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POTATO LAKE, WASHBURN COUNTY

2022-26 AQUATIC PLANT MANAGEMENT PLAN
WBIC: 2714500

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POTATO LAKE ASSOCIATION
SPOONER, WI 54801

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Table of Contents

INTRODUCTION **9**

OVERALL MANAGEMENT GOAL **10**

Implementation Goals 10

WISCONSIN'S AQUATIC PLANT MANAGEMENT STRATEGY **11**

SHALLOW LAKE MANAGEMENT CONSIDERATIONS **13**

Shallow Lake Alternative States and Stabilizing Mechanisms *13*

LAKE CHARACTERISTICS **15**

Physical Characteristics 15
Water Quality 15
Water Clarity *16*
Trophic State Index *17*
Fisheries and Wildlife *19*

WATERSHED CHARACTERISTICS **20**

Land Use 20
Soils 21
Wetlands 23
Coarse Woody Habitat (Wolter, 2012) 24
Shorelands 26
Protecting Water Quality *27*
Natural Shorelands Role in Preventing Aquatic Invasive Species *27*
Threats To Shorelands *28*
Shoreland Preservation and Restoration *28*

AQUATIC PLANT SURVEYS **30**

Warm-Water Full Point-Intercept Macrophyte Surveys 30
Simpson's Diversity Index *34*
Floristic Quality Index (FQI) *34*
Wild Rice 35
Curly-leaf Pondweed Surveys 39

AQUATIC INVASIVE SPECIES **40**

Non-native, Aquatic Invasive Plant Species 40
Curly-leaf Pondweed (CLP) *40*
Eurasian Watermilfoil (EWM) *41*
Purple Loosestrife *42*
Reed Canary Grass *44*
NON-NATIVE AQUATIC INVASIVE ANIMAL SPECIES 45
Mystery Snails *45*
Rusty Crayfish *46*
Zebra Mussels *47*
AIS Prevention Strategy 48

MANAGEMENT ALTERNATIVES **52**

No Management 52
Hand-pulling/Manual Removal 53
Diver Assisted Suction Harvesting 54

Mechanical Removal 55
Large-Scale Mechanical Harvesting *55*
Small-Scale Mechanical Harvesting *57*
Bottom Barriers and Shading 59
Dredging 59
Drawdown 60
Biological Control 60
Chemical Control 60
Management of Purple Loosestrife using Herbicides *61*

MANAGEMENT DISCUSSION **63**

The Value of Aquatic Plants 63
PROBLEMS WITH AQUATIC PLANTS 63
Aquatic Plant Harvesting 65
Application of Aquatic Herbicides 65
Aquatic Plant Surveying 66
Recon and Mapping Surveys *66*
Pre and Post Treatment Point-Intercept Surveys *66*
Whole-Lake, Point-Intercept Aquatic Plant Surveys *66*
Other AIS Monitoring and Management 66
Coarse Woody Habitat 67
Aquatic Plant Management in Potato Lake 67

POTATO LAKE AQUATIC PLANT MANAGEMENT GOALS, OBJECTIVES, AND ACTIONS **70**

Goal 1: Protect and preserve the native species community within and around Potato Lake 70
Objective 1: OVER THE COURSE OF THE NEXT FIVE YEARS (2021-2025) THE FOLLOWING MEASURES OF A HEALTHY NATIVE AQUATIC PLANT COMMUNITY WILL BE MAINTAINED OR EXCEEDED: *70*
OBJECTIVE 2: MONITOR AND MAINTAIN OR IMPROVE WATER. *70*
Goal 2: Maintain lake use including open water access and navigation impairments. 71
Objective 1: Removal of nuisance vegetation in riparian areas not to exceed guidelines in NR 109. *71*
Objective 2: Create navigation lanes through areas of dense summer vegetation. *71*
*Objective 3: Create open water Access lanes through areas of dense summer vegetation.**Error! Bookmark not defined.***
Goal 3: Prevent the introduction of aquatic invasive species 72
OBJECTIVE 1: CONTINUE TO IMPLEMENT A CLEAN BOATS CLEAN WATERS (CBCW) WATER CRAFT INSPECTION PROGRAM ANNUALLY *72*
OBJECTIVE 2: EDUCATE AND INFORM PROPERTY OWNERS AND LAKE USERS ABOUT AIS AND HOW TO IDENTIFY THEM *72*
Goal 4: Promote and support nearshore, riparian, and watershed best management practices that will improve fish and wildlife habitat, reduce runoff, and minimize nutrient loading into Potato Lake. 72
OBJECTIVE 1: Implement at least one healthy lakes and Rivers project annually on potato lake. *73*
Goal 5: Assess the progress and results of this project annually and report to and involve other stakeholders in planning efforts. 73
Objective 1: BUILD AND SUPPORT NEW AND EXISTING PARTNERSHIPS EACH YEAR. *73*
OBJECTIVE 2: COMPLETE ANNUAL PROJECT ACTIVITY AND ASSESSMENT REPORTS. *73*
OBJECTIVE 3: PROVIDE MULTIPLE OPPORTUNITIES AND VENUES ANNUALLY FOR LAKE RESIDENTS, USERS, AND OTHER PARTNERS TO KEEP INFORMED ABOUT MANAGEMENT PLANNING AND IMPLEMENTATION ACTIVITIES. *74*

IMPLEMENTATION AND EVALUATION **75**

WISCONSIN DEPARTMENT OF NATURAL RESOURCES GRANT PROGRAMS **76**

WORKS CITED **77**

Figures

Figure 1: Alternative stable states in a shallow water lake (Scheffer, 1998) 13
Figure 2: Potato Lake depth (left) and bottom substrate (right) 15
Figure 3: Black and white Secchi disk 16
Figure 4: Average summer (July-August) Secchi disk readings at the Deep Hole 17
Figure 5: Average Summer Wisconsin Tropic State Index Values in Potato Lake 19
Figure 6: Potato Lake Watershed (left) and Trego Lake-Middle Namekagon River Watershed (right) 20
Figure 7: Land use within the Potato Lake Watershed 21
Figure 8: Hydrologic soil profile of the Potato Lake Watershed 23
Figure 9: Wetland areas within the Potato Lake Watershed 24
Figure 10: Coarse woody habitat-Fishsticks projects 25
Figure 11: CWH within Potato Lake 26
Figure 12: Healthy, AIS Resistant Shoreland (left) vs. Shoreland in Poor Condition 29
Figure 13: 2010 and 2019 Native Species Richness 31
Figure 14: 2010 and 2019 Total Rake Fullness 31
Figure 15: 2010 and 2019 plant colonization depth chart 32
Figure 16: 2010 and 2019 littoral zone 33
Figure 17: Plant species with significant changes from 2010 to 2019 34
Figure 18: A very good crop year, Potato Lake, 2015 (top left); a very poor crop year, Potato Lake, 2019 (top right); and a recovery year, Potato Lake, 2020, no human intervention (bottom). 36
Figure 19: Wild rice beds mapped in Potato Lake in 2020 37
Figure 20: 2010 and 2019 Potato Lake Wild Rice Density and Distribution 38
Figure 21: 2011 Wild rice on the North end of Potato Lake, 2019 39
Figure 22: Wild rice on the North end of Potato Lake, 2020 39
Figure 23: CLP Plants and Turions 41
Figure 24: EWM fragment with adventitious roots and EWM in a bed 42
Figure 25: Purple Loosestrife 44
Figure 26: Reed Canary Grass (not from Potato Lake) 45
Figure 27: Chinese Mystery Snails (not from Potato Lake) 46
Figure 28: Rusty Crayfish and identifying characteristics 47
Figure 29: Zebra Mussels 48
Figure 30: Wisconsin Department of Natural Resources: Wisconsin Waterbodies – Integrated Pest Management March 2020 51
Figure 31: Aquatic vegetation manual removal zone 53
Figure 32: DASH - Diver Aided Suction Harvest (Chuck Druckery, 2016 Wisconsin Lakes Convention Presentation) 55
Figure 33: How a Harvester Works (Engle, 1987) 56
Figure 34: Aquatic Mower & Weedshear Weed Cutter (weedersdigest.com) 57
Figure 35: Hockney weed cutters: HC-10H and HP-7 58
Figure 36: Cut stem or herbicide "dabbing" to control AIS 61
Figure 37: Hand wicking invasive species with herbicide 62
Figure 38: Rake fullness values and developed shoreline. Points in the right photo represent rake fullness values of 2 or 3. Green polygons are wild rice. 64
Figure 39: Top: RFV for coontail, flat-stem pondweed, and filamentous algae, Bottom: Mats of filamentous algae in the south bay (ERS, 2020) 65
Figure 40: Pronghorn Clubtail (Gomphus graslinellus) 67
Figure 41: Horned Pondweed and its location in Potato Lake 68

Tables

Table 1: Average summer (July-August) Secchi disk readings at the Deep Hole 17
Table 2: Potato Lake Trophic State Index and Description of Conditions 18
Table 3: Summaries of 2014 fisheries surveys 19
Table 4: Land use within the Potato Lake Watershed 21
Table 5: Soil classes within the Potato Lake Watershed 22
Table 6: Comparison of Survey Statistics for 2010 and 2019 30
Table 7: Values to Measure the Health of the Native Aquatic Plant Community in Potato Lake 70

Appendices

Appendix A-1: Potato Lake Aquatic Plant Management Discussion Document
Appendix A: Potato Lake APM Plan Goals, Objectives, and Actions
Appendix B: Potato Lake APM Plan Implementation and Funding Matrix
Appendix C: Potato Lake APM Plan Calendar of Actions
Appendix D: Potato Lake Sample Harvesting Map
Appendix E: NR 109
Appendix F: WDNR Surface Water Grants Program

AQUATIC PLANT MANAGEMENT PLAN-POTATO LAKE

PREPARED FOR THE POTATO LAKE ASSOCIATION

INTRODUCTION

Potato Lake is located in east-central Washburn County in the Townships of Crystal and Madge. The lake provides many recreational opportunities to its roughly 70 shoreland property owners and to the public through an often-used public access site on the north end of the lake. The Potato Lake Association (PLA) has been monitoring the water quality of the lake since the late 1990s. A slight increase in the trophic state of the lake occurred in the mid-2000s but the water quality has since returned to conditions similar to those of the early 1990s.

In 2009 the PLA began the steps necessary to develop an Aquatic Plant Management Plan (APM Plan) with the first plan completed in 2010. From 2010 to 2020, no management actions were taken, however many properties on the lake exchanged hands during that time frame. These new property owners have new concerns related to aquatic plants so the PLA thought it would be a good time to update the existing APM Plan. The new plan is similar to the existing plan in that it provides direction for protecting the native plant community, which includes wild rice, and for continued aquatic invasive species monitoring to prevent the introduction of AIS to the lake. In addition, it lays out criteria to follow if the PLA should choose to implement management of native aquatic plants to provide a level of navigational and nuisance relief for the few areas of the lake most impacted.

Wild rice is abundant in Potato Lake which limits plant management actions. No aquatic herbicides are recommended for use in this plan because of the wild rice and because the navigation and nuisance issues are caused by native aquatic vegetation. Limited harvesting with removal is recommended. Physical removal by property owners is also recommended. The APM Plan is intended to be adaptable depending on what actions are implemented each year and the results of those actions. After five years, the APM Plan may be updated again, particularly if some level of active management of aquatic plants is completed during that time frame.

OVERALL MANAGEMENT GOAL

The main goal of this plan is to provide the Potato Lake Association and their constituency with updated information about the status of aquatic plants, both native and non-native, in the lake. Recommended management actions for the lake have not changed significantly since the last APM Plan was approved in 2010, however there are a number of new property owners asking questions now that are similar to the questions asked before that led to the development of the 2010 plan. More recent property owners on the lake will hopefully learn something about the lake, and property owners that have been on the lake for a long time will be reminded of some of the things that make Potato Lake the valued natural resource that it is.

The following is a list of the goals included in this updated version of the 2010 APM Plan. Each goal has one or more objectives and a number of actions to be implemented to meet the objective and satisfy the goal. There are intended to be implemented over the course of the next five years – 2021-2025. More detail is provided in later sections of this plan and in Appendix A.

IMPLEMENTATION GOALS

Goal 1: Protect and preserve the native species community within and around Potato Lake.

Goal 2: Maintain lake use including open water access and navigation impairments.

Goal 3: Prevent the introduction of aquatic invasive species.

Goal 4: Promote and support nearshore, riparian, and watershed best management practices that will improve fish and wildlife habitat, reduce runoff, and minimize nutrient loading into Potato Lake.

Goal 5: Assess the progress and results of this project annually and report to and involve other stakeholders in planning efforts.

WISCONSIN'S AQUATIC PLANT MANAGEMENT STRATEGY

The waters of Wisconsin belong to all people. Their management becomes a balancing act between the rights and demands of the public and those who own property on the water's edge. This legal tradition called the Public Trust Doctrine dates back hundreds of years in North America and thousands of years in Europe. Its basic philosophy with respect to the ownership of waters was adopted by the American colonies. The US Supreme Court has found that the people of each state hold the right to all their navigable waters for their common use, such as fishing, hunting, boating and the enjoyment of natural scenic beauty.

The Public Trust Doctrine is the driving force behind all management in Wisconsin lakes. Protecting and maintaining that resource for all of Wisconsin's people is at the top of the list in determining what is done and where. In addition to the Public Trust Doctrine, two other forces have converged that reflect Wisconsin's changing attitudes toward aquatic plants. One is a growing realization of the importance of a strong, diverse community of aquatic plants in a healthy lake ecosystem. The other is a growing concern over the spread of Aquatic Invasive Species (AIS), such as Eurasian watermilfoil. These two forces have been behind more recent changes in Wisconsin's aquatic plant management laws and the evolution of stronger support for the control of invasive plants.

To some, these two issues may seem in opposition, but on closer examination they actually strengthen the case for developing an APM Plan as part of a total lake management picture. Planning is a lot of work, but a sound plan can have long-term benefits for a lake and the community living on and using the lake.

The impacts of humans on Wisconsin's waters over the past five decades have caused public resource professionals in Wisconsin to evolve a certain philosophy toward aquatic plant management. This philosophy stems from the recognition that aquatic plants have value in the ecosystem, as well as from the awareness that, sometimes, excessive growth of aquatic plants can lessen our recreational opportunities and our aesthetic enjoyment of lakes. In balancing these, sometimes competing objectives, the Public Trust Doctrine requires that the State's public resource professionals be responsible for the management of fish and wildlife resources and their sustainable use to benefit all Wisconsin citizens. Aquatic plants are recognized as a natural resource to protect, manage, and use wisely.

Aquatic plant protection begins with human beings. We need to work to maintain good water quality and healthy native aquatic plant communities. The first step is to limit the amount of nutrients and sediment that enter the lake. There are other important ways to safeguard a lake's native aquatic plant community. They may include developing motor boat ordinances that prevent the destruction of native plant beds, limiting aquatic plant removal activities, designating certain plant beds as critical habitat sites and preventing the spread of non-native, invasive plants, such as EWM.

If plant management is needed, it is usually in lakes that humans have significantly altered. If we discover how to live on lakes in harmony with natural environments and how to use aquatic plant management techniques that blend with natural processes rather than resist them, the forecast for healthy lake ecosystems looks bright. To assure no harm is done to the lake ecology, it is important that plant management is undertaken as part of a long range and holistic plan.

In many cases, 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 required by the State of Wisconsin. To promote the long-term sustainability of our lakes, the State of Wisconsin endorses the development of APMPs and supports that work through various grant programs.

There are many techniques for the management of 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. These methods require permits and extensive planning.

While limited management on individual properties is generally permitted, it is widely accepted that a lake will be much better off if plants are considered on a whole lake scale. This is routinely accomplished by lake organizations or units of government charged with the stewardship of individual lakes.

SHALLOW LAKE MANAGEMENT CONSIDERATIONS

Lake management requires consideration of the differences between deep and shallow lakes. Shallow lakes are those lakes with a maximum depth of less than 20 feet or with an average depth of less than 10 feet (Cooke, Welch, Peterson, & and Nichols, 2005). Potato Lake falls under the shallow lake definition. Shallow lakes generally exist in one of two alternative states: the algae-dominated turbid water state and the plant-dominated clear water state (Figure 1). The turbid water state is characterized by dense algae (phytoplankton) populations, an undesirable bottom feeding fish community, and few aquatic plants whereas the clear water state is characterized by abundant aquatic plant growth, a greater number of zooplankton, and a diverse and productive gamefish community (Moss, Madgwick, & and Phillips, 1996).

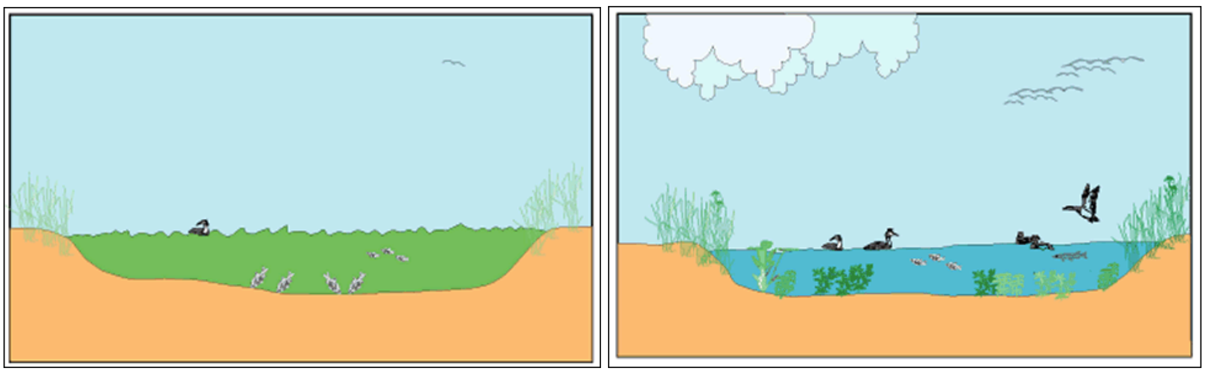


Figure 1: Alternative stable states in a shallow water lake *(Scheffer, 1998)*

SHALLOW LAKE ALTERNATIVE STATES AND STABILIZING MECHANISMS

Aquatic plants are the key to clear water in shallow lakes. A shallow lake that is free of both aquatic plants and algae is uncommon and it is unrealistic to expect such a lake to occur without a large investment of money and energy. Shallow lakes are more susceptible to internal nutrient loading (e.g. lake sediment phosphorus release) and biomanipulation (additions or removals of fish that affect the entire aquatic food web) than deep lakes, which are more responsive to changes in the external nutrient load from the watershed.

The addition or removal of nutrients can change the composition of an aquatic plant community, but can't displace aquatic plants altogether. A mechanism that displaces the plants and allows for algae to take over is called a forward switch (Moss, Madgwick, & and Phillips, 1996). Forward switches include the direct loss of plants through harvesting or herbicide use, repeated boat passage damaging the plants beyond recovery, runoff of herbicides from the surrounding watershed, static water levels, the introduction of carp, and a fish community that favors zooplanktivorous (fish that eat the Daphnia that eat the algae).

A reverse switch is a process or management option that restores and stabilizes the plant community by overcoming the buffers stabilizing the algae (Moss, Madgwick, & and Phillips, 1996). The most common techniques are biomanipulation, which is a manipulation of the fish community to reduce the number of zooplanktivores (often by adding piscivorous fish), and by re-establishing plants under conditions in which they can thrive. An important aspect of plant restoration is the re-establishment of wetland fringes (cattails, rushes, water lilies) that utilize nutrients, buffer wave action, provide refuge for daphnia and other algae grazers, and add to the lake's aesthetic appeal.

Each alternative state can persist over a wide range of nutrient concentrations. Aquatic plants can dominate without threat at total phosphorus concentrations below about 25 to 50µg/L. At total phosphorus levels greater than about 50µg/L either plant- or algae-dominated systems can exist, though at these higher nutrient levels there is a greater risk of the system switching from plant to algae dominance. Plant diversity also decreases at higher nutrient levels and filamentous algae can be common. Native plants can become a nuisance at high nutrient concentrations as highly adaptable species such as coontail, water celery, and water lilies become dominant.

If the goal of management is to return a lake from an algae-dominated state to an aquatic plant dominated state, there are several steps that can be undertaken to begin that restoration (Moss, Madgwick, & and Phillips, 1996):

- Identify the "forward switch" and remove it;
- Implement external and internal nutrient control measures;
- Restructure the ecosystem by a "reverse switch" (biomanipulation);
- Reestablish the aquatic plant community, including wetland fringe; and
- Stabilize and manage the restored system to keep it that way.

Identifying the historic forward switch that moved a lake from the plant-dominated to algae-dominated state can be difficult. It is more important to identify the switch mechanisms currently in operation. Once forward switches have been identified and removed, over-fertilization can be addressed through nutrient management strategies. External and internal nutrient sources should be reduced as much as possible to buffer against a forward switch and to establish conditions favorable for the next steps: biomanipulation and plant re-establishment (Moss, Madgwick, & and Phillips, 1996). A well-established plant community can withstand moderate impacts without further active management; however, the lakes and watershed should be monitored for changes and activities that might destabilize the system.

Out of 69 measurements of total phosphorus over a 16 year period 2004 to 2019, the mean concentration of total phosphorus in Potato Lake was 29.1μ/L. Only twice did the concentration exceed 50μ/L. This suggest that Potato Lake is in a more stable state dominated by large aquatic plant growth, but could make the switch to an algae dominated state if efforts to minimize nutrient loading are not made, and if management of native aquatic plants becomes to zealous.

LAKE CHARACTERISTICS

In order 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

Potato Lake is a 222-acre spring-fed, drainage lake located in east-central Washburn County. It reaches a maximum depth of 20ft near the north-central basin southwest of the east side public boat landing and has an average depth of 11ft. The lake's bottom substrate is predominantly organic muck, although a narrow ring of sand and rock occurs along most shorelines of the main basin (Figure 2).

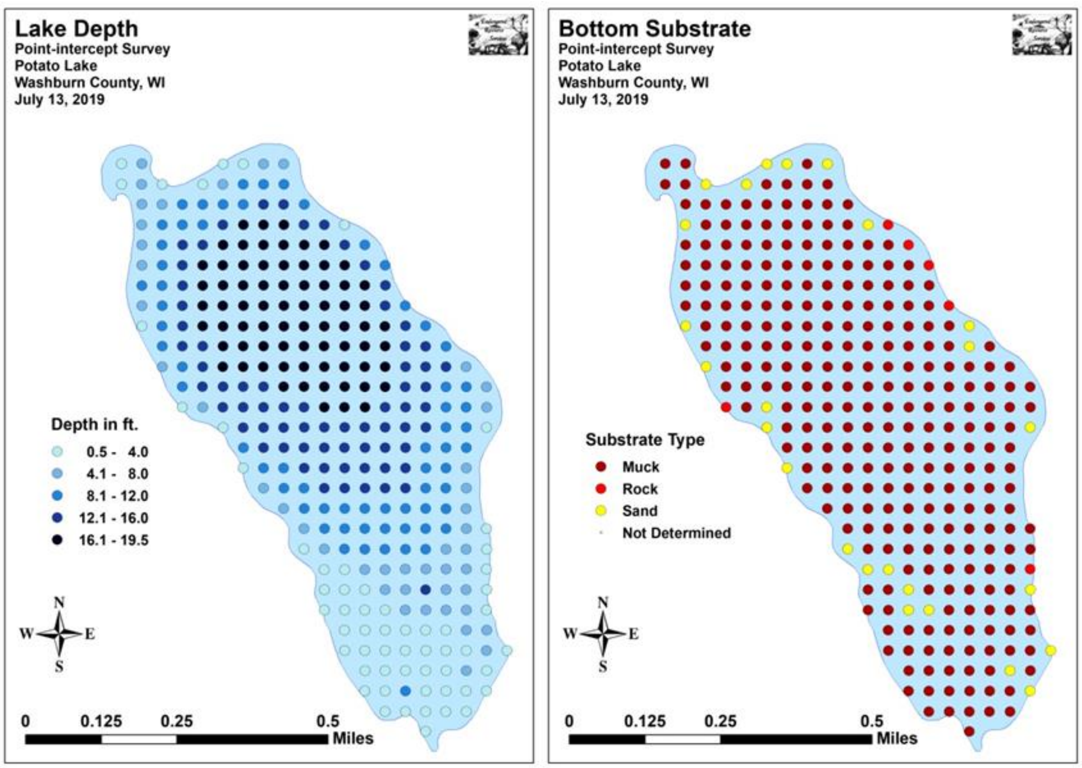


Figure 2: Potato Lake depth (left) and bottom substrate (right)

WATER QUALITY

Water clarity and water chemistry are important indicators of water quality. Secchi disk readings of water clarity have been collected by Wisconsin Citizen Lake Monitoring Network (CLMN), formerly the Self-help Lake Monitoring Program, volunteers since 2003. The Wisconsin Department of Natural Resources (WDNR) Surface Water Integrated Monitoring System (SWIMS) website indicates CLMN volunteers began collecting water chemistry data in 2008 with a few years lacking any or sufficient data.

The appearance of the water in the lake is predominately clear, with the water becoming murky later in the summer season. The color of the water was reported as predominantly green throughout the year. Perception is based on a volunteers' familiarity with lake conditions at any given time of year and was predominantly listed as having "very minor aesthetic problems" to "enjoyment somewhat impaired".

WATER CLARITY

Water clarity is a measurement of how deep sunlight can penetrate into the waters of a lake. It can be measured in a number of ways, the most common being 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 3). 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 from view.

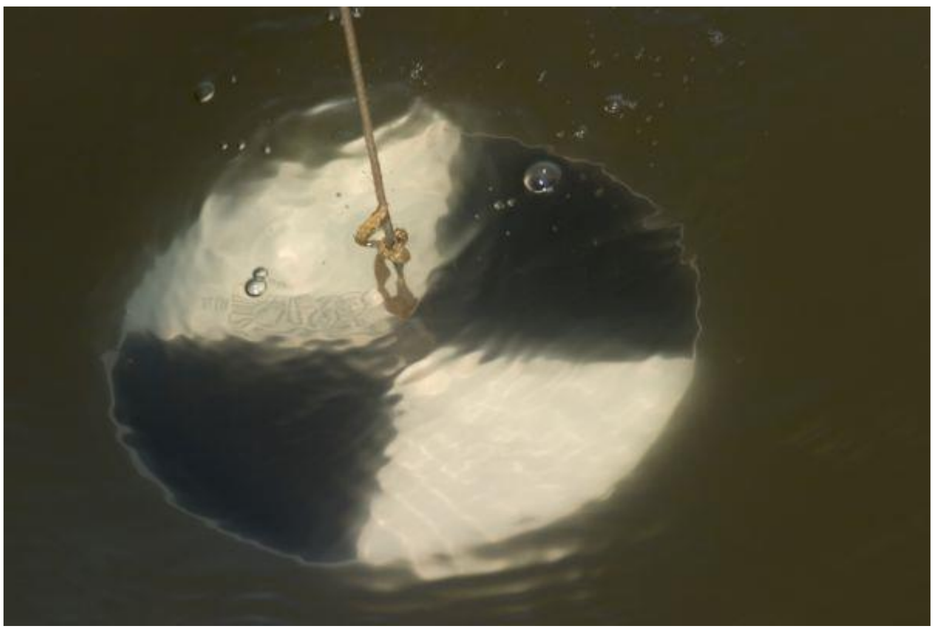


Figure 3: Black and white Secchi disk

The Secchi measurements taken in Potato Lake from 1998 through 2014 are shown in Figure 4. There has been little change to water clarity over the past 16 years. Secchi readings and other data collection about water clarity and quality have been reduced in the last 6 years and no accurate data from 2015-2020 can be reported. The overall mean summer Secchi depth was 7.55 ft. The largest departures from the overall mean occurred in 2006 and 2007 when the water clarity was about 2 feet less than average (Figure 4, Table 1).

Typically, the summer (June-Aug) water was reported as CLEAR and GREEN. This suggests that the Secchi depth to be mostly impacted by algae. Algal blooms are generally considered to decrease the aesthetic appeal of a lake because people tend to prefer clearer water to swim in and look at. Algae are always present in a balanced lake ecosystem. They are the photosynthetic basis of the food web. Algae are eaten by zooplankton, which are in turn eaten by fish. Without the algae in the system there would be no fisheries to speak of.

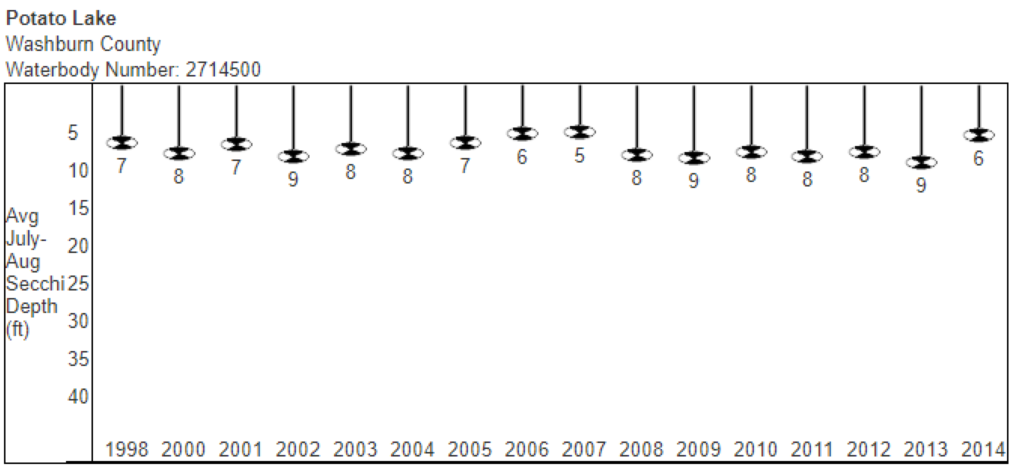


Figure 4: Average summer (July-August) Secchi disk readings at the Deep Hole

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1998	6.71	6	8	7
2000	8.25	7	10	4
2001	7	6	8.5	3
2002	8.67	6.5	11	3
2003	7.5	7.5	7.5	2
2004	8.17	7	9.5	3
2005	6.71	5	8.5	14
2006	5.56	3.5	8.5	9
2007	5.43	4	6	7
2008	8.31	6.5	11	13
2009	8.8	5.5	12	10
2010	8.03	5.5	11.5	8
2011	8.5	6	10.5	12
2012	7.91	4	11.5	14
2013	9.38	8	11	4
2014	5.88	4.5	8	4

Table 1: Average summer (July-August) Secchi disk readings at the Deep Hole

TROPHIC STATE INDEX

One method of classifying lakes is by the lake productivity, or trophic status. The most commonly used index of lake productivity is the Carlson's Trophic State Index (TSI), which is based on the near-surface concentrations of chlorophyll *a* and total phosphorus, and on Secchi depth. The Carlson's TSI was modified in the early 1990s by the WDNR to create an index that better represents Wisconsin Lakes, the Wisconsin TSI (WTSI). Oligotrophic lakes (clear, nutrient-poor) have WTSI values less than 40, eutrophic lakes (extremely productive, nutrient-rich lakes) have values greater than 50, and mesotrophic lakes (moderate supply of nutrients, moderate clarity) have values between 40 and 50. Higher WTSI values are often associated with poorer water quality.

The WTSI is a prediction of algal biomass, and therefore the chlorophyll *a* index ($WTSI_{CHL}$) is a better predictor of trophic status than the other two indices (total phosphorus, $WTSI_{TP}$; Secchi depth, $WTSI_{SD}$). Potato Lake is considered to eutrophic based on an average summer $WTSI_{CHL}$ of 52. The $WTSIS_{CHL}$ has remained consistent since data collection began in 2004. As with other lakes in this category, Potato Lake has decreased water clarity and oxygen depleted bottom waters during the summer (Table 3). Crystal Lake was the most productive lake monitored in 2010 with a $WTSI_{CHL}$ value of 68, which is near hyper-eutrophic conditions. Price Pond was the least productive with a $WTSI_{CHL}$ of 50, indicating borderline mesotrophic-eutrophic conditions.

The $WTSI_{TP}$ and $WTSI_{SD}$ are useful because the interrelationships between them and $WTSI_{CHL}$ can be used to identify other environmental factors influencing algal biomass. The $WTSI_{SD}$ has been less than the $WTSI_{CHL}$ in Potato Lake (Table 2, Figure 5), which suggests that large particulate algae dominate the system.

There were no consistent long-term trends in any of the three WTSIs for Potato Lake and the longer Secchi depth record shows little change in water quality over the past 16 years. The poorest water quality was from 2005 through 2007 which was also a period of moderate to severe drought in northwestern Wisconsin (Wisconsin State Climatology Office, 2011), suggesting an increase in lake retention time (less frequent flushing) is detrimental to the lake water quality.

Table 2: Potato Lake Trophic State Index and Description of Conditions

TSI	Description of Associated Conditions
< 30	Classical oligotrophy: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality.
30 - 40	Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer.
40 - 50	Water moderately clear, but increasing chance of low dissolved
50 - 60	Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth
60 - 70	Blue-green algae become dominant and algal scums are possible,
70 - 80	Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight).
> 80	Algal scums, summer fishkills, few plants, rough fish dominant. Very poor water quality.

Potato Lake

$WTSI_{CHL}$ = 52

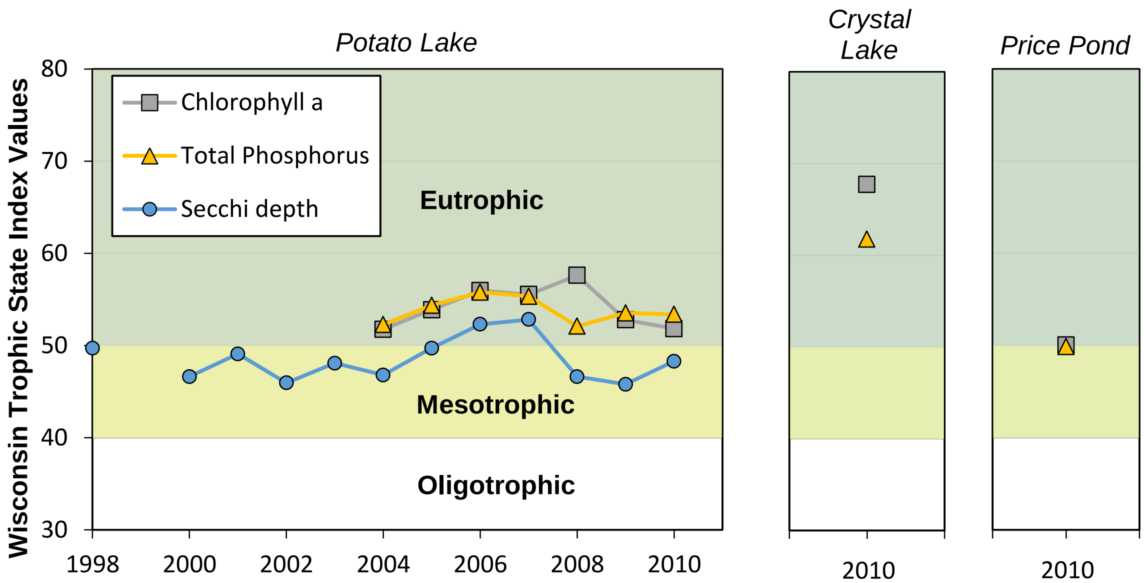


Figure 5: Average Summer Wisconsin Tropic State Index Values in Potato Lake

FISHERIES AND WILDLIFE

Potato Lake is considered a warm water fishery. All of the available survey data is from 2014, which was a cold winter with heavy fish kill. It is likely that the fish population has rebounded, as there hasn't been another cold winter with significant fish kill between 2014 and 2020. WDNR does not see a need to aerate the lake as it is spring fed which produces its own aeration during average winters. Fish kills in the lake have not been significant enough to worry about controlling or aiding in fish count rebounds. Overall, Potato Lake appears to have healthy bluegill and perch populations (Table 1). Although the numbers were low in 2014 for largemouth bass and northern pike, it is expected that numbers have risen.

Table 3: Summaries of 2014 fisheries surveys

2014 Potato Lake Electrofishing Summary

Fish Species	Number	Min	Max	Avg. Length
Largemouth Bass	20	4.5	8.0	6.6
Bluegill	129	2.7	7.9	4.8
Pumpkinseed	9	4.8	7.1	6.0
Northern Pike	15	11.0	23.0	20.0
Yellow Perch	132	2.5	9.3	3.1

The Potato Lake Watershed is one of several smaller watersheds which make up the larger Trego Lake - Middle Namekagon River Watershed. The Trego Lake - Middle Namekagon River Watershed includes the Namekagon River drainage from above the Trego Lake dam up to the Hayward Lake dam. The area encompasses a large portion of east central Washburn County and includes a small part of west central Sawyer County. The watershed is 172,087 acres in size and includes 217 miles of streams and rivers, 4,463 acres of lakes and 28,205 acres of wetlands. The watershed is primarily covered by forest (63%), wetlands (16%) and grassland (12%). The Potato Lake Watershed covers approximately 4,560 acres which accounts for approximately 3% of the entire Trego Lake - Middle Namekagon River watershed.

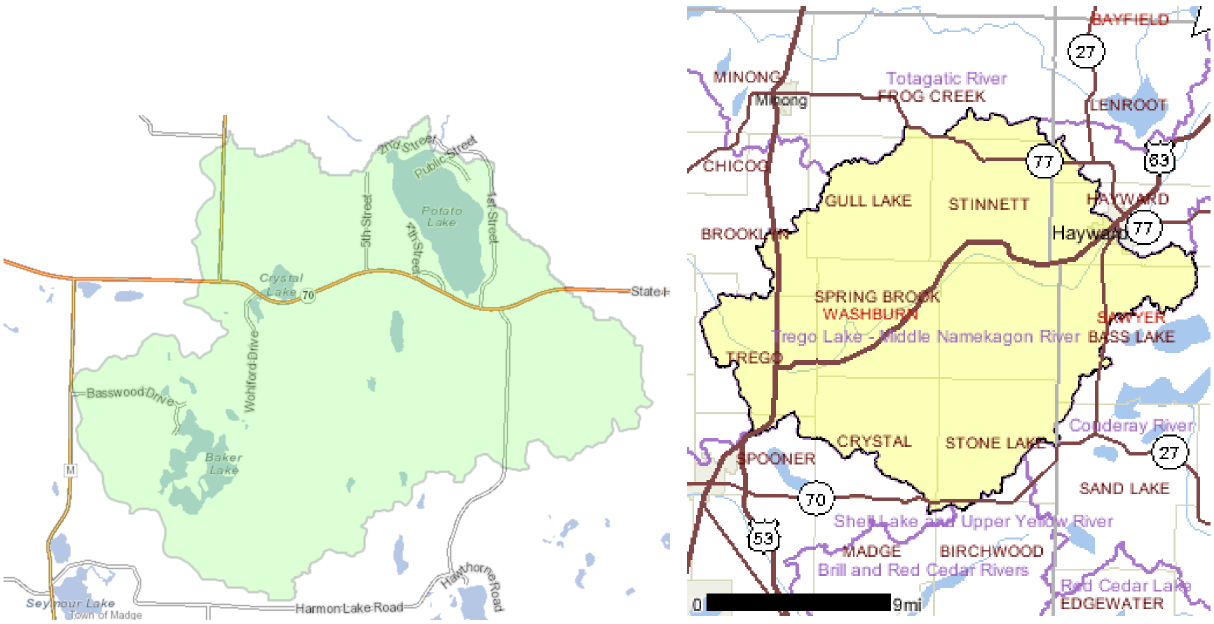


Figure 6: Potato Lake Watershed (left) and Trego Lake-Middle Namekagon River Watershed (right)

LAND USE

Within the Potato Lake Watershed, the vast majority (71%) of land use is forest. The remaining area is a relatively even mix of wetlands, pasture, and crops (Table 4). The non-forested areas are fairly concentrated in the northwestern portion of the watershed. All but a very small portion of the land directly adjacent to Potato Lake is forest (Figure 7).

Table 4: Land use within the Potato Lake Watershed

Cover Type	Area (Acres)	Percentage of Watershed
Open Water	338.9	7.4%
Wetlands	300.5	6.6%
Forest	3,225.6	70.8%
Pasture/ Grassland	388.5	8.5%
Crops	277.3	6.1%
Development	26.2	0.6%
Barren	0.0	0.0%

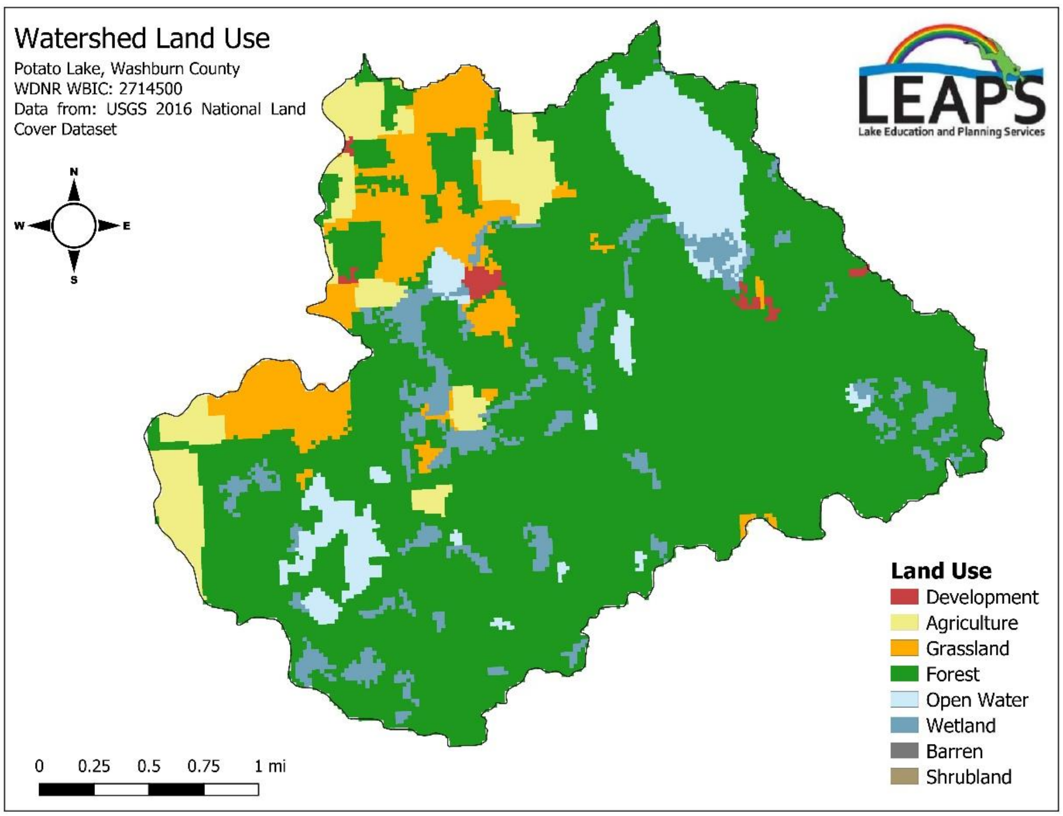


Figure 7: Land use within the Potato Lake Watershed

SOILS

Soils are classified into four main hydrologic soil groups (A, B, C, and D) to indicate their potential for producing runoff. Group A soils have a high infiltration rate which makes the potential amount of runoff very low. These soils are, generally very sandy and allow water to pass through unimpeded. Conversely, group D soils have a very low infiltration rate making their runoff potential fairly high. Group D soils are generally very dense with high amounts of organic material. This causes water to move slowly through group D soils often resulting in standing water on flat surfaces and flowing water over sloped surfaces. Group D soils are usually contained to wetland areas.

There are also three sub groups (A/D, B/D, and C/D) these indicated the infiltration rate of the soils with respect to the water table. If the water table is high and blocking infiltration, these soils are considered to have a high runoff potential and placed into group D, but when the water table is lower, these soils are similar to the first grouping. Nearly half of the soils within the Potato Lake watershed fall into Group C soils with Groups A (21.88%) and B (10.92%) making up the vast majority of the remaining soils (Table 5). Most of the soils directly adjacent to Potato Lake fall into group C (Figure 8). These soils have slow infiltration rates, so they generally allow more water to flow over the surface before seeping into the ground. This can result in higher amounts of surface runoff into the lake, particularly when the soils boarder the lake. One way to combat this higher runoff potential is to have a more natural shoreline. The trees, plants, and natural debris (i.e. rocks, downed trees, etc.) slow the flow of the water over the ground which allows more time for it to seep into the ground before entering the lake.

Table 5: Soil classes within the Potato Lake Watershed

Soil Group	Percentage of Watershed	Infiltration Rate
A	21.88%	High
B	10.92%	Moderate
C	49.95%	Slow
D	0.00%	Very Slow
A/D	3.77%	High when drained, very slow when undrained
B/D	0.00%	Moderate when drained, very slow when undrained
C/D	4.68%	Slow when drained, very slow when undrained
Water	8.80%	N/A

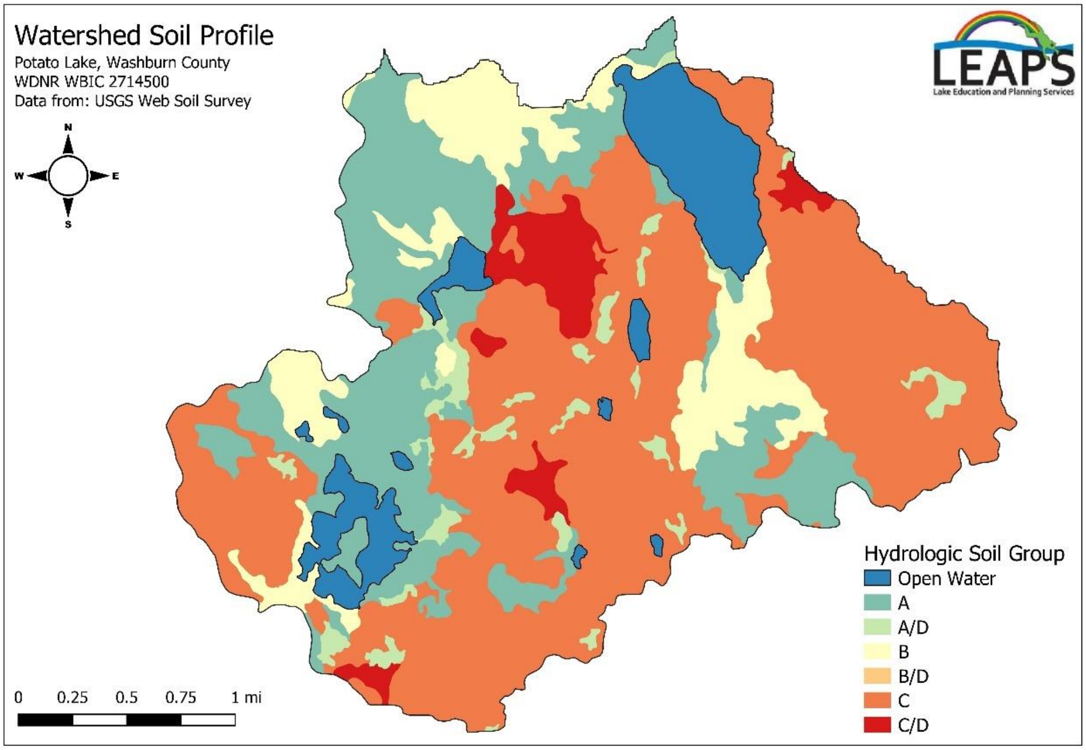


Figure 8: Hydrologic soil profile of the Potato Lake Watershed

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 a lake. 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 for fish, 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.

Wetlands also provide shoreline protection to lakes by acting as buffers between land and water. 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 help 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.

There is a not a lot of wetland areas within the Potato Lake Watershed. While there is a small wetland complex on the southern end of Potato Lake, most of the wetlands within the watershed are found west of

Potato Lake (Figure 9). These wetland areas may only cover a small portion of the total watershed, but they are still capable of capturing nutrients, and the PLA should support preserving these areas.

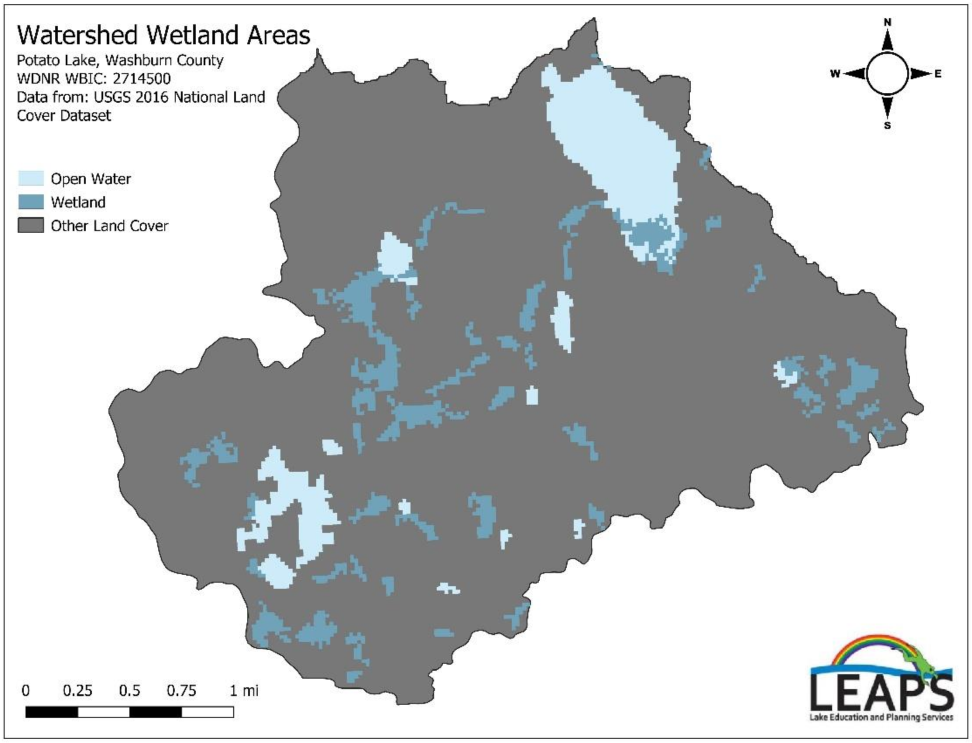


Figure 9: Wetland areas within the Potato Lake Watershed

COARSE WOODY HABITAT (WOLTER, 2012)

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. 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 was 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 have been well documented by researchers, making the loss of these habitats a critical concern.

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 1-4-2018). These types of projects are more formally called "tree drops" but are popularly are called "fish sticks" (Figure 10).

Figure 10: Coarse woody habitat-Fishsticks projects

The woody habitat within Potato Lake was quantified and mapped in October of 2019 (Figure 11). The northwestern shoreline has a fair amount of CWH already present while the northeastern shoreline has very little. This is likely due to there being very little development on the northwestern shore when compared to the northeastern shore. While the property owners nearest to the outlet on the north end as well as those near the spring hole on the south end would likely be unable to safely install fishsticks projects due to unsafe ice conditions, most of the shoreline, particularly the eastern shoreline, should be able to safely install fishsticks.

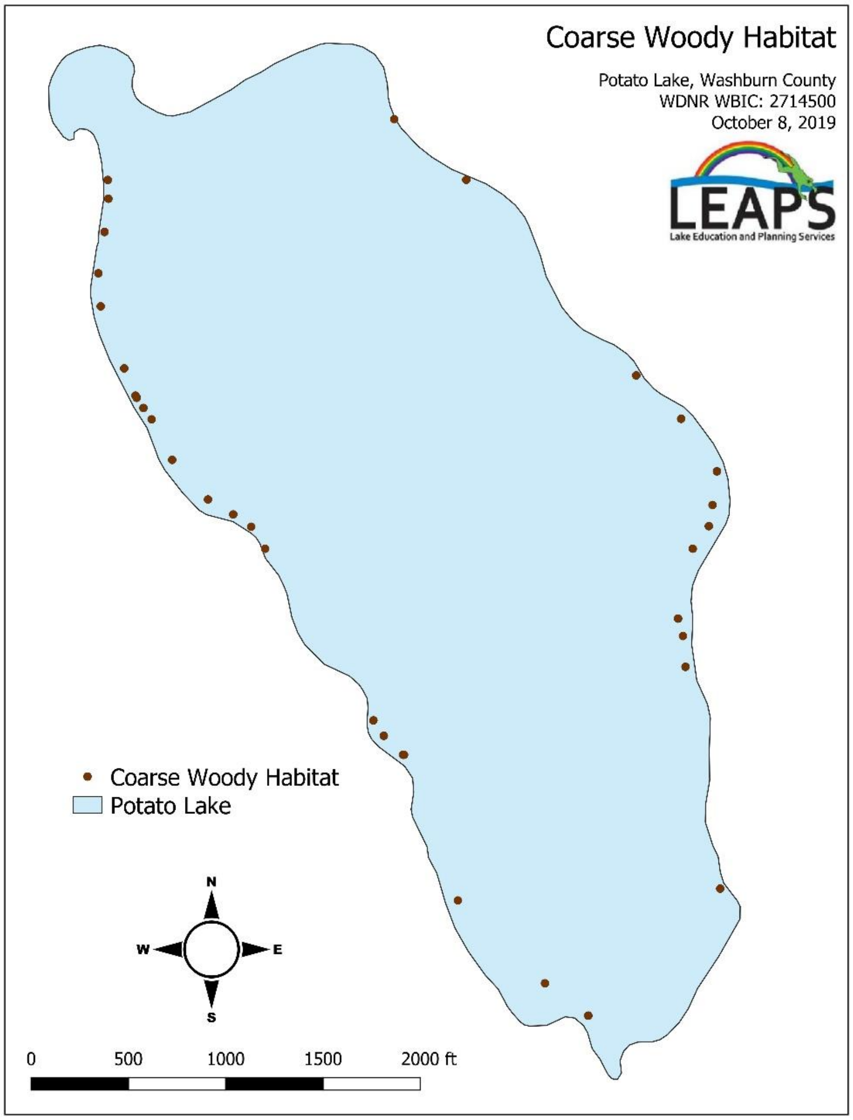


Figure 11: CWH within Potato Lake

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 aquatic invasive species 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 actually the hotbed of activity on a lake. 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, cover 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 where they can grow by how deeply light can penetrate the water.

Any buffer that does not extend back from the waters' edge at least 35' is not providing adequate protection for water quality and should be expanded to at least 35'. Local zoning ordinances and lakes classification systems have tried to provide better guidelines pertaining to buffer widths and setbacks based on lake type. Landowners are encouraged to go beyond the minimum requirements laid out by zoning and consider extending buffer widths to beyond 35' and integrating other innovative ways to capture and reduce the runoff flowing off from their property while improving critical shoreline habitat. Berms and low head retention areas can greatly increase the effective capture rate from developed portions in addition to that portion captured within the buffer.

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 decline and change what species can survive in 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 declines. 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 AQUATIC INVASIVE SPECIES

In addition to removing essential habitat for fish and wildlife, clearing native plants from shorelines and shallow waters can open up 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

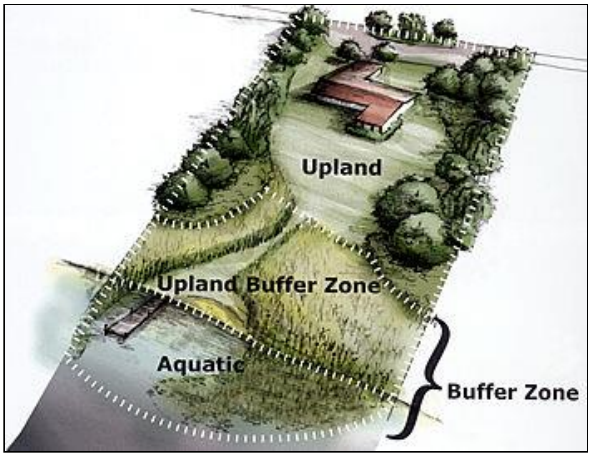
When a landowner develops a waterfront lot, many changes may take place including the addition of driveways, houses, decks, garages, sheds, piers, rafts and other structures, wells, septic systems, lawns, sandy beaches and more. Many of these changes result in the compaction of soil and the removal of 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 12 shows the difference between a natural and unnatural shoreline adjacent to a lake home. More information about healthy shorelines can be found at the following website: https://healthylakeswi.com/ (last accessed 3-15-2019).



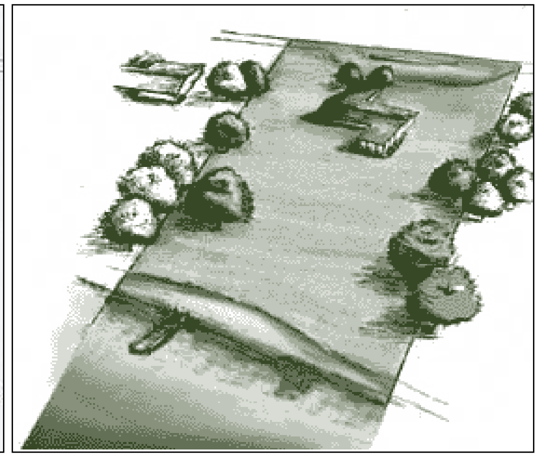


Figure 12: Healthy, AIS Resistant Shoreland (left) vs. Shoreland in Poor Condition

The habitat surrounding Potato Lake has not been assessed, so the condition is not currently known. If property owners are interested in ways to improve their lake shore property, information on WDNR grant eligible projects can be found at https://healthylakeswi.com/.

AQUATIC PLANT SURVEYS

Using a standard formula that takes into account the shoreline shape and distance, water clarity, depth, and total acreage, Michelle Nault (WDNR) generated the original 307-point sampling grid for Potato Lake in 2010. Using this same grid in 2019, in preparation for the 2019 revision of the management plan and to compare how the lake's vegetation may have changed since the last point-intercept surveys, the PLA and the WDNR authorized an early season CLP bed mapping survey on June 18th, and a full point-intercept survey for all aquatic plants on July 13th, 2019.

WARM-WATER FULL POINT-INTERCEPT MACROPHYTE SURVEYS

Warm-water point-intercept surveys were conducted in 2009 and 2018 in preparation for future management planning. Table 4 shows a brief comparison of summary statistics for both surveys. The PLA contracted with Endangered Resource Services, LLC (ERS) to complete these warm-water point-intercept surveys as well as the early season CLP surveys.

Table 6: Comparison of Survey Statistics for 2010 and 2019

Summary Statistics:	2010	2019
Total number of points sampled	307	307
Total number of sites with vegetation	189	202
Total number of sites shallower than the maximum depth of plants	206	287
Frequency of occurrence at sites shallower than maximum depth of plants	91.7	70.4
Simpson Diversity Index	0.89	0.90
Maximum depth of plants (ft.)	15.0	18.0
Mean depth of plants (ft.)	7.3	7.8
Median depth of plants (ft.)	7.5	8.0
Average number of all species per site (shallower than max depth)	2.73	2.37
Average number of all species per site (veg. sites only)	2.97	3.37
Average number of native species per site (shallower than max depth)	2.73	2.37
Average number of native species per site (sites with native veg. only)	2.97	3.37
Species richness	33	32
Species richness (including visuals)	33	36
Species richness (including visuals and boat survey)	39	42
Mean rake fullness (veg. sites only)	2.30	2.03

Total richness was moderate with 32 species in the lake (down from 33 species in 2010). This increased to 42 species when including visuals and those found growing in and immediately adjacent to the water during the boat survey (up from 39 total species in 2010). There was an average of 3.37 native species per site with native vegetation – a significant increase ($p=0.01$) from 2.97 per site in 2010 (Figure 13).

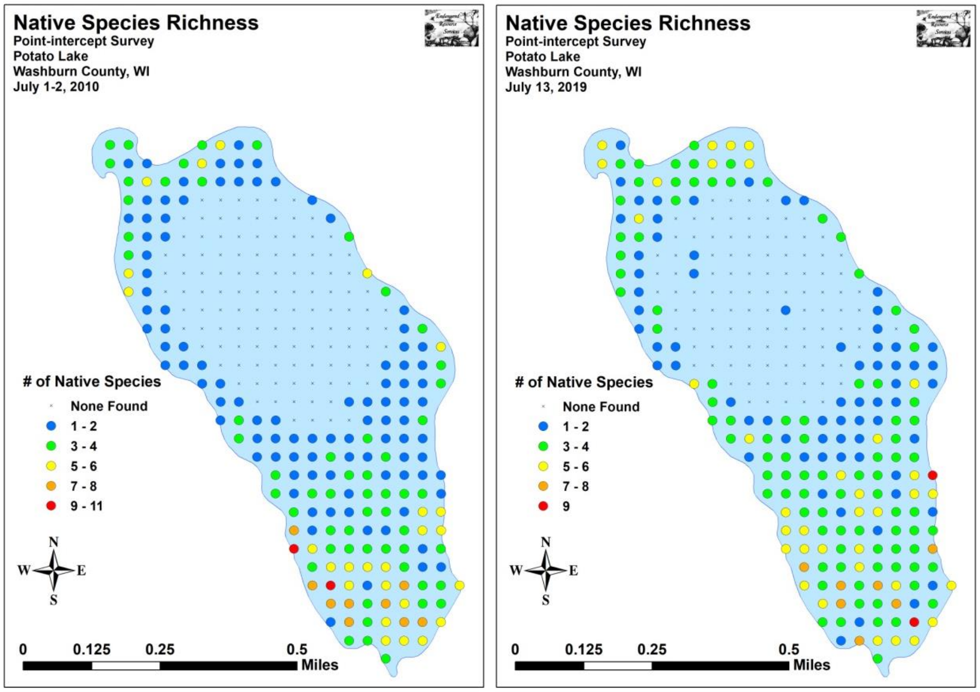


Figure 13: 2010 and 2019 Native Species Richness

While the number of native species per sampling site increased, there was a highly significant decline in total rake fullness ($p<0.001$) from a high 2.30 in 2010 to a moderate 2.03 in 2019 (Figure 14).

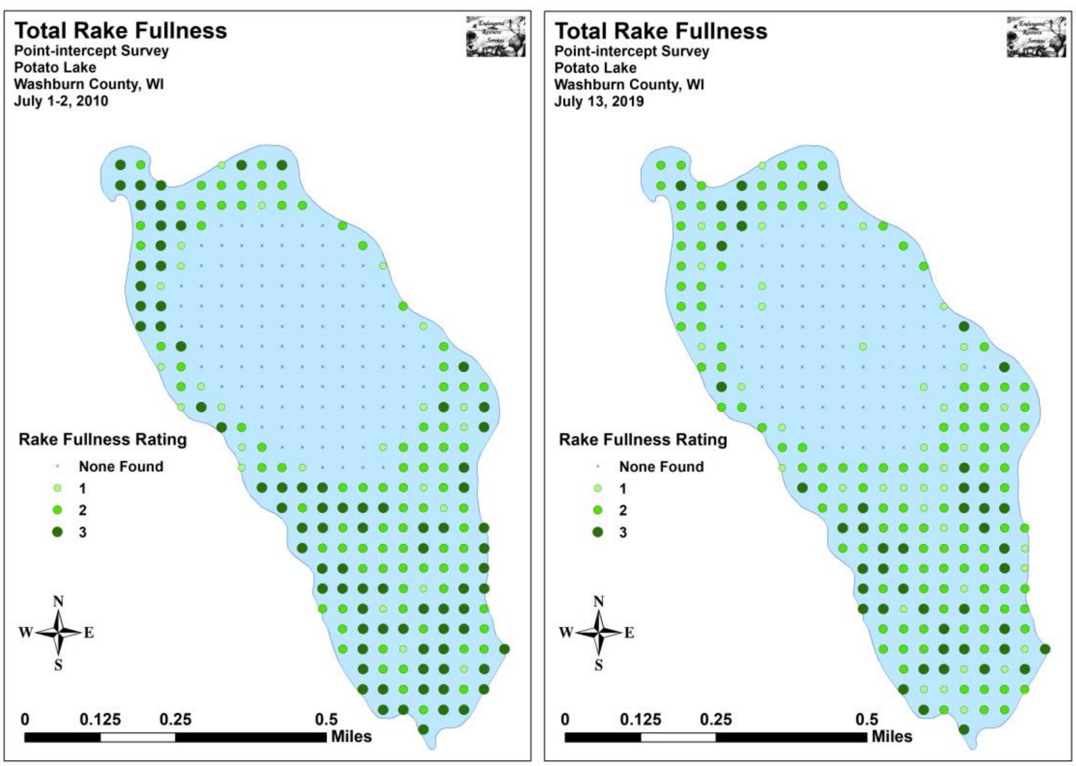


Figure 14: 2010 and 2019 Total Rake Fullness

In July 2019, plants were found growing to 18.0ft (Table 1). The total of 202 points with vegetation (approximately 65.8% of the entire lake bottom and 70.4% of the littoral zone) was up slightly from the 2010 survey plants were found at 189 points (61.5% of the bottom/91.7% of the then 15.0ft littoral zone). Growth in 2019 was slightly skewed to shallow water as the mean plant depth of 7.8ft was less than the median depth of 8.0ft. Both of these values were higher than in 2010 when the mean was 7.3ft and the median was 7.5ft (Figure 15).

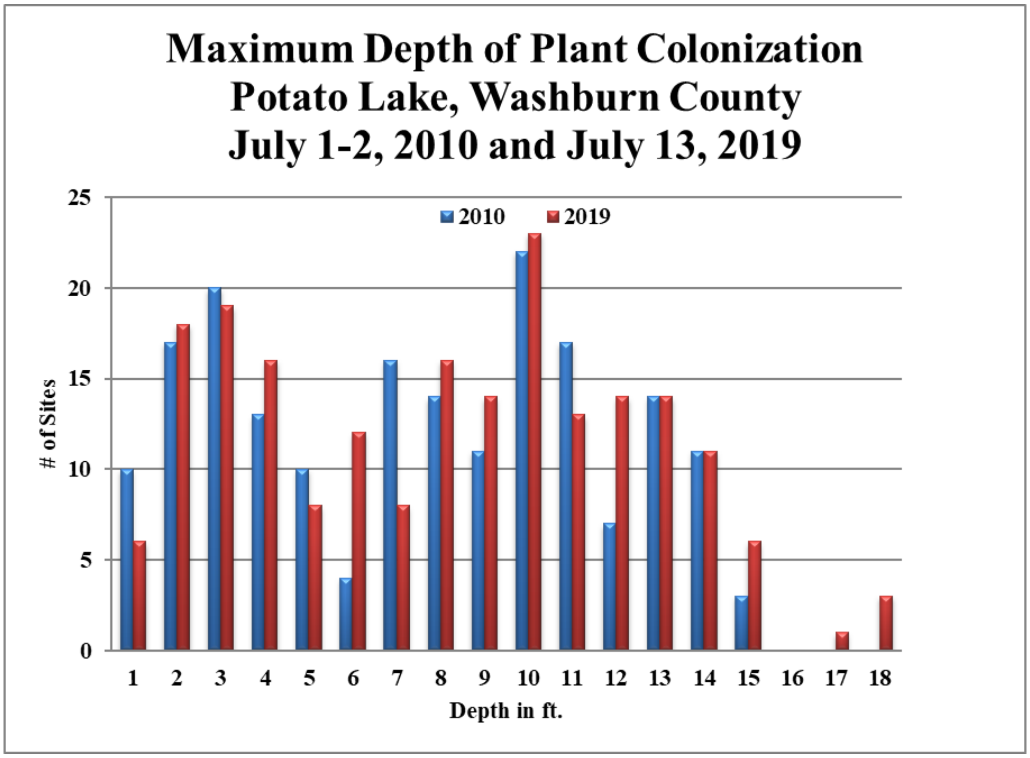
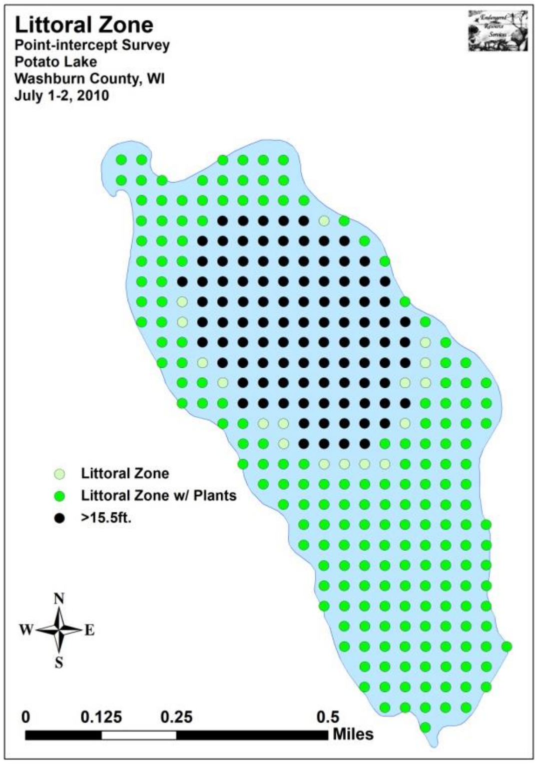


Figure 15: 2010 and 2019 plant colonization depth chart



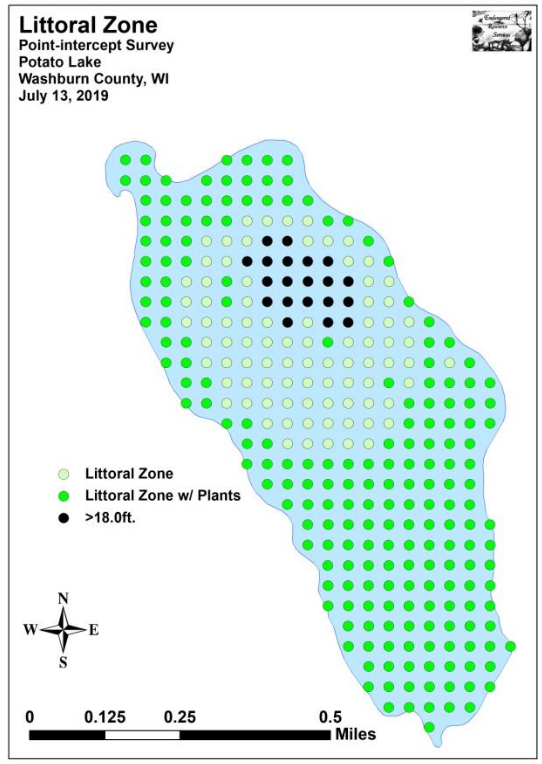


Figure 16: 2010 and 2019 littoral zone

Flat-stem pondweed, Fern pondweed, and White-stem pondweed were the most common macrophyte species in 2019. Found at 68.81%, 56.93%, 38.12%, and 23.27% of sites with vegetation, they captured 55.51% of the total relative frequency. In 2010, Flat-stem pondweed, Fern pondweed, Coontail, and Fries' pondweed were the most common species (77.25%, 37.04%, 33.86%, and 16.40% of survey points with vegetation/55.34% of the total relative frequency). Lake wide, from 2010-2019, seven species showed significant changes in distribution: coontail, filamentous algae, and forked duckweed enjoyed highly significant increases; and white-stem pondweed and common waterweed saw moderately significant increases. Conversely, flat-stem pondweed and northern wild rice suffered highly significant declines.

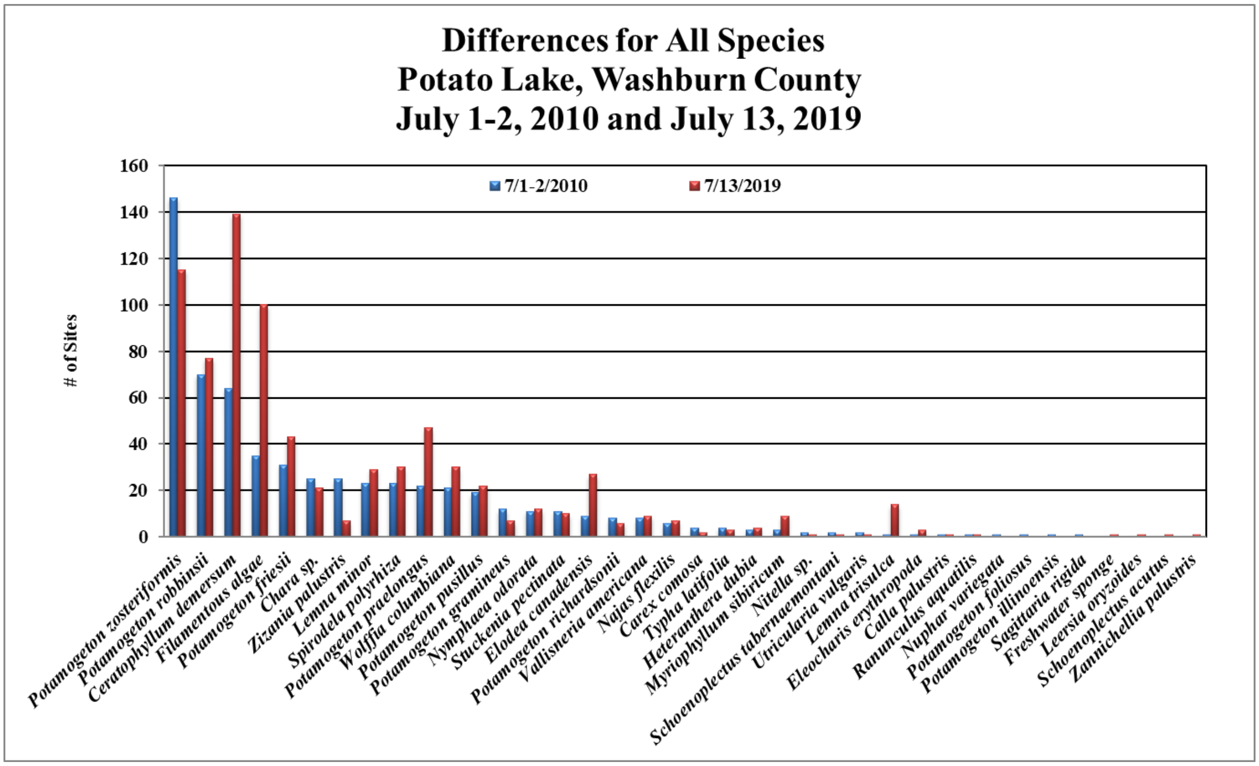


Figure 17: Plant species with significant changes from 2010 to 2019

SIMPSON'S DIVERSITY INDEX

A diversity index allows the entire plant community at one location to be compared to the entire plant community at another location. It also allows the plant community at a single location to be compared over time thus allowing a measure of community degradation or restoration at that site. With Simpson's Diversity Index, the index value represents the probability that two individual plants (randomly selected) will be different species. The index values range from 0 -1 where 0 indicates that all the plants sampled are the same species to 1 where none of the plants sampled are the same species. The greater the index value, the higher the diversity in a given location. Although many natural variables like lake size, depth, dissolved minerals, water clarity, mean temperature, etc. can affect diversity, in general, a more diverse lake indicates a healthier ecosystem. Perhaps most importantly, plant communities with high diversity also tend to be more resistant to invasion by exotic species. In Potato Lake, diversity was quite high in 2019 with a Simpson Index value of 0.90. This was slightly higher than the 2010 survey which had a Simpson Index value of 0.89.

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. Poskin Lake is in the Northern Central Hardwood Forests Region.

In 2010, a total of 33 native index species were identified in the rake during the point-intercept survey. They produced a mean Coefficient of Conservatism of 5.8 and a Floristic Quality Index of 33.6. A total of 31 native index plants were identified in the rake during the 2019 point-intercept survey. They produced a mean Coefficient of Conservatism of 5.8 and a Floristic Quality Index of 32.3. Nichols (1999) reported an average mean C for the North Central Hardwood Forests Region of 5.6 putting Potato Lake just above average for this part of the state. The FQI was also significantly above the median FQI of 20.9 for the North Central Hardwood Forests (Nichols 1999).

WILD RICE

Wild rice is a highly prized and protected emergent plant species in Wisconsin. Any activity included in a comprehensive lake or aquatic plant management plan that could potentially impact wild rice habitat requires consultation with the Voigt Intertribal Task Force. This task force, established in 1983, represents tribes with inland ceded territory treaty rights and is charged with overseeing the management and harvest of treaty resources in the inland ceded territories of Wisconsin, Minnesota, and Michigan (http://www.glifwc.org). This consultation with the Task Force is carried out by the WDNR.

No other native plant approaches the level of cultural, ecological, and economic values embodied by wild rice. Natural wild rice has been hand harvested as a source of food in the Great Lakes region for thousands of years. The Ojibwe people have a special cultural and spiritual tie to natural wild rice. Known as Manoomin, it is revered as a special gift from the Creator. In addition, many immigrants to Wisconsin and Minnesota adopted hand harvesting of natural wild rice as an annual ritual (MNDNR 2008).

Harvesting of wild rice is not limited to tribal members. Any Wisconsin resident may purchase a permit that would allow them to harvest wild rice. Certain restrictions are put in place reflecting select traditional harvesting practices.

The value of natural wild rice to wildlife has been long appreciated by Native Americans and was marveled at by early European explorers. Research has documented that wild rice provides food and shelter for many fish and wildlife species. It is one of the most important foods for waterfowl in North America. More than 17 species of wildlife listed in the MNDNR Comprehensive Wildlife Conservation Strategy as "species of greatest conservation need" use wild rice lakes as habitat for reproduction or foraging. Wild rice harvest has provided important economic benefits to local economies. Wild rice provides other benefits to a water body including tying up available nutrients and stabilizing sediments.

Wild rice is an annual grass species that completes its life cycle in a single season. As it grows, it takes a tremendous amount of nutrients from the sediment. The roots of the plant help to hold sediment in place so they do not get re-suspended in the water causing increased turbidity or dirty looking water. Wild rice stalks provide a place for small plants to attach and grow. These microflorae pull more phosphorous directly from the surrounding water, removing it before algae that can turn the water green can use it. Wild rice also provides a nursery for young-of-the-year fishes and offers protection from predation. This was observed during the 2010 plant survey which noted "schools of young-of-the-year and yearling bluegills, crappies and bass" present in the wild rice. Because of its cultural and ecological significance, wild rice holds special protective status in Wisconsin. Physical removal without a state issued permit is not allowed, even in the 30-ft corridor around docks and swimming areas where removal of other plants is allowed.

Wild rice has been abundant in Potato Lake for many years. A wild rice inventory completed by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) in 1986 lists 30 acres of dense wild rice growth in

Potato Lake (Andryk, 1986). During this inventory, a Wild Rice Suitability Index based on a set of physical waterbody criteria was used on a trial basis to determine the suitability of a waterbody to support wild rice growth. The highest possible score on this criteria checklist was 195. Values from 127 different lake sites on Potato Lake ranged from 91.6 to 166. The higher the index value the greater the expected quality of the rice habitat and the ability of the waterbody to support the growth of wild rice. Potato Lake had an overall index value of 154. The average annual rice harvest from Potato Lake reported to GLIFWC is 21.39 pounds.

More recent history has shown poorer wild rice growing seasons than long term history has documented. There are new threats to wild rice, including more heavy rain events that are damaging in the floating leaf stage of growth, and more disease outbreaks associated with hot, wet, and humid conditions.

Year to year, the heartiness of the wild rice crop is extremely variable. It can vary based on nutrient cycling and water levels as a result of rainfall. Drought years tend to have better wild rice yields. For these reasons, it is difficult to make a management plan based on one year of data alone. Figure 18 shows wild rice abundance in three different years as documented by aerial photography completed by GLIFWC.

Figure 18: A very good crop year, Potato Lake, 2015 (top left); a very poor crop year, Potato Lake, 2019 (top right); and a recovery year, Potato Lake, 2020, no human intervention (bottom).

Figure 19 reflects wild rice recon and mapping results from 2020. These surveys, completed by ERS, documented 15.72 acres of wild rice in three areas. This is still about half of what was documented in 2010, but way more than was documented in 2019, when there were no areas that even could be called a bed of wild rice.

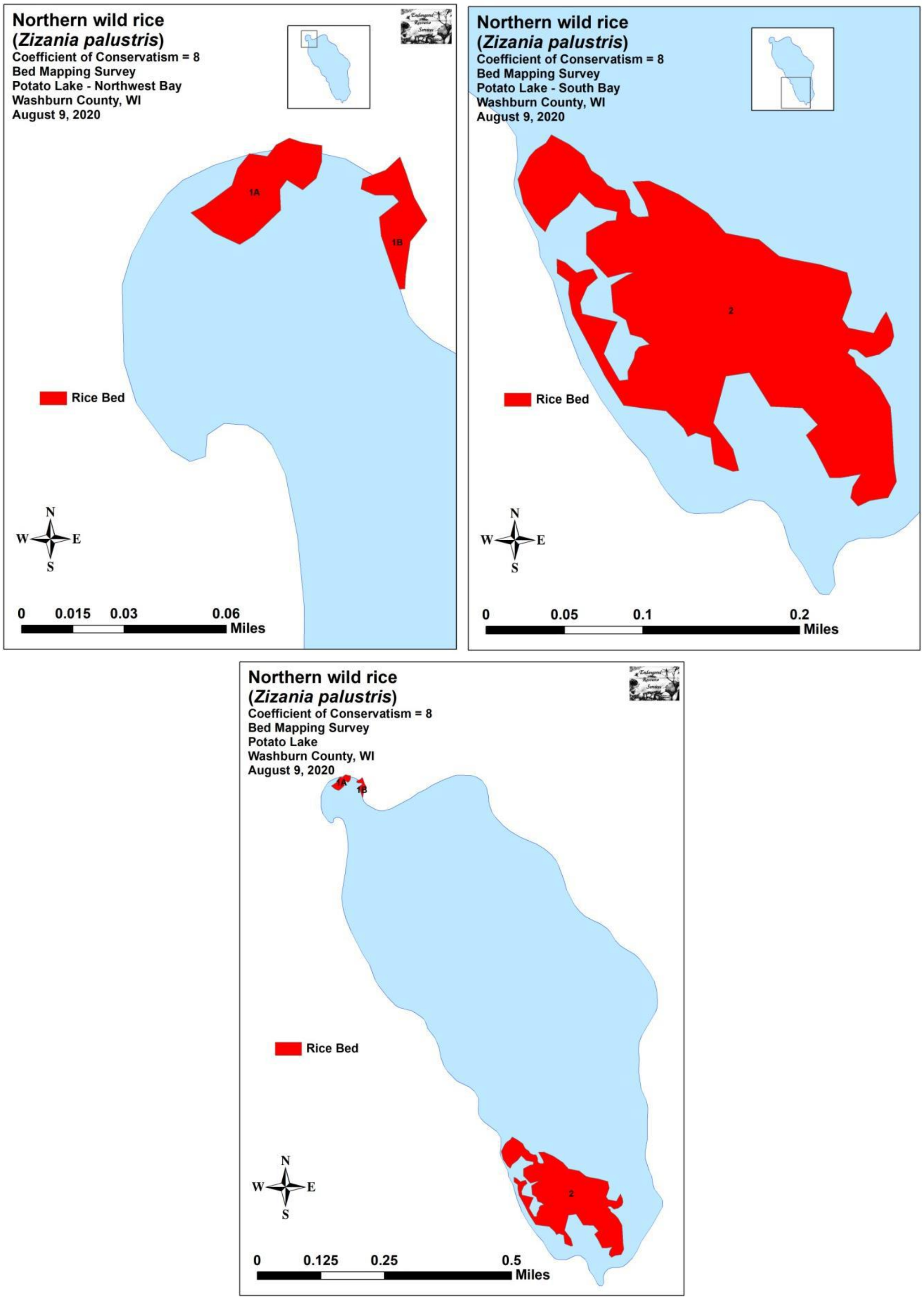


Figure 19: Wild rice beds mapped in Potato Lake in 2020

A survey in 2010 identified about 30 acres of wild rice in the lake. Wild rice beds ranged from sparse to dense and were found in the shallow southern third of the lake. Bed mapping the wild rice in 2019 was not possible as there were no true beds in 2019. A low-density patch in the northwest bay could have potentially been mapped. However, the vast majority of plants were goose cropped, and it was questionable whether many would even set seed. In the south bay, thick mats of filamentous algae seemed to have prevented most rice plants from tipping up. Although rice was peppered throughout, there was no place that could have been considered anything close to a bed. Consequently, there was no place on the lake that had human harvest potential, in 2019. As previously stated, the wild rice was re-surveyed in 2020. Based on a 2020 survey, the rice beds seem to have recovered on their own without human intervention.

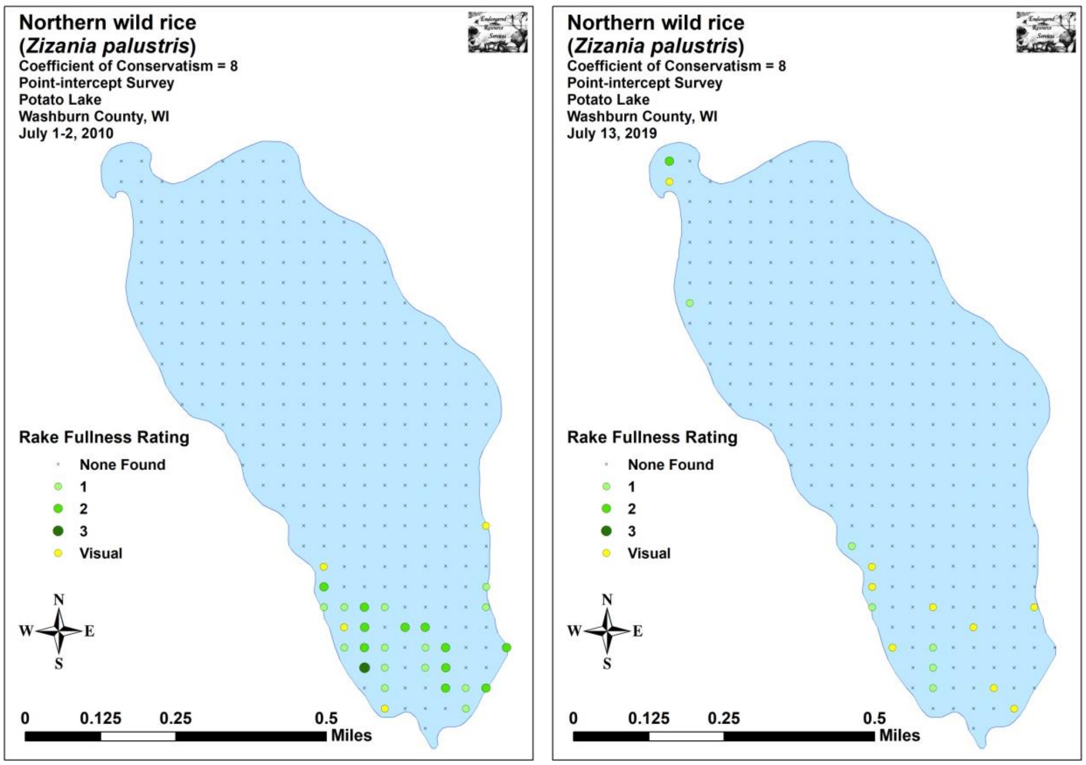


Figure 20: 2010 and 2019 Potato Lake Wild Rice Density and Distribution

Figure 21: 2011 Wild rice on the North end of Potato Lake, 2019

Figure 22: Wild rice on the North end of Potato Lake, 2020

CURLY-LEAF PONDWEED SURVEYS

Curly-leaf pondweed bed mapping occurred in both 2010 and 2019, with none identified in either survey.

AQUATIC INVASIVE SPECIES

Currently, the only aquatic invasive species present within Potato Lake is Chinese mystery snails which were verified by the WDNR in 2014. However, it is important to maintain monitoring and prevention efforts to keep other AIS from being introduced into the lake.

NON-NATIVE, AQUATIC INVASIVE PLANT SPECIES

There are not any non-native invasive plant species within Potato Lake. Reed canary grass can be found in some of the wetlands surrounding Potato Lake. Reed canary grass is a shoreland or wetland plant not generally problematic within the lake, but can be very problematic on the shores and in the wetlands adjacent to the lake. More information is given for each non-native species in the following sections.

CURLY-LEAF PONDWEED (CLP)

CLP is an invasive aquatic perennial that is native to Eurasia, Africa, and Australia (Figure 23). It was accidentally introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant. The leaves are reddish-green, oblong, and about 3 inches long, with distinct wavy edges that are finely toothed. The stem of the plant is flat, reddish-brown and grows from 1 to 3 feet long. The plant usually drops to the lake bottom by early August. CLP is commonly found in alkaline and high nutrient waters, preferring soft substrate and shallow water depths. It tolerates low light and low water temperatures. It has been reported in all states but Maine.

CLP spreads through burr-like winter buds (turions), which are moved among waterways. These plants can also reproduce by seed, but this plays a relatively small role compared to the vegetative reproduction through turions. New plants form under the ice in winter, making CLP one of the first nuisance aquatic plants to emerge in the spring. It becomes invasive in some areas because of its tolerance for low light and low water temperatures. These tolerances allow it to get a head start on and outcompete native plants in the spring. In mid-summer, when most aquatic plants are growing, CLP plants are dying off. Plant die-offs may result in a critical loss of dissolved oxygen. Furthermore, the decaying plants can increase nutrients which contribute to algal blooms, as well as create unpleasant stinking messes on beaches. CLP forms surface mats that interfere with aquatic recreation.

CLP is not found within Potato Lake, but is one of the most common AIS within Wisconsin, so this should still be monitored for regularly. There are several lakes less than ten miles from Potato Lake with CLP including Long Lake, Spooner Lake, Whitefish Lake, and Lac Courte Oreilles.

Figure 23: CLP Plants and Turions

EURASIAN WATERMILFOIL (EWM)

EWM (Figure 24) is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, EWM is difficult to distinguish from Northern water milfoil. EWM has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

EWM grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunistic species that prefers highly disturbed lake beds, lakes receiving nitrogen and phosphorous-laden runoff, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

Unlike many other plants, EWM does not rely on seed for reproduction. Its seeds germinate poorly under natural conditions. It reproduces by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. EWM is readily dispersed by boats, motors, trailers, bilges, live wells, and bait buckets; and can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, EWM is adapted for rapid growth early in spring. Stolons, lower stems, and roots persist over winter and store the carbohydrates that help milfoil claim the water column early in spring, photosynthesize, divide, and form a dense leaf canopy that shades out native aquatic plants. Its ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands of EWM provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of EWM also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by EWM may lead to deteriorating water quality and algae blooms in infested lakes.

Figure 24: EWM fragment with adventitious roots and EWM in a bed

EWM has not been found within Potato Lake, but should still be monitored for regularly. There are several nearby lakes that have EWM. EWM can be found approximately nine miles northeast of Potato Lake in both Whitefish Lake and Lac Courte Oreilles. It can also be found approximately ten miles northwest of Potato Lake in the Trego Flowage.

PURPLE LOOSESTRIFE

Purple loosestrife (Figure 25) is a perennial herb 3-7 feet tall with a dense bushy growth of 1-50 stems. The stems, which range from green to purple, die back each year. Showy flowers that vary from purple to magenta possess 5-6 petals aggregated into numerous long spikes, and bloom from August to September. Leaves are opposite, nearly linear, and attached to four-sided stems without stalks. It has a large, woody taproot with fibrous rhizomes that form a dense mat. By law, purple loosestrife is a nuisance species in Wisconsin. It is illegal to sell, distribute, or cultivate the plants or seeds, including any of its cultivars.

Purple loosestrife is a wetland herb that was introduced as a garden perennial from Europe during the 1800's. It is still promoted by some horticulturists for its beauty as a landscape plant, and by beekeepers for its nectar-producing capability. Currently, more than 20 states, including Wisconsin have laws prohibiting its importation or distribution because of its aggressively invasive characteristics. It has since extended its range to include most temperate parts of the United States and Canada. The plant's reproductive success across North America can be attributed to its wide tolerance of physical and chemical conditions characteristic of disturbed habitats, and its ability to reproduce prolifically by both seed dispersal and vegetative propagation. The absence of natural predators, like European species of herbivorous beetles that feed on the plant's roots and leaves, also contributes to its proliferation in North America.

Purple loosestrife was first detected in Wisconsin in the early 1930's, but remained uncommon until the 1970's. It is now widely dispersed in the state, and has been recorded in 70 of Wisconsin's 72 counties. Low densities in most areas of the state suggest that the plant is still in the pioneering stage of establishment. Areas of heaviest infestation are sections of the Wisconsin River, the extreme southeastern part of the state, and the Wolf and Fox River drainage systems.

This plant's optimal habitat includes marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. It is tolerant of moist soil and shallow water sites such as pastures and meadows, although established plants can tolerate drier conditions. Purple loosestrife has also been planted in lawns and gardens, which is often how it has been introduced to many of our wetlands, lakes, and rivers.

Purple loosestrife can germinate successfully on substrates with a wide range of pH. Optimum substrates for growth are moist soils of neutral to slightly acidic pH, but it can exist in a wide range of soil types. Most seedling establishment occurs in late spring and early summer when temperatures are high.

Purple loosestrife spreads mainly by seed, but it can also spread vegetatively from root or stem segments. A single stalk can produce from 100,000 to 300,000 seeds per year. Seed survival is up to 60-70%, resulting in an extensive seed bank. Mature plants with up to 50 shoots grow over 2 meters high and produce more than two million seeds a year. Germination is restricted to open, wet soils and requires high temperatures, but seeds remain viable in the soil for many years. Even seeds submerged in water can live for approximately 20 months. Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Vegetative spread through local perturbation is also characteristic of loosestrife; clipped, trampled, or buried stems of established plants may produce shoots and roots. Plants may be quite large and several years old before they begin flowering. It is often very difficult to locate non-flowering plants, so monitoring for new invasions should be done at the beginning of the flowering period in mid-summer.

Any sunny or partly shaded wetland is susceptible to purple loosestrife invasion. Vegetative disturbances such as water drawdown or exposed soil accelerate the process by providing ideal conditions for seed germination. Invasion usually begins with a few pioneering plants that build up a large seed bank in the soil for several years. When the right disturbance occurs, loosestrife can spread rapidly, eventually taking over the entire wetland. The plant can also make morphological adjustments to accommodate changes in the immediate environment; for example, a decrease in light level will trigger a change in leaf morphology. The plant's ability to adjust to a wide range of environmental conditions gives it a competitive advantage; coupled with its reproductive strategy, purple loosestrife tends to create monotypic stands that reduce biotic diversity.

Purple loosestrife displaces native wetland vegetation and degrades wildlife habitat. As native vegetation is displaced, rare plants are often the first species to disappear. Eventually, purple loosestrife can overrun wetlands thousands of acres in size, and almost entirely eliminate the open water habitat. The plant can also be detrimental to recreation by choking waterways.

Purple loosestrife has not been found around Potato Lake, but it has been found in several nearby wetlands including those surrounding Cable Lake, Tozer Lake, and several smaller lakes and streams roughly a mile south of Spooner. Monitoring efforts should include purple loosestrife.

Figure 25: Purple Loosestrife

REED CANARY GRASS

Reed canary grass (Figure 26) is a large, coarse grass that reaches 2 to 9 feet in height. It has an erect, hairless stem with gradually tapering leaf blades 3 1/2 to 10 inches long and 1/4 to 3/4 inch in width. Blades are flat and have a rough texture on both surfaces. The lead ligule is membranous and long. The compact panicles are erect or slightly spreading (depending on the plant's reproductive stage), and range from 3 to 16 inches long with branches 2 to 12 inches in length. Single flowers occur in dense clusters in May to mid-June. They are green to purple at first and change to beige over time. This grass is one of the first to sprout in spring, and forms a thick rhizome system that dominates the subsurface soil. Seeds are shiny brown in color.

Both Eurasian and native ecotypes of reed canary grass are thought to exist in the U.S. The Eurasian variety is considered more aggressive, but no reliable method exists to tell the ecotypes apart. It is believed that the vast majority of our reed canary grass is derived from the Eurasian ecotype. Agricultural cultivars of the grass are widely planted.

Reed canary grass is a cool-season, sod-forming, perennial wetland grass native to temperate regions of Europe, Asia, and North America. The Eurasian ecotype has been selected for its vigor and has been planted throughout the U.S. since the 1800's for forage and erosion control. It has become naturalized in much of the northern half of the U.S., and is still being planted on steep slopes and banks of ponds and created wetlands.

Reed canary grass can grow on dry soils in upland habitats and in the partial shade of oak woodlands, but does best on fertile, moist organic soils in full sun. This species can invade most types of wetlands, including marshes, wet prairies, sedge meadows, fens, stream banks, and seasonally wet areas; it also grows in disturbed areas such as bergs and spoil piles.

Reed canary grass reproduces by seed or creeping rhizomes. It spreads aggressively. The plant produces leaves and flower stalks for 5 to 7 weeks after germination in early spring and then spreads laterally. Growth peaks in mid-June and declines in mid-August. A second growth spurt occurs in the fall. The shoots collapse in mid to late summer, forming a dense, impenetrable mat of stems and leaves. The seeds ripen in late June and shatter when ripe. Seeds may be dispersed from one wetland to another by waterways, animals, humans, or machines.

This species prefers disturbed areas, but can easily move into native wetlands. Reed canary grass can invade a disturbed wetland in just a few years. Invasion is associated with disturbances including ditching of wetlands, stream channelization, and deforestation of swamp forests, sedimentation, and intentional planting. The difficulty of selective control makes reed canary grass invasion of particular concern. Over time, it forms large, monotypic stands that harbor few other plant species and are subsequently of little use to wildlife. Once established, reed canary grass dominates an area by building up a tremendous seed bank that can eventually erupt, germinate, and recolonize treated sites.

Reed canary grass is located in a few locations along the shoreland of Potato Lake, but it is primarily found in the wetlands that line Potato Creek.

Figure 26: Reed Canary Grass (not from Potato Lake)

NON-NATIVE AQUATIC INVASIVE ANIMAL SPECIES

Currently, there is only one non-native animal species, Chinese mystery snails, found in Potato Lake. Several additional non-vegetative, aquatic, invasive species are in nearby lakes, but have not been identified in Potato Lake. It is important for lake property owners and users to be knowledgeable of these species in order to identify them if they show up in Potato Lake.

MYSTERY SNAILS

The Chinese mystery snails and the banded mystery snails (Figure 27) are non-native snails that have been found in a number of Wisconsin lakes, including Potato Lake. There is not a lot yet known about these species, however, it appears that they have a negative effect on native snail populations. The mystery snail's large size and hard operculum (a trap door cover which protects the soft flesh inside), and their thick hard shell make them less edible by predators such as rusty crayfish.

The female mystery snail gives birth to live crawling young. This may be an important factor in their spread as it only takes one impregnated snail to start a new population. Mystery snails thrive in silt and mud areas although they can be found in lesser numbers in areas with sand or rock substrates. They are found in lakes, ponds, irrigation ditches, and slower portions of streams and rivers. They are tolerant of pollution and often thrive in stagnant water areas. Mystery snails can be found in water depths of 0.5 to 5 meters (1.5 to 15 feet). They tend to reach their maximum population densities around 1-2 meters (3-6 feet) of water depth. Mystery snails do not eat plants. Instead, they feed on detritus and in lesser amounts algae and phytoplankton. Thus, removal of plants in your shoreline area will not reduce the abundance of mystery snails.

Lakes with high densities of mystery snails often see large die-offs of the snails. These die-offs are related to the lake's warming coupled with low oxygen (related to algal blooms). Mystery snails cannot tolerate low oxygen levels. High temperatures by themselves seem insufficient to kill the snails as the snails could move into deeper water.

A common fear for many lake residents is mystery snails being carriers of the swimmer's itch parasite. In theory they are potential carriers, however, because they are an introduced species and did not evolve as part of the lake ecosystem, they are less likely to harbor the swimmer's itch parasites.

Figure 27: Chinese Mystery Snails (not from Potato Lake)

RUSTY CRAYFISH

Rusty crayfish have not been identified in Potato Lake, but they can be found in several nearby waters including Sand Lake and Lac Courte Oreilles, in Sawyer County, and the Yellow River.

Rusty crayfish (Figure 28) live in lakes, ponds and streams, preferring areas with rocks, logs and other debris in water bodies with clay, silt, sand or rocky bottoms. They typically inhabit permanent pools and fast-moving streams of fresh, nutrient-rich water. Adults reach a maximum length of 4 inches. Males are larger than females upon maturity and both sexes have larger, heartier, claws than most native crayfish. Dark "rusty" spots are usually apparent on either side of the carapace, but are not always present in all populations. Claws are generally smooth, with grayish-green to reddish-brown coloration. Adults are opportunistic feeders, feeding upon aquatic plants, benthic invertebrates, detritus, juvenile fish and fish eggs.

The native range of the rusty crayfish includes Ohio, Tennessee, Kentucky, Indiana, Illinois and the entire Ohio River basin. However, this species may now be found in Michigan, Massachusetts, Missouri, Iowa, Minnesota, New York, New Jersey, Pennsylvania, Wisconsin, New Mexico and the entire New England state area (except Rhode Island). The Rusty crayfish has been a reported invader since at least the 1930's. Its further spread is of great concern since the prior areas of invasion have led to severe impacts on native flora and fauna. It is thought to have spread by means of released game fish bait and/or from aquarium release. Rusty crayfish are also raised for commercial and biological harvest.

Rusty crayfish reduce the amount and types of aquatic plants, invertebrate populations, and some fish populations--especially bluegill, smallmouth and largemouth bass, lake trout and walleye. They deprive native fish of their prey and cover and out-compete native crayfish. Rusty crayfish will also attack the feet of swimmers. On the positive side, rusty crayfish can be a food source for larger game fish and are commercially harvested for human consumption.

Rusty crayfish may be controlled by restoring predators like bass and sunfish populations. Preventing further introduction is important and may be accomplished by educating anglers, trappers, bait dealers and science teachers of their hazards. Use of chemical pesticides is an option, but does not target this species and will kill other aquatic organisms.

It is illegal to possess both live crayfish and angling equipment simultaneously on any inland Wisconsin water (except the Mississippi River). It is also illegal to release crayfish into a water of the state without a permit.

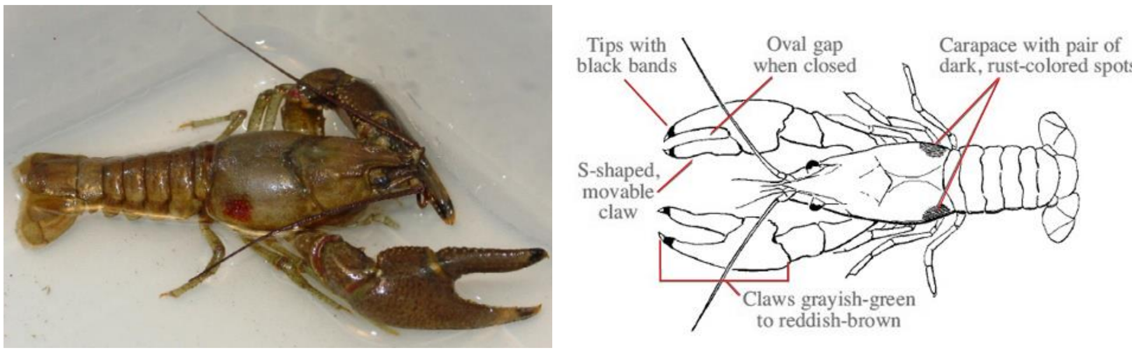


Figure 28: Rusty Crayfish and identifying characteristics

ZEBRA MUSSELS

Zebra mussels have not been identified in Potato Lake.

Zebra mussels (Figure 29) are an invasive species that have inhabited Wisconsin waters and are displacing native species, disrupting ecosystems, and affecting citizens' livelihoods and quality of life. They hamper boating, swimming, fishing, hunting, hiking, and other recreation, and take an economic toll on commercial, agricultural, forestry, and aquacultural resources. The zebra mussel is a tiny (1/8-inch to 2-inch) bottom-dwelling clam native to Europe and Asia. Zebra mussels were introduced into the Great Lakes in 1985 or 1986, and have been spreading throughout them since that time. They were most likely brought to North America as larvae in ballast water of ships that traveled from fresh-water Eurasian ports to the Great Lakes. Zebra mussels look like small clams with a yellowish or brownish D-shaped shell, usually with alternating dark- and light-colored stripes. They can be up to two inches long, but most are under an inch. Zebra mussels usually grow in clusters containing numerous individuals.

Zebra mussels feed by drawing water into their bodies and filtering out most of the suspended microscopic plants, animals and debris for food. This process can lead to increased water clarity and a depleted food supply for other aquatic organisms, including fish. The higher light penetration fosters growth of rooted aquatic plants which, although creating more habitat for small fish, may inhibit the larger, predatory fish from finding their food. This thicker plant growth can also interfere with boaters, anglers and swimmers. Zebra mussel infestations may also promote the growth of blue-green algae, since they avoid consuming this type of algae but not others.

Zebra mussels attach to the shells of native mussels in great masses, effectively smothering them. A survey by the Army Corps of Engineers in the East Channel of the Mississippi River at Prairie du Chien revealed a substantial reduction in the diversity and density of native mussels due to Zebra Mussel infestations. The East Channel provides habitat for one of the best mussel beds in the Upper Mississippi River. Future efforts are being considered to relocate such native mussel beds to waters that are less likely to be impacted by zebra mussels.

Once zebra mussels are established in a water body, very little can be done to control them. It is therefore crucial to take all possible measures to prevent their introduction in the first place. Some of the preventative and physical control measures include physical removal, industrial vacuums, and back flushing.

Chemical applications include solutions of chlorine, bromine, potassium permanganate and even oxygen deprivation. An ozonation process is under investigation (patented by Bollyky Associates Inc.) which involves the pumping of high concentrations of dissolved ozone into the intake of raw water pipes. This method only works in controlling veligers, and supposedly has little negative impacts on the ecosystem. Further research on effective industrial control measures that minimize negative impacts on ecosystem health is needed.

Figure 29: Zebra Mussels

While zebra mussels have not been identified in Potato Lake, they were found in western Washburn County in 2016. This was the first time that zebra mussels had been found in Northwestern Wisconsin. This discovery heightens the importance of monitoring and prevention activities for all northwestern Wisconsin lakes. In 2019, a team of researchers out of the UW- Madison Center of Limnology re-launched the AIS Smart Prevention tool. This tool takes several lake factors, including calcium concentration, into consideration to model lakes that are susceptible to zebra mussel populations. This tool breaks lakes down into suitable, borderline suitable, unsuitable, and no data. Potato Lake considered suitable (Center for Limnology, 2019). This means that if introduced to the Potato Lake, zebra mussels would likely be able to survive and sustain a population.

AIS PREVENTION STRATEGY

Potato Lake currently only has one established AIS, but there are many more that could be introduced to the lake. The PLA has and will continue to implement a watercraft inspection and AIS Signage program at the public access point on the lake. Information will be shared with lake residents and users in an effort to expand the watercraft inspection message. In addition to the watercraft inspection program, an in-lake and shoreland AIS monitoring program will be implemented. Both of these programs will follow UW-Extension Lakes and WDNR protocol through the Clean Boats, Clean Waters program and the CLMN Aquatic Invasive Species Monitoring program.

Additionally, having an educated and informed lake constituency is the best way to keep non-native aquatic invasive species at bay in Potato Lake. To foster this, the PLA should 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.

INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is an ecosystem-based management strategy that focuses on long-term prevention and/or control of species of concern or their damage. 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. Integrated pest management projects should be informed by current, comprehensive information on pest life cycles and the interactions among pests and the environment.

Groups should focus their efforts to keep the species of concern from becoming a problem by looking into the environmental factors that affect the species and its ability to thrive. Once groups understand the species of concern, they can create conditions that are either unfavorable or less beneficial for it.

Monitoring means checking the waterbody to identify what species are present, how many there are and what their impacts are on each other and on water use. Correctly identifying the species of concern and other species in the waterbody is key to knowing whether it is likely to become a problem and determining the best management strategy.

After monitoring and considering the 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. If control is needed, the data collected on the species and the waterbody will also help groups select the most effective management methods and the best time to use them.

The most effective, long-term way to manage species of concern is by using a combination of methods that work better together than separately. 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 on 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 isn't a single solution to species of concern problems. It's a process that combines common-sense methods and practices to provide long-term, economic pest control. Over time, a good IPM program should adapt whenever new information is provided on the target species 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 a group's 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.

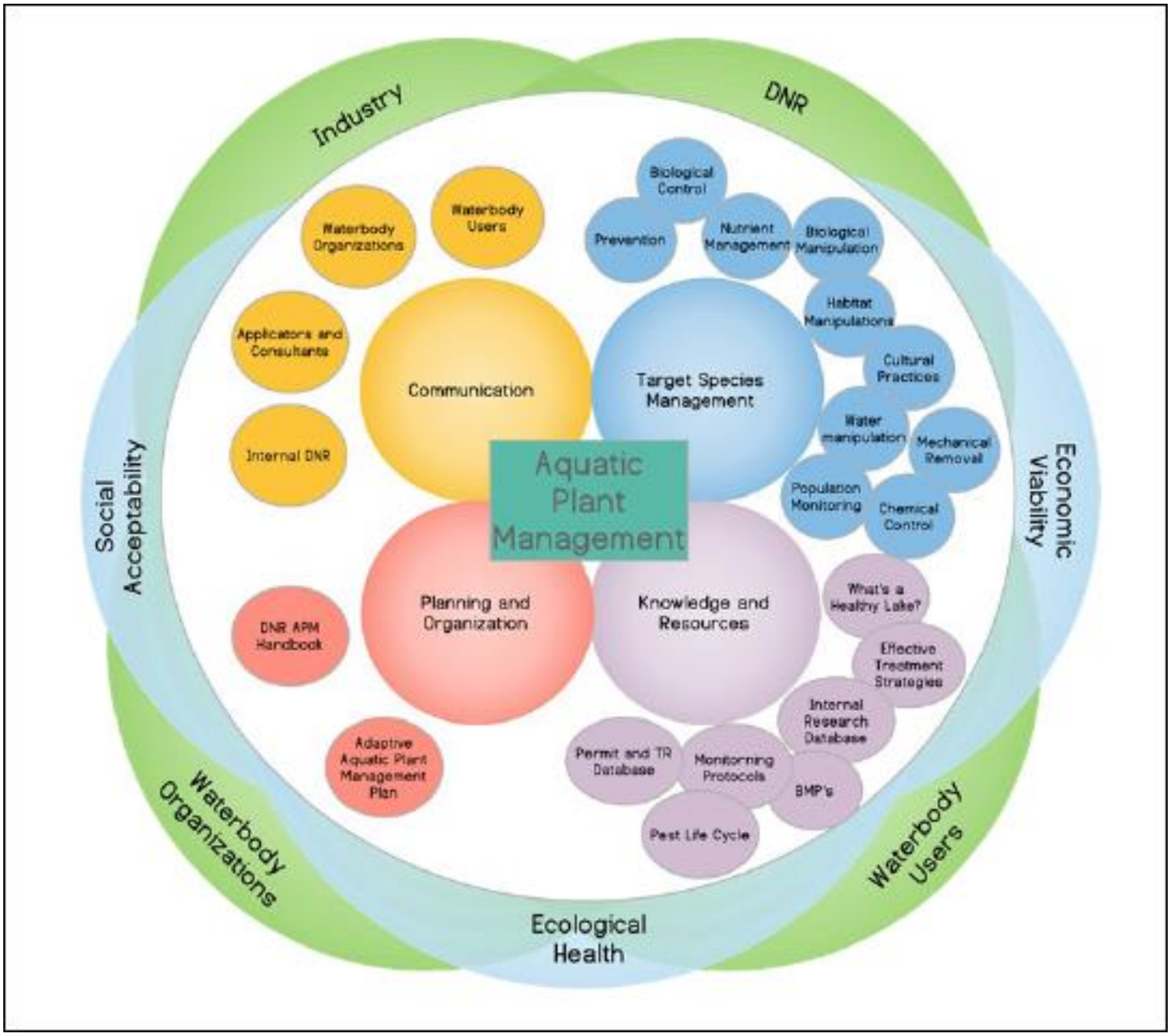


Figure 30: Wisconsin Department of Natural Resources: Wisconsin Waterbodies – Integrated Pest Management March 2020

MANAGEMENT ALTERNATIVES

Nuisance aquatic plants can be managed 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 approach to aquatic plant management that utilizes a number of control methods is necessary. The eradication of non-native aquatic invasive plant species such as EWM or CLP 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, and 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 by the use of herbicides that kill or impede the growth of the aquatic plant. 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 resources. Physical habitat alteration includes dredging, installing lake-bottom covers, manipulating light penetration, flooding, and drawdown. It may also include making changes to or in the watershed of a body of water to reduce nutrients going in.

Each of the above control categories are regulated by the WDNR and most activities require a permit from the WDNR to implement. Mechanical harvesting of aquatic plants and under certain circumstances, physical removal of aquatic plants, is regulated under Wisconsin Administrative Rule NR 109 (Appendix F). The use of chemicals and biological controls are regulated under Administrative Rule NR 107. Certain habitat altering techniques like the installation of bottom covers and dredging require a Chapter 30/31 waterway protection permit. In addition, anytime wild rice is involved one or more of these permits will be required.

Informed decision-making on 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.

In Potato Lake, any aquatic plant management completed would be for native vegetation to improve usability and access for lake users. There are several management techniques, outlined below, that can be used to control native plants within Potato Lake, but it is important to note that none of these management activities can be completed in areas with wild rice. Due to the ecological and cultural significance of wild rice, the State of Wisconsin has very strong protections which bar any form of management of wild rice or the areas where it is present. Regular, incidental boat traffic will generally keep wild rice down in the area where that traffic occurs to allow property owners lake access, but this cannot be done in a way that intentionally wipes out large swaths of wild rice (i.e. driving a boat in a large zig-zag pattern across wild rice beds).

NO MANAGEMENT

When evaluating the various management techniques, the assumption is erroneously made that doing nothing is environmentally neutral. In dealing with nonnative aquatic invasive species like CLP, 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, 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).

There are currently not invasive plant species within Potato Lake, so any plant management that does occur will be done to improve navigation and open water access. This means that no management is a reasonable form of management on Potato Lake, but it is not recommended if there is need to maintain or improve the usability of the lake.

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 Waivers under the following conditions:

- Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured along the shoreline provided that any piers, boatlifts, swim rafts and other recreational and water use devices are located within that 30-foot wide zone and may not be in a new area or additional to an area where plants are controlled by another method (Figure 31)
- Removal of nonnative or invasive aquatic plants as designated under s. NR 109.07 is performed in a manner that does not harm the native aquatic plant community
- Removal of dislodged aquatic plants that drift on-shore and accumulate along the waterfront is completed.
- The area of removal is not located in a sensitive area as defined by the department under s. NR 107.05 (3) (i) 1, or in an area known to contain threatened or endangered resources or floating bogs
- Removal does not interfere with the rights of other riparian owners
- If wild rice is involved, the procedures of s. NR 19.09 (1) are followed.

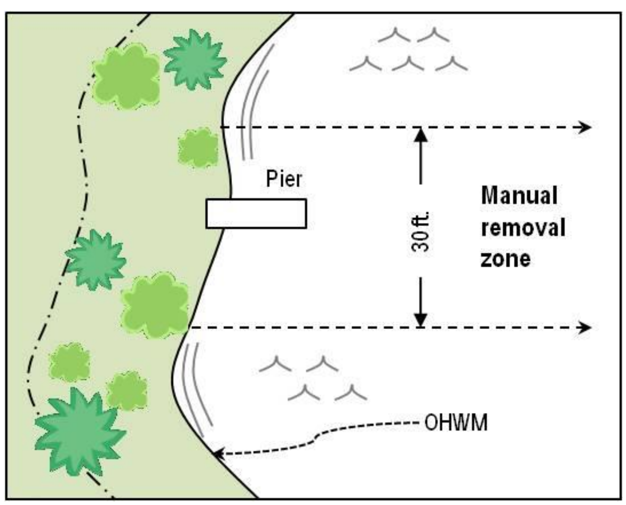


Figure 31: Aquatic vegetation manual removal zone

Although up to 30 feet of aquatic vegetation can be removed, removal should only be done to the extent necessary. 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. Physical removal of aquatic plants requires a permit if the removal area is located 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 aquatic invasive species 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 aquatic invasive species infestation within a lake when done properly.

This type of management can be done by individual property owners, and is recommended as the first management actions when aquatic vegetation adjacent to riparian properties are perceived as a problem.

DIVER ASSISTED SUCTION HARVESTING

Diver assisted suction harvesting or DASH, as it is often called, is a fairly recent aquatic plant removal technique. It is called "harvesting" rather than "dredging" because, although a specialized small-scale dredge is used, bottom sediment is not removed from the system. The operation involves hand-pulling of weeds from the lake bed and inserting them into an underwater vacuum system that sucks up plants and their root systems taking them to the surface. It requires water pumps on the surface (generally on a pontoon system) to move a large volume of water to maintain adequate suction of materials that the divers are processing (Figure 32). Only clean water goes through the pump. The material placed by the divers into the suction hose along with the water is deposited into mesh bags on the surface with the water leaving through the holes in the bag. The bags have a large enough 'mesh' size so that silts, clay, leaves and other plant material being collected do not immediately clog them and block water movement. If a fish or other living marine life is sucked into the suction hose it comes out the discharge unharmed and is returned to the body of water. It can have some negative impacts to other nearby non-target plants if not done carefully, particularly those plants that are perennials and expand their populations by sub-sediment runners (Eichler, Bombard, Sutherland, & Boylen, 1993).

In Wisconsin and Michigan, suction harvesting of unwanted aquatic plants is gaining popularity as a treatment method. There are several companies in the mid-west that are offering DASH services. Some of these companies are also building equipment that lake organizations and consultants can purchase to start up their own DASH program. There is one local company out of the Chippewa Falls, WI area that offers contracted DASH services.

Figure 32: DASH - Diver Aided Suction Harvest (Chuck Druckery, 2016 Wisconsin Lakes Convention Presentation)

DASH is generally intended to control AIS populations that are intermixed with native plants because it allows a certain level of selection to reduce the damage done to the nearby native plants. While this could technically be used to control native plants with a permit in hand, the cost of DASH would outweigh the benefits, so this is not a recommended management action on Potato Lake.

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 permit is required annually. An application for a permit is reviewed by the WDNR and other entities and if required criteria are met, a permit is issued. Using repeated mechanical disturbance such as bottom rollers or sweepers can be effective at control in small areas, but in Wisconsin these devices are illegal and generally not permitted.

LARGE-SCALE MECHANICAL HARVESTING

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water (Figure 33). The size, and consequently the 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.

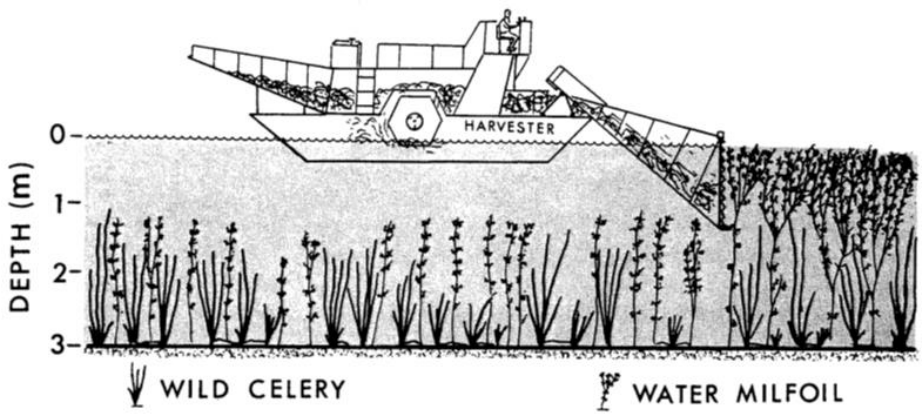


Figure 33: How a Harvester Works *(Engle, 1987)*

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results - open water and accessible boat lanes - are immediate, and can be enjoyed without the restrictions on lake use which follow 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 sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are many environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area. This loss of plants results in a subsequent loss of the functions they perform, including sediment stabilization and wave absorption. Shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole. While the results of harvesting aquatic plants may be short term, the negative consequences are not so short lived.

Harvesting aquatic plants is a little like mowing the lawn, some plants may grow back quickly and have to be harvested again in the same season. This is usually dependent on the amount of use a harvested area gets once harvesting has been completed, particularly when harvesting access channels. If these channels are used frequently by boaters, then they will likely be kept open. If they are not frequented by boaters, the plants will likely grow back. If this happens, it probably means it was not necessary to harvest the channel in the first place, and the benefits of doing so should be reevaluated. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

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 as well as cost.

The PLA could elect to purchase a smaller (five foot cutting head) mechanical harvester if they wanted total control of when harvesting occurs, but this would be very expensive both in terms of up-front costs to purchase the machine as well as long-term maintenance, storage, insurance, etc.. Alternatively, the PLA could contract with a harvesting company. Currently, there is only one local company, based out of Chippewa Falls, that offers aquatic plant harvesting services in Northwestern Wisconsin. The cost of contracted harvesting varies greatly depending on plant density, amount to be harvested. If the PLA can haul harvested plants to a dump site on their own, the final costs for contracted harvesting would be less. The time contracted harvesting could be implemented before its costs outweigh the cost of the PLA purchasing their own equipment has not been determined. If contracted harvesting were implemented for just a year or two, it would help determine overall costs to the PLA and could be compared to purchase of their own equipment.

SMALL-SCALE MECHANICAL HARVESTING

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 (Figure 34) range in prices from $200 for rakes to around $3000 for electric cutters with a wide range of sizes and capacities.

Figure 34: Aquatic Mower & Weedshear Weed Cutter (weedersdigest.com)

Larger cutters exist that can handle bigger jobs, but still don't have the capacity to remove the vegetation that is cut. They do come with a raking attachment that can make it easier to push cut vegetation to shore for easier removal. The Hockney Company out of Delevan, WI makes both a self-contained floating cutter, and a cutter that can be mounted on the front of a boat (Figure 35). More information about Hockney weed cutters can be found at https://weedcutter.com/hockney.

Figure 35: Hockney weed cutters: HC-10H and HP-7

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 aquatic invasive species growth, and cause ecological disruptions.

Small-scale harvesting could be used effectively to manage native plants on Potato Lake, even small, less dense areas. The same equipment could be used for control of dense growth native vegetation. With a small investment to purchase a boat mounted type weed cutter and some rakes, coupled with some volunteer time, and the proper WDNR permits, the areas of greatest impact to navigation could be improved. Kirby Lake is located just north of Cumberland, WI about 30 miles southwest of Potato Lake. A few years ago, the Kirby Lake District purchased a boat-mounted weed cutter and used it to open channels to maintain access from property owners to open water. They required participating land owners to provide some of the volunteer labor needed to remove the vegetation once cut. The PLA would also need to remove cut plants from the lake which would require a disposal site. This would likely be the most effective management option for Potato Lake. The only caveat being that any harvester purchased for use on Potato Lake would not be allowed in areas that wild rice is present.

BOTTOM BARRIERS AND SHADING

Physical barriers, fabric or other, placed on the bottom of the lake to reduce plant growth may provide temporary relief, but also inhibits fish spawning, affects 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 vegetation 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 aquatic plant growth has also been tried with mixed success. The general intention is to reduce light penetration in the water which in turns 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 Potato Lake are not recommended.

DREDGING

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. In Collins Lake, New York the biomass of CLP remained significantly lower than pre-dredging levels 10-yrs after dredging (Tobiessen, Swart, & Benjamin, 1992). 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 particular species with great success except under extenuating circumstances. Very limited dredging is allowed without a permit if certain requirements are met. Normally, dredging should not be performed for aquatic plant management alone. It is best used as a multipurpose lake remediation technique (Madsen, 2000).

Dredging is not a recommended management action for Potato Lake.

DRAWDOWN

Drawdown, like dredging, alters the plant environment by removing 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. 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 first on being able to draw the water down far enough to dewater the areas of most concern; and then 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 reduced. Winter drawdowns are most effective for plants like EWM and lily pads that reproduce from rhizomes and vegetative runners under the sediment. They are much less effective for controlling plants that grow annually from seeds or turions like CLP and other pondweeds. In some cases, pondweed species may actually benefit from a winter drawdown, as competition with other plants species may be reduced following a drawdown. This can aide certain native species like wild rice, but it could also result in CLP doing better in a lake.

There is no logistically feasible way to lower the lake level in Potato Lake, so this is not a recommended management action.

BIOLOGICAL CONTROL

Biological control involves using one plant, animal, or pathogen as a means 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.

Currently, there are no biological controls available for native plant control beyond what naturally occurs in the lake system.

CHEMICAL CONTROL

Aquatic herbicides are granules or liquid chemicals specifically formulated for use in water to kill plants or cease 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. Some individual states, including Wisconsin, also impose additional constraints on herbicide use.

The Wisconsin Department of Natural Resources 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 means that, in most cases, the herbicide will be degraded by the time peak recreation on the water starts. Chemical treatment as a means of controlling native plants is legal in Wisconsin, but not generally permitted by the WDNR except in extreme cases. It is very unlikely that there would be any sort of exception made for Potato Lake due to the presence of wild rice. No form of chemical control is recommended for Potato Lake at this time. The only exception to this would be the use of herbicides to control purple loosestrife – i.e. dabbed on to a cut stem, or wicked directly on plant leaves and stem (see next section).

MANAGEMENT OF PURPLE LOOSESTRIFE USING HERBICIDES

Herbicides may be considered for control of purple loosestrife provided it is "dabbed" on to the cut stem of the plant (Figure 35). This method is carried out by cutting stems of target species within two to four inches of the ground followed by application of herbicide, usually a Glyphosate based solution, to the cut surface. When treating larger stumps (>2 in.) herbicide should be applied to the outer edge of the stump, while smaller stumps (<2 in.) should be treated across the entire top surface. Treatment should occur immediately following cutting to ensure proper absorption of herbicide. A colored dye is usually added to the solution so that it is apparent as to where the herbicide has been applied.

Figure 36: Cut stem or herbicide "dabbing" to control AIS

Another method of herbicide use that could be considered is hand wicking. Hand wicking involves spraying an herbicide solution on an absorbent glove and carefully wiping the herbicide onto the surface of a leaf (Figure 36). It's important to wear an herbicide resistant glove beneath the absorbent glove, to protect your hand from the herbicide. This method is appropriate when controlling small populations of invasive species that are growing in a high-quality area, or when controlling invasive species in close proximity of endangered or threatened native species (https://muskegonlake.org/habitat-management-plan/invasive-species-control/, last accessed on August 6, 2020)

Figure 37: Hand wicking invasive species with herbicide

Herbicides can be a useful tool, and in some cases the only effective control method for certain invasive species. Herbicides fall into two broad categories; selective meaning they are only effective on certain types of plants (ex. Triclopyr based solution), and non-selective meaning they are effective on any plant they come in contact with (ex. Glyphosate based solution). The choice of herbicide depends on the target population, stage of growth, presence of desirable species, and the proximity of water resources. Herbicide treatments should be performed by certified pesticide applicators and applied in accordance with the chemical manufacturer label instructions. Use of herbicides near standing water requires a chemical application permit from the WDNR.

MANAGEMENT DISCUSSION

THE VALUE OF AQUATIC PLANTS

Aquatic plants are an often misunderstood and under-valued part of lakes and rivers. Though many people would rather not have them in their favorite swimming spot or fishing hole, native aquatic plants provide varied environmental benefits to many lakes. Aquatic plants are a food source for many animals. Aquatic plants provide important habitat for small animals like aquatic insects, snails and freshwater shrimp, which in turn supply food for fish and waterfowl. Young fish and amphibians use aquatic plants for cover from predatory fish and birds. Aquatic plants provide important nurseries for young fish, frogs and salamanders. Sturdy emergent plants provide many birds and mammals with material for nests and dens. Humans construct baskets, mats, boats and even dwellings from cattail, rush and bulrush stems. Submersed and emergent plants protect shorelines from erosive wave action or currents. They also help keep sediment on the lake bottom, which increases water clarity. Aquatic plants are a vital part of the complex system of chemical cycling in a lake, and can influence oxygen supply in the water. Aquatic plants can also soak up pollutants from contaminated water. And, if all of that wasn't enough, a diverse healthy native plant community is better able to repel invasion by opportunistic exotic weeds like EWM.

In a review of fish and aquatic plant literature completed by the Food and Agricultural Organization (FAO) of the United Nations in 2000, entitled *Interactions between Fish and Aquatic Macrophytes in Inland Waters, A Review* (Petr, 2000) the following list of aquatic plant characteristics which make them important to fish was referenced:

- Water purification,
- Nutrient recycling,
- Physical link between water and air for many invertebrates,
- Refuge for zooplankton,
- Cover for invertebrates,
- Cover for fish,
- Spawning areas and sites of oviposition (egg laying),
- Direct food source,
- Affect flow patterns favorable for fish, and
- Create discrete habitat and physical structure.

PROBLEMS WITH AQUATIC PLANTS

Plant diversity is a vital key to the overall health of a lake's system. Distribution of plants is nearly as vital. Where issues become apparent is when plant density/growth impedes recreational activities like general lake access, boating, and swimming. When growth becomes very thick, the density can also harm some fish by contributing to low dissolved oxygen levels at night, or by hampering the search for food or avoidance of predators.

While slightly less than 2010, aquatic plant density in 2019 was still >2 on a 1-3 rake fullness value (RFV) (Figure 37). The densest areas of vegetation adjacent to developed shoreline are along the south half of the east shore, along the north shore, and along the northwest shore. There are a few dwellings along the southwest shore as well, but much of this shoreline is in a natural state.

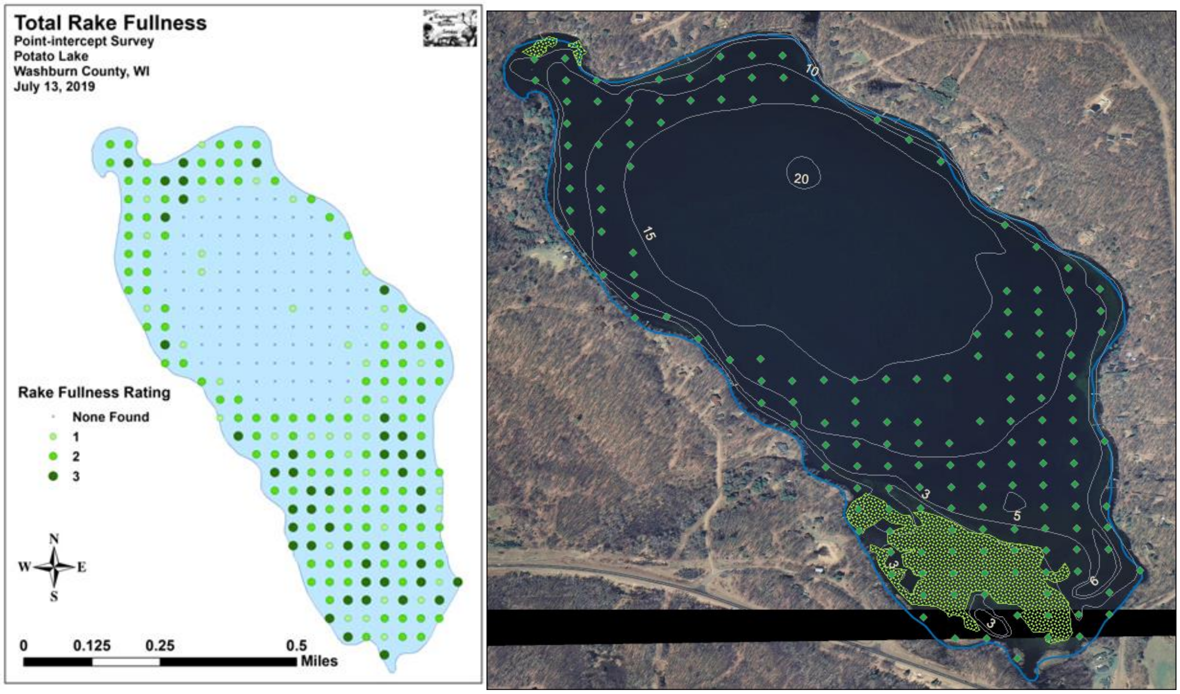


Figure 38: Rake fullness values and developed shoreline. Points in the right photo represent rake fullness values of 2 or 3. Green polygons are wild rice.

In the 2019 PI survey three species were noticeably problematic, particularly along the southeast shoreline: coontail, flat-stem pondweed, and filamentous algae. Filamentous algae is found at the surface of the lake attached to vegetation and other structure (Figure 38). Filamentous algae is both unaesthetic and can cause lake use issues.

Very dense native plant growth is usually caused by an overabundance of nutrients like phosphorus from multiple sources. Increased nutrient levels can accelerate the natural process of lake aging (eutrophication), increasing plant and algal growth. Once nutrients are in a lake, they can persist for decades before being flushed out, fueling plant and algae growth even after nutrient sources outside the lake have been addressed.

Additional problems arise when non-native, invasive plant species get introduced and established in a lake. This often happens when recreational users unknowingly carry plants from one waterbody to another, or when someone discards aquarium plants into a lake. Exotic species like CLP and EWM are aggressive; creating large mats of vegetation that can crowd out more desirable native vegetation and create greater nuisance conditions.

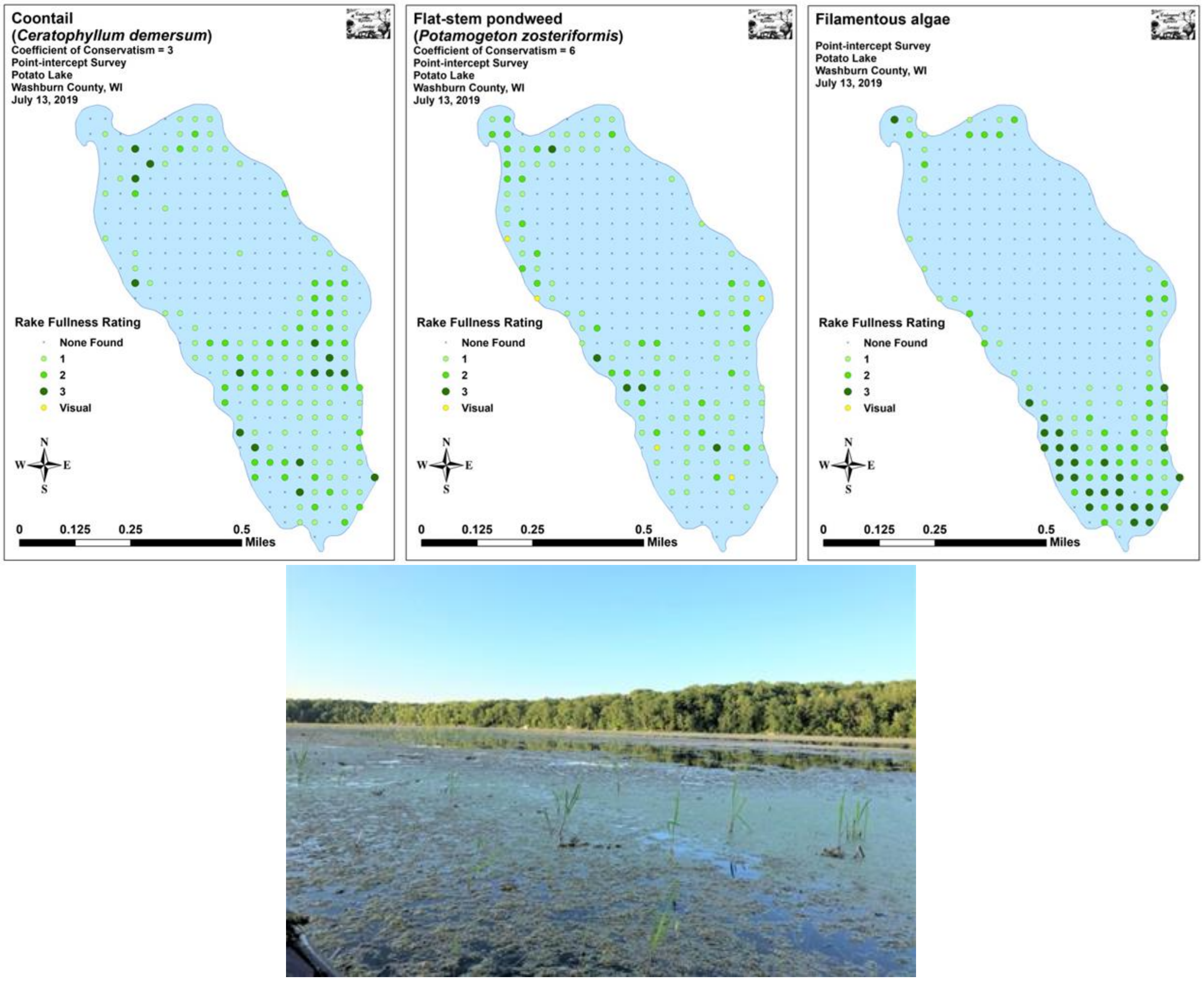


Figure 39: Top: RFV for coontail, flat-stem pondweed, and filamentous algae, Bottom: Mats of filamentous algae in the south bay (ERS, 2020)

AQUATIC PLANT HARVESTING

The need for harvesting on Potato Lake may vary in any given year depending on the level of growth. But if it is implemented, it should be no earlier than late June, and no later than late August, and it should only be in those areas that clearly present nuisance conditions or are interfering with navigation. Any harvesting operations that might be implemented will avoid areas that support the growth of wild rice. Harvesting programs will be focused on improving access to the lake by creating navigation lanes for boat traffic beginning around the 4th of July holiday. Clear-cutting of aquatic vegetation adjacent to riparian shoreline for the purpose of creating weed free areas for swimming or other recreational purposes is not an acceptable use of the mechanical harvester and is not recommended. Landowners, however, are not prohibited from physically removing aquatic vegetation in these areas, provided guidelines presented in NR 109 are followed.

APPLICATION OF AQUATIC HERBICIDES

At this time, there are no invasive aquatic plant species within Potato Lake. The plants that require some form of control are all native species. The WDNR generally will not permit the use of chemical control on native species until all other viable management actions have failed. Very select uses of herbicides like cut-stem application and plant wicking may be acceptable for non-native species like purple loosestrife.

AQUATIC PLANT SURVEYING

Potato Lake has a healthy and diverse native aquatic plant community. Currently, there are no known non-native plants found within the lake, but like non-native plants, 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.

RECON AND MAPPING SURVEYS

Recon and mapping surveys of the littoral zone (plant-growing zone) that look for a specific plant species like CLP or EWM are important as they can be the first indicator that there is something that does not belong. Recon and mapping 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. The PLA should conduct annual recon and mapping surveys each year to look for any new AIS that may be introduced.

PRE AND POST TREATMENT POINT-INTERCEPT SURVEYS

Pre and post-treatment, point-intercept surveys are more quantifiable and document short-term changes in those areas under management. They consist of a set of points that can be surveyed at 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 only requires pre and post-treatment, point-intercept aquatic plant surveying when greater than 10 acres of the littoral zone are proposed for treatment, or if a chemical treatment is grant funded. Pre- and post-treatment survey work will not need to occur in Potato Lake unless an invasive species requiring chemical control is discovered.

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 most lakes from one year to another, management decisions made by humans can also be a reason for change.

The last whole-lake, point-intercept survey of Potato Lake was completed in 2019. The next whole-lake point-intercept survey will need to be completed in 2024 at the end of this current plan.

OTHER AIS MONITORING AND MANAGEMENT

The PLA will participate in CLMN Aquatic Invasive Species Monitoring Program annually looking for EWM, CLP, purple loosestrife, zebra mussels, rusty crayfish, and other AIS not already in the lake. If an AIS is identified in the lake, recognized and approved management actions will be proposed and implemented with Tribal and WDNR approval.

COARSE WOODY HABITAT

Coarse woody habitat was formally quantified within Potato Lake in the fall of 2019 with the highest concentrations of coarse woody habitat being found along the northwestern shoreline and the east-central shoreline. While the addition of new coarse woody habitat structures would likely be most beneficial in the areas currently lacking these structures, any property owner on the lake would be eligible for grant funding through the WDNR Healthy Lakes Initiative. Installations of coarse woody habitat, called fishsticks, can be partially funded with these grants. These installations are a great way to increase wildlife habitat and help reduce shoreline erosion from wave action.

AQUATIC PLANT MANAGEMENT IN POTATO LAKE

The individual aquatic plants found in Potato Lake are not rare or unique, however the overall plant community is. There are no aquatic invasive plant species, wild rice is abundant, filamentous algae is problematic but not in the usual places, certain native plant species that are generally not dominant in most lakes, are dominant in Potato, and much of the vegetation in the lake is covered with marl deposits indicating a high mineral content. While most lakes are fed by ground water, not many lakes have large up-wellings or spring holes that are clearly visible which impacts conditions in the littoral zone.

The uniqueness of this system is also shown by the presence of only the second documented reproducing population in the state of a dragonfly Species of Special Concern in Wisconsin, Pronghorn Clubtails (Figure 37) (Berg, 2010).

Figure 40: Pronghorn Clubtail (Gomphus graslinellus)

In addition, horned pondweed was documented for the first time in a Washburn County lake. While not a threatened or endangered species, or a species of special concern like the dragonfly, it is still an exciting find.

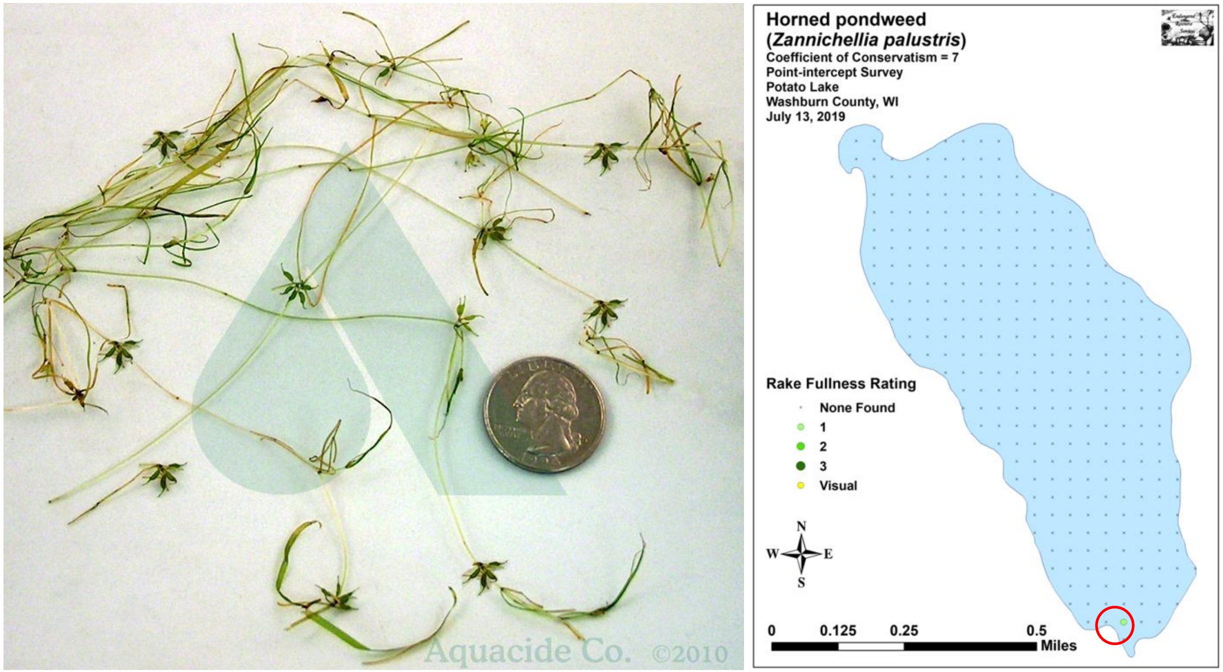


Figure 41: Horned Pondweed and its location in Potato Lake

Aquatic plants are abundant and the diversity of these plants is high as indicated by a Simpsons Diversity Index of 0.89. This value represents the probability that when two plant samples are chosen at random from the lake, they will be different species. A value of zero says the two plants will always be the same, a value of 1 says they will always be different. Any plant management activity should strive to protect and enhance the existing aquatic plant community. Management may be necessary to provide temporary relief from significant nuisance or navigation impairing plant growth but it should be limited and targeted to very small areas that will lessen the overall impact to the entire plant community. Wild rice is the one exception to the need for management. Wild rice will not be the target of any management activity in the lake.

Physical removal by land owners is the best management alternative for problematic plant growth in the lake. Hand-pulling or raking of plants is recommended provided it follows the guidelines in NR 109. Wild rice is again an exception to this recommendation. It is illegal to intentionally remove wild rice from a body of water. Normal boat use can aide land owners in opening navigation lanes to and from docks to open water and is completely legal.

The use of chemical herbicides to control purple loosestrife should be allowed provided it is applied in a manner that will not impact wild rice or any other plant near the one(s) being chemically treated.

Wisconsin does not currently support the use of bottom rollers or surface sweepers for individual property aquatic plant control. Because of the numerous negative effects of these devices, their use is not recommended. One of the best ways for riparian property owners to gain navigation relief near their docks is to use their watercraft on a regular basis.

Large or small scale harvesting with motorized weed cutters on floating rigs is the only recommended native aquatic plant management action other than physical removal. Approximately 1.5 miles of navigation and access to open water lanes are included in a management map. These lanes would be between 10-20 feet wide and cut in water no shallower than 3-ft. They are primarily along developed shorelines with the densest vegetation.

Access channels to be cut that are adjacent to wild rice will be no wider than 10-ft. Navigation channels that are not adjacent to wild rice may be up to 20-ft wide. In any given year, the maximum acreage of harvested vegetation will not exceed 3.6 acres. The average acreage harvested will likely remain under 2.0 acres.

The PLA can decide on an annual basis if they want to pursue mechanical harvesting or not. It is likely the PLA would contract these limited services, rather than purchasing their own mechanical harvester. The other option would be to purchase small-scale cutting equipment and then work with land owners who would supply efforts to remove that which is cut. The amount of vegetation cut and removed would likely not total 1.5 miles using this management method. Any navigation channels that might be cut in this way to improve landowner access to open water would avoid disturbances where wild rice could be impacted.

In either case, a mechanical harvesting permit must be prepared and submitted to the WDNR annually by no later than June 15th with a map showing the areas that are intended to be harvested. Both Tribal and WDNR approval of the permit will be needed.

Having a plan to dispose of the vegetation harvested it extremely important for the success of a harvesting program. The PLA should reach out to membership and/or local land owners to establish a disposal location prior to beginning any harvesting.

Contracted harvesting comes with the possibility of a new AIS being introduced to the lake, so if implemented, increasing the amount of AIS monitoring should accompany it.

The next section defines the goals, objectives, and specific actions recommended in this plan. They are also included in Appendix A. A timeline for implementation is located in Appendix B. This aquatic plant management discussion section is also included as a separate Appendix (Appendix A-1).

POTATO LAKE AQUATIC PLANT MANAGEMENT GOALS, OBJECTIVES, AND ACTIONS

GOAL 1: PROTECT AND PRESERVE THE NATIVE SPECIES COMMUNITY WITHIN AND AROUND POTATO LAKE

Native plant and animal species in a lake are a valuable and vital part of a healthy lake ecosystem. Potato Lake has a number of native plants and animals that warrant special consideration. Wild rice has been and will continue to be a highly valuable resource in Potato Lake. The unique lake characteristics that support the second documented breeding population of the Pronghorn Clubtail dragonfly should be maintained. The local fishery is satisfactory at the present time, but with the potential of winter fish kill it is important to maintain a dialogue with the WDNR. Protecting the overall distribution, diversity, density of the aquatic plant community will help to maintain better water quality, may help keep aquatic invaders at bay, and will help to preserve the uniqueness of the system.

OBJECTIVE 1: MAINTAIN OR EXCEED MEASUREMENTS OF A HEALTHY NATIVE AQUATIC PLANT COMMUNITY OVER THE COURSE OF THE NEXT FIVE YEARS (2022-26).

Table 7: Values to Measure the Health of the Native Aquatic Plant Community in Potato Lake

All Plants	2019
Simpson's Diversity Index (SDI)	0.90
Floristic Quality Index (FQI)	32.3
Total Species Richness including boat survey	42

Action Item: Complete a whole-lake, point-intercept, aquatic plant survey in five years if management actions are implemented.

Action Item: Determine appropriate management actions annually based on management and survey results from the previous year.

- Determine areas to be harvested annually based on where problems exist and if the area has been identified in previous surveys
- Representatives from the PLA and/or a resource professional retained by the PLA will use prior year plant survey results and management results to determine "next year" management actions.

Action Item: Implement aquatic plant management actions that will minimize to the extent possible disruption of the native aquatic plant population and wildlife habitat.

OBJECTIVE 2: MAINTAIN OR IMPROVE MEASUREMENTS OF WATER QUALITY OVER THE COURSE OF THE NEXT FIVE YEARS (2022-26)

Action Item: Continue involvement in the WDNR/UWEX-Lakes CLMN Water Quality Monitoring Program at the Deep Hole location in Potato Lake.

- Collect Secchi disk readings of water clarity and temperature/dissolved oxygen profiles 2-3 times per month May-October.
- Collect total phosphorus and chlorophyll-a through the CLMN expanded water quality monitoring program May-August.

Action Item: Continue dissolved oxygen testing through the winter months to provide information for consideration of future winter aeration projects.

- Maintain a dialogue with WDNR fisheries managers regarding the possibility of winter fishkills.

Action Item: When resources are available, complete total phosphorus and chlorophyll a sampling in September and October.

- CLMN water sampling ends in August, but in many lakes the poorest water quality is in the late summer, early fall.

GOAL 2: REDUCE NUISANCE AND NAVIGATION ISSUES CAUSED BY EXCESSIVE AQUATIC PLANT AND ALGAE GROWTH IN POTATO LAKE.

This plan recognizes that there are areas of Potato Lake that do present nuisance conditions and/or make access to open water from riparian owners difficult. NR 109 sets guidelines for the physical removal of nuisance aquatic vegetation without a permit. Physical removal should always be the first management action attempted to reduce issues caused by dense growth vegetation. In areas where physical removal may be overwhelming, navigation lanes parallel to shore at a depth of at least 3-ft have been identified. In areas where dense growth vegetation extends for several hundred feet out toward open water, a limited number of open water access lanes perpendicular to shore have been identified. In these areas harvesting can be implemented with an approved permit from the WDNR. Permit applications are required annually.

OBJECTIVE 1: PROVIDE SEASONAL RELIEF FROM EXCESSIVE AQUATIC PLANT GROWTH IN THE NEARSHORE AREA ADJACENT TO DEVELOPED SHORELINE.

Action Item: Physical removal of aquatic plants by property owners in shallow areas around docks, lifts, swimming areas, and where wild rice is present.

Action Item: The PLA may purchase weed rakes or cutters for use by property owners and/or consider hiring someone to do physical removal for property owners.

OBJECTIVE 2: CREATE NAVIGATION LANES THROUGH AREAS OF DENSE SUMMER VEGETATION THAT INTERFERE WITH GENERAL LAKE ACCESS AND USE.

Action Item: Implement small-scale mechanical harvesting in pre-designated areas under the following guidelines.

- No more than 3.6 acres of the surface area of the lake will be harvested in any single year.
- Harvesting will only occur in pre-determined navigation lanes in water >3-ft deep
- Harvesting depth in any location will not exceed two-thirds (2/3) of the depth of the water column.
- Lanes will be no more than 20-ft wide, no more than 10-ft wide when adjacent to wild rice.
- Areas to be harvested must be included in a mechanical harvesting permit.
- Harvesting for the specific purpose of removing wild rice is illegal. Incidental take of wild rice will be avoided.
- Harvested material disposal sites will be identified by the PLA and approved by the WDNR.
- PLA representatives will complete an inspection of contracted harvesting equipment prior to it being launched in Potato Lake.
- PLA representatives will be present while contracted harvesting operations are going on to make sure it is done according to an approved plan.

- The PLA will keep records of what plant species are harvested, where they are harvested, and how much is harvested annually.

Action Item: Experiment with different small-scale harvesting methods to determine what the best fit is for Potato Lake.

- Determine the efficiency and effectiveness of different levels of harvesting beginning with rakes and cutters, moving to contracted harvesting, and then possible purchase of mechanical harvesting equipment by the PLA.

GOAL 3: KEEP NEW AIS FROM ENTERING THE LAKE AND EXISTING AIS FROM INCREASING THEIR DISTRIBUTION AND DENSITY.

At the present time Potato Lake is free of aquatic invasive species like CLP, EWM, and purple loosestrife that can negatively impact an aquatic ecosystem. Efforts to prevent these and other non-native aquatic invasive species from getting into the lake through watercraft inspection and in-lake monitoring are paramount to preserving the ecological integrity of Potato Lake. Efforts to educate and inform all lake residents and users need to be continued and repeated on a regular basis.

OBJECTIVE 1: IMPLEMENT ACTIONS TO PREVENT NEW AIS FROM ENTERING AND BECOMING ESTABLISHED IN THE LAKE.

Action Item: Make AIS prevention and constituent education a regular part of PLA annual activities.

- Apply for a CBCW grant to support watercraft inspection annually.
- Maintain current AIS signage and a decontamination station at the landing.

Action Item: Make AIS monitoring of Potato Lake a regular part of PLA annual activities

- Participate in CLMN AIS monitoring.
- Hire resource professionals to complete AIS recon and mapping surveys.
- Complete physical removal of any AIS like purple loosestrife or CLP located during surveys.

OBJECTIVE 2: INCREASE THE LEVEL OF LAKE PROPERTY OWNERS AND LAKE USERS AWARENESS AND KNOWLEDGE ABOUT AIS AND HOW TO IDENTIFY THEM

Action Item: Increase lake user AIS awareness and education by distributing AIS materials, holding workshops, and discussing them at annual meetings and other PLA events.

Action Item: Report findings of suspect AIS to the Washburn County, WDNR, and other resource entities.

GOAL 4: IMPROVE FISH AND WILDLIFE HABITAT, REDUCE RUNOFF, AND MINIMIZE NUTRIENT LOADING INTO POTATO LAKE.

An important part of controlling undesirable aquatic plant growth and the production of algae is reducing the amount of nutrients (mainly phosphorus) that enters the lake. The PLA will promote and encourage the implementation of simple and generally inexpensive best management practices including but not limited to shoreland buffers, rain gardens, diversions, and infiltration trenches to reduce runoff and nutrient loading from the nearshore area.

Trees and other vegetation that naturally fall into a lake or that is intentionally placed in the lake by permit, is known as coarse woody habitat (CWH). CWH provides many benefits to fish and wildlife. Like aquatic vegetation, CWH is essential to the overall health of a lake and should be protected and enhanced, not eliminated. The PLA will provide information about and encourage property owner participation in protecting and/or enhancing CWH.

OBJECTIVE 1: IMPLEMENT AT LEAST ONE HEALTHY LAKES AND RIVERS PROJECT ANNUALLY ON POTATO LAKE.

Action Item: Introduce projects included in the Healthy Lake and River program to property owners on Potato Lake.

- Identify at least one property owner willing to implement a Healthy Lake and Rivers project annually.
- Identify at least three locations for the installation of Fishsticks in the next five years.

Action Item: Apply for at least one Wisconsin Healthy Lakes and Rivers grant in the next five years to support projects that will improve fish and wildlife habitat and reduce runoff into Potato Lake.

GOAL 5: ASSESS THE PROGRESS AND RESULTS OF THIS PROJECT ANNUALLY AND REPORT TO AND INVOLVE OTHER STAKEHOLDERS IN PLANNING EFFORTS.

This APM Plan is not intended to be a static document, but rather a plan that makes room for management changes that still fall under the guise of the stated goals, but that may make attaining those goals easier and more efficient. Call adaptive management, the ability to assess management actions implemented each year and to modify them to better meet stated goals, is a necessary component of management planning. Management actions implemented in each year of this plan will be evaluated for how well they helped meet stated goals and objectives. Small changes will be made automatically if it is determined they will improve outcomes. Larger management changes will be presented to the PLA, WDNR, and other Stakeholders for approval before implementation.

An end of project report summarizing the success and failures after five years of management will be completed. This report will be completed by the PLA and its retainers and shared with property owners, lake users, WDNR, and other Stakeholders. A whole-lake, summer, PI, aquatic plant survey will be completed following the last year included in this plan (2025) following the same procedures that were used in the past PI surveys. Results from all PI surveys will be compared to each other with the results leading to development of the next five years of aquatic plant management in Potato Lake.

OBJECTIVE 1: BUILD AND SUPPORT NEW AND EXISTING PARTNERSHIPS EACH YEAR.

Action Item: The PLA will communicate with local, county, and state entities; schools and local business; clubs and organizations, etc. to generate support for management actions.

OBJECTIVE 2: COMPLETE ANNUAL PROJECT ACTIVITY AND ASSESSMENT REPORTS.

Action Item: The PLA and their Consultant will prepare end-of-year reports summarizing the management actions completed and how they impacted the lake and share/review them with the PLA constituency, partners, and the WDNR.

OBJECTIVE 3: PROVIDE MULTIPLE OPPORTUNITIES AND VENUES ANNUALLY FOR LAKE RESIDENTS, USERS, AND OTHER PARTNERS TO KEEP INFORMED ABOUT MANAGEMENT PLANNING AND IMPLEMENTATION ACTIVITIES.

Action Item: The PLA will distribute annually management planning and implementation information to PLA constituency via newsletters, with social media outlets, at local businesses, and during meetings and other events attended by PLA members.

IMPLEMENTATION AND EVALUATION

This plan is intended to be a tool for use by the PLA to move forward with aquatic plant management actions that will maintain the health and diversity of Potato 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 PLA funds is highly recommended. An Implementation and Funding Matrix is provided in Appendix B. A Calendar of Actions is provided in Appendix C. A sample harvesting plan for navigational purposes is included in Appendix D.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES GRANT PROGRAMS

In 2020, all WDNR surface water grant programs were combined into one new program. Grant funding is still available under several different categories including surface water education and planning, surface water restoration and management, and AIS prevention and management. These sources of grant funding are explained in more detail in Appendix E. Actions in this APM Plan that are eligible for one or more of these funding sources are identified in the Implementation and Funding Matrix, Appendix B.

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Appendix A

Potato Lake APM Plan Goals, Objectives, and Actions

Appendix B

Potato Lake APM Plan Implementation and Funding Matrix

Appendix C

Potato Lake APM Plan Calendar of Actions

Appendix D

Potato Lake Sample Harvesting Map

Appendix E

NR 109

Appendix F

WDNR Surface Water Grants Program

Appendix G

Public Use Survey Report