest of Little Gilmore and most of the central and south basins. Most of the gravel and cobble substrates occurred along steep drop-offs in the south basin where wave action appeared to be keeping the bottom free of fine sediment (Figure 5).

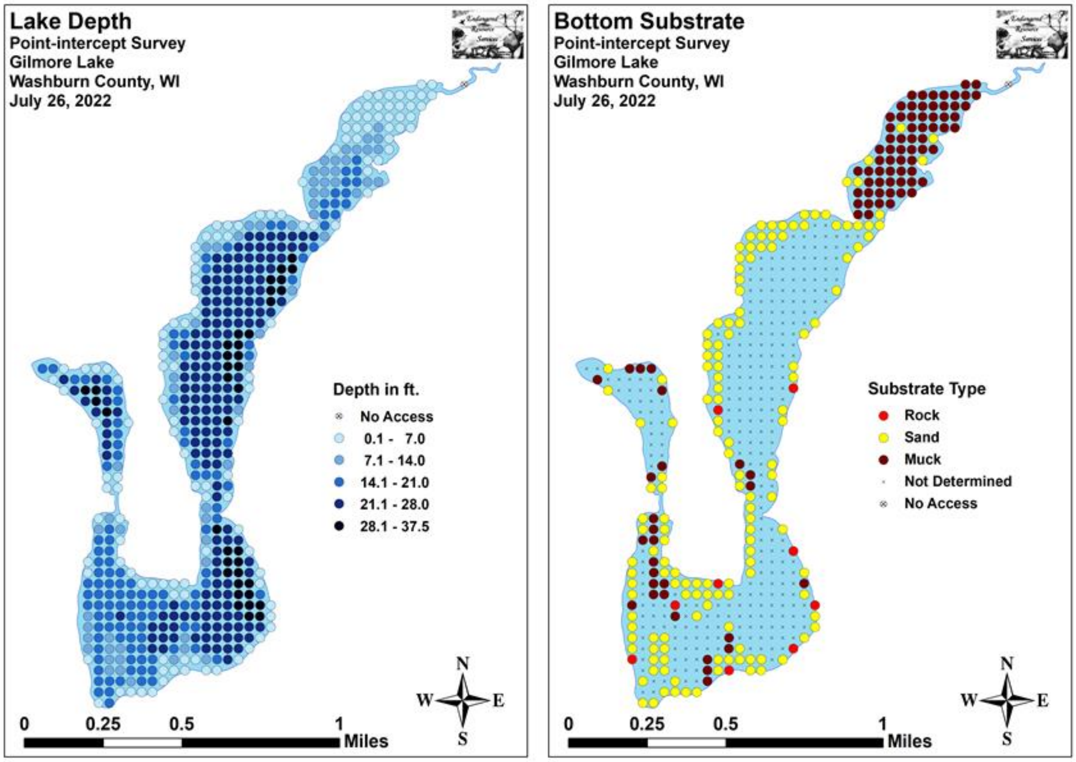

Figure 5: Gilmore Lake depth and bottom substrate

CRITICAL HABITAT

Every body of water has areas of aquatic vegetation that offers critical or unique fish and wildlife habitat. Such areas can be identified by the WDNR and identified as Sensitive Areas per Ch. NR 107. The sensitive habitat areas have not been determined by the WDNR at this time, but that is not to say that there are no areas of sensitive habitat within Gilmore Lake. Aquatic habitat areas provide the basic needs (e.g. habitat, food, nesting areas) for waterfowl, fish, and wildlife. Disturbance to these areas during mechanical harvesting should be avoided or minimized and chemical treatment is generally not allowed. Areas of rock and cobble substrate with little or no fine sediment are considered high quality walleye spawning habitat. No dredging, structures, or deposits should occur in these sensitive areas.

WATER QUALITY

Through the Citizen Lake Monitoring Network (CLMN) volunteers have been collecting water quality data on Gilmore Lake since 1991. From 1991 through 2004, this data was only regular Secchi depth readings from ice-out through early October. In 2005, water chemistry data were added to the monthly sampling routine. This consisted of total phosphorus and chlorophyll-a concentration testing as well as dissolved oxygen and temperature profiles.

As a part of the Clean Water Act, states are required to assemble a list of waters within the state that fail to meet an established set of parameters. Waters are evaluated during odd numbered years and those that fail to meet the state standards are placed on the Federally Impaired Waters List in even numbered years. In 1998, Gilmore Lake was listed as a 303(d) impaired water due to mercury contamination being found in fish tissues. In 2020 it was officially removed from the impaired waters list for mercury due to a change in fish consumption advisory levels in 2001.

In 2014, Gilmore Lake was added to the impaired water list for total phosphorus levels that exceeded the state threshold for recreation use as well as fish and aquatic life use. Gilmore Lake was reevaluated in 2016, 2018, 2020, and most recently in 2022. During the 2022 evaluation, total phosphorus sample data clearly exceeded 2022 listing thresholds for the Recreation use and Aquatic Life use, based on Gilmore Lake being designated as a complex two-story fishery under the state's Natural Community Determinations. It is designated as such because it can support a cold-water fishery consisting of cisco (Figure 6). However, chlorophyll data were clearly below REC and AL thresholds.

Figure 6: Cisco (whitefish): a cold-water fish species Gilmore Lake can support (WDNR)

WATER CLARITY

Water clarity is a measurement of how deep sunlight can penetrate the waters of a lake. It is most often measured using an 8" disk divided into four sections, two black and two white, lowered into the lake water from the surface by a rope marked in measurable increments (Figure 7). The water clarity reading is the point at which the Secchi disk when lowered into the water can no longer be seen from the surface of the lake. Water color (like dark water stained by tannins from nearby bogs and wetlands), particles suspended in the water column (like sediment or algae), and weather conditions (cloudy, windy, or sunlight) can impact how far a Secchi disk can be seen down in the water. Some lakes have Secchi disk readings of water clarity of just a few inches, while other lakes have conditions that allow the Secchi disk to be seen for dozens of feet before it disappears.

Figure 7: Black and white Secchi disk

CLMN volunteers have been collecting monthly Secchi depth readings since 1991 (Figure 8). The overall average Secchi depth for all data from 1991 through 2023 is 7.93ft. The summer (July-August) average is slightly better than the overall average at 8.47ft but removes the worse readings in the spring and the fall. Since 1991, Secchi depth measurements have ranged from a low of 4.0ft on August 31, 2010, to a high of 14.5ft on June 25, 2007. Average monthly Secchi readings follow a common pattern of shallow or poor in the spring during snow melt, spring rains, and spring turnover; deeper readings in June and early July; followed by poorer readings again in late August and September when thermal stratification is in place and there is likely some internal loading of phosphorus (see next section) (Figure 9). There is a statistically significant trend toward improving water clarity in the lake overall (Figure 8).

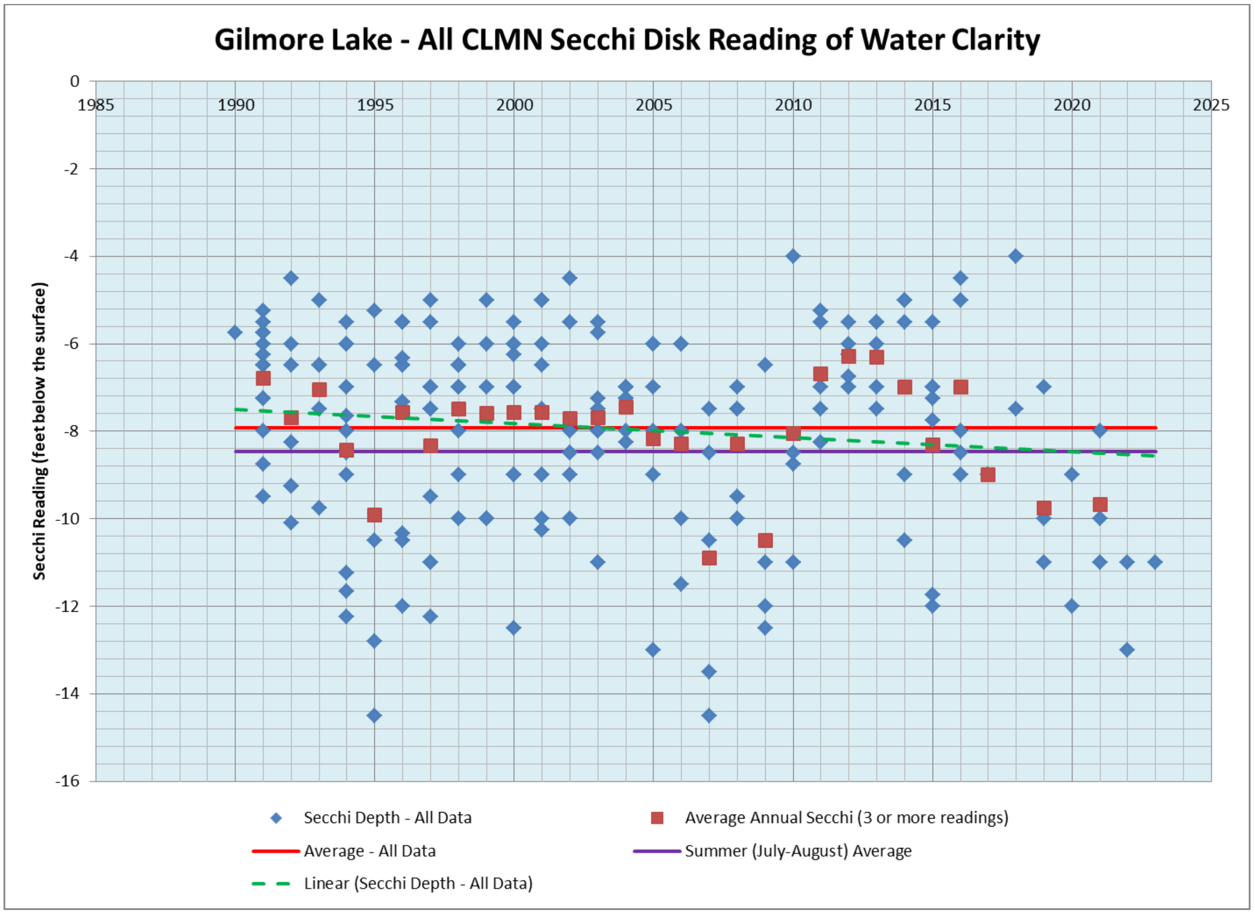

Figure 8: All Secchi depth measurements from 1990 through 2023 w/overall average, annual average, summer average, and trend line

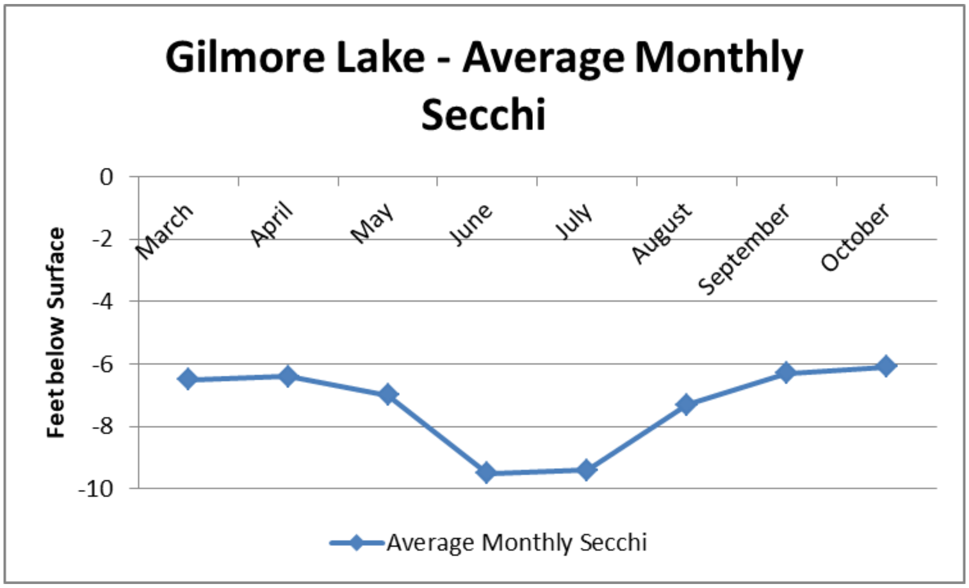

Figure 9: Average monthly Secchi depth measurements – All data

TOTAL PHOSPHORUS

Phosphorus is an important nutrient for plant growth and is commonly the nutrient limiting plant production in Wisconsin lakes. There are many sources of excess phosphorus to lake water: farm runoff, roadway runoff, nearshore runoff, failing septic systems, and decay of grass clippings, leaves, and other lawn debris that end up in the lake. This excess phosphorus can cause an increase in algae and deteriorate the health of a lake if the amount of algae gets too high. Increasing phosphorus levels generally supports greater algae growth. Greater algae growth often leads to reduced water clarity and less rooted aquatic plant growth, both of which can help to shift a mesotrophic lake with a healthy plant population to an alga dominated eutrophic system.

In 2005, CLMN volunteers began collecting water samples monthly during the summer to measure total phosphorus and chlorophyll-a concentrations. As a part of the CLMN, total phosphorus (TP) water samples are supposed to be collected four times during the open water season – two weeks after ice out, June, July, and August. In 10 of the 19 years with TP data, all four sample periods were met. Analysis of all the TP data and just the data from those years with complete data, return the same results for minimum, maximum, and average sample results. Figure 10 shows all the TP data currently included in the WDNR SWIMS database between 2005 and 2023. The average for all data (0.019mg/L) is the same as the average for just the summer months of July and August (0.019mg/L) (Figure 10). A linear trend line suggests that annual TP concentrations are improving, although the improvement is not statistically significant. Figure 11 shows the monthly averages for TP from 2005 to 2023. Monthly TP follows a common pattern, with the highest concentrations in the spring and then again in the late summer months.

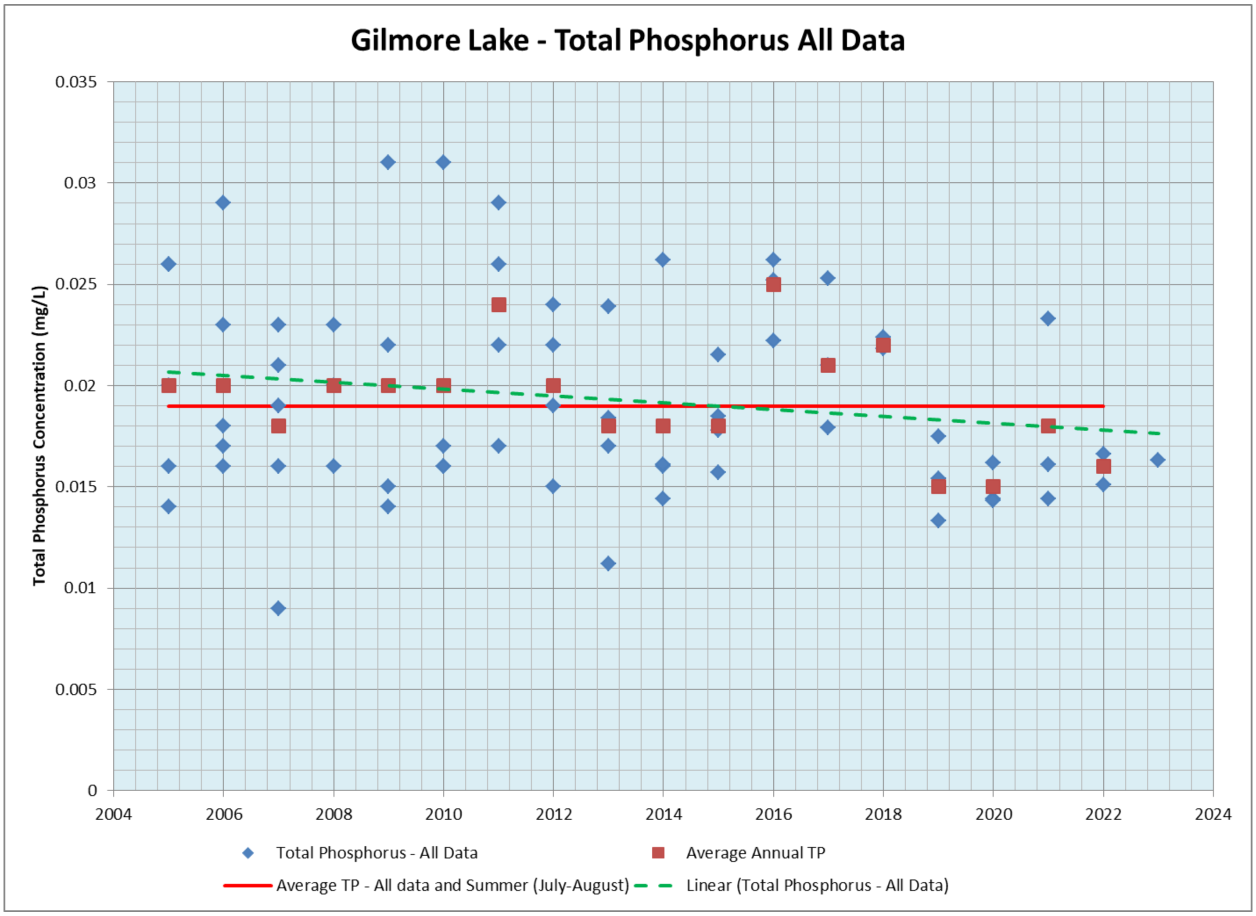

Figure 10: All total phosphorus results from 2005 through 2022 w/overall average, summer (July-August) average annual average and trend line

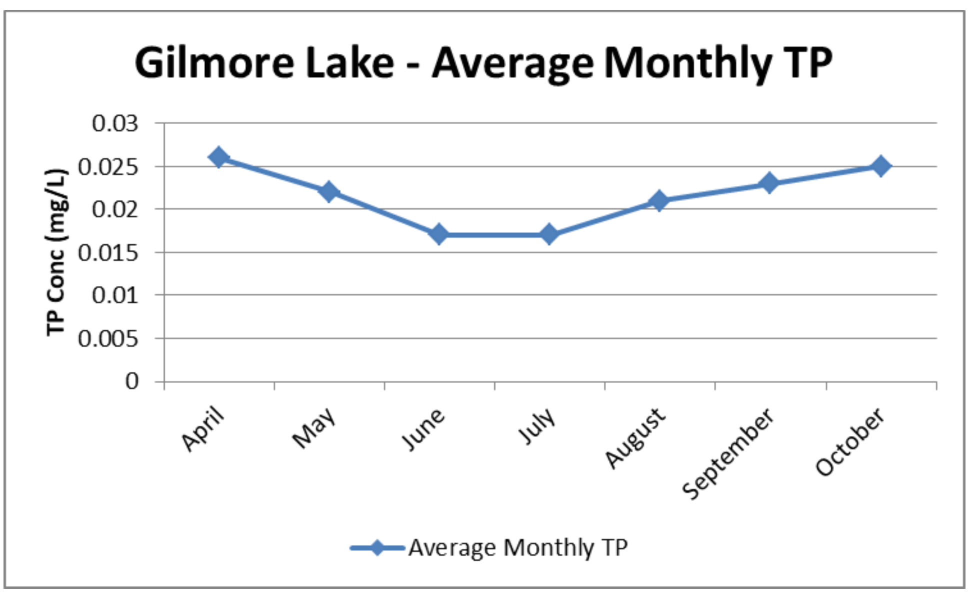

Figure 11: Average monthly TP concentrations – All data

CHLOROPHYLL-A

Chlorophyll-a (Chla) concentration is used as a measure of the amount of algae in a lake. Values greater than 10μg/L are considered indicative of eutrophic conditions and concentrations of 20μg/L or higher are associated with algal blooms. As a part of CLMN, chlorophyll-a (Chla) water samples are supposed to be collected three times during the open water season – June, July, and August (Figure 12). In 15 of the 19 years with Chla data, all three sample periods were met. Based on that data, average Chla concentrations have remained below the 10ug/L level except from 2011 to 2013. The overall average of all data (7.15ug/L) is just slightly lower than the summer (July/August) average (7.5ug/L). There is a positive trend toward lower Chla concentrations over time, but it is not statistically significant (Figure 12).

Increasing Chla concentrations in the latter part of the open water season (August to October) match the increase in TP and decrease in Secchi readings during the same time frame.

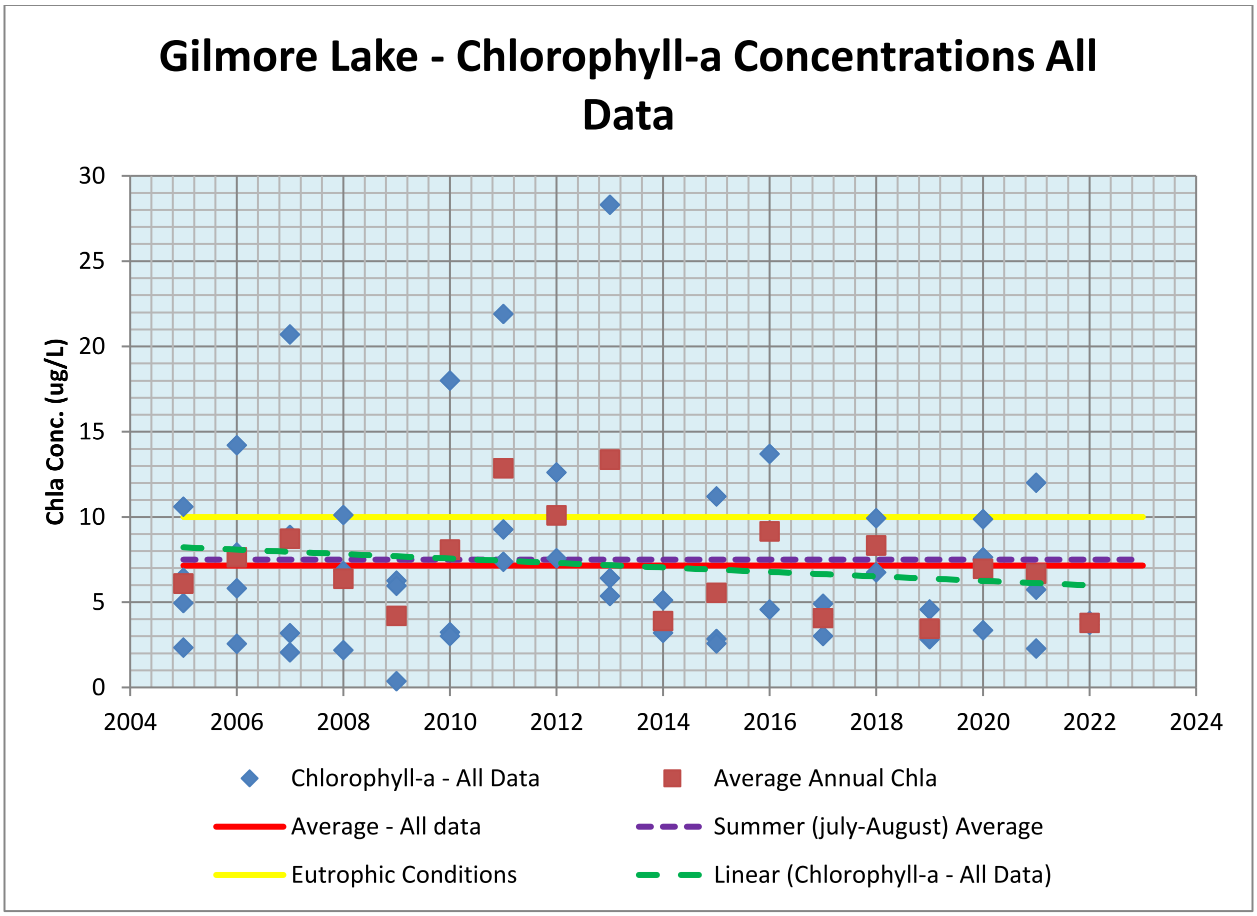

Figure 12: Chlorophyll-a concentrations – all data, plus average for all data, annual average, summer average, and trend line

TEMPERATURE AND DISSOLVED OXYGEN

Temperature and dissolved oxygen (DO) are important factors that influence aquatic organisms and nutrient availability in lakes. As temperature increases during the summer in deeper lakes, the colder water sinks to the bottom and the lake develops three distinct layers as shown in Figure 13. This process, called stratification, prevents mixing between the layers due to density differences which limits the transport of nutrients and DO between the upper and lower layers. In most lakes in Wisconsin that undergo stratification, the whole lake mixes in the spring and fall when the water temperature is between 53 and 66°F, a process called overturn. Overturn begins when the surface water temperatures become colder and therefore denser causing that water to sink or fall through the water column. Below about 39°F, colder water becomes less dense and begins to rise through the water column. Water at the freezing point is the least dense which is why ice floats and warmer water is near the bottom (called inverse stratification) throughout the winter.

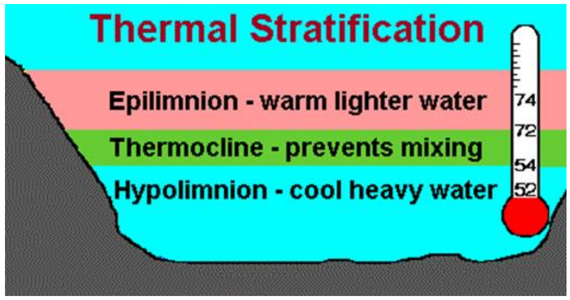

Figure 13: Summer thermal stratification

Temperature and dissolved oxygen profiles have been collected in Gilmore Lake regularly since 2005. These profiles take measurements of both the temperature and DO at the surface and then every five feet down through the water column.

In the Deep Hole of Gilmore Lake, the thermocline forms early in the season, usually in late May, and remains in place throughout the summer until the lake begins to turn over again in the fall. Dissolved oxygen levels usually drop below 1.0 mg/L (considered anoxic) around 25-ft in the summer. When water in the hypolimnion goes anoxic, chemical reactions that release phosphorus previously bound up in the sediment back into the water column occur. When this happens the phosphorus can get mixed back into the epilimnion of the lake which may lead to additional algae growth in a lake late in the open water season. DO levels less than what can support a cold-water fishery (about 4.0mg/L) generally occur in water deeper than 25-ft beginning in June.

TROPHIC STATE INDEX

One of the most used metrics of water quality is the trophic state of a lake. The trophic state is defined as the total load of biomass in a waterbody at any given time (Carlson & Simpson, 1996). To determine the trophic state of any given lake, the Tropic State Index (TSI) is generally used. This index uses the three main variables of Secchi depth, total phosphorus, and chlorophyll-a concentration. TSI values are technically limitless, but when applied, they almost always fall between 0 and 100. To make sense of these values, they are broken into different trophic states. The four main trophic states are oligotrophic (TSI<40), mesotrophic (TSI 40-50), eutrophic (TSI 50-70), and hypereutrophic (TSI>70) (Figure 14). Oligotrophic lakes are usually very clear, clean lakes with low nutrient levels. Mesotrophic lakes are moderately clear with some nutrients and more plants present within the system. Eutrophic lakes have excess nutrients that support a great deal of algae growth and may have a large aquatic plant community. Hypereutrophic lakes are typically very green with dense algae and limited plant growth.

Based on the averages of all data for Secchi (7.9ft), TP (19ug/L), and Chla (7.15ug/L) and the data presented in Figure 14, Gilmore Lake is considered mesotrophic.

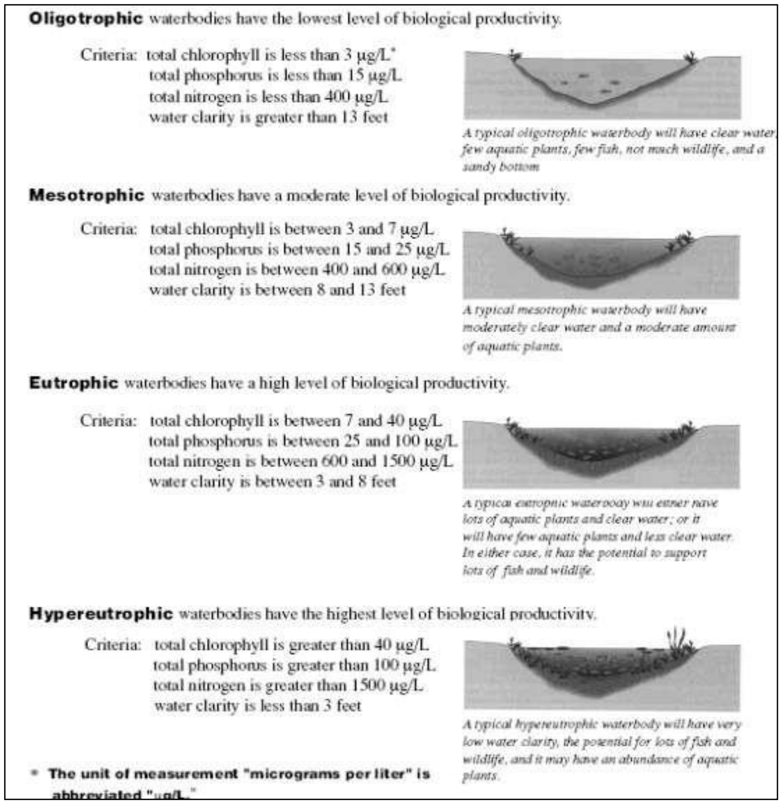

Figure 14: Trophic Status in Lakes

According to CLMN data from 2007-2022, Gilmore Lake has bounced between being mesotrophic and eutrophic depending on the year (Figure 15). TSI values for Secchi depth indicate the lake is mostly mesotrophic. TSI values for TP indicate the lake is mostly eutrophic. TSI values for Chla indicate the lake is mostly mesotrophic.

TSI values can also be used to identify some common patterns in a lake. Over the last 10 years, TSI values for TP have been greater than those for Chla and Secchi suggesting grazing of algae in the water by zooplankton (small critters in the water) has reduced smaller algae particles in the water leaving the larger particles. As a result, the biomass of algae in the lake has been reduced below what might be predicted by the amount of TP in the water (Carlson & Havens, 2005).

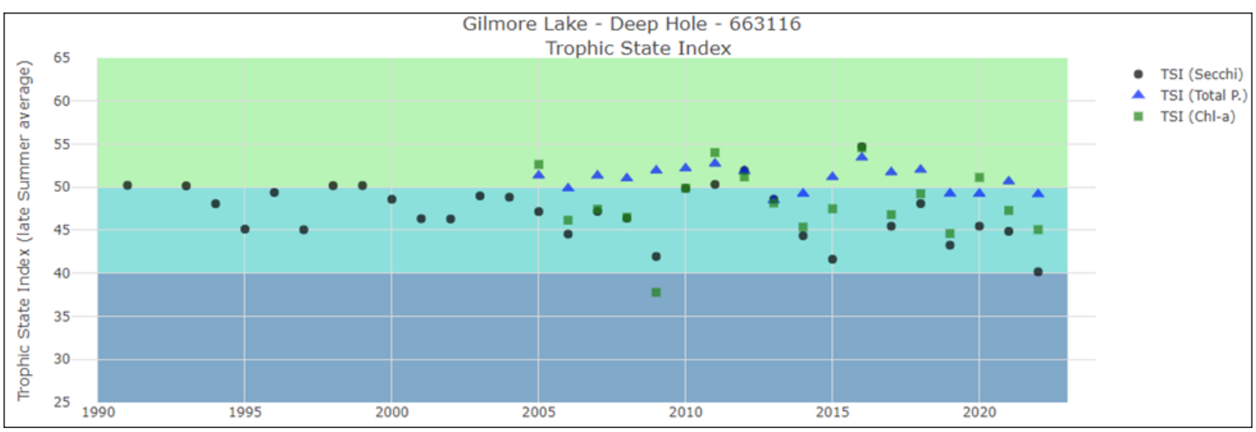

Figure 15: Summer (June-August) TSI Values 1991-2023 (green-eutrophic, light blue-mesotrophic, blue-oligotrophic)

WATER LEVEL

Fluctuating water levels have been an ongoing issue on Gilmore Lake and have been getting more extreme in recent years. Relatively small rainfall events can bring the water level up 1-2 feet. Although the Totagatic River technically does not flow into Gilmore Lake, when water levels get high in the river, it backs up into Gilmore Lake. When that happens, the water level in the lake may stay up for several days until the Totogatic gets back to normal flow. As an example, on June 20, 2018, after about 6 inches of rain over a three-day period, the water level in the lake was at least 6.2 feet over normal. Just two years prior in July 2016, an 11-inch deluge coupled with the Colton Flowage Dam failure, water levels in Gilmore Lake went up a reported greater than 10-ft from normal levels.

Because of these rapidly fluctuating water levels, the GLA began a water level monitoring program back in 2014. There is a link on the GLA webpage that allows access to past and present water level monitoring data.[2] Lake level readings from 2014 through 2021 were gathered by a GLA volunteer along with rainfall data. During 2021 and 2022, an automated system was used, with the manual readings as a backup. In 2023, the automated system has worked only intermittently, and the data is spotty.

Figures 16 and 17 reflect water level monitoring from April 1, 2015, through September 25, 2023. Warning levels and Alert levels were set by the GLA based on what they considered normal lake level at approximately 1001 feet above sea level. In the past, lake levels have been tracked by GLA volunteers and lake residents contacted if either the warning or alert level were reached or expected to be reached. The July 2016 flood and the high water in June 2018 are examples of this and easy to see in the figures. Spring runoff events that exceed warning and alert levels can also be seen in pretty much every year of monitoring through 2023.

Despite lower water levels over the last couple of years, it is expected that large rainfall events will continue impacting Gilmore Lake. Due to the large EWM bed in the North Basin, during every water backflow event from the Totagatic River into the North Basin and Gilmore Lake, EWM will be spread throughout the lake. Conversely, outflow from Gilmore Lake into the Totagatic River will carry EWM downstream into one of the best wild rice areas in NW Wisconsin, the area east of Smith Bridge on the Minong Flowage.

The GLA has been considering a more permanent water level measurement system that is more reliable. Information gathering and system design continues but is not complete. In addition, in 2020, the Town of Minong approved a "slow-no-wake" ordinance for Gilmore Lake if the water level hits 2 feet over normal (~ 1001' over sea level). This ordinance has not been finalized with the DNR but is still being pursued by the GLA.

[2] https://gilmorelakeassociation.com/water-level-daily/

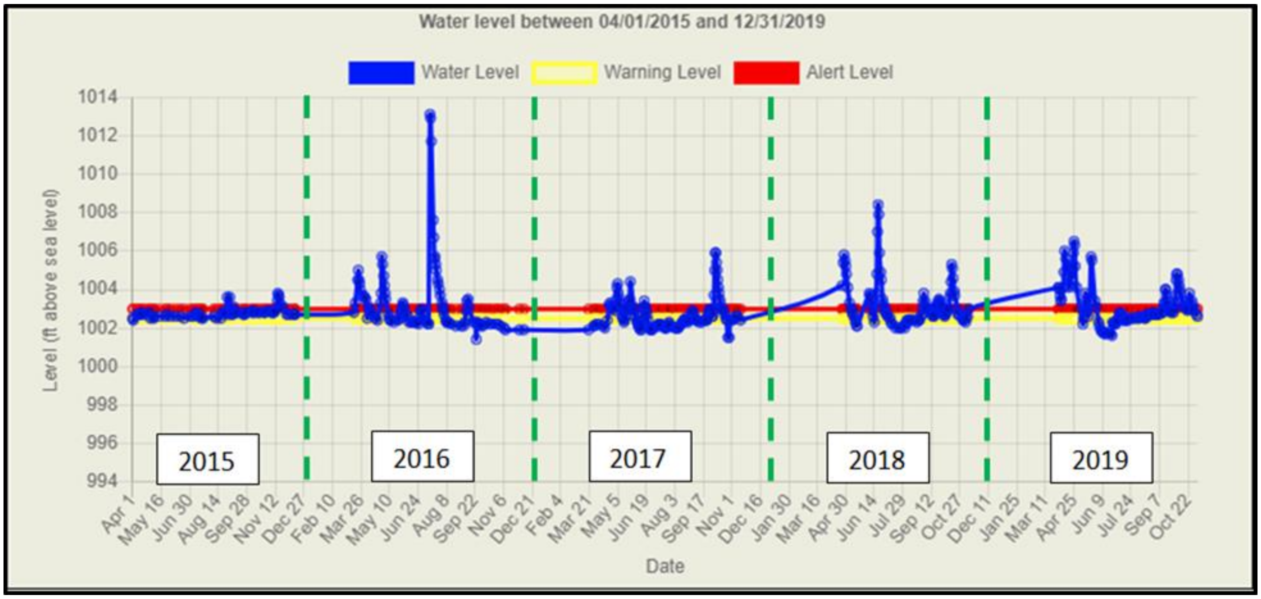

Figure 16: Water level monitoring in Gilmore Lake from 2015 to 2019 (GLA webpage)

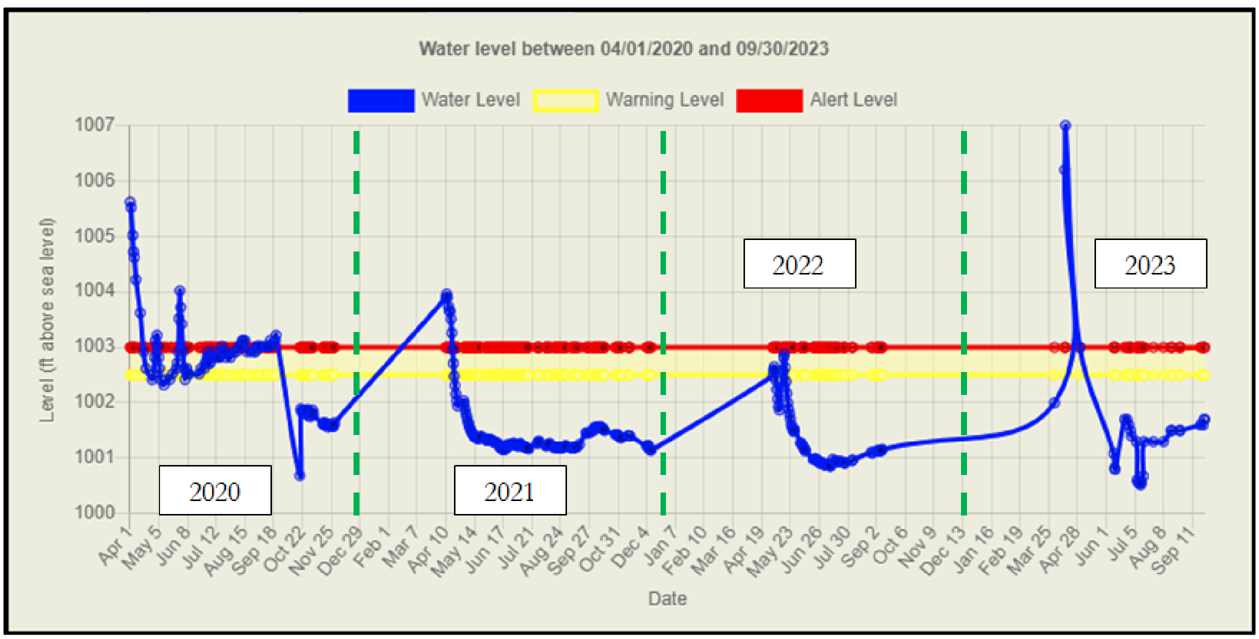

Figure 17: Water level monitoring in Gilmore Lake from 2020 to 2023 (GLA webpage)

FISHERIES AND WILDLIFE

TWO-STORY FISHERY

Gilmore Lake is considered a two-story fishery capable of supporting cold-water fish species (specifically cisco) assuming there is enough DO present in the colder water in the thermocline. Recent WDNR (Minahan, 2017) documentation suggests that cisco need DO levels >6.0mg/L and water temperatures <73°F to survive in a lake. The survival of cold-water fish species like cisco depends on conditions in and below the thermocline that allow them to move up in the water column as oxygen levels in the bottom of the lake decline, while at the same time staying in cold enough water to keep them alive (Figure 18). Table 2 shows examples of when both DO, and temperature profiles were taken at the same time from the last 10 years with the zones that would support cisco colored blue.

In new water quality criteria being developed by the WDNR, lakes designated as two-story fisheries have to be able to maintain conditions that support that fishery in at least two out every three years. If it does not, then it will be considered impaired (Minahan, 2017).

As of 2021, Gilmore Lake was still listed as a complex two-story fishery with cisco present in its waters.

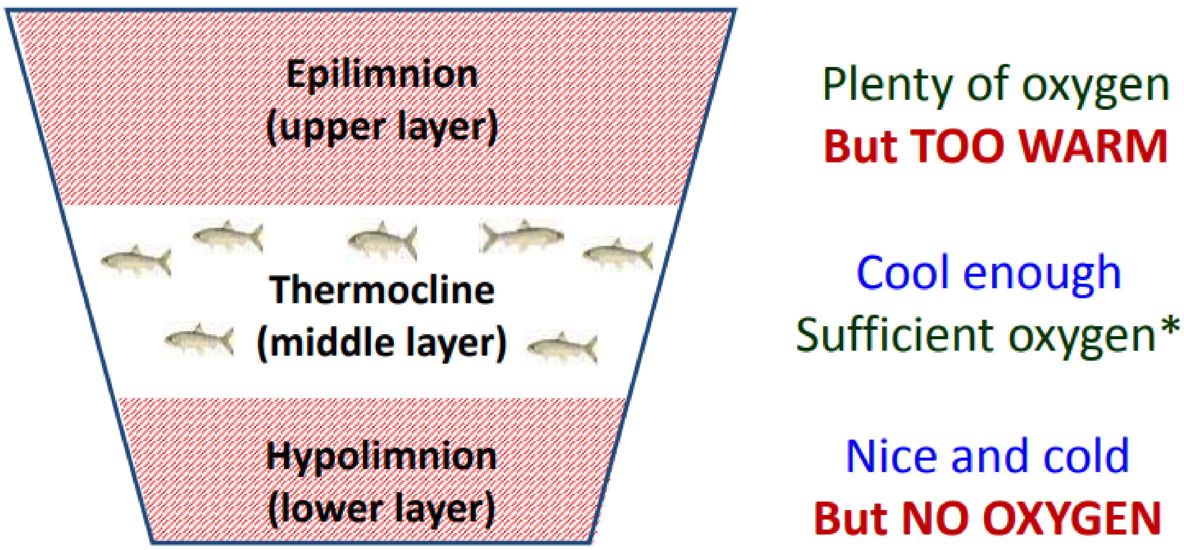

Figure 18: Lake Stratification Zones necessary to support a Two-story Fishery (Minahan, 2017)

Table 2: DO and Temperature Zones on various dates over the last 10 years that would support a two-story fishery in Gilmore Lake

DO (mg/L)	TEMP (°F)	Depth	Date of Profile
7.8	72.5	1 Feet	7/16/2014 11:15:00 AM
7.7	70.7	5 Feet	7/16/2014 11:15:00 AM
7.6	69.9	10 Feet	7/16/2014 11:15:00 AM
4.4	62.9	15 Feet	7/16/2014 11:15:00 AM
.5	50.7	20 Feet	7/16/2014 11:15:00 AM
.2	48	25 Feet	7/16/2014 11:15:00 AM
.2	45.5	30 Feet	7/16/2014 11:15:00 AM
.2	44.9	35 Feet	7/16/2014 11:15:00 AM
7.9	72.8	1 Feet	6/24/2015 10:15:00 AM
7.7	69.8	5 Feet	6/24/2015 10:15:00 AM
7.14	68	10 Feet	6/24/2015 10:15:00 AM
7.58	66.3	15 Feet	6/24/2015 10:15:00 AM
3.2	59.1	20 Feet	6/24/2015 10:15:00 AM
.78	53.6	25 Feet	6/24/2015 10:15:00 AM
.53	50.5	30 Feet	6/24/2015 10:15:00 AM
7.9	77.8	0 Feet	7/22/2015 10:00:00 AM
7.5	75.4	5 Feet	7/22/2015 10:00:00 AM
7.2	73.8	10 Feet	7/22/2015 10:00:00 AM
8.5	73.8	15 Feet	7/22/2015 10:00:00 AM
1.8	64.5	20 Feet	7/22/2015 10:00:00 AM
7.5	67.6	0 Feet	8/26/2015 2:30:00 PM
7.5	67.6	5 Feet	8/26/2015 2:30:00 PM
7.5	67.3	10 Feet	8/26/2015 2:30:00 PM
6.9	66.4	15 Feet	8/26/2015 2:30:00 PM
5.6	58.7	20 Feet	8/26/2015 2:30:00 PM
1.2	62.2	25 Feet	8/26/2015 2:30:00 PM
.9	52	30 Feet	8/26/2015 2:30:00 PM
9.03	74.1	1 Feet	6/22/2016 11:15:00 AM
9.5	73.6	5 Feet	6/22/2016 11:15:00 AM
9.6	72.3	10 Feet	6/22/2016 11:15:00 AM
7.26	63.3	15 Feet	6/22/2016 11:15:00 AM
4.8	55.9	20 Feet	6/22/2016 11:15:00 AM
3	52.5	25 Feet	6/22/2016 11:15:00 AM
1.73	50.9	30 Feet	6/22/2016 11:15:00 AM
1.38	50.4	33 Feet	6/22/2016 11:15:00 AM
	72	1 Feet	8/25/2016 11:00:00 AM
8.2	71.6	5 Feet	8/25/2016 11:00:00 AM
7.9	71	10 Feet	8/25/2016 11:00:00 AM
7.5	68	15 Feet	8/25/2016 11:00:00 AM
1.6	61	20 Feet	8/25/2016 11:00:00 AM
1.3	57	25 Feet	8/25/2016 11:00:00 AM
.9	54	30 Feet	8/25/2016 11:00:00 AM
.7	52	33 Feet	8/25/2016 11:00:00 AM
8.8	69.9	1 Feet	8/22/2017 10:45:00 AM
8.8	69.9	5 Feet	8/22/2017 10:45:00 AM
8.7	69.9	10 Feet	8/22/2017 10:45:00 AM
9.3	68.5	15 Feet	8/22/2017 10:45:00 AM
2.4	61	20 Feet	8/22/2017 10:45:00 AM
.8	54	25 Feet	8/22/2017 10:45:00 AM
.9	51	30 Feet	8/22/2017 10:45:00 AM

A two-story fishery indicates that there may be cold-water fish species present, but there are also other warm water fishes present in Gilmore Lake. The most recent comprehensive survey was completed in 2018. This survey showed bluegill to be the largest fishery within Gilmore Lake, but there was a good number of largemouth bass and other predatory fish as well (Table 3). Creel survey data from the 2005-2006 season and walleye recruitment survey data from 2016 also showed pumpkinseeds, rock bass, and suckers as well as several species of native minnow to be present in the lake.

Table 3: Gilmore Lake 2018 Fisheries Assessment

2018 Gilmore Lake Survey Summary

Fish Species	Number	Min	Max	Average
Largemouth Bass	94	5.8	18.7	12.6
Northern Pike	47	12.1	23.4	17.3
Walleye	18	11.0	18.2	14.4
Bluegill	196	2.0	9.0	5.6
Black Crappie	3	9.4	10.2	9.8
Yellow Perch	19	2.3	7.0	3.5
Pumpkinseed	16	4.3	8.2	6.0

Like many lakes in Wisconsin, the walleye population in Gilmore Lake has faced a steep decline in recent years. The 2005 survey estimated the walleye population to only be at 0.4fish/acre. In early spring 2019, the WDNR again sampled walleye. In that survey 17 walleye ranging from 14 – 25.5 inches were collected. This is a low rate for a lake with walleye natural reproduction and stocking.[3] With these low population numbers, the walleye population is not considered sufficient enough to be able to stabilize itself through natural reproduction. To combat this decline, walleye stocking has been completed by the WDNR on a regular basis in Gilmore Lake since 1972. In 2014 the GLA took over stocking efforts and paid for stocking in 2014, 2016, and 2021. The goal of these stocking efforts is to create a healthy population of walleye that can be sustained through natural reproduction. Historic stocking data is shown in Table 4.

[3] Personal communication from Craig Roberts, WDNR Fisheries Manager for Washburn County, September 5, 2023

Table 4: Fish stocking in Gilmore Lake

Stocking Year	Source	Species	Age Class	Number Fish Stocked	Avg Fish Length(IN)
2021	PRIVATE HATCHERY	WALLEYE	LARGE FINGERLING	2000	8
2016	PRIVATE HATCHERY	WALLEYE	LARGE FINGERLING	1397	6
2014	PRIVATE HATCHERY	WALLEYE	LARGE FINGERLING	1679	5.5
2012	DNR	WALLEYE	LARGE FINGERLING	1855	7.5
2010	DNR	WALLEYE	SMALL FINGERLING	13615	1.75
2008	DNR	WALLEYE	SMALL FINGERLING	13975	1.4
2006	DNR	WALLEYE	SMALL FINGERLING	13713	1.7
2004	DNR	WALLEYE	SMALL FINGERLING	19550	1.3
2002	DNR	WALLEYE	SMALL FINGERLING	19791	1.5
2000	DNR	WALLEYE	SMALL FINGERLING	25012	1.7
1998	DNR	WALLEYE	SMALL FINGERLING	19450	1.3
1996	Non-DNR Governmental	WALLEYE	FINGERLING	6090	2.9
1996	Non-DNR Governmental	WALLEYE	FRY	3190	2.9
1996	DNR	WALLEYE	FINGERLING	178	7.7
1994	DNR	WALLEYE	FINGERLING	19450	1
1992	Non-DNR Governmental	WALLEYE	FINGERLING	4732	2
1992	DNR	WALLEYE	FINGERLING	35170	2
1991	DNR	WALLEYE	FINGERLING	9723	4.5
1988	DNR	WALLEYE	FINGERLING	19679	3
1985	DNR	WALLEYE	FINGERLING	20701	3
1983	DNR	WALLEYE	FINGERLING	39000	3
1981	DNR	WALLEYE	FINGERLING	39080	3
1978	DNR	WALLEYE	FINGERLING	15054	3
1975	DNR	WALLEYE	FINGERLING	15036	4.33
1972	DNR	WALLEYE	FINGERLING	17700	3

In addition to the fisheries, there is a wide array of wildlife that can be found in or around Gilmore Lake including loons and beavers. There are several plant species and a turtle that carry the designation of either threatened or special concern that can be found within Minong Township in Washburn County (Table 5).

Table 5: Species of Special Concern and Threatened in the Town of Minong, Washburn County (NHI Portal, August 2023)

Common Name	Scientific Name	WI Status	Federal Status	Group
Blanding's Turtle	Emydoidea blandingii	SC/P	SOC	Turtle~
Clustered Bur-reed	Sparganium glomeratum	THR		Plant~
Northeastern Bladderwort	Utricularia resupinata	SC		Plant~
Vasey's Pondweed	Potamogeton vaseyi	SC		Plant~
Prairie Sagebrush	Artemisia frigida	SC		Plant
Bald Eagle	Haliaeetus leucocephalus			Bird~

COARSE WOODY HABITAT

Coarse woody habitat (CWH) in lakes is classified as trees, limbs, branches, roots, and wood fragments at least 4 inches in diameter that enter a lake by natural (beaver activity, toppling from ice, wind, or wave scouring) or human means (logging, intentional habitat improvement, flooding following dam construction). CWH in the littoral or near-shore zone serves many functions within a lake ecosystem including erosion control, as a carbon source, and as a surface for algal growth which is an important food base for aquatic macro invertebrates. The presence of CWH has also been shown to prevent suspension of sediments, thereby improving water clarity. CWH serves as important refuge, foraging, and spawning habitat for fish, aquatic invertebrates, turtles, birds, and other animals. The amount of littoral CWH occurring naturally in lakes is related to characteristics of riparian forests and likelihood of toppling. However, humans have also had a large impact on amounts of littoral CWH present in lakes through time. During the 1800's the amount of CWH in northern lakes increased beyond natural levels as a result of logging practices. But time changes in the logging industry and forest composition along with increasing shoreline development have led to reductions in CWH present in many northern Wisconsin lakes.

CWH is often removed by shoreline residents to improve aesthetics or select recreational opportunities (swimming and boating). Jennings et al. (2003) found a negative relationship between lakeshore development and the amount of CWH in northern Wisconsin lakes. Similarly, Christensen et al. (1996) found a negative correlation between density of cabins and CWH present in Wisconsin and Michigan lakes. While it is difficult to make precise determinations of natural densities of CWH in lakes it is believed that the value is likely on the scale of hundreds of logs per mile. The positive impact of CWH on fish communities has been well documented by researchers, making the loss of these habitats a critical concern. One study determined that black crappie selected nesting sites that were usually associated with woody debris, silty substrate, warmer water, and protected from wind and waves (Pope & Willis, 1997).

Fortunately, remediation of this habitat type is attainable on many waterbodies, particularly where private landowners and lake associations are willing to partner with county, state, and federal agencies. Large-scale CWH projects are currently being conducted by lake associations and local governments with assistance from the WDNR where hundreds of whole trees are added to the near-shore areas of lakes. For more information on this process visit: http://dnr.wi.gov/topic/fishing/outreach/fishsticks.html (last accessed on 8-29-2018).

Small-scale CWH projects, more commonly referred to as "fishsticks," can also be done by individual property owners, and are eligible for grant assistance through the WNDR Healthy Lakes program. This program is intended to help individual property owners make a positive impact on their lake's ecosystem through small-scale projects such as fishsticks (Figure 19).

Figure 19: Coarse woody habitat-Fishsticks projects

SHORELANDS

How the shoreline of a lake is managed can have big impacts on the water quality and health of that lake. Natural shorelines prevent polluted runoff from entering lakes, help control flooding and erosion, provide fish and wildlife habitat, may make it harder for AIS to establish themselves, muffle noise from watercraft, and preserve privacy and natural scenic beauty. Many of the values lake front property owners appreciate and enjoy about their properties - natural scenic beauty, tranquility, privacy, relaxation - are enhanced and preserved with good shoreland management. And healthy lakes with good water quality translate into healthy lake front property values.

Shorelands may look peaceful, but they are the hotbed of activity on a lake given that 90% of all living things found in lakes - from fish, to frogs, turtles, insects, birds, and other wildlife - are found along the shallow margins and shores.

Many species rely on shorelands for all or part of their life cycles as a source for food, a place to sleep, protection from predators, and to raise their young. Shorelands and shallows are the spawning grounds for fish, nesting sites for birds, and where turtles lay their eggs. There can be as much as 500% more species diversity at the water's edge compared to adjoining uplands.

Lakes are buffered by shorelands that extend into and away from the lake. These shoreland buffers include shallow waters with submerged plants (like coontail and pondweeds), the water's edge where fallen trees and emergent plants like rushes might be found, and upward onto the land where different layers of plants (low ground cover, shrubs, trees) may lead to the lake. A lake's littoral zone is a term used to describe the shallow water area where aquatic plants can grow because sunlight can penetrate to the lake bottom. Shallow lakes might be composed entirely of a littoral zone. In deeper lakes, plants are limited to where they can grow by how deeply light can penetrate the water.

Shorelands are critical to a lake's health. Activities such replacing natural vegetation with lawns, clearing brush and trees, importing sand to make artificial beaches, and installing structures such as piers, can cause water quality to decline and change what species can survive in the lake. In addition to being potentially damaging, some of these undertakings require permits and approval. Most changes to lakebed exposed by fluctuating water levels (removal of sediments, additions of beach sand, etc.), often require permits and approval. The only exceptions to this are manual removal of a 30-foot corridor of native plants or the removal of non-native invasive plants. These regulations have been put in place to encourage property owners to responsibly manage their shorelands to improve and maintain the quality of the lake.

PROTECTING WATER QUALITY

Shoreland buffers slow down rain and snow melt (runoff). Runoff can add nutrients, sediments, and other pollutants into lakes, causing water quality to decline. Slowing down runoff will help water soak (infiltrate) into the ground. Water that soaks into the ground is less likely to damage lake quality and recharges groundwater that supplies water to many of Wisconsin's lakes. Slowing down runoff water also reduces flooding and stabilizes stream flows and lake levels.

Shoreland wetlands act like natural sponges trapping nutrients where nutrient-rich wetland sediments and soils support insects, frogs, and other small animals eaten by fish and wildlife.

Shoreland forests act as filters, retainers, and suppliers of nutrients and organic material to lakes. The tree canopy, young trees, shrubs, and forest understory all intercept precipitation, slowing runoff, and contributing to water infiltration by keeping the soil's organic surface layer well-aerated and moist. Forests also slow down water flowing overland, often capturing its sediment load before it can enter a lake or stream. In watersheds with a significant proportion of forest cover, the erosive force of spring snow melts is reduced as snow in forests melts later than snow on open land and melt water flowing into streams is more evenly distributed. Shoreland trees grow, mature, and eventually fall into lakes where they protect shorelines from erosion, and are an important source of nutrients, minerals, and wildlife habitat.

NATURAL SHORELANDS ROLE IN PREVENTING AIS

In addition to removing essential habitat for fish and wildlife, clearing native plants from shorelines and shallow waters can open opportunities for invasive species to take over. Like tilling a home garden to prepare it for seeding, clearing shoreland plants exposes bare earth and removes the existing competition (the cleared shoreland plants) from the area. Nature fills a vacuum. While the same native shoreland plants may recover and reclaim their old space, many invasive species possess "weedy" traits that enable them to quickly take advantage of new territory and out-compete natives.

The act of weeding creates continual disturbance, which in turn benefits plants that behave like weeds. The modern-day practice of mowing lawns is an example of keeping an ecosystem in a constant state of disturbance to the benefit of invasive species like turf grass, dandelions, and clover, all native to Europe. Keeping shoreline intact is a good way to minimize disturbance and minimize opportunities for invasive species to gain a foothold.

THREATS TO SHORELANDS

When a landowner develops a waterfront lot, many changes may take place including the addition of driveways, houses, decks, garages, sheds, piers, rafts and other structures, wells, septic systems, lawns, sandy beaches and more. Many of these changes result in the compaction of soil and the removal of trees and native plants, as well as the addition of impervious (hard) surfaces, all of which alter the path that precipitation takes to the water.

Building too close to the water, removing shoreland plants, and covering too much of a lake shore lot with hard surfaces (such as roofs and driveways) can harm important habitat for fish and wildlife, send more nutrient and sediment runoff into the lake, and cause water quality decline.

Changing one waterfront lot in this fashion may not result in a measurable change in the quality of the lake or stream. But cumulative effects when several or many lots are developed in a similar way can be enormous. A lake's response to stress depends on what condition the system is in to begin with, but bit by bit, the cumulative effects of tens of thousands of waterfront property owners "cleaning up" their shorelines, are destroying the shorelands that protect their lakes. Increasing shoreline development and development throughout the lake's watershed can have undesired cumulative effects.

SHORELAND PRESERVATION AND RESTORATION

If a native buffer of shoreland plants exists on a given property, it can be preserved, and care taken to minimize impacts when future lake property projects are contemplated. If a shoreline has been altered, it can be restored. Shoreline restoration involves recreating buffer zones of natural plants and trees. Not only do quality wild shorelines create higher property values, but they bring many other values too. Some of these are aesthetic in nature, while others are essential to a healthy ecosystem. Healthy shorelines mean healthy fish populations, varied plant life, and the existence of the insects, invertebrates and amphibians which feed fish, birds, and other creatures. Figure 20 shows the difference between a natural and unnatural shoreline adjacent to a lake home.

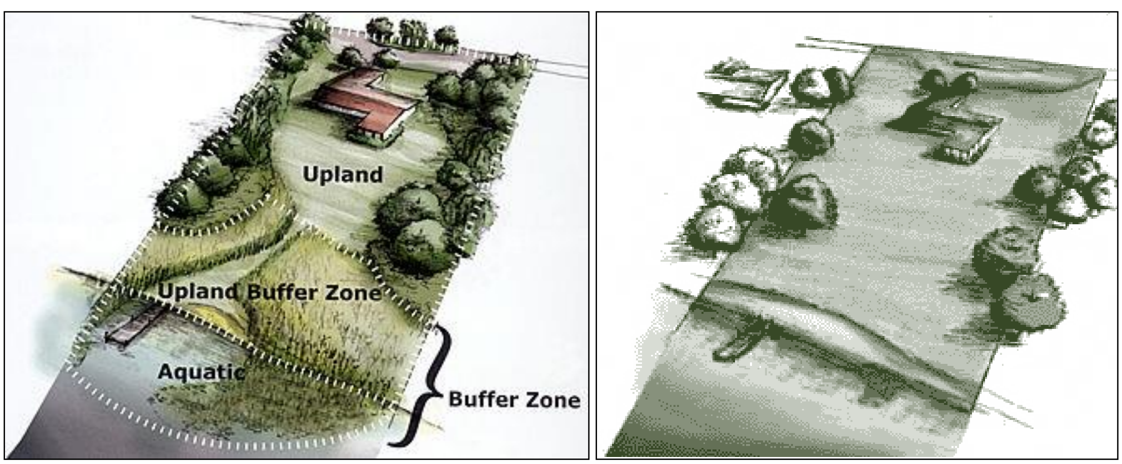

Figure 20: Healthy, AIS Resistant Shoreland (left) vs. Shoreland in Poor Condition

Most of the shoreline around Gilmore Lake is privately owned residential property. Many of these properties could probably be improved in such a way that more shoreland habitat for wildlife could be created, and surface water runoff which carries sediment, nutrients, and other pollutants into the lake could be reduced. Many projects used to accomplish these things are inexpensive, unobtrusive, and easy to plan and implement. To help fund these types of projects, the WDNR offers financial assistance through its Healthy Lakes and Rivers Initiative cost-share grant program. The GLA can apply for Healthy Lakes Initiative grants of up to $1,000.00 per project and up to $25,000.00 for multiple projects in November each year. Acceptable Healthy Lakes and Rivers projects include rain gardens, native plantings along the shore, rainwater diversions, French drains, and Fishsticks.

2010, 2015, AND 2022 AQUATIC PLANT SURVEYS

A prerequisite to updating the APMP for Gilmore Lake was to compare how the lake's vegetation had changed under active management since the last point intercept survey completed in 2015. In 2022, the warm-water, whole-lake, point-intercept survey of aquatic plants that was completed by the Endangered Resource Services, LLC (ERS) in 2010 and 2015 was repeated. This new survey was also completed by ERS. In 2015 and 2022, the littoral zone of the lake covered approximately 110 acres.

COMPARISON OF EURASIAN WATER-MILFOIL IN 2010, 2015, AND 2022:

In July 2010, no EWM was found in the rake at any point, and the only plants seen were within the buoyed area along the western shore of the south basin – the site of the original infestation (Figure 21). The July 2015 survey again found no EWM plants in the rake or as a visual at any points (Figure 21), although several 100 plants were identified during the bed mapping survey.

Unfortunately, the July 2022 survey documented a sharp uptick in EWM – especially in the north basin. EWM was found in the rake at 17 points (3.2% of the entire lake/8.8% littoral coverage) with six additional visual sightings. Of these, seven points had a rake fullness of 3, three were a 2, and the remaining seven rated a 1. This produced a mean rake fullness of 2.00 and suggested 1.9% of the lake and 5.2% of the littoral zone had a significant infestation (rake fullness of 2 or 3) (Figure 22).

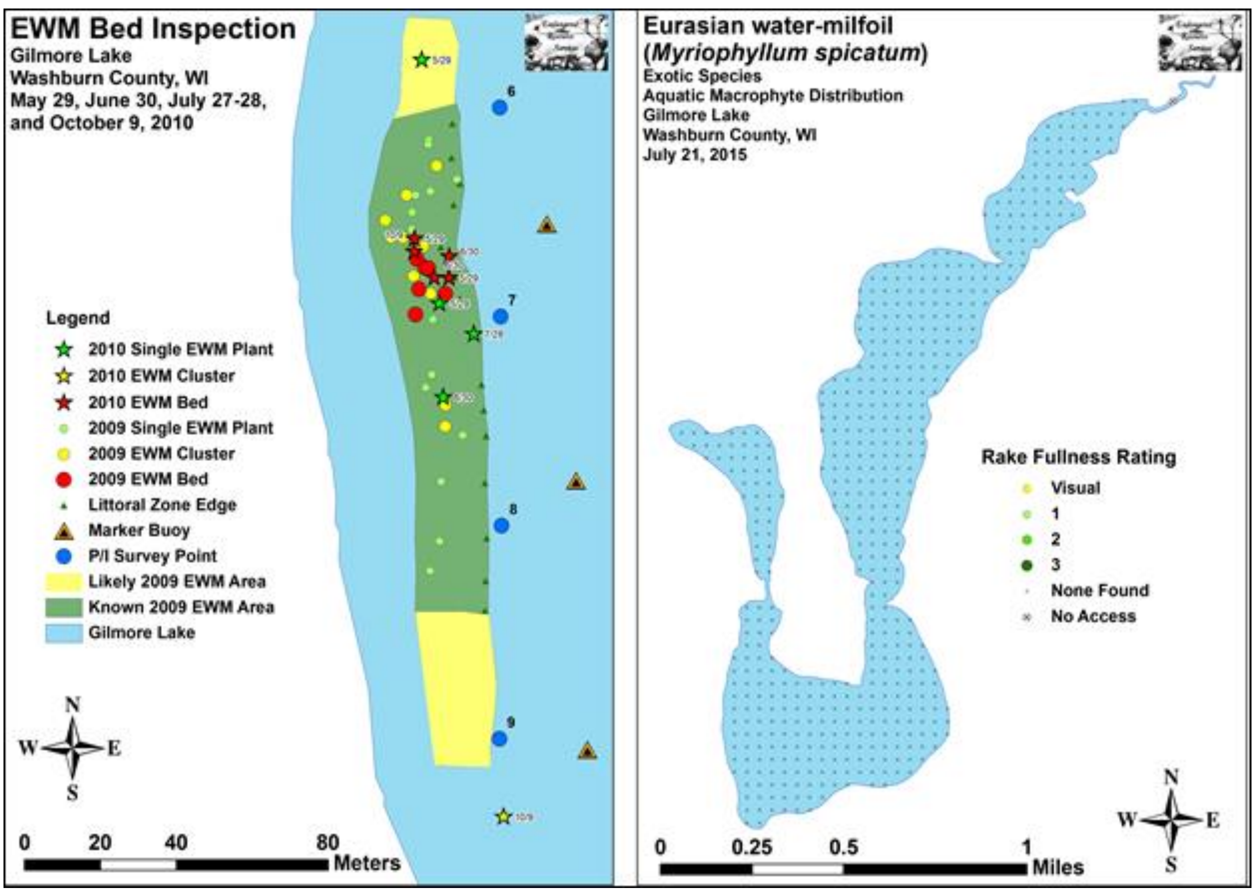

Figure 21: 2010 and 2015 EWM (ERS)

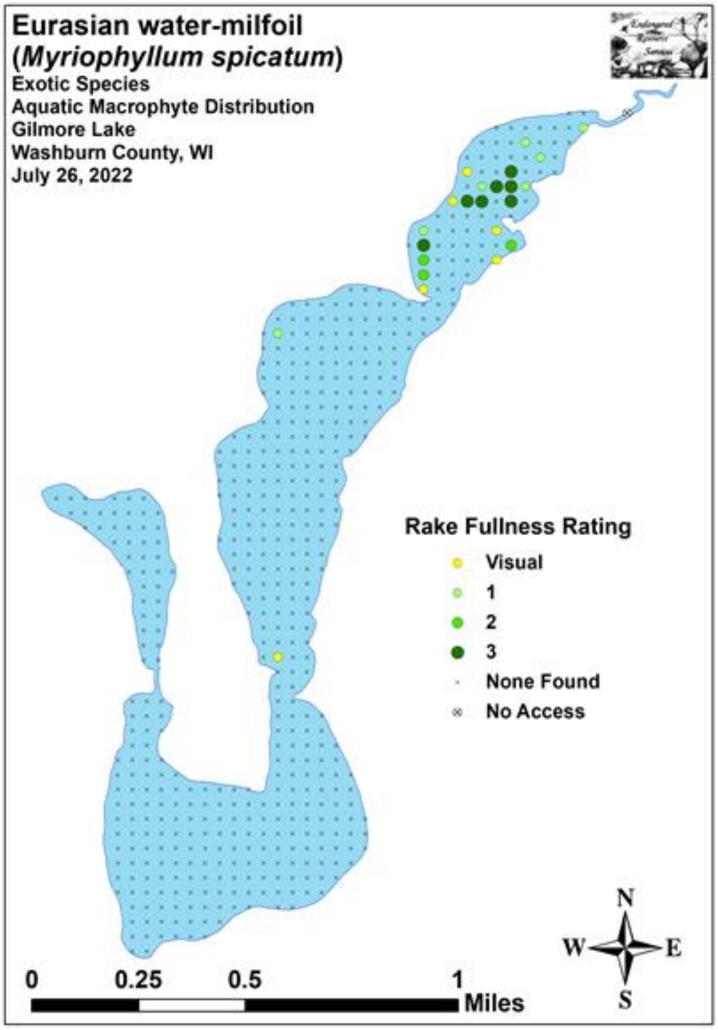

Figure 22: 2022 EWM distribution and density (ERS)

EURASIAN WATER-MILFOIL BED MAPPING SURVEY

During the late summer or early fall a meandering survey of the entire lake is completed by ERS with the sole purpose of mapping all beds of EWM and individual EWM plants. During the 2010 survey, the surveyor manually removed all clusters of Eurasian water-milfoil plants and microbeds found along the western shoreline of the south basin. During the 2015 bed mapping survey, two beds that totaled 0.65 acre (0.2% coverage) were delineated. One consisted of perhaps a few hundred canopied plants on the sunken island, and the other was a loose scattering of plants established on the southern shoreline of the south basin (Figure 23).

Between 2015 and 2023, several years of herbicide treatments in the South Basin and in Little Gilmore Lake were completed. During the 2022 survey, no evidence of EWM in these areas was documented (Figure 23). However, two low-density microbeds were present in the central basin, and two moderate to exceptionally dense canopied beds dominated much of the north basin (Figure 23). Collectively, these four beds totaled 7.65 acres and covered approximately 2.1% of the lake's surface area. In 2023, EWM had spread in the north basin, now covering 10.41 acres (Figure 23, Table 6) with at least 20 microbeds (Figure 24, Table 6) throughout the lake adding another 0.38 acres, representing an increase of nearly 16 acres from 2015 or 2.9% coverage of the lake.

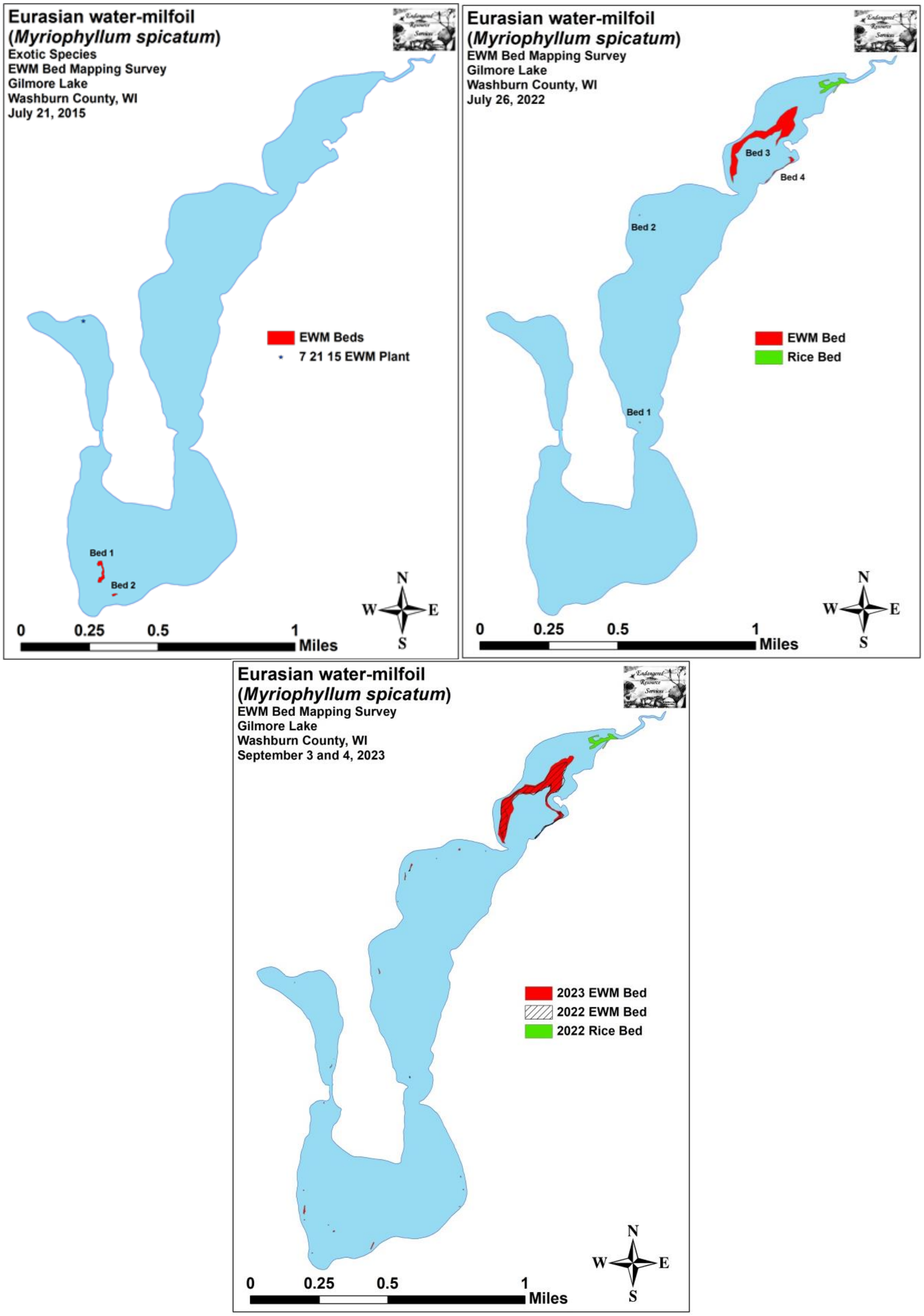

Figure 23: 2015, 2022, and 2023 EWM bed mapping results – whole lake (ERS)

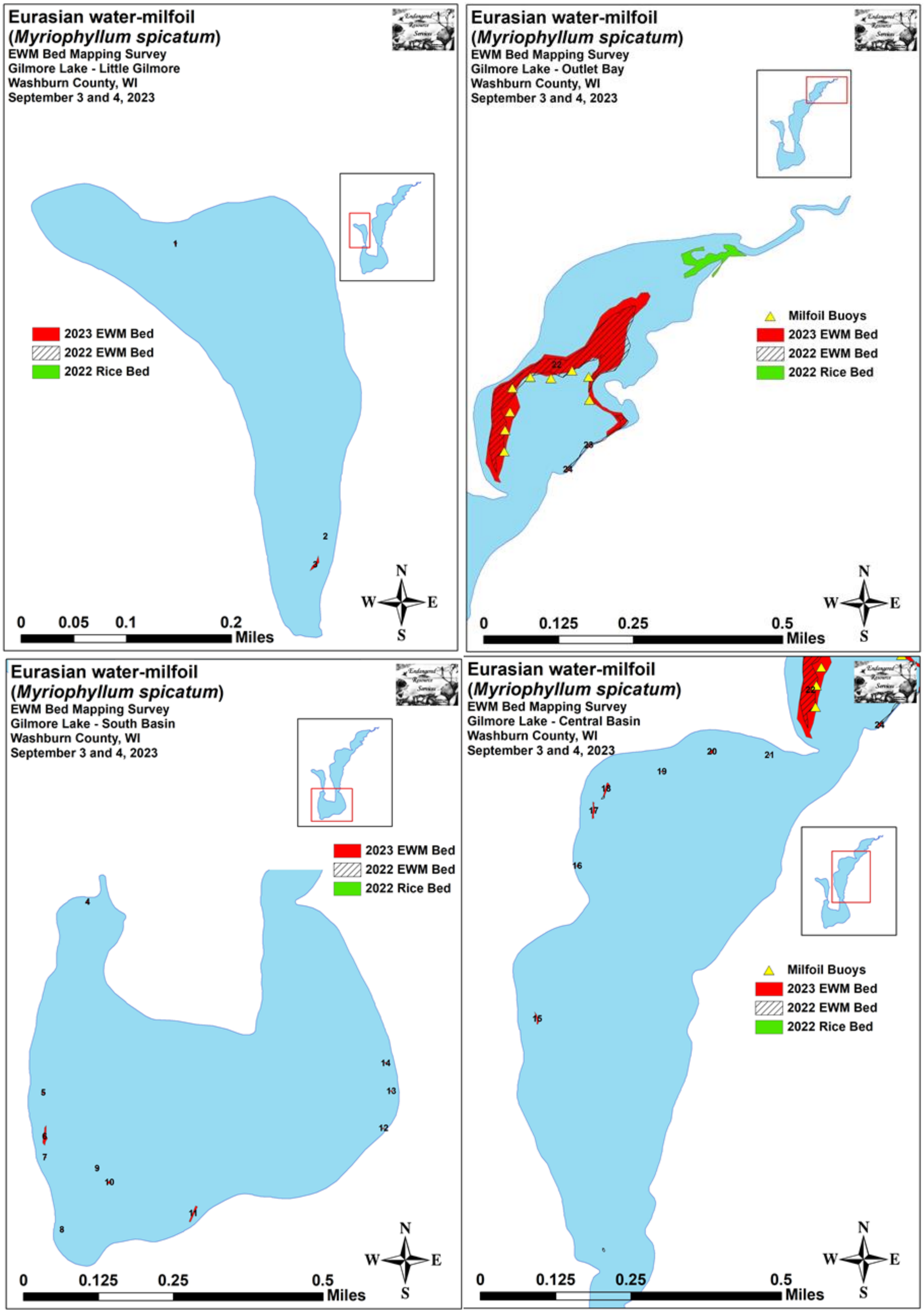

Figure 24: 2023 EWM bed mapping results – Little Gilmore (top left), South Basin (bottom left), Central Basin (bottom right), and North Basin (top right) (ERS)

Table 6: Eurasian Water-milfoil Bed Mapping Acreage Gilmore Lake – Washburn County, Wisconsin September 3&4, 2023

EWM	Acreage
1	0.003
2	0.001
3	0.018
4	0.007
5	0.006
6	0.084
7	0.005
8	0.005
9	0.005
10	0.018
11	0.053
12	0.004
13	0.005
14	0.007
15	0.030
16	0.004
17	0.048
18	0.050
19	0.004
20	0.023
21	0.003
22	10.366
23	0.023
24	0.019
TOTAL	**10.79**

WARM-WATER FULL POINT-INTERCEPT AQUATIC PLANT SURVEYS

All data in this section of the APM Plan is taken from the 2022 PI Plant Survey Report completed by Matt Berg of Endangered Resource Services.

In 2010, using a standard formula that considers the shoreline shape and distance, water clarity, depth, and total lake acres, Michelle Nault (WDNR) generated a 538-point sampling grid for Gilmore Lake that was used for all surveys. Using this grid, each survey point was located with a handheld mapping GPS unit, depth was recorded with a metered pole, and a rake was used to sample an approximately 2.5ft section of the bottom. All plants on the rake, as well as any that were dislodged by the rake, were identified, and assigned a rake fullness value of 1-3 as an estimation of abundance. Visual sightings of all plants within six feet of the sample point not found in the rake were also recorded. In addition to a rake rating for each species, a total rake fullness rating was also noted.

In July 2022, aquatic plants were found at 159 sites (29.6% of the bottom and 82.0% of the 14.0ft littoral zone) (Figure 25). This was almost identical to 2015 when plants were present at 160 points (29.8% of the entire lake bottom and in 73.1% of the then 16.5ft littoral zone). Both suggest a littoral zone covering about 110 acres. Each of the two most recent surveys were, however, a moderately significant decline from the original 2010 survey when aquatic plants were found growing at 202 sites (37.6% total coverage/87.4% of the then 17.5ft littoral zone) (Figure 25).

Growth in 2022 was strongly skewed to deep water as the mean depth of 3.7ft was nearly double the median depth of 2.0ft (Table 7). This sharp difference between the mean and median was similar to both 2015 (mean 4.7ft/median 3.0ft) and 2010 (mean 6.6ft/median 4.0ft). The overall decline in the mean from 2010 to 2015 was due to the contraction of the littoral zone, while the further reduction observed in 2022 was likely at least partially due to the low water levels seen on the lake during an extended period of drought.

Table 7: 2010, 2015, and 2022 Aquatic Macrophyte PI Survey Summary Statistics
Gilmore Lake, Washburn County

Summary Statistics:	2010	2015	2022
Total number of points sampled	537	537	537
Total number of sites with vegetation	202	160	159
Total number of sites shallower than the maximum depth of plants	231	219	194
Frequency of occurrence at sites shallower than maximum depth of plants	87.4	73.1	82.0
Simpson Diversity Index	0.95	0.96	0.96
Maximum depth of plants (ft)	17.5	16.5	14.0
Mean depth of plants (ft)	6.6	4.7	3.7
Median depth of plants (ft)	4.0	3.0	2.0
Number of sites sampled using a rake on a rope	56	54	0
Number of sites sampled using a rake on a pole	203	196	240
Average number of all species per site (shallower than max depth)	3.49	2.55	2.96
Average number of all species per site (veg. sites only)	3.99	3.49	3.62
Average number of native species per site (shallower than max depth)	3.49	2.55	2.88
Average number of native species per site (sites with native veg. only)	3.99	3.49	3.58
Species richness	54	57	59
Species richness (including visuals)	60	64	61
Species richness (including visuals and boat survey)	67	71	74
Mean rake fullness (veg. sites only)	2.39	2.08	2.32

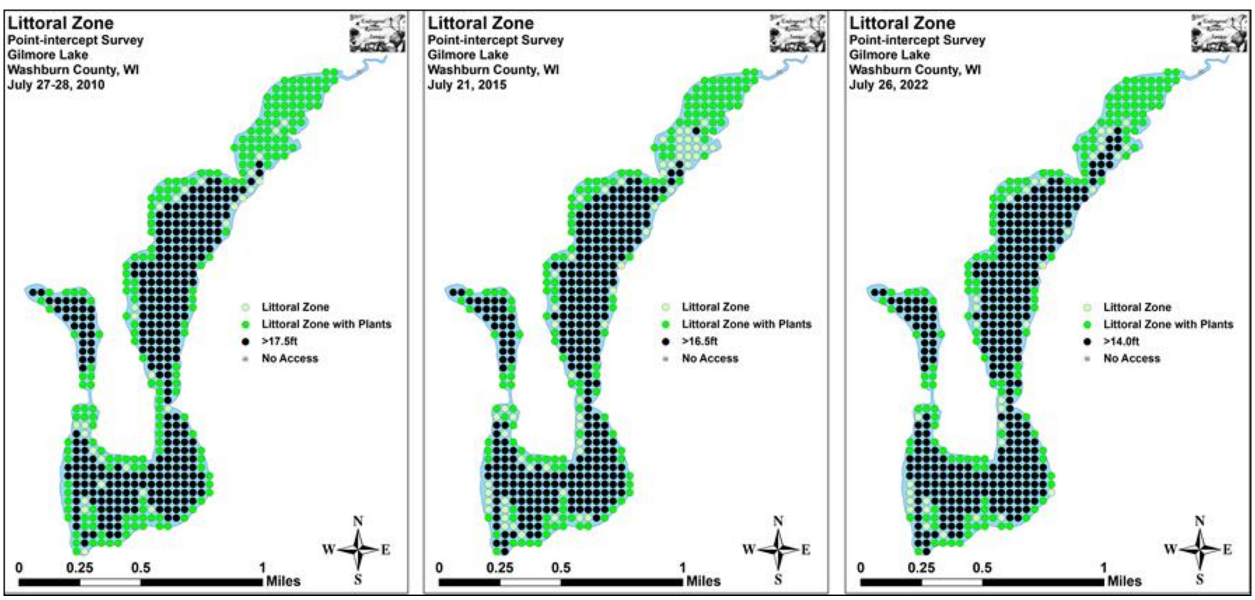

Figure 25: Littoral zone in 2010, 2015, and 2022

Plant diversity was exceptionally high in 2022 with a Simpson Index value of 0.96 – identical to 2015 and up from 0.95 in 2010. Total richness was also high with 59 species found in the rake (up from 57 in 2015 and 54 to 2010). This total increased to 74 species when including visuals and plants seen during the boat survey (up from 71 total species in 2015 and 67 in 2010) (Table 7).

Although overall richness increased from 2010 to 2015, mean native species richness at sites with native vegetation underwent a moderately significant decline from 3.99 species/site to 3.49 species/site. In 2022, a mean of 3.58 native species/site – a non-significant increase (p=0.35) over 2015 was calculated (Figure 26).

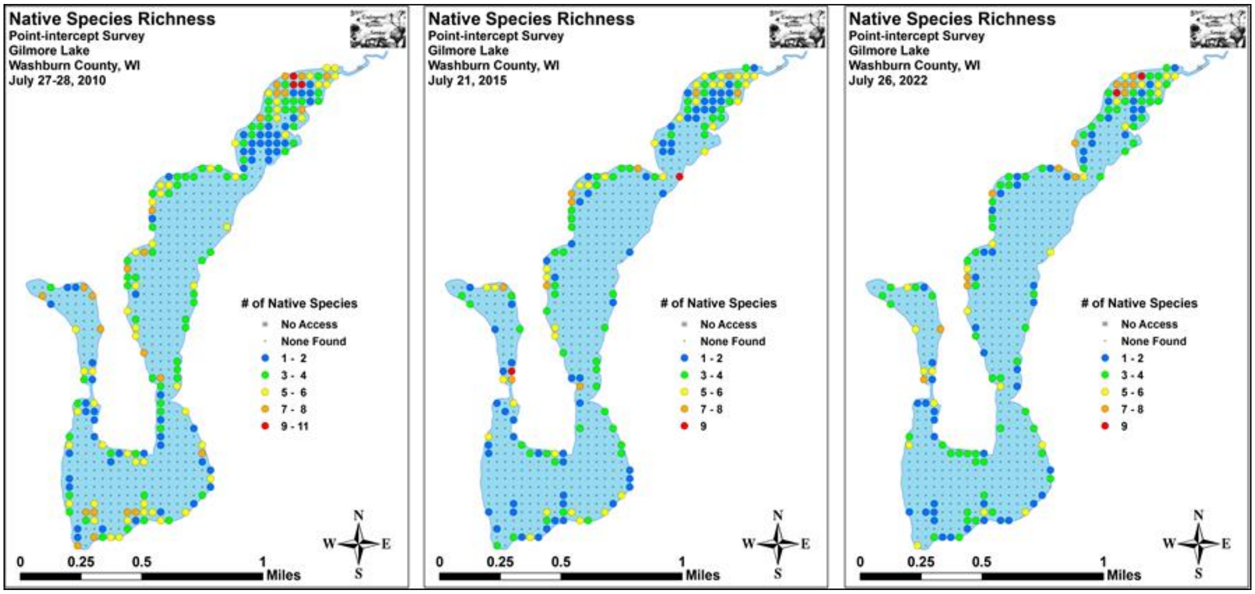

Figure 26: 2010, 2015, and 2022 native species richness (ERS)

From 2010 to 2015, total density underwent a highly significant decline from a moderately high mean rake fullness of 2.39 to a moderate 2.08. At the time, it was noted both the declines in localized richness and total biomass appeared to be lakewide (Figure 27). This trend reversed in 2022 as a moderately significant increase in density back to a moderately high mean rake fullness of 2.32 was documented.

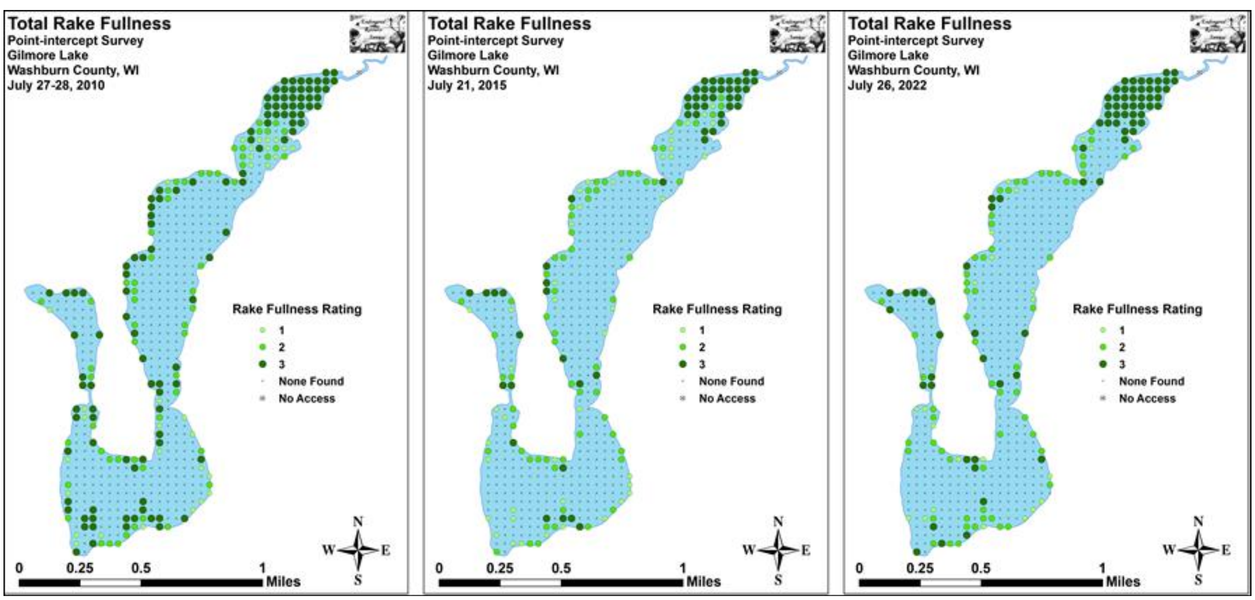

Figure 27: Native species richness (top) and total rake density (bottom)

During the 2010 survey, Wild celery, Small pondweed, Fern pondweed, and Common waterweed were the most common species found at 31.68%, 29.21%, 29.21%, and 26.73% of survey points with vegetation respectively. They accounted for 29.28% of the total relative frequency in 2010 (Figure 28).

The July 2015 survey identified Slender naiad, Fern pondweed, Needle spikerush, and Wild celery as the most common species found them at 31.88%, 31.25%, 23.13%, and 21.25% of sites with vegetation. They encompassed 30.76% of the total relative frequency in 2015 (Figures 28 and 29).

The July 2022 survey identified Fern pondweed (32.08% of points with vegetation), Slender naiad (29.56%), Wild celery (22.64%), and Variable pondweed (22.01%) as the most common species with a combined relative frequency of 29.39% (Figures 28, 29, and 30).

Lakewide, 11 species showed significant changes in distribution from 2010 to 2015 (Figure 31). Small pondweed, Common waterweed, Coontail, and Flat-stem pondweed all suffered highly significant declines; Wild celery, Variable pondweed, Northern watermilfoil, and Small bladderwort experienced moderately significant declines; and Water marigold demonstrated a significant decline. Conversely, Spiral-fruited pondweed and Northern naiad both saw significant increases.

From 2015 to 2022, Eurasian watermilfoil saw a highly significant increase in distribution; and Variable pondweed and Common waterweed both had significant increases. Grass-leaved arrowhead was the only species that showed a statistically significant decline in distribution, and it was moderately significant (Figure 32).

Figure 28: Wild celery, Small pondweed, Common waterweed, and Fern-leaf pondweed (ERS)

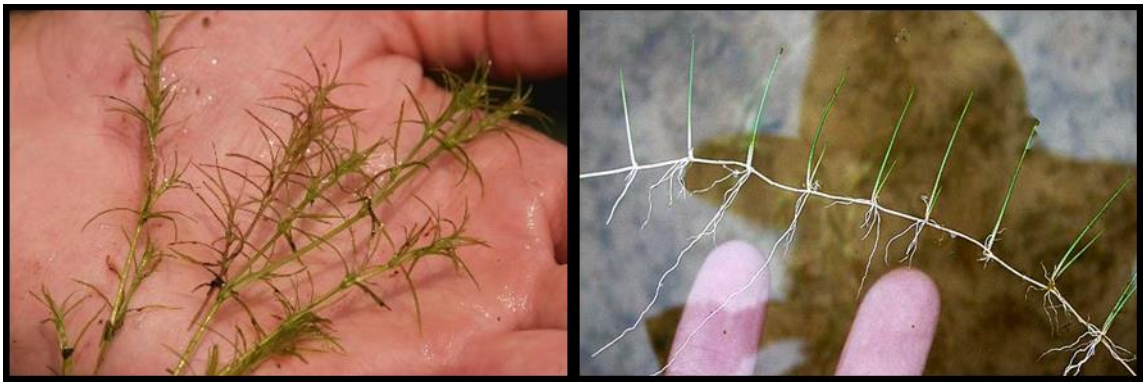

Figure 29: Slender naiad and Needle spikerush (ERS)

Figure 30: Variable pondweed and Eurasian watermilfoil (invasive species) (ERS)

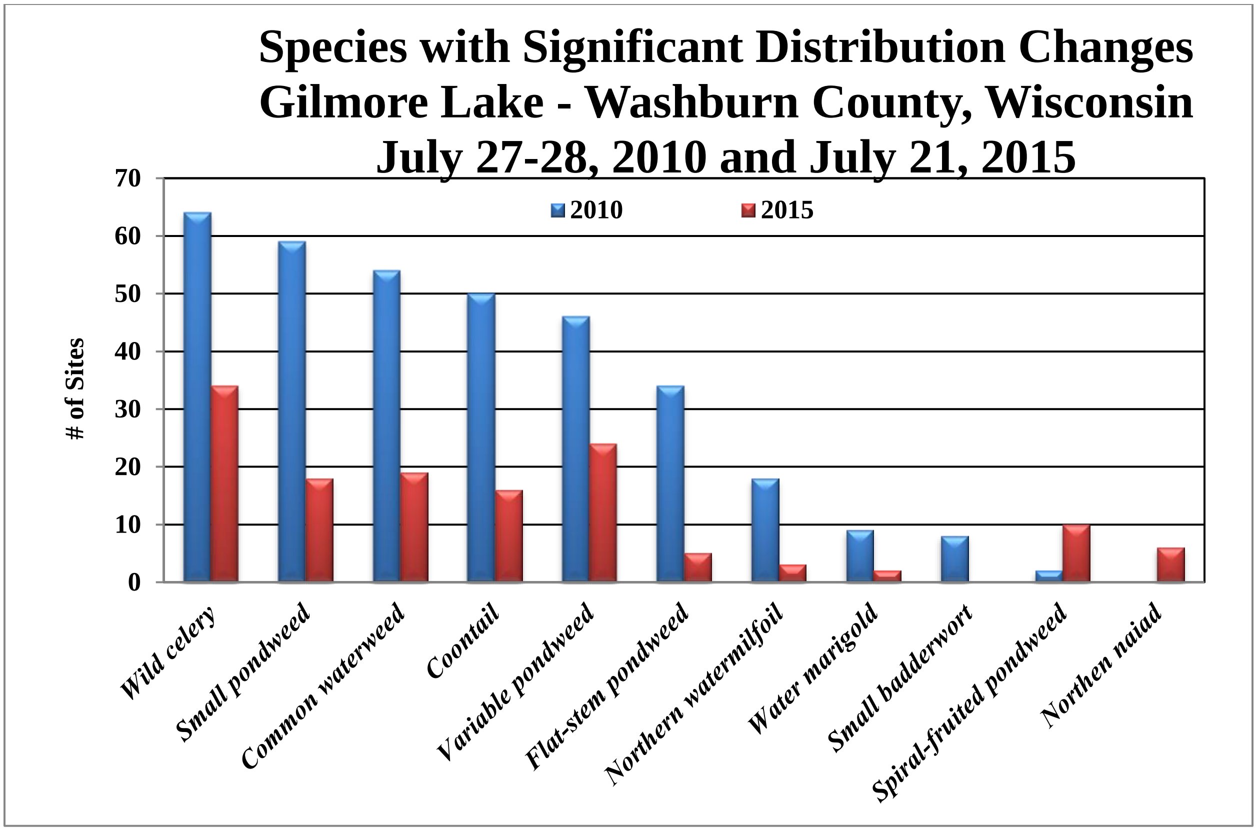

Figure 31: Species with significant changes between 2010 and 2015

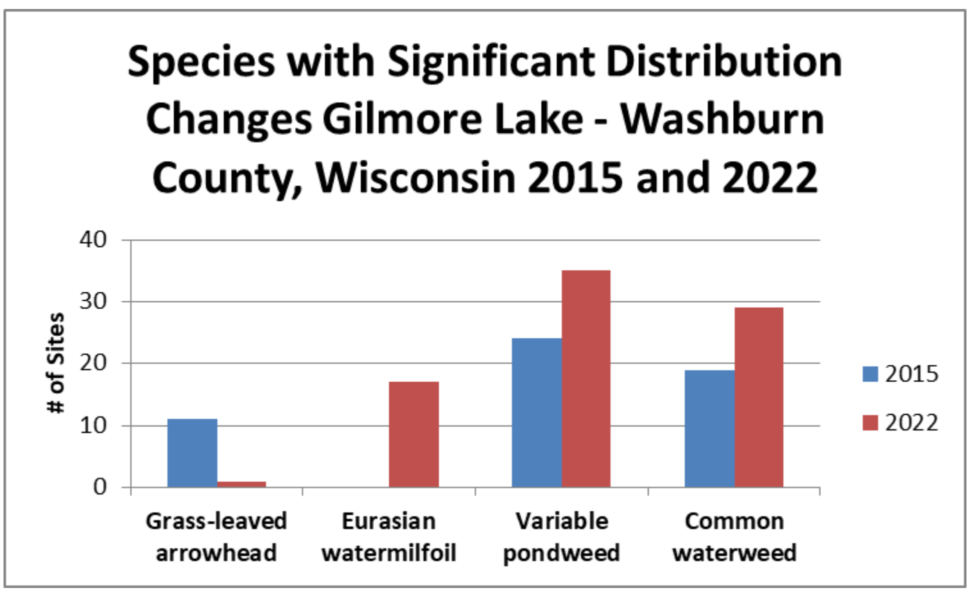

Figure 32: Species with significant changes between 2015 and 2022

FLORISTIC QUALITY INDEX (FQI)

This index measures the impact of human development on a lake's aquatic plants. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species. The FQI is calculated by averaging the conservatism value for each native index species found in the lake during the point-intercept survey and multiplying it by the square root of the total number of plant species (N) in the lake. Statistically speaking, the higher the index value, the healthier the lake's aquatic plant community is assumed to be. Nichols (1999) identified four eco-regions in Wisconsin: Northern Lakes and Forests, North Central Hardwood Forests, Driftless Area and Southeastern Wisconsin Till Plain. He recommended making comparisons of lakes within ecoregions to determine the target lake's relative diversity and health. Gilmore Lake is in the Northern Lakes and Forests Ecoregion.

In 2010, a total of 52 native index species were identified in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 6.8 and a Floristic Quality Index of 49.0.

The 2015 point-intercept survey identified a total of 51 native index plants in the rake. They produced a mean Coefficient of Conservatism of 6.8 and a Floristic Quality Index of 48.6.

The 2022 point-intercept survey found a total of 54 native index plants in the rake. They produced a mean Coefficient of Conservatism of 7.0 and a Floristic Quality Index of 51.2. Both results are higher than previous results in 2010 and 2015. Nichols (1999) reported an average mean C for the Northern Lakes and Forest Region of 6.7 putting Gilmore Lake above average for this part of the state. The FQI was also more than double the median FQI of 24.3 for the Northern Lakes and Forest Region (Nichols 1999).

AQUATIC PLANT CHANGES IN THE NORTH BASIN

The most significant change in aquatic vegetation from 2015 to 2022 is the amount of EWM identified in the North Basin (Figure 33). The 2022 survey identified EWM at 23 points in the entire lake, 21 of those points were in the North Basin with an average rake density of 2.0. In 2010 and 2015 there were no points with EWM in the North Basin. Most of the EWM in the North Basin is established in deep water that only supported minimal native aquatic plant growth prior to the invasion. When looking at the number of points in the North Basin with native vegetation, only one species appears to have been negatively impacted by the EWM. Wild celery decreased by 80% in the North Basin from 2015 to 2022 (Figure 34, Table 8). The number of points in the rest of the lake with wild celery remained the same from 2015 to 2022 (Table 8).

Several other species in the North Basin also saw decrease in distribution from 2015 to 2022, but similar decreases were also experienced in the rest of the lake so it cannot be said that the decreases were the result of an increase in EWM.

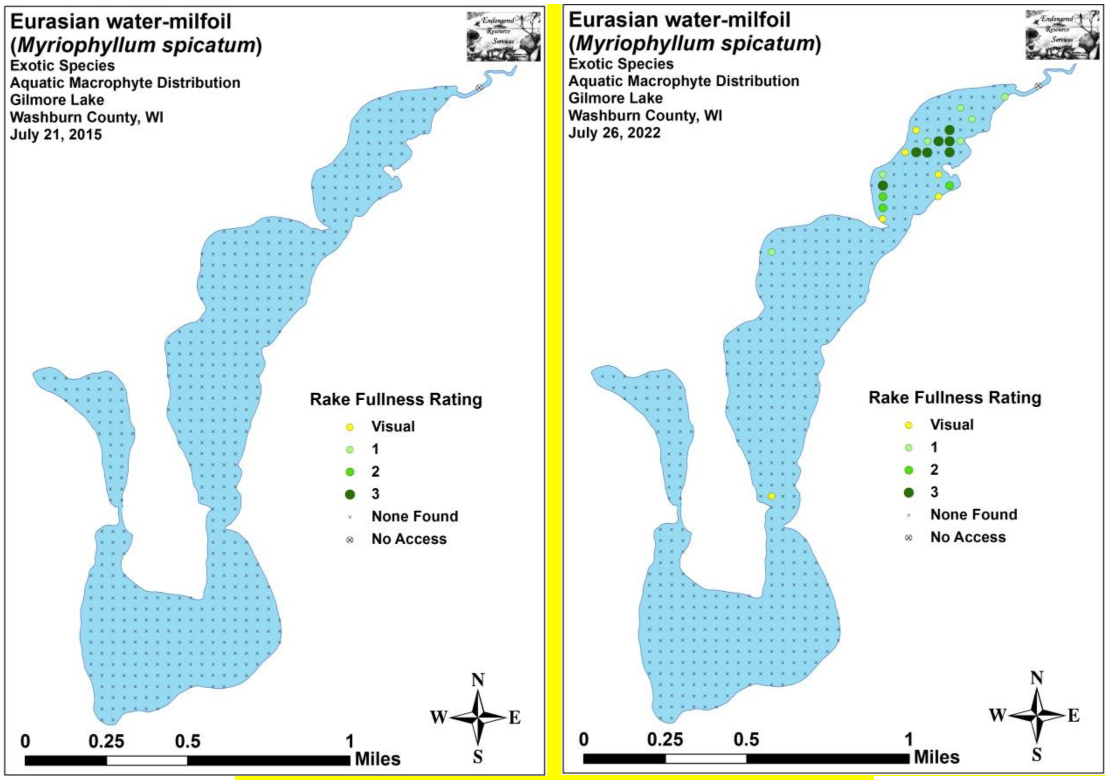

Figure 33: EWM changes in the North Basin (ERS)

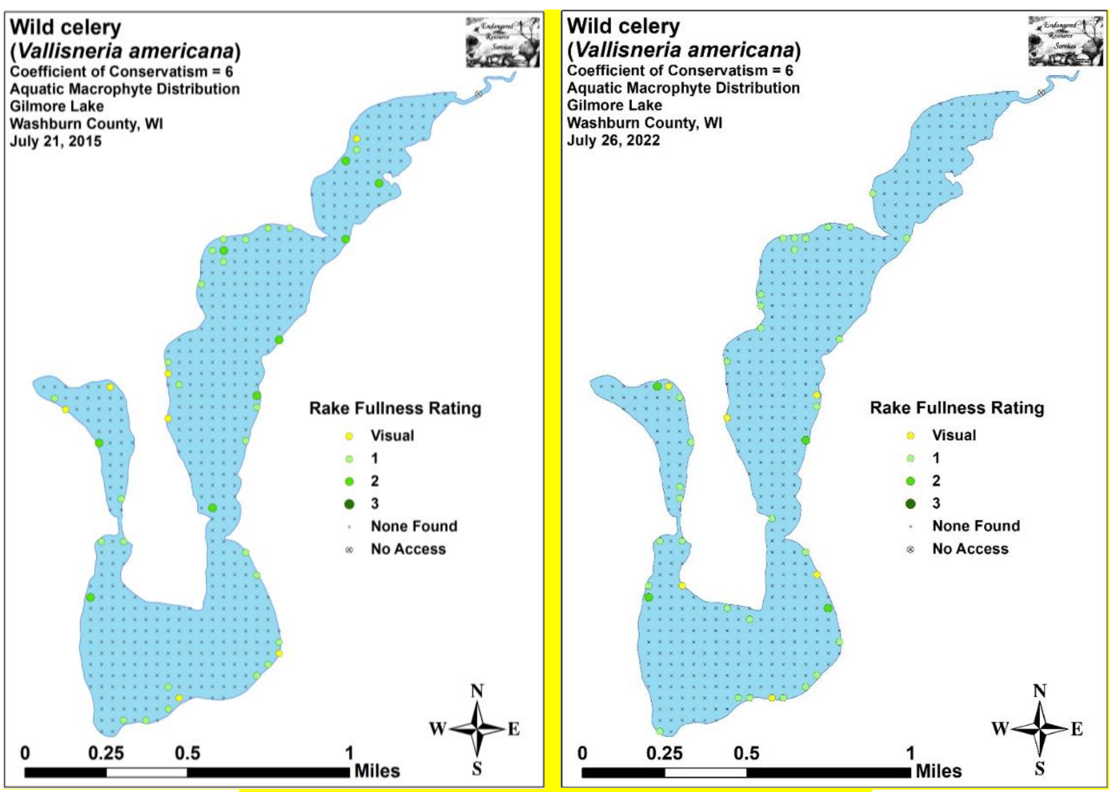

Figure 34: Changes in wild celery from 2015 to 2022

Table 8: Changes in wild celery distribution from 2015 to 2022

Wild Celery	2015	2022
North Bay	5	1
Rest of Lake	41	41

WILD RICE

According to the Great Lakes Indian Fish and Wildlife Commission (GLIFWC), Gilmore Lake is wild rice water. Additionally, wild rice was found during both whole-lake aquatic plant surveys of the lake. Any activity included in a comprehensive lake or aquatic plant management plan that could potentially impact the growth of wild rice in any body of water that has in the past, currently has, or potentially could have wild rice in the future requires consultation with the Tribal Nations. This consultation is completed by the Department of Natural Resources during their review of lake management documents. When present in a lake, wild rice is afforded numerous protections due to its ecological and cultural significance and management is therefore focused on harvest goals and protection rather than removal.

Wild rice is an annual aquatic grass that produces seed that is a nutritious source of food for wildlife and people. As a native food crop, it has a tremendous amount of cultural significance to the Wisconsin and Minnesota Native American Nations. Wild rice pulls large amounts of nutrients from the sediment in a single year and the stalks provide a place for filamentous algae and other small macrophytes to attach and grow. These small macrophytes pull phosphorus in its dissolved state directly from the water. Wild rice can benefit water quality, provide habitat for wildlife, and help minimize substrate re-suspension and shoreland erosion.

In Wisconsin, wild rice has historically ranged throughout the state. Declines in historic wild rice beds have occurred statewide due to many factors, including dams, pollution, large boat wakes, and invasive plant species. Renewed interest in the wild rice community has led to large-scale restoration efforts to reintroduce wild rice in Wisconsin's landscape. Extensive information is available on wild rice from GLIFWC and the WDNR.

Gilmore Lake has long supported rice, but the bed is limited to the north end of the lake, near the outlet to the Totagatic River (Figure 35). Although this bed often appears to be harvestable, and harvest at the site is date-regulated, it rarely turns up in harvest surveys, perhaps because it is a long paddle from the public access to the rice bed. Interestingly, the outlet reportedly sometimes acts as an inlet; during flood conditions on the Totagatic River, flow has reportedly reversed, causing the level of Gilmore Lake to jump. This is probably detrimental to the rice beds when it occurs. Watch status is low due to site familiarity (David, 2010).

Figure 35 – July 2022 wild rice at the outlet of Gilmore Lake looking toward the lake (left, ERS); Year 2000 aerial photo of wild rice at the Gilmore Lake outlet (David, 2010)

In 2010, rice occurred at such a low density in the outlet bay that there were no true beds, and no attempt to delineate the total area with rice plants was made. The 2015 survey again found that very low-density rice was scattered among other emergents in the outlet bay. Again, a formal bed mapping survey was not completed, but the surveyor estimated that rice was present within an approximately eight-acre area. Despite this sizable coverage, the density was so low that there were no places that even approached having human harvest potential.

In 2022, a formal rice bed mapping survey was completed. Again, there were again almost no areas where rice truly formed beds or was dense enough for even moderate harvesting. Rather, it occurred as scattered single plants or clusters of plant within an area that was dominated by Pickerelweed and waterlilies within approximately the same area rice was during the 2015 survey. Ultimately, 1.27ac (0.3% total coverage) where rice was generally dominant was mapped (Figure 36). The lone bed occurred near the lake outlet on either side of the channel. Due to low water and floating muck bogs, the bed was essentially inaccessible with no areas that were realistically accessible for human harvest.

In 2010, wild rice was found at two points around the outlet channel with one additional visual sighting (Figure 37). During the 2015 survey the population appeared to have undergone a slight expansion as wild rice was recorded in the rake at three points with nine additional visual sightings (Figure 37). In 2022, a further expansion in distribution to eight points with four additional visual sightings was documented (Figure 37). Of these, none had a rake fullness value of 3, one was a 2, and seven were a 1. This produced a mean rake fullness of 1.13 and suggested 0.2% of the lake had a significant amount of rice (rake fullness of 2 or 3). Except for the moderately significant increase in visual sightings from 2010 to 2015, none of the other year-over-year changes, either combined or broken out by rake fullness, were significant.

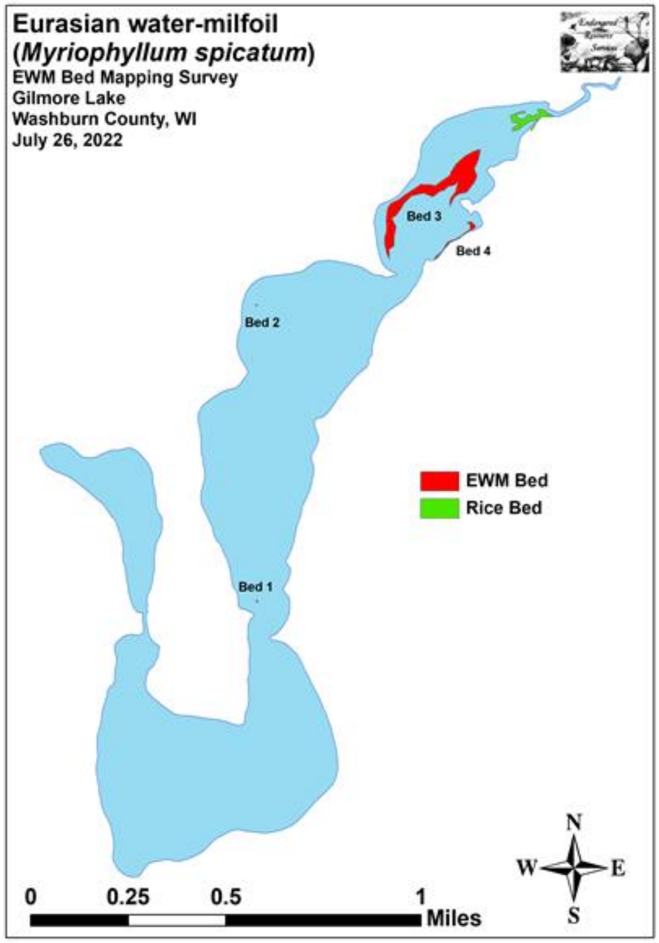

Figure 36: 2022 wild rice bed mapping results (ERS)

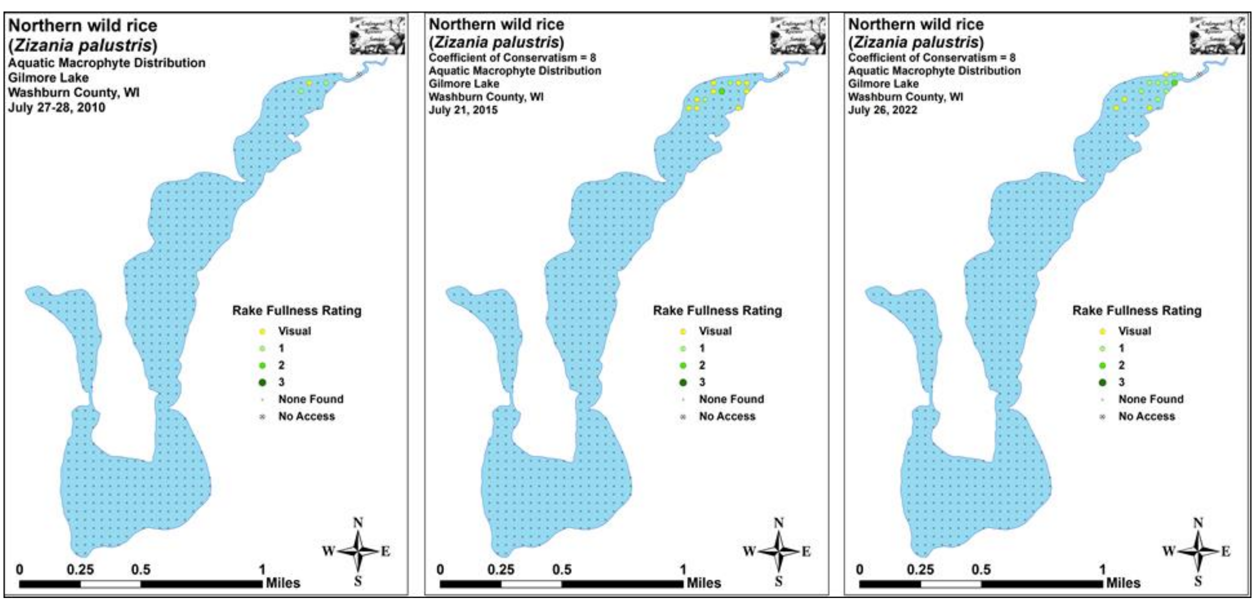

Figure 37: 2010, 2015, and 2022 wild rice locations and density

FLOATING BOG

Concern has been expressed by members of the GLA related to a floating bog in the North Basin of the lake (Figure 38). The concern relates to how it moves around the North Basin when under high water conditions. The bog is currently blocking several privately owned lots and is directly in front of a newly constructed cabin. The bog moved across the lake from the Eastern shore to the Western shore in the flooding during 2018 (two floods with 5 & 7 feet over normal) and moved again in the spring flood of 2023 a few hundred yards to the north along the western shore.

According to an article written by Carolyn Scholl from Vilas County WI, that briefly discusses some of the issues with changing water levels, floating bogs being one of them, there are only a few things that can be done in Wisconsin.

- Leave them alone.
- Move them to an area of the lake that is undeveloped and secure them to the shoreline or lake bottom (with adjacent property owner permissions); or
- Remove the floating vegetation from the lake by obtaining a permit from the WDNR through the Aquatic Plant Management program if the plants are floating, or through a dredging permit through the Water Regulation and Zoning program if the "bog is rooted or stuck to the lake bottom".

Individuals or lake organizations should contact their local DNR staff for advice and guidance through any permitting process and/or grant eligibility questions.

The GLA board and the affected property owners would like to move the bog to undeveloped areas near the present location. GLA will explore removal options from the present location to a less intrusive area and will need assistance and advice from the WDNR and the lake consultant on appropriate management.

Figure 38: Location of the floating bog in Gilmore Lake

AQUATIC INVASIVE SPECIES (AIS)

There are currently only two non-native species that have been officially documented in Gilmore Lake. One of these is the aquatic plant, Eurasian watermilfoil (EWM) and the other is a snail species native to Asia, the Chinese mystery snail (CMS). EWM was discovered in Gilmore Lake in 2009 and the Chinese mystery snails were found in 2011.

During the three whole-lake PI surveys (2010, 2015, and 2022) purple loosestrife, reed canary grass, and hybrid cattail have been identified. Since then, no other AIS has been discovered within Gilmore Lake or the surrounding shoreline. Curly-leaf pondweed and Yellow flag iris are two additional AIS that have been found locally but not officially in Gilmore Lake.

Information on these and other AIS is included in Appendix A.

AIS PREVENTION STRATEGY

Gilmore Lake only has one well-established AIS (EWM). There are many more that could be introduced to the lake. The GLA will continue to do watercraft inspection and AIS signage at the boat landing. They will also continue monitoring the lake for other species. Both programs will follow UW-Extension Lakes and WDNR protocol through the Clean Boats, Clean Waters program and the Citizen Lake Monitoring Network AIS Monitoring program.

Additionally, having educated and informed lake residents is the best way to keep non-native AIS at bay in Gilmore Lake. To foster this, the GLA will host and/or sponsor lake community events including AIS identification and management workshops; distribute education and information materials to lake property owners and lake users through the newsletter, webpage, and general mailings.

The GLA was one of the first lake groups to develop an AIS Rapid Response Plan in case a new AIS was discovered in the lake. If this plan has not been updated recently, the GLA will do so in 2024.

EWM MARKER BUOYS

AIS prevention also relates to the in-lake environment. One in-lake prevention strategy that the GLA has implemented is placing EWM marker buoys around the perimeter of the large EWM bed in the North Basin. The goal of installing marker buoys is to make lake users more aware of the bed, and possibly prevent them from accidentally boating into the middle of it. The buoys will also be used to set a perimeter for where EWM management efforts will begin, with the goal of not allowing the EWM to spread outside of the perimeter.

PAST AIS MANAGEMENT

Around 2006, the GLA developed an aquatic invasive species monitoring and rapid response plan for Gilmore and Little Gilmore Lake. This plan became a model for other lake associations to follow in developing their own plans. Unfortunately, the Rapid Response plan was put into play with the discovery of EWM in Gilmore Lake in 2009. EWM had already been identified in Nancy Lake (1991) and the Minong Flowage (2005) by this time. Management of EWM began that same year with a fall treatment of about 2 acres of EWM in Gilmore Lake using Navigate (granular 2,4-D), an herbicide approved for use in Wisconsin waters for control of aquatic invasive species. In 2010, diver removal was completed three times in Gilmore Lake where EWM was first found in 2009. In 2011, more physical removal was completed in Gilmore Lake and there was discussion about implementing a summer herbicide application, although it is not known whether this happened or not. Despite these efforts, another small-scale EWM herbicide application was needed in Gilmore Lake in 2012, and again in 2013.

EWM was first found in the Little Gilmore basin in the summer of 2011. Physical removal was completed in Little Gilmore in 2011, 2012, and 2013, but no herbicides were applied. The primary reason for this was the inability of the contracted herbicide applicator to drive his boat through the culvert separating Little Gilmore and Gilmore Lake. In 2014, several members of the GLA completed online training to become licensed herbicide applicators, and at least one received his certification.

In 2016, EWM had spread to a level that necessitated the hiring of a commercial herbicide applicator to treat areas in Gilmore Lake that again exceeded 2 acres. In both 2017 and 2018, a commercial applicator treated 1.25 acres in Gilmore Lake. Physical removal completed by the GLA continued (Table 9).

From 2018 to 2023, under the guidance of a new APMP, management efforts included small-scale herbicide applications applied by a commercial applicator (Table 10).

In 2021, ProcellaCOR was used for the first time in Gilmore Lake. Six beds covering more than 7 acres (not including the North Basin) of EWM were treated (Table 10, Figure 39). During a pre-treatment survey of 101 points, EWM was found on the rake at 19 points scattered throughout the six treatment areas and recorded as a visual at 18 additional sites. During the post-treatment, there was no evidence of EWM at or inter-point within the treatment areas. Statistically speaking, this resulted in a highly significant reduction in total distribution, total density, and visual sightings; a moderately significant reduction in rake fullness 2; and a significant reduction in rake fullness 3 and 1 (Figure 40).

The littoral zone increased slightly from 10.0ft pretreatment to 12.5ft posttreatment; however, the frequency of plant occurrence dropped from 93.7% pretreatment to 88.8% posttreatment. Total richness increased from 16 species pretreatment to 21 species posttreatment; and the Simpson's Diversity Index also rose from a high pretreatment value of 0.87 to a very high 0.90 posttreatment. The Floristic Quality Index (another measure of native plant community health) also increased sharply from 23.5 pretreatment to 29.5 posttreatment. Mean native species richness at points with native vegetation demonstrated a highly significant increase from 2.32 species per point pretreatment to 3.14/point posttreatment. Total mean rake fullness saw a nearly significant increase from a moderate 1.93 pretreatment to 2.10 posttreatment.

Because of the success in 2021 using ProcellaCOR, both in controlling EWM and not causing significant harm to native vegetation, no chemical treatment was completed in 2022. In 2023, the GLA tried unsuccessfully to get a permit to chemically treat the 8-acre bed in the North Basin with ProcellaCOR, but because of concerns related to the unknown impacts of the herbicide on wild rice, it was denied. They did receive a permit to use a 2,4D-based herbicide on certain areas of the Central Basin, Southern Basin, and Little Gilmore, but none was completed. The use of ProcellaCOR will again be requested in 2024.

Table 9: EWM Management in Gilmore and Little Gilmore Lakes 2009-2016

EWM Management in Gilmore and Little Gilmore Lakes 2009-2016									
		2009	2010	2011	2012	2013	2014	2015	2016
Gilmore	NAS (small-scale herbicide)	2	NT	NT	1.61	1.02	NT	0.34	2.05
	Diver/physical Removal	x	x	x	x	x	x	x	x
Little Gilmore	NAS (small-scale herbicide)	NA	NA	NA	NA	NA	NA	NA	NA
	Diver/physical Removal	NA	NA	x	x	x	x	x	x
Notes		EWM found in Gilmore		EWM found in Little Gilmore, Milfoil Maurauder Commissioned		No treatment on Little Gilmore due to access issues with applicator			Year of Great Flood and Colton Flowage Dam Rupture

Table 10: EWM management in Gilmore and Little Gilmore Lakes 2017-2023

EWM Management in Gilmore and Little Gilmore Lakes 2017-2023									
		2017	2018	2019	2020	2021	2022	2023	2024
Gilmore	NAS (small-scale herbicide)	1.25	1.25	1.25	1.92	7.24	NT	NT	
	Diver/physical Removal	x	x	x	x	x	x	x	
	DASH (diver-assisted suction harvest)							3 days	
Little Gilmore	NAS (small-scale herbicide)	NA	NA	NA	NA	NA	NA	NA	
	Diver/physical Removal	x	x	x	x	x	x	x	
Notes						ProcellaCOR was used to treat all areas			Treatment parameters are as of yet undetermined

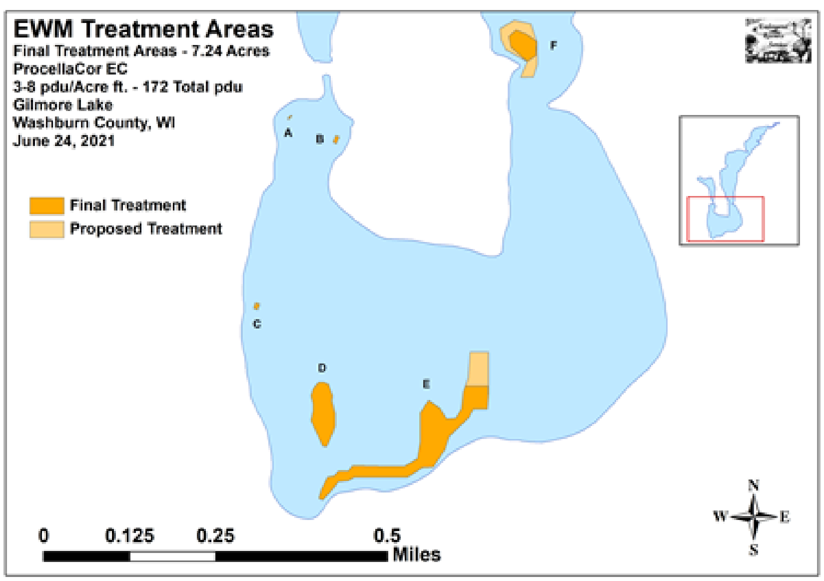

Figure 39: 2021 ProcellaCOR treatment of EWM

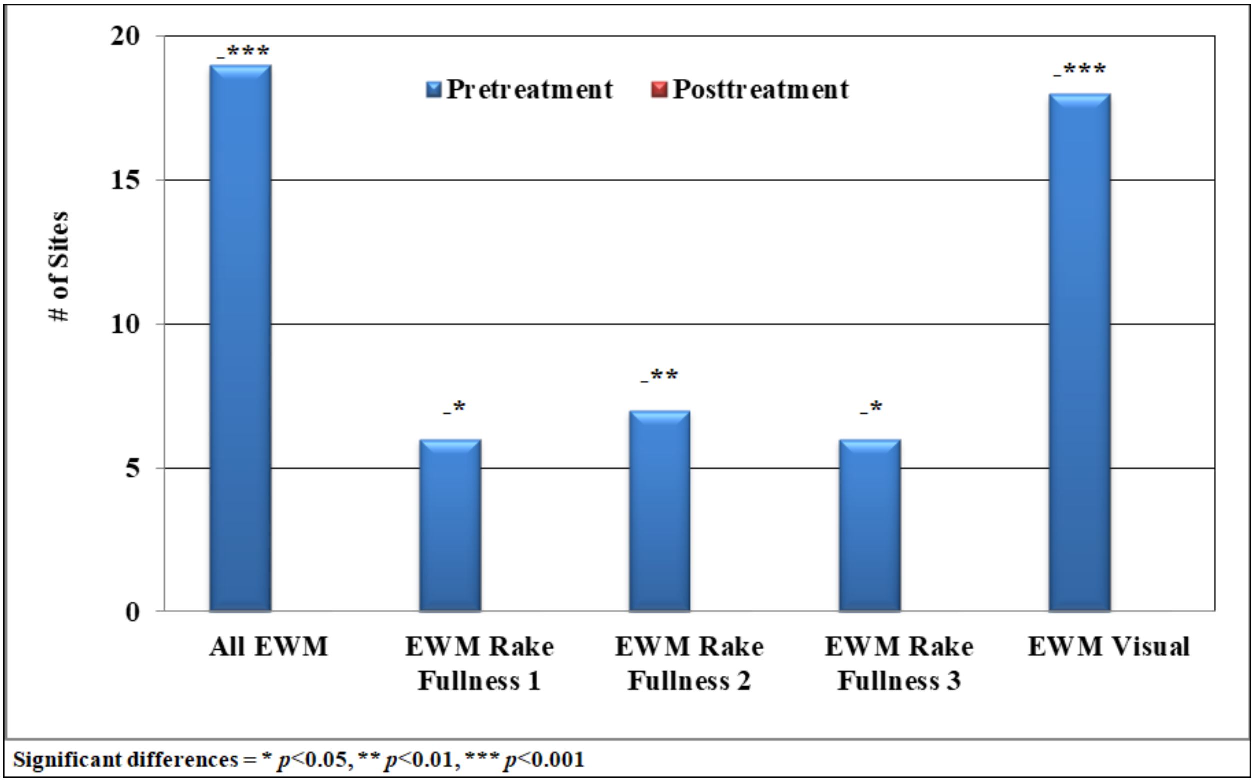

Figure 40: Pre-Post changes in EWM rake fullness after application of ProcellaCOR (the absence of the posttreatment bar is intended, there was no EWM discovered posttreatment)

In early August 2023, the GLA contracted with a company that offers DASH removal of EWM. The company was brought in for three days of DASH removal focused primarily on the southeast shoreline of the North Basin across from the larger, 8-acre bed. During their time on the water, 132 onion bags of EWM were removed (Figure 41).

Figure 41: One day's DASH removal results (McCloskey, 2023)

EWM bed mapping in the North Basin completed after the DASH removal of EWM found more EWM in the bigger bed (Bed 22) on the north side of the basin, and still found EWM in the south portion of the basin where DASH had been completed (Beds 23 & 24) but it was not as continuous as it was in 2022 (Figure 42).

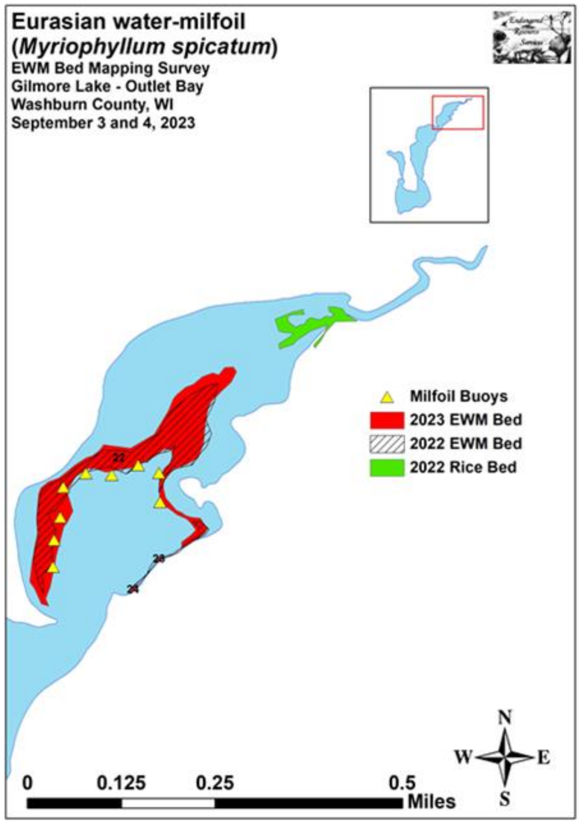

Figure 42: 2023 EWM bed mapping in the North Basin

WISCONSIN'S AQUATIC PLANT MANAGEMENT STRATEGY

There are many techniques for managing native and non-native aquatic plants in Wisconsin. Often management may mean protecting desirable aquatic plants by selectively hand pulling the undesirable ones. Sometimes more intensive management may be needed such as using harvesting equipment, herbicides, or biological control agents. Because aquatic plants are recognized as a natural resource to be protected, managed, and used wisely, the development of long-term, integrated aquatic plant management strategies to identify important plant communities and manage nuisance aquatic plants in lakes, ponds or rivers is often required by the State of Wisconsin.

The Public Trust Doctrine is the driving force behind all management, plant or other, in Wisconsin lakes. Protecting and maintaining Wisconsin's lakes for all of Wisconsin's people are at the top of the list in determining what is done and where. Two other factors that reflect Wisconsin's changing attitude toward aquatic plants. One is a growing realization of the importance of a strong, diverse community of aquatic plants in a healthy lake ecosystem; and the other is the concern over the spread of AIS.

INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is an ecosystem-based management strategy that focuses on long-term prevention and/or control of a species of concern. Adapted for aquatic plant management, IPM considers all the available control practices such as: prevention, biological control, biomanipulation, nutrient management, habitat manipulation, substantial modification of cultural practices, pesticide application, water level manipulation, mechanical removal and population monitoring (Figure 43). In addition to monitoring and considering information about the target species' life cycle and environmental factors, groups can decide whether the species' impacts can be tolerated or whether those impacts warrant control. Then, an IPM-based plan informed by current, comprehensive information on pest life cycles and the interactions among pests and the environment can be formed. If control is needed, data collected on the species and the waterbody will help groups select the most effective management methods and the best time to use them.

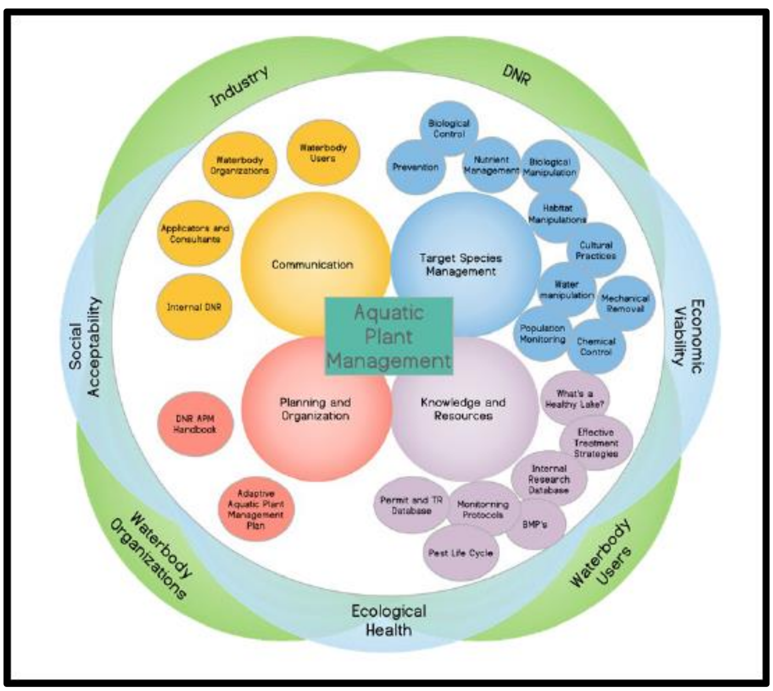

Figure 43: WDNR: Wisconsin Waterbodies – Integrated Pest Management March 2020

The most effective, long-term approach to managing a species of concern is to use a combination of methods. Approaches for managing pests are often grouped in the following categories:

- **Assessment** – is the use of learning tools and protocols to determine a waterbodies' biological, chemical, physical and social properties, and potential impacts. Examples include point-intercept (PI) surveys, water chemistry tests and boater usage surveys. This is the most important management strategy for every single waterbody.
- **Biological Control** – is the use of natural predators, parasites, pathogens, and competitors to control target species and their impacts. An example would be beetles for purple loosestrife control.
- **Cultural controls** – are practices that reduce target species establishment, reproduction, dispersal, and survival. For example, a Clean Boats, Clean Waters program at boat launches can reduce the likelihood of the spread of species of concern.
- **Mechanical and physical controls** – can kill a target species directly, block them out, or make the environment unsuitable for it. Mechanical harvesting, hand pulling, and diver assisted suction harvesting are all examples.
- **Chemical control** – is the use of pesticides. In IPM, pesticides are used only when needed and in combination with other approaches for more effective, long-term control. Groups should use the most selective pesticide that will do the job and be the safest for other organisms and for air, soil, and water quality.

IPM is a process that combines informed methods and practices to provide long-term, economic pest control. A quality IPM program should adapt when new information pertaining to the target species is provided or monitoring shows changes in control effectiveness, habitat composition and/or water quality.
While each situation is different, eight major components should be established in an IPM program:

1. Identify and understand the species of concern.
2. Prevent the spread and introduction of the species of concern.
3. Continually monitor and assess the species' impacts on the waterbody.
4. Prevent species of concern impacts
5. Set guidelines for when management action is needed.
6. Use a combination of biological, cultural, physical/mechanical, and chemical management tools.
7. Assess the effects of target species' management.
8. Change the management strategy when the outcomes of a control strategy create long-term impacts that outweigh the value of target species control.

MANAGEMENT ALTERNATIVES

Nuisance aquatic plants can be managed in a variety of ways in Wisconsin. The best management strategy will be different for each lake and depends on which nuisance species needs to be controlled, how widespread the problem is, and the other plants and wildlife in the lake. In many cases, an integrated pest management (IPM) approach to aquatic plant management that utilizes several control methods is necessary. The eradication of non-native aquatic invasive plant species such as CLP and EWM is generally not feasible but preventing them from becoming a more significant problem is an attainable goal. It is important to remember however, that regardless of the plant species targeted for control, sometimes no manipulation of the aquatic plant community is the best management option. Plant management activities can be disruptive to a lake ecosystem and should not be done unless it can be shown they will be beneficial and occur with minimal negative ecological impacts.

Management alternatives for nuisance aquatic plants can be grouped into four broad categories:

- Manual and mechanical removal
- Chemical application
- Biological control
- Physical habitat alteration.

Manual and mechanical removal methods include pulling, cutting, raking, harvesting, suction harvesting, and other means of removing the physical plant from the water. Chemical application is typified using herbicides that kill or impede the growth of the aquatic plant. It is illegal to put any chemical into the waters of Wisconsin without a chemical application permit from the WDNR. Some forms of physical removal, specifically suction harvest and mechanical harvesting, also require a WDNR permit. Biological control methods include organisms that use the plant for a food source or parasitic organisms that use the plant as a host, killing or weakening it. Biological control may also include the use of species that compete successfully with the nuisance species for available resources. This activity may require a WDNR permit. Physical habitat alteration includes dredging, installing lake-bottom covers, manipulating light penetration, flooding, and drawdown. These activities may require WDNR permits. They may also include making changes to or in the watershed of a body of water to reduce nutrients going in.

Informed decision-making related to aquatic plant management implementation requires an understanding of plant management alternatives and how appropriate and acceptable each alternative is for a given lake. The following sections list scientifically recognized and approved alternatives for controlling aquatic vegetation.

NO MANAGEMENT

When evaluating the various management techniques, the assumption is erroneously made that doing nothing is environmentally neutral. In dealing with nonnative species like EWM, the environmental consequences of doing nothing may be high, possibly even higher than any of the effects of management techniques. Unmanaged, these species can have severe negative effects on water quality, native plant distribution, abundance and diversity, and the abundance and diversity of aquatic insects and fish (Madsen J. , 1997). Nonindigenous aquatic plants are the problem, and the management techniques are the collective solution. Nonnative plants are a biological pollutant that increases geometrically, a pollutant with a very long residence time and the potential to "biomagnify" in lakes, rivers, and wetlands (Madsen, 2000).

The following information about EWM and the issues it can cause in a waterbody comes from Michigan Tech Research Institute and can be viewed at https://www.mtu.edu/mtri/research/project-areas/environmental/water/eurasian-watermilfoil/impacts/.

- EWM has many characteristics that contribute to its tendency to become a nuisance and is considered one of the most problematic submerged aquatic plant species in North America. The primary issue with EWM is the amount of biomass the plant will produce, not necessarily its presence—not all EWM populations will become major infestations. When EWM is moved to a suitable habitat, it has the propensity to accumulate biomass quickly and rapidly expand in population size. Although EWM prefers warmer water temperatures, it can tolerate and photosynthesize in low temperatures. Cold tolerance allows it to grow earlier in the season and out-compete other macrophytes for space and subsequently light once a canopy is formed. It has a wide tolerance range for many environmental attributes, so it can colonize a variety of habitats. It can colonize previously unvegetated habitats, and fragments from nearby populations can quickly establish and grow in habitats where native macrophytes are disturbed or removed by ice scour, sedimentation, bioturbation, herbivory, and water level changes. Once established, it can persist through disturbances.

- Dense EWM populations often lead to major ecological impacts and have ramifications toward native habitats and native organisms. EWM can disrupt food-webs in both estuarine and freshwater water bodies. Invasive species are an important threat to biological diversity, second only to habitat losses. EWM has been shown to displace native species in a span of two to three years.

- EWM can alter the chemical and physical properties of water when it grows in dense stands. EWM decomposition has been shown to accelerate eutrophication by releasing nutrients, especially phosphorous that was translocated from the sediment into plant tissue during growth, into the water column. Since EWM self-prunes its leaves and dies back in the fall, large populations of EWM result in the buildup of biomass on the sediment. EWM biomass decomposition and the increased respiration rates of microbes will lead to lower dissolved oxygen levels in the water column. EWM's restriction on flow and mixing of the water column can also result in an alteration of the temperature profile by up to 10C per meter, further reducing dissolved oxygen.

- EWM can form dense canopies, especially in turbid waters, that will block the light from reaching the substrate restricting the growth of macrophytes underneath it. EWM grows early and elongates rapidly, thus giving it a competitive advantage for light over native plants, including the native northern watermilfoil.

- EWM can have major implications on aquatic food webs. EWM's primary contribution to the food web is through decomposing material in the detritus. However, EWM is allelopathic. Allelopathy is the ability of one plant (or other organism) to chemically inhibit the growth of another, due to the release into the environment of substances acting as germination or growth inhibitors (dictionary definition). Therefore, the presence of released allelopathic compounds by EWM could directly affect the algal and periphyton community, thus reducing productivity. The allelopathic compounds contained within senesced EWM also reduce the quality of detritus. The changes in microbial communities and the quality of detritus then affect the invertebrate community.

- EWM and the epiphyton that grows on it do not contribute much energy or nutrients to higher trophic levels; fish prefer prey that originates from native plant communities. Even fish that use EWM stands for harborage have been shown to get their energy and nutrients from native plant communities. Dense stands of EWM also influence the predation rates of piscivorous fish. Largemouth bass, for example, have difficulty entering and foraging for prey in dense EWM stands, which can result in an increase of bluegill and a decrease in bass. EWM will also reduce spawning success by covering the spawning grounds.

- Dense infestations will alter the hydrology of the water body slowing currents and wave action. The standing water then provides habitat for mosquitoes and Schistosomatidae parasites that cause swimmers itch (cercarial dermatitis). The reduction in dissolved oxygen in the water column through decreases in mixing and increased decomposition can also displace fish and other animals.

- EWM is a low-quality food source, so although it may be edible, it is not preferred by waterfowl. Dense populations of EWM will displace desirable vegetation species, leading to low-quality habitat for waterfowl.

- The presence of EWM has been shown to have a major impact on land values. According to data collected in Wisconsin, property owners are willing to pay an average of approximately $30,000 more for a property on an EWM-free lake, and EWM presence decreases property value (land and structures) an average of eight percent and land value by 13 percent. Homeowners in the Pacific Northwest are willing to pay much larger sums, over $94,000, to live on EWM-free lakes corresponding in a 19 percent decrease in property values (Olden and Tamayo 2014). A model produced by Zhang and Boyle (2010) suggests that property values decrease exponentially as EWM coverage increases in a lake. If EWM increases in areal coverage, for example, from approximately 50±10 percent to 70±10 percent, there is a 6.4 percent decrease in property value. The reduction in property values may also directly result in reductions in property tax, thus providing less revenue for local governments.

Foregoing any management of EWM in Gilmore Lake is not a recommended action, nor does the general lake constituency support "no management". The biggest issue with "no management" is the continued, and likely more rapid spread of EWM in Gilmore Lake. What had been just a few areas with micro/small to moderates beds or areas of EWM through at least 2021 have now become individual plants and small beds spread throughout the lake and one exceedingly large area in the North Basin acting as a major source of fragments to continue making the problem worse.

HAND-PULLING/MANUAL REMOVAL

Manual or physical removal of aquatic plants by means of a hand-held rake or cutting implement; or by pulling the plants from the lake bottom by hand is allowed by the WDNR without a permit per NR 109.06. As a rule though, these activities can only occur in a zone that is no more than 30-ft wide and adjacent to a pier or lake use area (Figure 44). There is no limit as to how far out into the lake the 30-ft zone can extend, however clearing large swaths of aquatic plants not only disrupts lake habits, it also creates open areas for non-native species to establish.

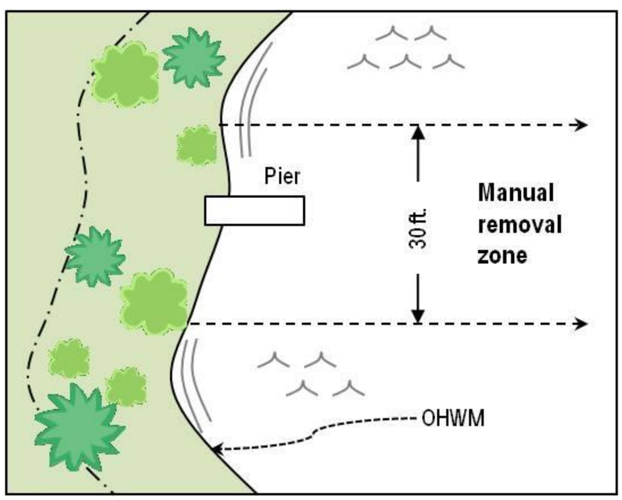

Figure 44: Aquatic vegetation manual removal zone

Physical removal of aquatic plants does require a permit if the removal area is in a "sensitive" or critical habitat area previously designated by the WDNR. Manual or physical removal can be effective at controlling individual plants or small areas of plant growth. It limits disturbance to the lake bottom, is inexpensive, and can be practiced by many lake residents. In shallow, hard bottom areas of a lake, or where impacts to fish spawning habitat need to be minimized, this is the best form of control. If water clarity in a body of water is such that aquatic plants can be seen in deeper water, pulling AIS while snorkeling or scuba diving is also allowable without a permit according to the conditions in NR 106.06(2) and can be effective at slowing the spread of a new AIS infestation within a lake when done properly.

Although up to 30 feet of aquatic vegetation can be removed, removal should only be done to the extent necessary. Clearing large swaths of aquatic plants not only disrupts lake habits, it also creates open areas for non-native species to establish (Figure 45).

Many of the areas with EWM found in Gilmore Lake can be managed by hand-pulling/manual removal, particularly in the spring when plants are small and can be removed root and all. The effectiveness of this management action is dependent on having enough volunteer support to implement it and how much EWM there is to remove.

Figure 45: "Cleared" shoreline and EWM on a local lake

DIVER ASSISTED SUCTION HARVESTING

Diver assisted suction harvesting or DASH, as it is often called, is a recent aquatic plant removal technique. DASH involves scuba divers who swim along the bottom of the lake with a hydraulic suction tube and when a target plant is found, it is dislodged by the diver and fed into the suction tube. Hydraulic suction brings the removed plant to the surface of the lake and deposits into a bag or bin on the boat (Figures 46 and 47). It is called "harvesting" rather than "dredging" because, although a specialized small-scale dredge is used, bottom sediment is not removed from the system. DASH increases the ability of a diver to remove the offending vegetation from a larger area, faster, but also requires a Mechanical Harvesting permit from the WDNR. The cost to implement DASH is also more expensive than employing a diver alone. A DASH boat consists of a pontoon boat equipped with the necessary water pump, catch basin, suction hose, and other apparatus (Figure 47).

Figure 46: DASH boat and underwater operation (ILM Environments)
https://www.youtube.com/watch?v=YQmLMKzc1UM

Figure 47: DASH – Feeding EWM into the underwater Suction Hose (Marinette Co.); and a sample DASH Pontoon Boat (Beaver Dam Lake Management District)

DASH may work well in areas of Gilmore Lake where small, dense beds of EWM have been identified. It is less effective when used to remove individual and small clumps of plants spread out over a large area due to the time it takes to travel to all these sites. In the case of these individual and small clumps, using a diver (with or without scuba gear) to swim down to the bottom and pull the plants would likely be more effective and less expensive. DASH is also not likely to be efficient or effective on the large, dense bed in the North Basin of Gilmore Lake, unless it is only used to try and keep the EWM from spreading beyond a designated boundary. It might also be used to help open and maintain navigation lanes to developed properties in the North Basin. Using DASH, with the goal of removing all of the EWM in the North Basin, is likely not possible, there is simply too much EWM, the bottom is to easily stirred up reducing visibility, and disturbance of the muck bottom will likely encourage greater growth of EWM, even after DASH removal.

Access to DASH services is also limited, with only one private company offering services in all northern WI. Contracted DASH services usually run in the $2,000.00 to $3,000.00 per day range with no guarantees on how much EWM can be removed in a day. The estimated costs to build a custom DASH boat range from $15,000.00 to $20,000.00.

MECHANICAL REMOVAL

Mechanical management involves the use of devices not solely powered by human means to aid removal. This includes gas and electric motors, ATV's, boats, tractors, etc. Using these instruments to pull, cut, grind, or rotovate aquatic plants is illegal in Wisconsin without a permit. DASH is also considered mechanical removal. To implement mechanical removal of aquatic plants a Mechanical/Manual Aquatic Plant Control Application is required annually. The application is reviewed by the WDNR, and other entities and a permit awarded if required criteria are met.

SMALL-SCALE, MECHANIZED AQUATIC PLANT MANAGEMENT[4]

Using repeated mechanical disturbance devices such as bottom rollers, automated rakes or sweepers, and Aqua-Thrusters can be effective at control in small areas, although in Wisconsin, they generally require a "permit".

Weed rollers are typically slow-moving pivot beams attached to a pier or wharf that slowly roll along a lake bottom, agitating lakebed material to prevent aquatic plant growth. Because these are submerged structures, they can potentially cause navigation concerns and can limit habitat availability for fish and aquatic life. For these reasons, rollers are not typically permissible in Wisconsin's waters. A miscellaneous structure individual permit is required if a riparian owner wishes to pursue a roller.

A weed rake is a device that attaches to an existing structure such as a pier or piling, designed to mechanically remove aquatic plants by the movement of rake tines attached to a floating boom without grubbing, lifting or rolling of the bottom sediments. A weed rake general permit is available for qualifying weed rake projects. Projects that cannot meet the eligibility requirements of the general permit must apply for a miscellaneous structure individual permit.

Jetting is a process of forcefully shooting water toward the lakebed to dislodge sediment and/or plants. Aqua-Thrusters are a common site on many Wisconsin lakes and are an example of "jetting". The dislodged sediment typically moves from one area of a lake to another and can cause several environmental concerns including declining water clarity, nutrient release, destruction of fish and wildlife habitat, and increased sedimentation of neighboring properties or channels. Due to these potentially severe side effects, the jetting of sediment is classified as dredging and requires a DNR dredging permit.

LARGE-SCALE MECHANICAL HARVESTING

Large-scale mechanical harvesting is more traditionally used for control of curly-leaf pondweed, but can be an effective way to reduce EWM biomass in a water body, particularly if other management alternatives are either not available or not permitted by the WDNR. It is typically used to open channels through existing beds of EWM to improve access for both human related activities like boating, and natural activities like fish distribution and mobility on lakes in maintenance mode where EWM is well-established and restoration efforts have been discontinued.

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water (Figure 48). The size and harvesting capabilities of these machines vary greatly. As they move, harvesters cut a swath of aquatic plants that is between 4 and 20 feet wide and can be up to 10 feet deep. The on-board storage capacity of a harvester ranges from 100 to 1,000 cubic feet (by volume) or 1 to 8 tons (by weight). Most harvesters can cut between 2 and 8 acres of aquatic vegetation per day, and the average lifetime of a mechanical harvester is 10 years.

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[4] For more information about mechanized aquatic plant management and required permits go to: https://dnr.wisconsin.gov/topic/Waterways/construction/mechanizedAPM.html

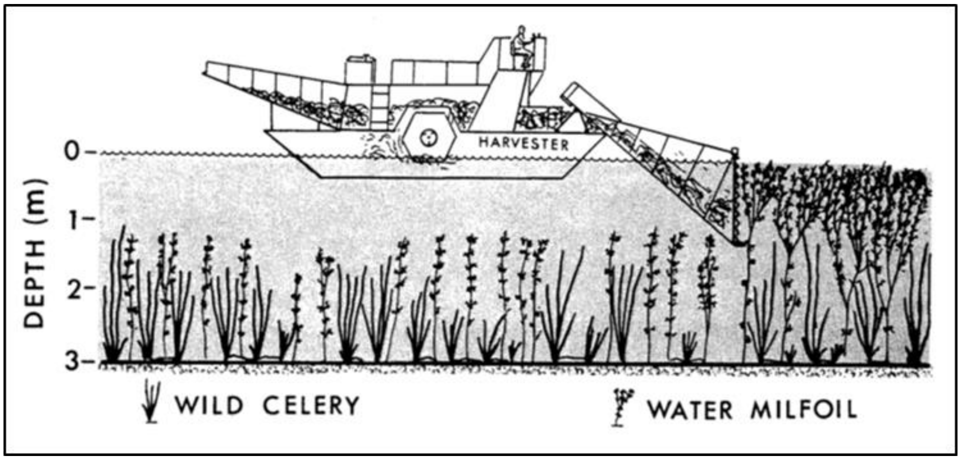

Figure 48: How a mechanical harvester works (Engle, 1987)

Harvesters can remove thousands of pounds of vegetation in a relatively short period. They are not, however, species specific. Everything in the path of the harvester will be removed, including the target species, other plants, macro-invertebrates, semi-aquatic vertebrates, forage fishes, young-of-the-year fishes, and even adult game fish found in the littoral zone (Booms, 1999). Plants are cut at a designated depth, but the root of the plants is often not disturbed. Cut plants will usually grow back after time, and re-cutting several times a season is often required to provide adequate annual control (Madsen J. , 2000).

Harvesting activities in shallow water can re-suspend bottom sediments into the water column releasing nutrients and other accumulated compounds (Madsen J. , 2000). Even the best aquatic plant harvesters leave some cutting debris in the water to wash up on the shoreline or create loose mats of floating vegetation on the surface of the lake. This "missed" cut vegetation can potentially spread offending vegetation as it floats around the lake and establishes in new sites. Floating mats of "missed" cut vegetation can pile up on shorelines creating another level of nuisance that property owners may have to deal with.

Aquatic plant harvesting removes large amounts of plant biomass from a water body. This large-scale removal can help reduce organic material build up in the bottom of the lake over time and even help to improve water clarity and reduce phosphorus loading.

The results of mechanical harvesting - open water and accessible boat lanes - are immediate and can be enjoyed without the restrictions on lake use which follow some herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the build-up of organic material that normally occurs because of the decaying of this plant matter is reduced. Additionally, repeated harvesting may result in thinner, more scattered growth.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures don't make their way back into the lake or to other lakes. The number of available disposal sites and their distance from the targeted harvesting areas will determine the efficiency of the operation, in terms of time and cost.

Timing is also important. The ideal time to harvest, to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments or other plant parts with them and facilitate the spread of aquatic invasive species from one body of water to another.

Large-scale mechanical harvesting is commonly used for control of CLP, and in the absence of other management alternatives or conditions that prevent the use of other management alternatives, can also be an effective way to reduce EWM biomass in a water body.

Harvesting Totals and Estimated Costs (Owning versus Contracting Services)

The costs per acre to harvests varies with the number of acres harvested, accessibility of disposal sites to the harvested areas, density, and species of the harvested plants, and whether a private contractor or public entity does the work. Costs as low as $250 per acre have been reported. Private contractors generally charge $500 to $800 per acre or $2000 to $3000 per day. The purchase price of new harvesters ranges from $75,000 to $300,000. There are several harvester manufacturers in the United States (including at least two in Wisconsin) and some lake groups may choose to operate and purchase their own machinery rather than contracting for these services.

In the last several years, more companies have started offering contracted mechanical harvesting, DASH, and physical removal services. Several companies are in the northern half of Wisconsin including TSB Lakefront Restoration and Diving (New Auburn, WI) and Aquatic Plant Management (Minocqua, WI). Several other companies exist in southeastern WI, the Twin Cities area, and even in northern Illinois. Most of the services they offer run about $2,500-$3,500.00 per day.

There are benefits and drawbacks for both contracted harvesting and purchasing a harvester outright. With contracted harvesting, the cost per acre can vary depending on vegetation density, distance between the area being harvesting and the off-loading site, and the distance to the designated disposal site. Another issue is timing. When contracted harvesting takes place, is likely going to be dependent on the availability of the contractor, not necessarily on when the best time to complete harvesting is. There are many benefits to contracted harvesting, the biggest one being the reduced costs associated with contracting. There is no large outlay of funds for purchasing a harvester, no maintenance and storage costs, no insurance costs, and there are reduced costs or no costs if, in any given year, there is less, or no harvesting completed.

Purchasing is the more expensive option due to not only the initial cost of purchase, but also insurance, storage, maintenance, and an operator's salary (unless volunteer operated). However, there are many benefits to purchasing. Purchasing a harvester eliminates the potential for new AIS to be introduced to the lake from the harvester, the cost per acre tends to go down the longer a harvester is operational, and these costs will not increase dramatically if the amount of vegetation being harvested increases. This also allows harvesting to be done during the best times as well as providing a way to maintain navigation channels throughout the summer. The biggest drawbacks to purchasing a harvester are the increased up-front cost and the annual costs associated with maintaining the harvester. Even during years with less harvesting, the maintenance, storage, and other miscellaneous costs will remain around the same as those costs would be during years that require large amounts of harvesting.

SMALL-SCALE CUTTING WITH REMOVAL

There are a wide range of small-scale mechanical harvesting techniques, most of which involve the use of boat mounted rakes, scythes, and electric cutters. As with all mechanical harvesting, removing the cut plants is required. Commercial rakes and cutters range in prices from $200 for rakes to around $3000 for electric cutters with a wide range of sizes and capacities. Using a weed rake or cutter that is run by human power is allowed without a permit, but the use of any device that includes a motor, gas or electric, would require a permit. Dragging a bed spring or bar behind a boat, tractor, or any other motorized vehicle to remove vegetation is also illegal without a permit. Although not truly considered mechanical management, incidental plant disruption by normal boat traffic is a legal method of management. Active use of an area is often one of the best ways for riparian owners to gain navigation relief near their docks. Most aquatic plants won't grow well in an area actively used for boating and swimming. It should be noted that purposefully navigating a boat to clear large areas is not only potentially illegal it can also re-suspend sediments, encourage AIS growth, and cause ecological disruptions.

A more recent option for small-scale mechanical harvesting of aquatic plants is using a "mini" harvester that is remote-controlled. Weeders Digest currently offers two versions of a remote controlled mini mechanical harvester, the WaterBug and the WaterGator (Figure 49).

The WaterBug is 5.4' wide by 11' 9" long but weighs only 370 lbs. and boasts a storage bunk capacity of 600 lbs. This makes it easy for one person to use as it fits on a compact trailer that can be pulled behind a 4-wheeler or garden tractor. It floats in as little as 4" of water and can cut and skim 34" wide, is adjustable to 15-16" water depth by remote control (can be set manually to a depth of 24") and features long-lasting batteries that can operate 5 hours on a single charge.

The WaterGator features the same technology as the WaterBug including a harvesting camera that shows the operator what the WaterGator sees on the remote viewing screen. The WaterGator cuts, skims, and collects aquatic vegetation. It is easy for any user to operate, and it is extremely versatile, with a cutting range reaching 3-1/2 feet deep, and a generous cutting and skimming width of 42 inches. It has a storage bunk capacity of 1,200 lbs. double that of the WaterBug. The WaterGator is battery powered and provides the operator with 8-plus hours of run time on a single charge. The WaterGator is designed for larger ponds, lake shores, channels, and other medium size bodies of water.

The cost of a WaterBug is estimated at around $17,000.00. The cost of a WaterGator is about double that at $35,000.00.

Physical removal using snorkelers, scuba divers, and/or DASH, and the use of aquatic herbicides, specifically ProcellaCOR will be the main management actions implemented in Gilmore Lake over the next five years. However, mechanical harvesting, either large-scale or small-scale, should not be ruled out, particularly in the North Basin, where the presence of wild rice could prevent the use of aquatic herbicides for several years. Generally, mechanical harvesting is not recommended for removal of EWM as the very process of harvesting creates untold numbers of fragments that can spread throughout the lake. However, if herbicide use is not permitted at all, and EWM in the North Basin spreads beyond the capacity of DASH to keep access open, harvesting will be considered.

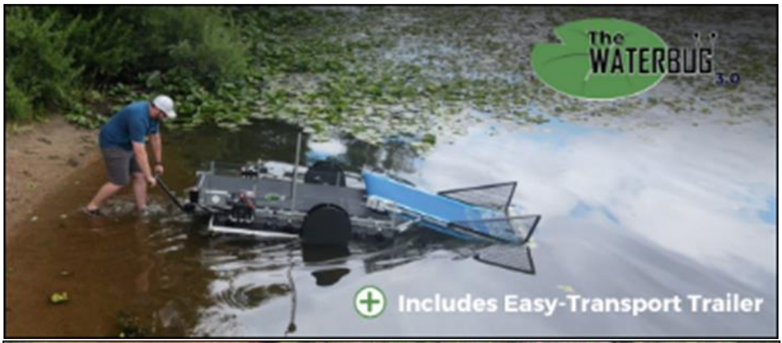

Figure 49: Waterbug and Watergator remote controlled mini aquatic plant harvesters (https://lakeweedharvester.com/waterbug/)

BOTTOM BARRIERS AND SHADING, DREDGING, AND DRAWDOWN

Physical barriers, fabric or other, placed on the bottom of the lake to reduce EWM growth would eliminate all plants, inhibit fish spawning, affect benthic invertebrates, and could cause anaerobic conditions which may release excess nutrients from the sediment. Gas build-up beneath these barriers can cause them to dislodge from the bottom and sediment can build up on them allowing EWM to re-establish. Bottom barriers are typically used for very small areas and provide only limited relief. Currently the WDNR does not permit this type of control. Creating conditions in a lake that may serve to shade out EWM growth has also been tried with mixed success. The general intention is to reduce light penetration in the water which in turn limits the depth at which plants can grow. Typically, dyes have been added to a small water body to darken the water.

Bottom barriers and attempts to further reduce light penetration in Gilmore Lake are not recommended.

Dredging is the removal of bottom sediment from a lake. Its success is based on altering the target plant's environment. It is not usually performed solely for aquatic plant management but rather to restore lakes that have been filled in with sediment, have excess nutrients, inadequate pelagic and hypolimnetic zones, need deepening, or require removal of toxic substances (Peterson, 1982). In shallow lakes with excess plant growth, dredging can make areas of the lake too deep for plant growth. It can also remove significant plant root structures, seeds/turions, rhizomes, tubers, etc. Dredging is very expensive, requires disposal of sediments, and has major environmental impacts. It is not a selective procedure so it can't be used to target any one species with great success except under extenuating circumstances. Dredging at any level must be permitted by the WDNR if it is done through mechanical means.

Dredging is not a recommended management action for Gilmore Lake.

Drawdown, like dredging, alters the plant environment by removing all water in a water body to a certain depth, exposing bottom sediments to seasonal changes including temperature and precipitation. A winter drawdown is a low cost and effective management tool for the long-term control of certain susceptible species of nuisance aquatic plants. Winter drawdown has been shown to be an effective control measure for EWM, but typically only provides 2-3 years of relief before EWM levels return to pre-drawdown levels. A winter drawdown controls susceptible aquatic plants by dewatering a portion of the lake bottom over the winter, and subsequently exposing vascular plants to the combined effect of freezing and desiccation (drying). The effectiveness of drawdown to control plants hinges on the combined effect of the freezing and drying. If freezing and dry conditions are not sustained for 4-6 weeks, the effectiveness of the drawdown may be diminished.

It is not possible to draw down Gilmore Lake as there is no way to manipulate the water level at the existing outlet.

BIOLOGICAL CONTROL

Biological control involves using one plant, animal, or pathogen to control a target species in the same environment. The goal of biological control is to weaken, reduce the spread, or eliminate the unwanted population so that native or more desirable populations can make a comeback. Care must be taken however, to ensure that the control species does not become as big a problem as the one that is being controlled. A special permit is required in Wisconsin before any biological control measure can be introduced into a new area.

EWM WEEVILS

While many biological controls have been studied, only one has proven to be effective at controlling EWM under the right circumstances. Euhrychiopsis lecontei is an aquatic weevil native to Wisconsin that feeds on aquatic milfoils (Figure 50). Their host plant is typically northern watermilfoil; however, they seem to prefer EWM when it is available. Milfoil weevils are typically present in low numbers wherever northern or Eurasian watermilfoil is found. They often produce several generations each year and over winter in undisturbed shorelines around the lake. All aspects of the weevil's life cycle can affect the plant. Adults feed on the plant and lay their eggs. The eggs hatch and the larva feed on the plant. As the larva mature, they eventually burrow into the stem of the plant. When they emerge as adults later, the hole left in the stem reduces buoyancy often causing the stem to collapse. The resulting interruption in the flow of carbohydrates to the root crowns reduces the plant's ability to store carbohydrates for over wintering reducing the health and vigor (Newman, Holmberg, Biesboer, & Penner, 1996).

Figure 50: EWM weevil

The weevil is not a silver bullet. They do not work in all situations. The extent to which weevils exist naturally in a lake, adequate shore land over wintering habitat, the population of bluegills and sunfish in a system, and water quality characteristics are all factors that have been shown to affect the success rate of the weevil. Monitoring to see if the weevil is already present in Gilmore Lake is an educational activity that would provide interesting, if not altogether useful, information. Artificially rearing and releasing weevils in the lake to augment and existing population or introduce a new one is not recommended in this management plan, particularly since the process necessary to do so has changed significantly in the last few years. There is no longer a company that "raises" weevils for EWM control.

Weevils can still be raised by volunteers in cooperation with an overseeing entity but requires that all EWM used in the rearing process be secured from the host lake, and only weevils reared on host lake EWM can be released into the host lake.

GALERUCELLA BEETLES

Two species of Galerucella beetles are currently approved for the control of purple loosestrife in Wisconsin (Figure 51). The entire lifecycle of Galerucella beetles is dependent on purple loosestrife. In the spring, adults emerge from the leaf litter below old loosestrife plants. The adults then begin to feed on the plant for several days until they begin to reproduce. Females lay their eggs on loosestrife leaves and stems. When the larvae emerge from these eggs they begin feeding on the leaves and developing shoots. When water levels are high these larvae will burrow into the loosestrife stems to pupate into adult beetles. These new adults emerge and begin feeding on the loosestrife again (Sebolt, 1998). Galerucella beetles do not forage on any plants other than purple loosestrife. Because of this the populations, once established, are self-regulating. When the purple loosestrife population drops off, the beetle population also declines. When the loosestrife returns, the beetle numbers will usually increase.

Figure 51: Galerucella beetle

These beetles will not eradicate purple loosestrife entirely. This is true of almost all forms of biological control. Galerucella beetles will help regulate loosestrife which will allow native plants to also become re-established. Raising Galerucella beetles does not require a lot of skill or material. Materials consist of 3–5-gallon pails, kids wading pool, fine mesh nets, and a net supporting structure. The cooperator must also have access to purple loosestrife plants and a source of "starter beetles". Because rearing these beetles requires the cultivation of a restricted species, a permit is necessary. Purple loosestrife rootstock and starter beetles can be obtained from the WDNR, private vendors, or many of the public wetlands around Wisconsin.

Washburn County is active in rearing and releasing beetles for control of purple loosestrife and if there were interested volunteers on Gilmore Lake they could partner with the County.

NATIVE PLANT RESTORATION

A healthy population of native plants might slow invasion or reinvasion of non-native aquatic plants. It should be the goal of every management plan to protect existing native plants and restore native plants after the invasive species has been controlled. In many cases, a propagule bank probably exists that will help restore native plant communities after the invasive species is controlled (Getsinger et al (1997).

OTHER BIOLOGICAL CONTROLS

There are other forms of biological control being used or researched. It was thought at one time that the introduction of plant eating carp could be successful. It has since been shown that these carp have a preference list for certain aquatic plants. EWM is very low on this preference list (Pine & Anderson, 1991). Use of "grass carp" as they are referred to in Wisconsin is illegal as there are many other environmental concerns including what happens once the target species is destroyed, removal of the carp from the system, impacts to other fish and aquatic plants, and preventing escapees into other lakes and rivers. Several pathogens or fungi are currently being researched that when introduced by themselves or in combination with herbicide application can effectively control EWM and lower the concentration of chemical used or the time of exposure necessary to kill the plant (Sorsa, Nordheim, & Andrews, 1988).

None of these have currently been approved for use in Wisconsin and are not recommended for use in Gilmore Lake.

CHEMICAL CONTROL

Aquatic herbicides are granular or liquid chemicals specifically formulated for use in water to kill plants or retard plant growth. Herbicides approved for aquatic use by the U.S. Environmental Protection Agency (EPA) are considered compatible with the aquatic environment when used according to label directions.

The WDNR evaluates the benefits of using a particular chemical at a specific site vs. the risk to non-target organisms, including threatened or endangered species, and may stop or limit treatments to protect them. The Department frequently places conditions on a permit to require that a minimal amount of herbicide is needed and to reduce potential non-target effects, in accordance with best management practices for the species being controlled. For example, certain herbicide treatments are required by permit conditions to be in spring because they are more effective, require less herbicide and reduce harm to native plant species. Spring treatments also mean that, in most cases, the herbicide will be degraded and gone by the time peak recreation on the water starts.

The advantages of using chemical herbicides for control of aquatic plant growth are the speed, ease and convenience of application, relatively low cost, and the ability to control plant types somewhat selectively with certain herbicides. Disadvantages of using chemical herbicides include possible toxicity to aquatic animals or humans, oxygen depletion after plants die and decompose which can cause fishkills, a risk of increased algal blooms as nutrients are released into the water by the decaying plants, adverse effects on desirable aquatic plants, loss of fish habitat and food sources, water use restrictions, and a need to repeat treatments due to existing seed/turion banks and plant fragments. Chemical herbicide use can also create conditions favorable for non-native AIS to outcompete native plants (for example, areas of stressed native plants or devoid of plants).

EFFICACY OF AQUATIC HERBICIDES

The efficacy of aquatic herbicides is dependent on both application concentration and exposure time, and these factors are influenced by two separate but interconnected processes - dissipation and degradation. Dissipation is the physical movement of the active herbicide within the water column both vertically and horizontally. Dissipation rates are affected by wind, water flow, treatment area relative to untreated area, and water depths. Degradation is the physical breakdown of the herbicide into inert components. Depending on the herbicide utilized, degradation occurs over time either through microbial or photolytic (chemical reactions caused by sunlight exposure) processes.

SMALL-SCALE HERBICIDE APPLICATION

Small-scale herbicide application involves treating areas less than 10 acres in size. Small-scale chemical applications are usually completed in the early season (April through May). Concern on the part of the WDNR regarding the use of small-scale herbicide applications to control CLP or EWM has been expressed for several years. As an example, during the most recent Aquatic Plant Management Industry Meeting held January 31, 2023, concerns were expressed specifically to the use of Aquathol K (liquid endothall) and Aquathol Super K (granular endothall) to control CLP. The concerns were that when CLP distribution is sporadic throughout a lake and treatment areas are small, that the efficacy of Aquathol K and Aquathol Super K may be compromised due to rapid dilution.

Similar views have been expressed about the use of 2,4D or triclopyr-based aquatic herbicides for control of EWM. Small-scale applications tend to dissipate rapidly minimizing effective results. Granular herbicides do not provide any greater contact time than liquid herbicides. Large-scale herbicide applications with an expected long target species contact time should require a lower application rate. Like endothall and CLP, areas to be treated with 2,4D or triclopyr projects should be at least 5 acres in size. Smaller treatment areas are likely to be less effective, and possibly denied by the WDNR when considering chemical permit applications and/or requests for grant funding. For both endothall and 2,4D-based aquatic herbicides, the desired target species contact time is between 18 and 36 hours. Dissipation and dilution in small treatment areas makes this level of contact difficult to achieve.

ProcellaCOR, used more and more for the control of EWM, requires a much lower target species/herbicide contact time – down to only 2-4 hours. The effective bed size for the use of ProcellaCOR has not been defined by the WDNR.

Installation of a Limno-Barrier Application

Small-scale herbicide applications can be made more effective by installing a limno-barrier or curtain around a treatment area to help hold the applied herbicide in place, longer. By doing so, the herbicide/target species contact time is increased. The curtain is generally a continuous sheet of plastic that extends from the surface to the bottom of the lake (Figure 52). The surface edge of the curtain is generally supported by floatation devices. The bottom of the curtain is held in place by some form of weighting. The curtain or barrier, sometimes thousands of feet of it, is installed around the proposed treatment area with the purpose of holding the herbicide in place longer by preventing dilution and drifting away from the treated area (Figure 53).

Figure 52: Limno-curtain material on a roll before installation (photo from Marinette Co. LWCD)

Figure 53: Limno-curtain installed on Thunder Lake (photo from Marinette Co. LWCD)

In the Thunder Lake, Marinette County limno-curtain trial completed in 2020, a curtain was installed around two small areas (0.9 and 2.9 acres) of dense growth EWM prior to chemical treatment. Liquid 2,4-D was applied at 4.0ppm inside the barrier. The barriers stayed in place until 48 hours after treatment. Herbicide concentration testing was completed within the treated areas to determine how long the herbicide stayed in place and at what concentration. Figure 54 reflects what happened to the herbicide that was applied. Herbicide concentrations stayed relatively high for a longer period of time (48hrs). Once the curtain was removed, the herbicide dissipated rapidly.

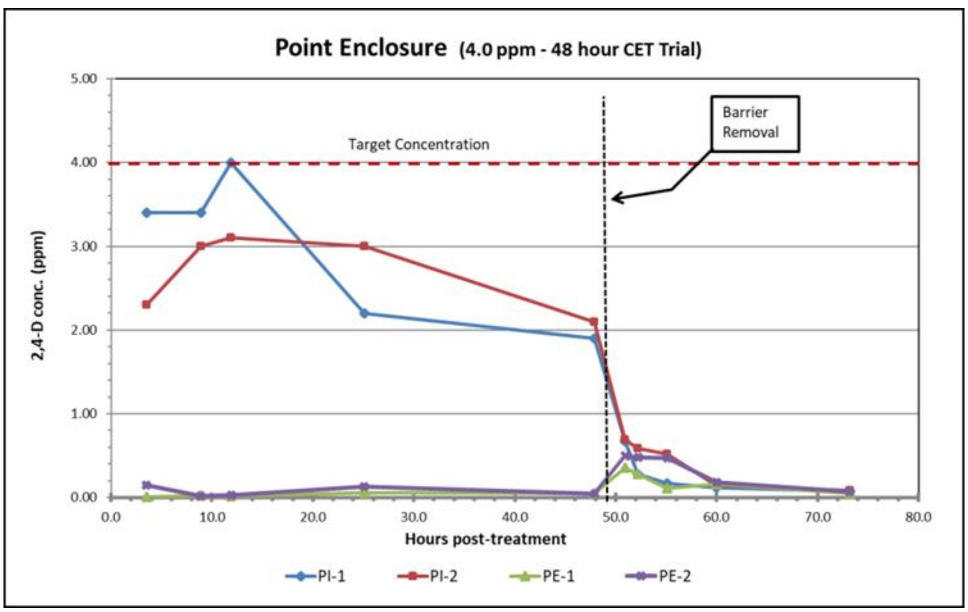

Figure 54: Herbicide concentration results from 2020 Thunder Lake limno-curtain trial (Marinette Co LWCD)

LARGE-SCALE HERBICIDE APPLICATION

Large-scale herbicide application involves treating areas more than 10 acres in size. Like small-scale applications, this is usually completed in the early season (April through May) for control of non-native invasive species like CLP or EWM while minimizing impacts on native species. It is generally accepted that with large-scale applications the likelihood of the herbicide staying in contact with the target plant for a longer time is greater. If the volume of water treated is more than 10% of the volume of the lake, or the treatment area is ≥160 acres, or 50% of the lake's littoral zone, effects can be expected at a whole-lake scale. Large-scale herbicide application can be extended in some lakes to include whole bay or even whole lake treatments. The size of the treatment area, the more contained the treatment area, and the depth of the water in the treatment area, are factors that impact how whole bay or whole lake treatments are implemented.

COMMON AQUATIC HERBICIDES

ProcellaCOR® (PCOR) is a relatively new systemic, selective herbicide that can be used to target EWM with limited impact to most native species. It is also very fast acting, making it an effective control measure on smaller beds that may be too large for DASH, especially ones in high boat traffic areas and/or deeper water. In addition, applications rates are measured in ounces, not gallons as is common with almost all other liquid herbicides. And while it is more expensive to use than 2,4-D equivalents, it has been shown to provide two or more years of control without re-application.

Sonar®, whose active ingredient is fluridone, is a broad-spectrum herbicide that interferes with the necessary processes in a plant that create the chlorophyll needed to turn sunlight into plant food through a process called photosynthesis. Sonar is generally applied during a whole-lake application and is expected to be in the lake at very low concentrations for weeks or months once applied.

2,4-D and triclopyr are active ingredients in several selective herbicides including 2,4-D Amine 4®, Navigate®, DMA 4®, Renovate®, and Renovate Max G®. These herbicides stimulate plant cell growth causing them to rupture, but primarily in narrow-leaf plants like milfoil. These herbicides are considered selective as they have little to no effect on monocots in treated areas. ProcellaCOR, fluridone, 2,4-D, and triclopyr are all considered systemic. When applied to the treatment area, plants in the treatment area draw the herbicide in through the leaves, stems, and roots killing all the plant, not just the part that comes in contact with the herbicide.

Aquathol® whose active ingredient is endothall and Reward® whose active ingredient is diquat are considered broad spectrum contact herbicides. They destroy the outer cell membrane of the material they come in contact with and therefore kill a plant very quickly. Neither of these is considered selective and has the potential to kill all the plant material that they come in contact with regardless of the species. As such, great care should be taken when using these products. Certain plant species like CLP begin growing very early in the spring, even under the ice, and are often the only growing plant present at that time. This is a good time to use a contact herbicide like Aquathol, as few other plants would be impacted. Using these products later in the season, will kill all vegetation in contact with the herbicide and can provide substantial nuisance relief from a variety of aquatic plants. Endothall based herbicides are the most used herbicides for CLP control, but diquat can be used under the appropriate circumstances.

It is possible to apply more than one herbicide at a time when trying to establish control of unwanted aquatic vegetation. An example would be controlling EWM and CLP at the same time with an early season application and controlling aquatic plants and algae at the same time during a mid-season nuisance relief application. Applying systemic and contact herbicides together has a synergistic effect leading to increased selectivity and control. Single applications of the two could result in reduced environmental loading of herbicides and monetary savings via a reduction in the overall amount of herbicide used and of the manpower and number of application periods required to complete the treatment.

Incidental Impacts of Aquatic Herbicides on Wild Rice

Of great concern to Wisconsin's Tribal Resources and the WDNR is the potential impact of aquatic herbicides on wild rice. The following is a summary of studies compiled by the WDNR that identify possible negative effects.

Nelson et al. (2003) examined the effects of diquat, endothall, fluridone, and 2,4D on the growth and survival of seedling, young, and mature northern wild rice. The degree of herbicide damage varied with growth stage. Younger stages of wild rice were more sensitive than later growth stage plants. Mature wild rice plants were not impacted by any of the products or rates tested. Wild rice was most sensitive to 2,4D, with rates as low as 1.0 parts per million (ppm) significantly inhibiting tiller, seed head, and biomass production. Biomass of wild rice was also reduced following exposure to endothall, diquat, and fluridone, however seed head and tiller production was not impacted. Results of this study suggest that wild rice is most resistant to herbicides applied to the water column when plants are mature or in the late flowering stages.

Madsen et al. (2008) investigated the sensitivity of seedling, young, and mature northern wild rice to liquid triclopyr. Concentrations were 0, 0.75, 1.5, and 2.5 ppm and plants were exposed to the herbicide for 72 hours. Rice exposed to the highest concentration (2.5 ppm) exhibited reduced biomass and height regardless of growth stage. Declines in biomass, height, seed head density, and tiller formulation were not observed at lower concentrations (0.75 ppm), though seedlings appeared more sensitive to this exposure rate.

Miller (1994) studied the impacts of Fluridone and 2,4D on the floating leaf growth stage of southern wild rice. Fluridone applied to water at higher rates (i.e., ≥ 8 ppb) caused significant decreases in biomass, while lower rates (i.e., 2 and 4 ppb) did not impact biomass. 2,4D applied at rates as low as 0.4 ppm significantly reduced biomass weight by 24%, while higher rates (i.e., 0.8, 1.6, & 3.2 ppm) results in even greater biomass losses (67, 88, & 94%, respectively).

Clay and Oelke (1990) evaluated applications of 2,4D amine salt for weed control in commercial rice populations. 2,4D rates as low as 1.1 kg/ha applied at the two-aerial-leaf growth stage severely injured wild rice plants, and higher rates significantly reduced grain yield.

Oelke and McClellan (1991) similarly observed that 2,4D rates ≥ 0.84 kg/ha applied to wild rice in the mid- to late-tillering growth stage significantly injured plants and reduced grain yields.

To date there have been no published studies on the impact of ProcellaCOR on wild rice.

Pre and Post Treatment Aquatic Plant Surveying

When introducing new chemical treatments to lakes where the treatment size is greater than ten acres or greater than 10% of the lake littoral area and more than 150-ft from shore, the WDNR may require pre and post chemical application aquatic plant surveying. Results from pre and post treatment surveying are used to improve consistency in analysis and reporting, and in making the next season's management recommendations.

The number of pre and post treatment sampling points required is based on the size of the treatment area. Ten to twenty acres generally requires at least 100 sample points. Thirty to forty acres requires at least 120 to 160 sampling points. Areas larger than 40 acres may require as many as 200 to 400 sampling points. Regardless of the number of points, each designated point is sampled by rake recording depth, substrate type, and the identity and density of each plant pulled out, native or invasive.

In the year prior to an actual treatment, the area to be treated must have a mid-season/summer/warm water point intercept survey completed that identifies the target plant and other plant species that are present. A pre-treatment aquatic plant survey is done in the year the herbicide is to be applied, prior to application to confirm the presence and level of growth of the target species. A post-treatment survey is done in the same year as the chemical treatment was completed or in the year after a chemical treatment was completed, sometimes both. A post-treatment survey should be scheduled when native plants are well established, generally mid-July through mid-August. For the post-treatment survey, the same points sampled in the pre-treatment survey will again be sampled. For whole-lake scale treatments, a full lake-wide PI survey should be conducted.

Continued implementation of pre- and post-chemical treatment aquatic plant surveying is an important tool in determining the impacts of management actions on both the target and non-target species. Results from pre and post treatment surveying are used to improve consistency in analysis and reporting, and in making the next season's management recommendations.

Chemical Concentration Testing

Chemical concentration testing is often done in conjunction with treatment to track the fate of the chemical herbicide used. Concentration testing can help to determine if target concentrations are met, to see if the chemical moved outside its expected zone, and to determine if the chemical breaks down in the system as expected. Monitoring sites are located both within and outside of the treatment area, particularly in areas that may be sensitive to the herbicide used, where chemical drift may have adverse impacts, where movement of water or some other characteristic may impact the effect of the chemical, and where there may be impacts to drinking and irrigation water. Water samples are collected prior to treatment and for a period of hours, days, weeks, or even months following chemical application.

OVERUSE OF AQUATIC HERBICIDES

Concerns exist when herbicide treatments using the same herbicide are done over multiple and subsequent years. Target plant species may build up a tolerance to a given herbicide making it less effective, susceptible plant species may be damaged and/or disappear from the lake (ex. water lilies), concerns over fish and other wildlife might occur, and concern over recreational use in chemically treated water may be voiced. By using several different aquatic herbicides interspersed with physical removal efforts between treatments, many of these concerns are minimized.

PCOR is classified as an auxin herbicide (WSSA Group 4; HRAC Group O), like other systemic herbicides including 2,4D and triclopyr. If herbicides with the same mode of action are used repeatedly in the same body of water, resistant plant biotypes may eventually dominate the weed population and may not be controlled by these products. To delay development of herbicide resistance, the following practices are recommended:

- Alternate use of products containing ProcellaCOR EC with other products with different mechanisms of action.
- ProcellaCOR EC can be tank mixed or used sequentially with other approved products to broaden the spectrum of weed control, provide multiple modes of action and control weeds that ProcellaCOR EC does not control.
- Herbicides should be used based on an IPM program.
- Monitor treated areas and control escaped weeds.

CONCERNS RELATED TO WHOLE-LAKE/LARGE-SCALE CHEMICAL TREATMENTS

In 2020, the WDNR published a paper (Mikulyuk, et al., 2020) comparing the ecological effects of the invasive aquatic plant EWM with the effects of lake-wide herbicide treatments used for EWM control using aquatic plant data collected from 173 lakes in Wisconsin. First, a pre–post analysis of aquatic plant communities found significant declines in native plant species in response to lake-wide herbicide treatment. Second, multi-level modeling using a large data set revealed a negative association between lake-wide herbicide treatments and native aquatic plants, but no significant negative effect of invasive EWM alone. Taken together, their results indicate that lake-wide herbicide treatments aimed at controlling EWM had larger effects on native aquatic plants than did the target of control-EWM.

This study reveals an important management tradeoff and encourages careful consideration of how the real and perceived impacts of invasive species like EWM in a lake and the methods used for their control are balanced.

MANAGEMENT DISCUSSION

Gilmore Lake continues to have a rich and diverse native aquatic plant community - one of the most diverse in northwestern WI according to the Aquatic Plant Biologist who completed all three of the whole-lake, PI surveys. Unfortunately, EWM will continue to pose a threat to that diversity and the resource as a whole moving forward.

Since the discovery of EWM in Gilmore Lake, the GLA has been using a combined approach of physical and diver removal and small and large-scale herbicide treatments using granular and liquid 2,4-D products. In 2021, ProcellaCOR (PCOR) was added to the herbicides used in the lake. This approach had proven successful at keeping the spread of EWM in the main body of the lake in check until the new, larger, and more dense bed was found in the North Basin two years ago. While management actions used to date will likely still be successful in the central and southern basins and in Little Gilmore, they will not work in the North Basin to control the large EWM bed. Small-scale application of herbicide on beds <5.0 acres in size have been determined "less effective" and are already ineligible for grant funding. In the future, it may also be difficult to get a WDNR chemical application permit to complete small-scale chemical treatments with or without grant funding.

The effective bed size for the use of PCOR has not been defined by WDNR. While it has been shown to be effective on small, even micro-sized beds at application rates well within what is allowed by the label, whether a minimum size for treatment with PCOR should be a tenth of an acre, a quarter acre, one acre, three acres, five acres, or some other acreage is still not agreed upon within the aquatic plant management program of Wisconsin. More field work is needed to test out bed size and application rate in different management scenarios.

It is also not clear within the aquatic plant management program, the impact PCOR may or may not have on wild rice. Because these impacts had not been clearly determined, the use of PCOR was prohibited in 2023 in lakes with wild rice including Gilmore Lake. Any amount of wild rice adjacent to a treatment area, downstream of a treatment area, or upstream of a treatment area - was cause for the WDNR to deny a treatment permit. It is not known if this ban on the use of PCOR will be continued in 2024 or subsequent years.

GLA PARTICIPATION IN PROCELLACOR RESEARCH

Given the distribution of EWM in Gilmore Lake and its proximity to wild rice beds at the outlet of the lake and in the Totagatic River downstream of the outlet, the GLA should make every attempt/approach/offer to work with the WDNR, SePRO (the company that makes ProcellaCOR), and Tribal Resources to help research the impact of it on wild rice. In addition, the distribution of EWM throughout the lake, mostly in very small areas (at least for now) also opens the door for research into how effective PCOR can be when used on small or micro applications.

MANAGEMENT OF EWM IN GILMORE LAKE

At the present time, EWM management in Gilmore Lake will use two different management scenarios. Small-scale management actions including physical removal, snorkel/diver removal, DASH, and application of aquatic herbicides will be continued in Little Gilmore, South Basin, and Central Basin where these management alternatives have successfully kept the amount of EWM at very low levels while maintaining native aquatic plant diversity. In the North Basin, where many of the traditional small-scale management alternatives used in the rest of the lake will be less effective, other management actions will be used.

The size and density of the EWM bed in the North Basin makes any application of herbicides a large-scale management action, likely treating five or more acres in a single bed. As such, application of herbicide will also include herbicide concentration testing and pre and post treatment point-intercept aquatic plant survey work. Large-scale management using aquatic herbicides may also include the installation of a limno-curtain either around a designated treatment area or potentially around an area with wild rice. PCOR is likely the best herbicide to use in the North Basin, but liquid 2,4D-based products or diquat-based products may be considered, particularly if PCOR is not an option. DASH may be used to help keep EWM in a designated area, like behind a designated buoy line, or used to open navigation and access lanes to developed properties in the North Basin. Mechanical harvesting may also be considered if herbicides and DASH don't work or are not permitted.

Artificially enhanced biological control (for EWM), habitat manipulation, and zero management are not recommended at this time.

LITTLE GILMORE, SOUTH, AND CENTRAL BASINS

This APMP recommends a scenario-based approach to managing EWM in the main basins of the lake. In a scenario-based approach to EWM management, there is no set minimum or maximum amount of EWM that is "OK" in the lake, or a "trigger" for management. Any amount of EWM at any time can be managed in the lake, albeit using different management alternatives. Determining when to use a particular management alternative or to move to a different alternative is the basis of a scenario-based approach to control EWM. Doing so minimizes negative impacts to native aquatic vegetation caused by the continued spread of EWM or by the management used to control EWM.

In these basins, physical removal efforts will play a larger role in management of EWM. Physical removal refers to hand-pulling by property owners on Gilmore Lake, raking, removal of EWM in deeper water by snorkelers and/or scuba divers, and removal of EWM by DASH. Snorkeling and scuba removal can be completed by GLA volunteers or be completed by outside contractors. DASH removal can be contracted by the GLA, or at some point, they could build their own DASH boat. These management alternatives should be incorporated prior to, at the same time as, and as follow-up to the use aquatic herbicides.

To support a scenario-based approach to EWM management in Gilmore Lake, the following monitoring and control activities are recommended:

1) EWM will be monitored by volunteers throughout the growing season.
2) Fall bed mapping will be completed annually by a Resource Professional or trained Gilmore Lake volunteers.
3) Areas of EWM with sparse, isolated plants will be hand pulled or raked by volunteers in shallow water (≈ 3 feet) around docks and along shorelines.
    a. These services can be completed at any time during the open-water season and do not require a WDNR permit.
4) Snorkel, rake, and/or scuba diver removal of EWM in deeper water will take place in areas with isolated plants, small clumps, or small beds of plants where practical and if resources are available.
    a. Used on areas of EWM <0.01 acre (not definitive, use as a guideline)
    b. Could be done by GLA volunteers or contracted by the lake organization, can be completed at any time during the open water season.
    c. Does not require a WDNR permit.
5) Diver-assisted Suction Harvest or DASH can be used in place of or in combination with snorkel, rake, and/or scuba diver removal of EWM where practical and if resources are available. DASH may allow larger areas of EWM to be managed without the use of herbicides.
    a. Used on areas >0.01 acre (not definitive, use as guideline)
    b. Would be contracted by the GLA, can be completed at any time during the open water season.
    c. Requires a WDNR Mechanical Harvesting permit.
6) Aquatic herbicides can be used in any area if their application can be justified under the following guidelines.
    a. Conditions exist that are likely to make other management alternatives less effective.
        i. Bed size and density of EWM in the area (>0.5 acre, not definitive – use as a guideline)
            1. Up to a 25-ft buffer can be extended around any mapped bed.
            2. Small beds within 100-ft of each other can be combined to make larger beds.
        ii. Location of the area in relation to lake access and usability

        1. Example: limited boat access into Little Gilmore
    iii. Water depth and clarity
    iv. Limited or unavailable access to contracted diver or DASH services
    v. Limited financial resources
    vi. Less than a majority constituent support for a proposed management action.

b. Areas that are <5.00 acres should be treated with ProcellaCOR.
    i. Application rates will be limited to 5pdus/acft or less, unless discussion with the Company dealing ProcellaCOR, the Consultant/lake organization, the WDNR, and the Applicator recommend and agree on higher rates.
    ii. 2,4D or triclopyr-based herbicides can be considered if a limno-curtain is installed around the treatment area.

c. Areas ≥5.0 acres may be treated with ProcellaCOR, 2,4D-based herbicides, or 2,4D/triclopyr blends, or contact herbicides (endothall and diquat) depending on available resources.
    i. Suggested application rates for ProcellaCOR would be 3-5pdus/acft.
    ii. Suggested application rates for 2,4D or triclopyr-based herbicides would be 4ppm/acft depending on size (larger treatment areas could be managed with <4ppm/acft.
    iii. Suggested application rates for contact herbicides – follow label instructions.
    iv. Treatments >5 acres using any aquatic herbicide may have a lakewide impact, so the following monitoring is suggested.
        1. Pre (prior year and/or year of) and post (year of and/or year after) treatment aquatic plant surveys.
        2. Herbicide concentration monitoring.
    v. Treatments >10 acres using any aquatic herbicide may have a lakewide impact, so the following monitoring is required.
        1. Pre (prior year and/or year of) and post (year of and/or year after) treatment aquatic plant surveys.
        2. Herbicide concentration monitoring.

d. The same area will not be chemically treated two years in a row with the same herbicide or any herbicide with the same mode of action – in this case classified as a Group 4 herbicide (ProcellaCOR, 2,4D, and triclopyr).

Installation of a Limno-curtain

The installation of a limno-curtain would likely improve the results of small-scale EWM management (<3 to 5 acres), particularly when using liquid 2,4D products. The curtain should be installed all the way around any treatment area, be constructed in such a way that there are few gaps between multiple sections of curtain (if needed), anchored on the bottom-edge of the curtain, and floats installed on the top-edge of the curtain. If posts are driven into the bottom of the lake in shallow water to support the curtain, gaps between the posts and the curtain should be minimized to the extent possible. An example of material that could be used is shown in Figure 55.

Figure 55: Limno-curtain material

NORTH BASIN

EWM management alternatives are limited in the North Basin. Physical removal can be implemented along the shoreline of the North Basin to help prevent additional spread of EWM. DASH can be used in parts of or all of the North Basin to help keep EWM from taking over more area. At the present time, the application of ProcellaCOR to control EWM is not being permitted. There remain too many questions about the impact of ProcellaCOR on wild rice. Until such a time that research shows minimal or no impacts on wild rice, ProcellaCOR will likely continue not to be permitted. There are concerns related to other herbicides commonly used for early season control of EWM as well. In their study, Nelson et al (2003) referenced multiple studies showing negative impacts to wild rice caused by the application of herbicides to wild rice while it was in its early growth stages (see more detail in the Incidental Impacts of Aquatic Herbicides section). Due to this, applying certain herbicides (2,4D, endothall, diquat, fluridone) to control EWM in the North Basin in the spring or early summer is likely not an acceptable management action. However, there are several approaches to the application of aquatic herbicides to control EWM in the North Basin that could be considered, that may minimize negative impacts on wild rice.

One approach would be to apply an herbicide late in the season, after wild rice maturation and seed development. In the 2003 study referenced in the previous paragraph, Nelson et al looked at the impacts of four herbicides used for EWM control (2,4D, endothall, fluridone, & diquat) and their impact on wild rice. They concluded "Aquatic herbicides do not significantly affect wild rice when applied to water containing mature plants (mid to late flowering); however, plants treated at younger growth stages (seedlings with floating leaves and young plants with aerial leaves and early tillers) are sensitive to herbicide application." They further concluded that "wild rice is most resistant to herbicide injury when submersed applications are made during late stages of plant development." From the study, "Treatment of the water column with fluridone, diquat, endothall, and 2,4-D, at rates sufficient to control milfoil, did not negatively impact the growth and seedhead production of mature wild rice plants."

In another study specifically focused on the use of the herbicide triclopyr, Madsen et al (2008) concluded that "wild rice is tolerant to triclopyr concentrations typically used in Eurasian watermilfoil control." They further concluded that "A triclopyr concentration of 0.75 mg ae L-1 should have a negligible effect on wild rice at all growth stages, based on those evaluated in this study."

In either case, applying herbicides in the fall or considering the use of low dose triclopyr, further protection for wild rice in the immediate area of the North Basin or downstream in the Totogatic River could be afforded by installing a limno-curtain around any area of the North Basin that might be chemically treated or along the edge of a wild rice bed, in a manner that would prevent the herbicide from reaching the wild rice bed.

Application of aquatic herbicides to control EWM in the North Basin would result in longer-term control, reduce fragmentation limiting the spread of EWM in the rest of the lake, and be more cost-efficient. As such, it is still considered a potential management action in this APMP if the appropriate permits can be obtained. The GLA should remain open to involvement in any research level project or study that could help alleviate the concerns related to wild rice and the use of aquatic herbicides.

In the absence of effective methods of physical removal and limits on the use of aquatic herbicides, mechanical harvesting becomes a viable management alternative. There are both benefits and drawbacks to mechanical harvesting. The benefits include immediate removal of a lot of EWM from the lake, no harm caused to wild rice, and when used to remove a large, monotypic bed of EWM like what is in the North Basin, likely little to no harm to non-target species impacts. The drawbacks to using mechanical harvesting include finding contracted services, spread of fragments missed by the harvester, regrowth of cut, but not killed EWM, and cost of contracted or "purchased" mechanical harvesting services and/or equipment.

In all these possible management scenarios, determining a limit for what is "acceptable EWM" in the North Basin is important. The GLA currently installs EWM marker buoys along the perimeter of the bed as it exists right now (Figure 56). Keeping the EWM within the area currently designated by the buoys, or establishing a boundary that creates an even smaller area of acceptable EWM may be an important strategy for management. Where the boundary is established is most likely dependent on the management actions that are implemented in the North Basin.

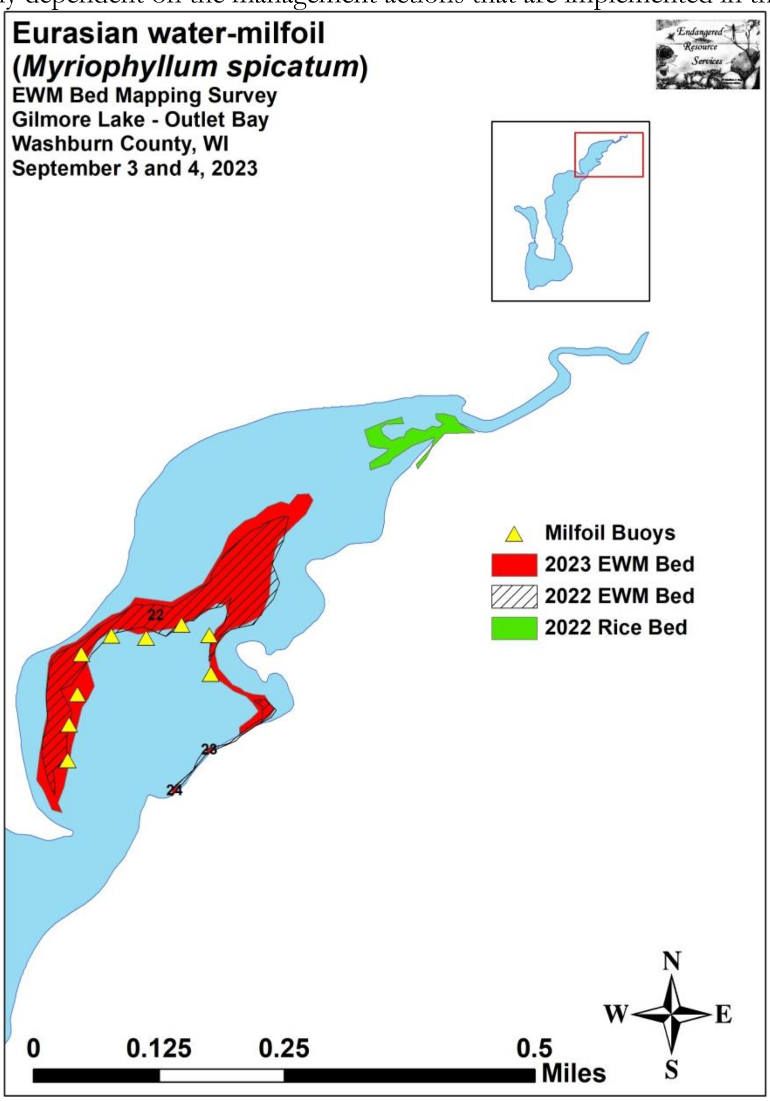

Figure 56: EWM marker buoys in the north basin of Gilmore Lake

AQUATIC PLANT SURVEYING

Gilmore Lake has a very healthy and diverse native aquatic plant community. Both native and non-native aquatic plant species need to be monitored to determine the desired and undesired impacts of management implementation. There are at least three levels of aquatic plant surveying that help better assess and understand how management actions affect the lake and the aquatic plants within it.

MEANDERING SURVEYS

Meandering surveys of the littoral zone (plant-growing zone) looking for a specific plant species like EWM are important as they generally are the first indicator that there is something that does not belong. Meandering surveys help find target plant species, document the location where target plants are found using GPS technology or general mapping, and provides an opportunity to physically remove the target plant or make it a part of another management action. Fall bed-mapping of EWM is considered a meandering survey and serves to identify areas of concern for management in the following spring. The GLA does several meandering surveys each season and will continue to do so as a part of this new plan.

PRE- AND POST-TREATMENT POINT-INTERCEPT SURVEYS

Pre- and post-treatment, point-intercept surveys are used to document short-term changes in those areas under management. They consist of a set of points that can be surveyed multiple times, usually before and after a chemical treatment. Statistical information can be gathered from the data collected during one of these surveys. The WDNR requires pre- and post-treatment, point-intercept aquatic plant surveying when greater than 10% or 10 acres of the littoral zone are proposed for treatment, or if a chemical treatment of any size is grant-funded. If a proposed chemical treatment of >10 acres is expected to happen in Gilmore Lake, the GLA will complete pre- and post-treatment survey work.

WHOLE-LAKE, POINT-INTERCEPT, AQUATIC PLANT SURVEYS

Whole-lake, point-intercept surveys are intended to track changes to the aquatic plant community over time. Typically, in a lake where management of aquatic plants (non-native or native) takes place, whole-lake surveys are recommended at least every five years using the same set of pre-designated points each time. The first time a whole-lake point-intercept survey is completed; the results serve as a baseline for future comparisons. After the first survey, the results from any future surveys can be compared to the first survey for changes. If any changes are identified, it is then possible to analyze what might have caused the changes. While changes naturally occur in nature from one year to another, management actions including management of EWM can also be a reason for change.

Since the last whole-lake, point-intercept survey of Gilmore Lake was completed in 2022, another one is recommended in 2026 or 2027. Results from the PI survey would be used to update the APMP for the next five-year period.

HERBICIDE CONCENTRATION TESTING

If aquatic herbicides are used on more than 10 acres or 10% of the littoral zone of Gilmore Lake, and/or EWM management using aquatic herbicides is funded in part by WDNR Surface Water grants, herbicide concentration testing will be required. Concentration data can provide some insight into what happens to the herbicide once it is applied to a bed of EWM. In the North Basin, it would tell if the herbicide applied reaches the wild rice bed, how long it took to do so, and at what concentration it was when it did. Concentration testing also provides information related to how effective a chemical treatment has been. If a chemical treatment did not work as well as expected, it might be because the herbicide applied did not reach the expected concentration.

When applying aquatic herbicides on any size treatment area, it is a good idea to complete some level of concentration testing, even if it is not required.

Aquatic plant survey work and herbicide concentration testing are grant reimbursable expenses.

OTHER AIS MONITORING AND MANAGEMENT

Other AIS including curly-leaf pondweed (CLP) and purple loosestrife (PL) will be monitored by GLA volunteers and physical removal completed if possible. It is not expected that any other form of management to control CLP or PL will be necessary during the five years covered by this Aquatic Plant Management Plan.

GLA volunteers will continue to monitor the shoreline for purple loosestrife removing what is found if possible. The GLA will not be involved in rearing beetles for biological control of purple loosestrife at this time.

At the present time, it is expected that no other form of AIS management is necessary on or around Gilmore Lake. GLA volunteers will participate in the Citizen Lake Monitoring Network Aquatic Invasive Species Monitoring Program annually looking for zebra mussels, spiny waterflea, rusty crayfish, hydrilla, and other AIS not already in the lake.

SHORELAND IMPROVEMENT AND COARSE WOODY HABITAT

Like many aquatic exotic plant species, EWM tends to grow best in areas with excessive nutrients in the water; especially when there is also bottom disturbance. To help limit EWM's opportunities to thrive and expand, all lake residents are encouraged to evaluate how their shoreline practices may be impacting the lake. Simple things like establishing or maintaining their own buffer strip of native vegetation along the lake shore to prevent erosion, building rain gardens, bagging grass clippings, switching to a phosphorus-free fertilizer, or preferably eliminating fertilizer near the lake altogether, collecting pet waste, and disposing of the ash from fire pits away from the lakeshore can all significantly reduce the amount of nutrients entering the lake. Avoiding motor starts in water less than 4ft deep can also maintain native vegetation and prevent the stirring up of nutrient-rich sediment. By limiting nutrient inputs, residents not only create less than ideal growing conditions for EWM, but also promote better water clarity and quality by limiting algal growth. A greater understanding of how all property owners can have lake-wide impacts will result in more people taking appropriate conservation actions.

WATER QUALITY TESTING

There is a substantial amount of water clarity and water quality data courtesy of the Citizen Lake Monitoring Network and Gilmore Lake volunteers. This data is used to compare changes in water quality in Gilmore Lake over time and to help determine if EWM and EWM management actions are affecting water quality. Gilmore Lake will maintain its involvement in the CLMN.

2024-2028 AQUATIC PLANT MANAGEMENT GOALS, OBJECTIVES, AND ACTIONS

There are seven goals associated with this Aquatic Plant Management Plan. Each goal has several objectives and a list of actions to complete to help meet the objective and accomplish the goal (Appendix B). Each of these goals is important for keeping Gilmore and Little Gilmore Lakes healthy and to maintain their expected uses over at least the next five years. The objectives included in this plan are measurable and presumed to be reachable and reasonable. The actions in this plan are intended to be implemented by the GLA with input and assistance from the lake constituency and from the WDNR, private consultants, and other resource professionals.

- Goal 1 - Protect and enhance the native aquatic plant community.
- Goal 2 - Minimize the negative impact of EWM on the native aquatic plant community through the implementation of management actions.
- Goal 3 - Reduce the threat that a new aquatic invasive species will be introduced and go undetected in Gilmore Lake and that existing AIS will be carried to other lakes.
- Goal 4 - Improve the level of knowledge property owners and lake users have related to aquatic invasive species and how they can impact the lake.
- Goal 5 - Improve the level of knowledge property owners and lake users have related to how their actions impact the aquatic plant community, lake community, and water quality.
- Goal 6 - Complete APM Plan implementation and maintenance for a period of five years following adaptive management practices.
- Goal 7 - Evaluate and summarize the results of management actions implemented during the entire 5-year timeframe of this plan.

IMPLEMENTATION AND EVALUATION

This plan is intended to be a tool for use by the GLA to move forward with aquatic plant management actions that will maintain the health and diversity of Gilmore Lake and its aquatic plant community. This plan is not intended to be a static document, but rather a living document that will be evaluated on an annual basis and updated as necessary to ensure goals and community expectations are being met. This plan is also not intended to be put up on a shelf and ignored. Implementation of the actions in this plan through funding obtained from the WDNR and/or GLA funds is highly recommended. An Implementation and Funding Matrix is provided in Appendix C.

Since many actions occur annually, a calendar of actions to be implemented was created in Appendix D.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES GRANT PROGRAMS

There are several WDNR grant programs that may be able to assist the GLA in implementing its new APM Plan. AIS grants are specific to actions that involve education, prevention, planning, and in some cases, implementation of AIS management actions. Lake Management Planning grants can be used to support a broad range of management planning and education actions. Lake Protection grants can be used to help implement approved management actions that would help to improve water quality.

Management actions included in this APMP could be supported by WDNR Surface Water grant funding should the GLA wish to apply for it. Grant funding is not a guarantee but will not be awarded if it is not applied for. More information about WDNR grant programs can be found at: https://dnr.wisconsin.gov/aid/SurfaceWater.html

OUTSIDE RESOURCES TO HELP WITH FUTURE MANAGEMENT PLANNING

Many of the actions recommended in this plan cannot be completed solely by the GLA. They will continue to need the help of an outside consultant or other outside resource. Multiple outside resources and expertise exist to help guide implementation. Appendix E lists several outside resources that the GLA could partner with to implement the actions in this plan.

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