The Big Portage Lake Adaptive Management Plan

(Town of Land O' Lakes, Vilas County, Wisconsin)

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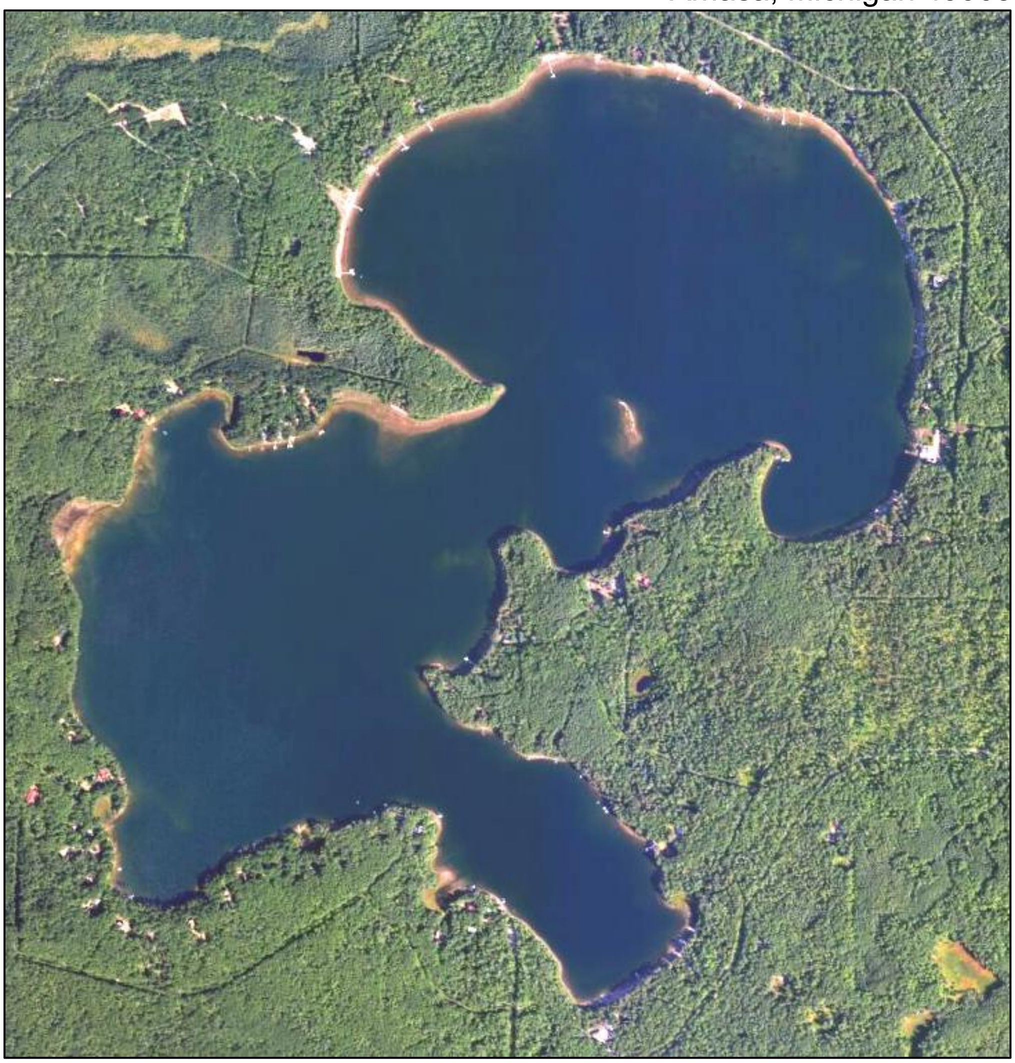

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This document is a product of a WDNR Lake Planning Grant awarded to:

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CHAPTER 1

What Is the Big Portage Lake Adaptive Management Plan?

The *Big Portage Lake Adaptive Management Plan* results from a project funded by a Wisconsin Department of Natural Resources (WDNR) Lake Planning Grant. The project was submitted by the Big Portage Lake Riparian Owners Association (hereby referred to as the BPLROA or Association). White Water Associates, Inc., an independent ecological consulting firm and environmental laboratory, served as a consultant to the BPLROA.

Project participants have adopted the concept of "adaptive management" in their approach to Big Portage Lake stewardship. Simply stated, adaptive management uses findings from monitoring activities to inform future management actions and refinement of plans. An adaptive management plan accommodates new findings by integrating this information into successive iterations of the plan. The plan is a dynamic entity, evolving to fit the needs of Big Portage Lake Stewardship Program and the BPLROA. A central premise of adaptive management is that scientific knowledge about ecosystems is uncertain and incomplete. It follows that a practical management plan allows for ongoing adjustments in management designed to "adapt" to changing conditions and new information or understanding. Monitoring the outcomes of plan implementation is essential to the process of adaptive management. Future monitoring should focus on tangible indicators.

It is appropriate that the Association leads in the implementation of this plan. The BPLROA is comprised of people who care deeply about the lake. Successful implementation of the plan depends on a coalition of stewards, each carrying out appropriate tasks and communicating needs and findings to other participants. Future projects and ongoing monitoring results will inspire updates to the plan. The overall vision of the BPLROA is a healthy, sustainable Big Portage Lake. This adaptive plan is an important tool to realize that vision.

The Big Portage Lake Adaptive Management Plan is the second plan to guide stewardship of Big Portage Lake. In 2012, *The Big Portage Lake Comprehensive Management Plan* was completed. In that document, the BPLROA articulated its mission statement: ***to preserve and protect the natural environment and quality of Big Portage Lake for current and future generations, through continued education and involvement of stakeholders, monitoring of the lake environment, and being prepared to respond to change.*** In 2019, BPLOA board members reaffirmed their dedication to this mission.

Besides this introductory chapter, this plan is organized in seven additional chapters. Chapter 2 describes the audience for the *Adaptive Management Plan*. Chapter 3 addresses why there should be a plan and discusses adaptive management and the underlying assumptions of the approach. Chapter 4 details how the plan was created, including the methods used. Chapter 5 presents the findings from efforts to gather existing and new information about Big Portage Lake and its environs by providing summaries of information in eleven subsections. Chapter 6 (*What Goals Guide the Plan?*) presents the desired future condition and goals established by the BPLROA and the plan writers. Chapter 7 (*What Objectives and Actions Move Us Toward the Goals?*) offers a logical menu of practical management actions ready to be adopted and adapted by those interested in taking an active role in caring for Big Portage Lake and its surroundings. Eleven appendices complete this document. Appendix A contains the *Literature Cited.* Appendix B contains the *Big Portage Lake Aquatic Plant Management Plan (APMP)*. Appendix C presents the *Big Portage Lake Review of Water Quality*. Appendix D includes the *Big Portage Lake Conductivity Survey*. Appendix E is the *Big Portage Lake Shoreland and Shallows Habitat Monitoring Report*. Appendix F encompasses the *Big Portage Lake Fisheries Report*. Appendix G presents the *Big Portage Lake Frog and Toad Survey.* Appendix H is a description of the *Big Portage Lake Bat Survey.* Appendix I provide information about the *Big Portage Lake Aquatic Invasive Survey.* Appendix J consists of the *Big Portage Lake SWOT Analysis.* Finally, Appendix K reviews the *Lake User Survey* for Big Portage Lake.

CHAPTER 2

Who Is the Audience for the Adaptive Management Plan?

The title of Chapter 3 poses the question: "Why Have the *Big Portage Lake Adaptive Management Plan*?" The short answer is "Because we care!" We believe that people working together in the stewardship of this lake can make a difference. We can protect and restore a healthy ecosystem if we take a long-term, strategic approach. That approach is presented in this adaptive plan. It is an adaptive plan in the sense that it will grow and evolve. Implemented actions will be monitored. The plan will be evaluated. It will be reviewed and refined as years go by – as new generations take up their stewardship responsibility.

People who care about Big Portage Lake and its surroundings are the most direct audience for this plan. They will be the implementers and evaluators. They will be the reviewers and future plan writers. Many of them live in or near the watershed. These are the "grassroots" – the constituency most connected to Big Portage Lake. People who care are also those who live beyond the watershed boundaries. Some of these people visit Big Portage Lake for recreation and enjoyment. But the audience also includes foundations and other funding agencies, resource and regulatory agencies concerned with environmental quality, and other citizens that are working on their watersheds.

For those in the "grassroots" camp, this plan is intended to provide a practical approach to carrying out protection and restoration of Big Portage Lake and other regional waters. The plan does not have all the answers (it doesn't even have all the questions). It does not recommend all conceivable rehabilitation or protection actions. But the plan provides plenty with which to get started and it leaves room for ideas and contributions from others. Our recipe mixes a pinch of the theoretical with a cupful of the practical. Those of you who are "hands-on" have plenty to do.

The mixed audience of this plan challenges the authors to present a plan that is scientifically grounded and technically oriented, but at the same time accessible and understandable by the public who will in large part be responsible for its implementation. Although scientists are the primary authors of the plan, the writing is aimed at non-scientists. We define terms where clarity is needed and cite other literature for those interested in the source of a statement, or in learning more about the topic. The BPLROA has interacted with the plan writers throughout the process and reviewed draft components of the plan. The BPLROA has encouraged our practical approach so that applications of the plan are conspicuous.

We will end this chapter with our strongest management recommendation:

Approach lake and watershed management with humility.

Lake and watershed ecosystems are enormously complex. Our understanding of how they work is not complete. This is even truer when aquatic invasive species are part of the mix. Our ability to predict outcomes from specific actions is uncertain. New discoveries are made every day that have important implications for future watershed management. We may never know all we need, but that fact can't stop us from starting work on Big Portage Lake today. The fact that ecosystems are inherently resilient is to our great advantage. They are able to rebound from disturbance and repair themselves from injury. In fact, some of today's best watershed managers state that *"...successful restoration usually has less to do with skillful manipulation of ecosystems than it does with staying out of nature's way"* (Williams et al. 1997). This plan is intended to complement nature's own processes.

CHAPTER 3

Why Have the Big Portage Lake Adaptive Management Plan?

Why create the *Big Portage Lake Adaptive Management Plan*? The gut-level answer ("because we care") was offered in Chapter 2, but the question deserves more thoughtful reflection – the focus of this chapter. This requires consideration of environment, economy, history, and culture. This chapter also defines some important terms and presents the process and underlying assumptions.

Part 1 - Why Should We Care?

The health of a watershed and the health of local economies like those that exist in the Big Portage Lake watershed are highly integrated. A sustainable economy depends on a healthy environment. In fact, all social and economic benefits are based on the biological and physical properties of watersheds (Williams et al. 1997). Our economy should be viewed as being nested inside our environment (Lanoo 1996).

This link between a healthy environment and the economy is true at several scales. For example, most property owners on Big Portage Lake have invested in an ecosystem. The reasons that they have purchased the property are linked to the quality of the environment. The economic value of their investment is linked to the health of lake and surroundings. If ecological health declines, so does the value of the property.

At a slightly larger scale, this same principal linking the environment and economy applies to municipalities. The larger human community is caretaker of many ecosystems including Big Portage Lake. The long-term economic health of the municipality is tied to the health of Big Portage Lake and other lakes and streams in the area. This applies to the Town of Land O' Lakes and Vilas County and, at a larger scale, to the State of Wisconsin.

The BPLROA and this plan aspire to cultivate a deep connection to the lake and its surroundings. It is the people of the watershed that will make the management plan work. Lake and watershed stewardship must be a cultural imperative. In some ways, watershed restoration is about cultural restoration – rejuvenating citizens' civic responsibility to care for the environment in which they live. This is what Aldo Leopold referred to as "...the oldest task in human history: to live on a piece of land without spoiling it" (Leopold 1948).

People need to feel vital by working to improve, beautify, or build. Sometimes that need is expressed by gardening, caring for a lawn, or volunteering on civic projects. The BPLROA and this plan aim to harness that energy and apply it to protection and restoration actions focused on Big Portage Lake and its landscape. Education, rehabilitation, and protection become outlets for this creative energy.

Why should you care about creating and implementing a practical resource plan? Because we realize the economy and the economic options available to citizens in the watershed are tied to a healthy environment. Because we are all connected to the Big Portage Lake landscape in some way. Because we feel a civic responsibility to care for the lake. Because we realize Big Portage Lake potentially affects other lakes. Because we can feel vital by doing meaningful work in the watershed. Because future generations depend on us to hand down a healthy Big Portage Lake ecosystem for them to enjoy.

The adaptive management plan will be successful if it educates citizens and inspires meaningful stewardship work for Big Portage Lake. It needs to make provision for different kinds of approaches and different kinds of people who want to be part of the process. It has to be strategic and integrated so that various actions complement one another, and are consistent with the lake's natural processes. The plan should help avoid management actions that work at cross-purposes or whose outcomes are risky or undesirable.

Part 2 - What Is an Adaptive Management Plan?

An adaptive management process (Walters 1986) is an appropriate model to use in lake and watershed management. In adaptive management, a plan is made and implemented based on the best available information and well-defined goals and objectives. Outcomes of management actions are monitored to ascertain whether they are effective in meeting stated goals and objectives. Based on this evaluation the plan is adapted (modified) in a process of continuous learning and refining.

Adaptive management concedes and confronts a truth that resource managers are sometimes reluctant to acknowledge – uncertainty. Because natural systems are so diverse, so complex, and so variable, almost all management actions will have uncertain outcomes. An adaptive management approach essentially takes a position that says, "We will make our best attempt and get better as we go along. We'll listen to what the natural system tells us." In adaptive management, monitoring is crucial. Adaptive management uses information from monitoring to continually evaluate and refine management practices. Monitoring measures the success of restoration or management. Well-designed monitoring should indicate how effectively management measures are working and give us new insights into ecosystem structure and function. Monitoring should provide needed information to adapt management goals. As stated by Aldo Leopold (1953):

The last word in ignorance is the man who says of an animal or plant, "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering."

The *Big Portage Lake Adaptive Management Plan* can be implemented through five kinds of management actions: protection, rehabilitation, enhancement, education, and research. Research actions have a special subset called "monitoring actions" that serve all of the management actions. Each kind of action is summarized in the following bullets.

- Protection actions are used when high quality areas or ecosystem elements are identified and need to be safeguarded. Since aspects of Big Portage Lake and its surroundings are quite pristine, much of this adaptive management could fall under this kind of action. There are numerous forms that protection actions can take including protecting water quality, conservation easements, buffer zones to prevent runoff into the lake, etc.
- Rehabilitation actions are those that manipulate site-specific elements of ecosystems in order to repair some past impact. Examples include planting lakeside natural vegetation in areas of erosion, placing fish structure where large woody material has been removed from the lake, or healing an area of active erosion. Individual rehabilitation actions contribute to overall lake and watershed restoration.
- Enhancement actions are intended to improve some function or value of the ecosystem. In some cases, these actions are meant to benefit human users of the lake (for example, enhancing recreation values by planting fish or creating new fish habitat).
- Education actions are those that promote stewardship and inform people about natural ecosystems. This includes this management plan as an education piece. These actions include installation of interpretive kiosks or integrating lake biology in science curricula of area schools. Each person that visits the lake represents an educational opportunity.
- Research actions are employed to learn about the system being managed. We often know little about the plants, animals, habitats, ecosystems, and processes that our management actions influence. Research actions on water quality began at Big Portage Lake years ago with basic measures that continue today. Surveys for aquatic plants have contributed to our understanding of the lake's ecosystem. Monitoring actions (a subset of research actions) are those that serve to evaluate the outcomes of protection, rehabilitation, enhancement, and education actions. Monitoring actions guide future management.

A word of caution is warranted. Our society often thinks a long-term planning horizon is one year, but this is out of synch with ecosystem functioning. An ecological clock ticks off time in years, decades, centuries, and millennia. Lake and watershed management and restoration must be viewed from this perspective. In fact, the final outcomes of some of the good work conducted today might not be apparent until a new generation of lake stewards is on the scene.

Part 3 - What Are the Plan's Underlying Assumptions?

As an adaptive plan, a basic assumption is that the management actions will change over time. Through refinement, the plan will more closely reflect the needs of the lake and the people who care about it. This plan assumes a desired condition of sustainable lake health. The plan attempts to reflect the collective vision of the people and organizations that are concerned with the lake. The BPLROA, Vilas County Land & Water Conservation Department, the WDNR, and those living and recreating in the Big Portage Lake watershed are among these stakeholders. The plan also attempts to reflect and foster the intrinsic characteristics and potential of the lake itself.

The Vilas County Land & Water Conservation Department provides a variety of services including: natural resource and water quality protection, invasive species assistance, geographic information, rural addressing, Public Land Survey System, property ownership and tax assessment info and mapping products. This office can provide important assistance in subsequent phases of Big Portage Lake stewardship. The North Central Wisconsin Regional Planning Commission (NCWRPC) created the *Vilas County Land and Water Resource Management Plan 2015-2024* (2014). Vilas County Land and Water Conservation invited participants from a variety of resource protection agencies, interested citizens, and lake groups to discuss and prioritize conservation concerns (NCWRPC 2014). There was also a study that looked at the impact of water clarity on home prices in Vilas and Oneida Counties in Wisconsin and Big Portage Lake was one of the studied lakes (Kemp et al. 2018).

At a larger geographic scale, the WDNR published the *Headwaters Basin Integrated Management Plan* (WDNR et al. 2002) that provides a look at current conditions of resources in the larger drainage basin that includes Big Portage Lake. The Plan outlines issues of concern, including control of exotic species, shoreline development, resource inventory and monitoring, habitat loss, user conflicts, and protection of endangered, special concern, and unique species

The integrating feature of this lake management plan is Big Portage Lake and its surroundings. The plan assumes that proper planning in the beginning will save time and money throughout the life of the program and that this can be accomplished by managing the causes rather than (or at least, in addition to) managing the symptoms of any impairments.

CHAPTER 4

How Was the Big Portage Lake Management Plan Made?

In this chapter, we describe the methods that were employed to accomplish various project tasks and objectives. A team of scientists (White Water) in consultation with the BPLROA prepared this adaptive management plan. The methods that were used followed closely the goals, objectives, and tasks that were described in the grant proposal submitted to the WDNR. We describe these methods in this section under descriptive paragraph headings.

The effort included gathering, reviewing, and summarizing existing information pertaining to Big Portage Lake biota and water quality. Existing information is found in many repositories and forms including anecdotal accounts of residents, resource agency reports and memos, municipal planning and zoning documents, scientific reports, old and new photographs, best guesses of knowledgeable people, and government land office records. Not all of the existing information is of equivalent value in the planning process. Some is not verifiable and the methods by which it was collected are unknown.

Watershed - Big Portage Lake watershed analysis included delineating the Big Portage Lake watershed area, mapping land cover/use and soils of the watershed; and digital elevation models. This information is discussed further in the *Big Portage Lake Aquatic Plant Management Plan* (Appendix B). We used existing layers of geographic information available from the WDNR and other sources and manipulated these data using geographical information system technology. We reviewed and summarized existing institutional programs that influence water quality (for example the *Headwaters Basin Integrated Management Plan*, the *Vilas County Land and Water Resources Management Plan*, and various township zoning ordinances).

Aquatic Plants - An aquatic plant survey was conducted on Big Portage Lake in 2018 by White Water Associates using a point-intercept protocol. Collected data were analyzed and summarized in this plan. The data allow calculation of ecological metrics such as number of sites where a plant species is found, relative percent frequency of species occurrence, frequency of occurrence within vegetated areas, frequency of occurrence at all sites, and maximum depth at which plants are found. The data also allow calculation of metrics such as total number of points sampled, total number of sites with vegetation, total number of sites shallower than maximum depth of plants, frequency of occurrence at sites shallower than maximum depth of plants, Floristic Quality Index, maximum depth of plants (feet), average number of all species per site, average number of native species per site, and species richness. This data and the subsequent analyses were used in the creation of the *Aquatic Plant Management Plan* component (found in Appendix B) of the *Big Portage Lake Adaptive Management Plan*.

***Aquatic Plant Management Plan* -** An important component of this project was our objective to prepare an *Aquatic Plant Management Plan* (APMP) for Big Portage Lake. This involved interpreting and summarizing the Big Portage Lake aquatic plant data for inclusion in the plan. We created an APMP that includes goals, objectives, historical plant management, monitoring, evaluation, plant community, nuisance species or AIS, management alternatives, and recommendations. The APMP is included as Appendix B of this adaptive management plan.

Water Quality - One of our objectives was to gather, consolidate, assess, and manage information about Big Portage Lake water quality and potential risks to water quality. Four tasks were applied to achieving this objective: (1) collect and review existing limnological information about Big Portage Lake, (2) analyze and summarize Big Portage Lake water quality data, (3) assess the existing regimen of water quality sampling for Big Portage Lake and determine appropriateness to lake conditions, and (4) revise (if needed) the water quality sampling regimen for Big Portage Lake as dictated by current information needs. This water quality data provides insight into lake health and is a useful starting point for adaptive lake management. The Review of Big Portage Lake Water Quality can be viewed in Appendix C.

In the 2012 *Big Portage Lake Comprehensive Management Plan*, the water quality-planning tool called the *Wisconsin Lake Modeling Suite* (WiLMS) was applied to Big Portage Lake. The model is comprised of four parts: the setup, phosphorus prediction, internal loading and trophic response (Hassett et al. 2003). The composition of the landscape in terms of percent cover types (forest, agricultural land, urban, and so forth) in large part determines the model's outcomes. This 2012 analysis did not need to be repeated in the current study, since very little change has occurred in the landscape. Nevertheless, the results can be reviewed in the 2012 plan.

White Water did a conductivity study on Big Portage Lake in 2019. Conductivity (sometimes called specific conductance) measures substances dissolved in the water. A lake's natural conductivity is influenced by the geology and soils in the watershed, but areas of relatively high conductivity can be indicators of pollution or faulty septic systems. A report of this study can be found in Appendix D.

Littoral and Riparian Zones – In 2016, the WDNR developed a protocol called *Lake Shoreland and Shallows Habitat Monitoring* (WDNR 2016). It provides a standard methodology for surveying, assessing, and mapping habitat in lakeshore areas, including the Riparian buffer, Bank, and Littoral Zones (WDNR 2016). In 2018, a shoreland and shallow water assessment was conducted on Big Portage Lake. This information will be useful to local and regional resource managers, community stakeholders, and others interested in protecting and enhancing Wisconsin's lakes and rivers (WDNR 2016). Part of the shallow water habitat survey includes documenting woody habitat. White Water biologists conducted an assessment of Big Portage Lake using the protocol. A detailed report can be found in Appendix E.

Fisheries - As part of the adaptive management plan, White Water biologists gathered and summarized information about Big Portage Lake fisheries. This objective was fulfilled by reviewing WDNR fisheries reports and communicating with the Vilas County area WDNR fisheries biologist. White Water biologists summarized this information for inclusion in this adaptive management plan (Appendix F).

Wildlife - As part of this project, frog and toad surveys were conducted near Big Portage Lake in 2018 and 2019. Volunteers were trained to monitor for frog and toad species. Design and procedure of the frog and toad monitoring can be read in the *Big Portage Lake Frog and Toad Survey*, Appendix G of this plan. Also, a volunteer collected bat information that can be found in Appendix H.

Big Portage Lake Attributes and Risks – Another objective was to prepare a catalog of Big Portage Lake environmental, cultural, and aesthetic attributes with a qualitative evaluation of the quality and associated potential threats. This objective included three tasks: (1) Through collaboration with the BPLROA and other Big Portage Lake area stakeholders, list water-related environmental, cultural, and aesthetic attributes and describe each; (2) qualitatively evaluate each of the attributes; (3) identify and describe potential threats to the Big Portage Lake attributes. Appendix J is the SWOT Analysis conducted by BPLROA.

Educational Outreach - A planning objective was to support the educational program efforts where related to Big Portage Lake and other management elements. Toward this end, White Water staff was available for phone consultation with members of the BPLROA and other stakeholders. We endeavored to increase support, capacity, and involvement of the BPLROA and other stakeholders in long-term stewardship of Big Portage Lake through communication of project progress and findings. White Water staff provided a floating workshop involving stakeholders on a pontoon boat field trip on Big Portage Lake to discuss lake ecology, riparian ecology, aquatic invasive species, native plants, and other topics.

Lake User Survey – BPLROA in consultation with White Water staff and WDNR prepared a lake user survey. The BPLROA distributed the survey and analyzed the returned data. These results are presented in Appendix K of this document.

Adaptive Management Plan – A final project objective called for the creation of this initial adaptive management plan for Big Portage Lake that will help ensure high quality lake management and will serve as a firm foundation for future iterations of the plan. The adaptive management plan integrates the *Aquatic Plant Management Plan* with other information about Big Portage Lake and its watershed. This objective was guided by two basic tasks. The first task was to develop management recommendations for Big Portage Lake. These recommendations include topics such as water quality, fish habitat, special species habitat (rare plants and animals), sensitive areas, non-native species, and ecological threats. The second task was to prepare a practical written plan, grounded in science that includes sections on implementation, monitoring, and adaptive management. The plan lays the basis for its expansion in future phases. It will identify where more information is required.

CHAPTER 5

What is the State of Big Portage Lake and its Watershed?

An understanding of the features and conditions of the Big Portage Lake and its landscape is the foundation for developing and implementing strategies that seek to protect and restore the biological health of the area. We have sought information useful to devising the lake's adaptive management plan. Future project phases will collect and incorporate additional information.

This chapter is intended to teach us about Big Portage Lake. What is the lake like? What is the surrounding landscape? What organisms live here? How healthy is the lake? How have humans contributed (or detracted) from that health? Do threats to watershed health exist? This chapter identifies and organizes existing information and reports on new findings.

If you are new to Big Portage Lake, this chapter will make you familiar with existing features and conditions and provide insight as to why things are the way they are. If you are a life-long resident, you may be familiar with parts of the discussion in this chapter. You may have things to contribute or correct. This would be a welcome response. Become engaged! Improve the understanding of the watershed by adding your knowledge in future iterations of this plan.

We present Chapter 5 in eleven Parts, each part reflecting the following topics: the lake and surroundings; aquatic plants; water quality; littoral and riparian zones; fisheries; wildlife; non-native invasive species; regional plans, special attributes, environmental threats, and the lake user survey. Various appendices are referenced from the text.

Part 1. Big Portage Lake and the Surrounding Area

Big Portage Lake is located 8.5 miles southwest of Land O' Lakes (Vilas County). Big Portage Lake has a 6.8 mile shoreline with 586 acres of surface area. No state or federal land surrounds the lake. A boat ramp at the south side allows public access. The lake is developed with permanent homes and cottages, although areas of natural riparian area also exist. In 2017, the Northwoods Land Trust (NWLT) transferred ownership of 8.73 acres of vacant land with 750 feet of lake frontage to the BPLROA. This land, known as the Walllmann-Holzer Nature Preserve, will be maintained in a natural state with a perpetual conservation easement and serves as an example of a natural shoreline for present and future generations and promotes conservation. The property is only accessible by boat and fishing, hiking and wildlife observations are permitted. Exhibit 1 shows the Big Portage Lake area.

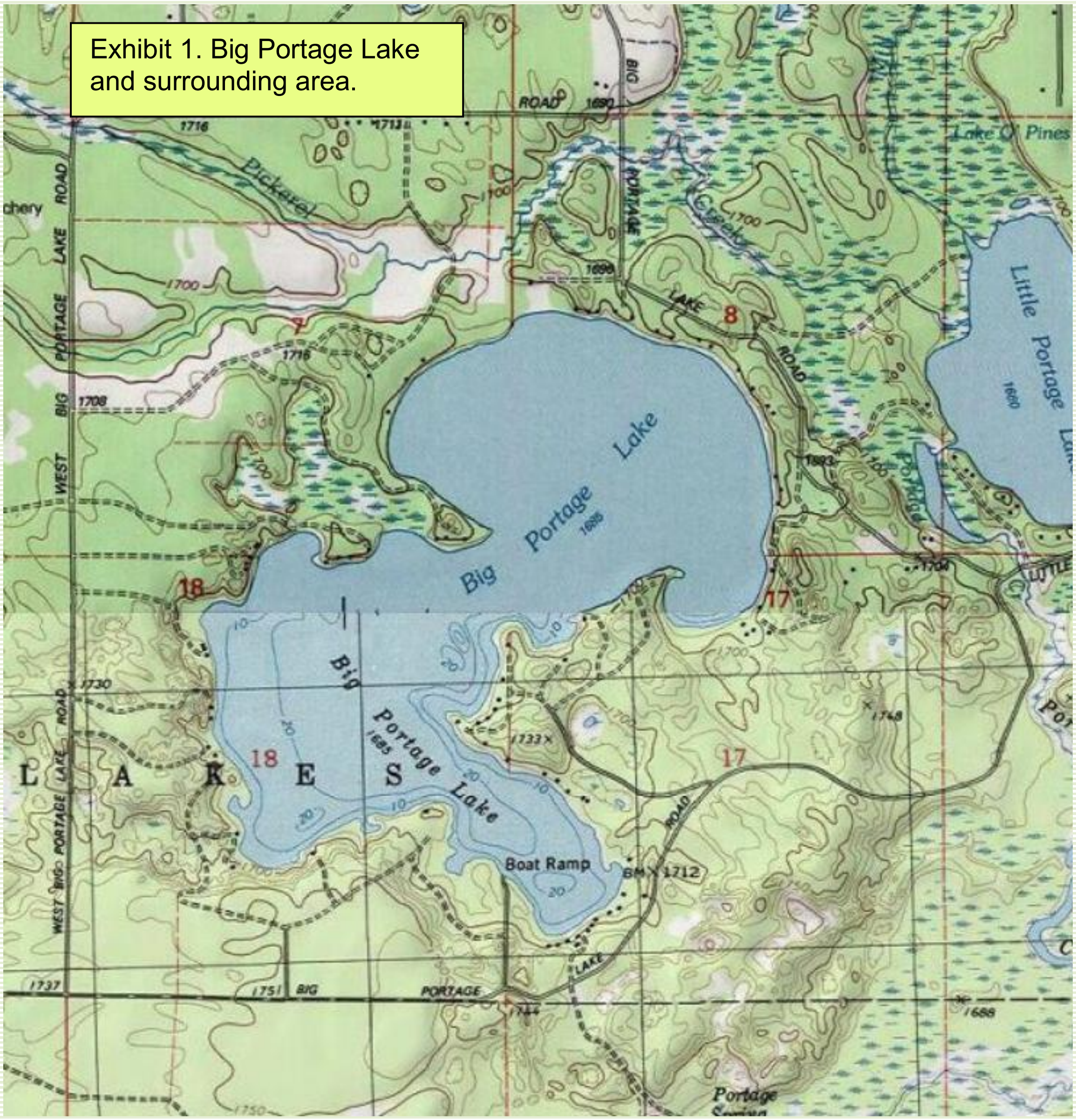

Exhibit 1. Big Portage Lake and surrounding area.

Part 2. Aquatic Plants and Aquatic Plant Management Plan

An aquatic plant survey was conducted on Big Portage Lake in 2018 by White Water Associates and a BPLOA volunteer. The point-intercept aquatic plant survey documented 22 native species. The aquatic plant community is diverse and has a good floristic quality. These topics are discussed in detail in the APMP which also compares results to an earlier plant survey.

Part 3. Big Portage Lake Water Quality

The water body identification code (WBIC) for Big Portage Lake is 1629500. The lake has a maximum depth of 40 feet. Exhibit 2 illustrates the lake bathymetry. The current water quality data support a mesotrophic classification (WDNR 2018; Exhibit 3). Trophic status is assessed using a combination of up to three variables: total phosphorus concentration, water transparency (measured with a Secchi disk), and chlorophyll a concentration. Each of the three variables might indicate a slightly different trophic status, so using three provides more evidence. Trophic status is a continuum of conditions. Big Portage Lake tends to be near the arbitrary border between oligotrophic and mesotrophic. At present the preponderance of evidence causes the WDNR to designate the lake as mesotrophic.

Existing water quality data has been collected since 1989 to present. White Water biologists took additional water samples in 2018. Water quality information is briefly summarized below, but more fully described in Appendix C.

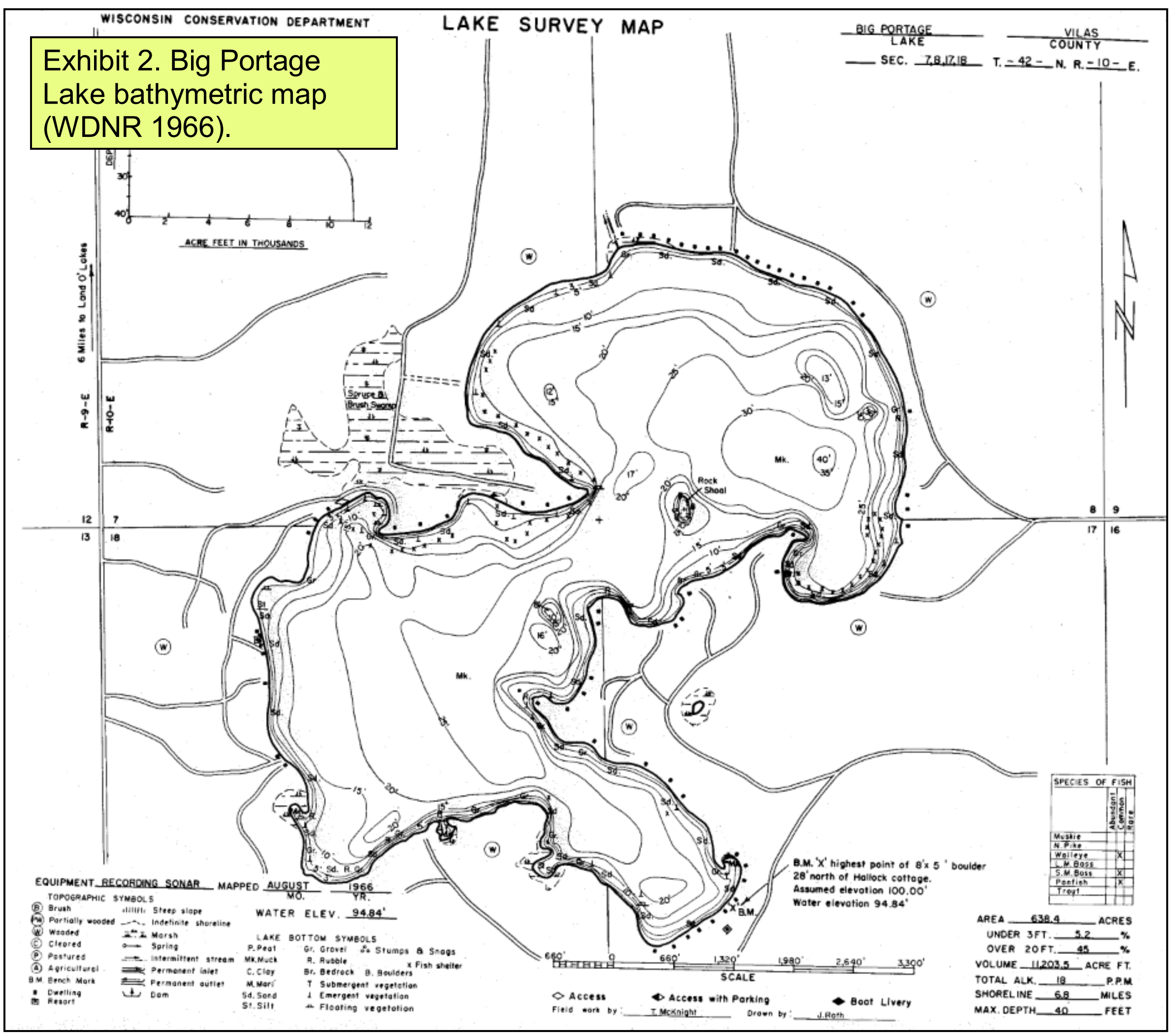

Exhibit 2. Big Portage Lake bathymetric map (WDNR 1966).

Exhibit 3. Trophic Status

***Trophic state** of a lake is an indicator of water quality. Lakes are typically divided into three categories of trophic state: oligotrophic, eutrophic, and mesotrophic.*

***Oligotrophic** lakes are clear, deep, and free of weeds or large algal blooms. They are low in nutrients and do not support large fish populations, but they can develop a food web capable of sustaining a desirable fishery.*

***Eutrophic** lakes are high in nutrients and support large biomass (plants and animals). They are usually either weedy or subject to large algal blooms or both. Eutrophic lakes can support large fish populations, but are also susceptible to oxygen depletion. Small, shallow, eutrophic lakes are especially vulnerable to winterkill.*

***Mesotrophic** lakes are intermediate between the oligotrophic and eutrophic. The deepest levels become devoid of oxygen in late summer and limit coldwater fish. Anoxic conditions at the water-sediment interface causes phosphorus to be released from the sediments.*

Over long periods of time, lakes go through natural aging from oligotrophic through mesotrophic to eutrophic. As part of this process, they begin to fill in. This aging process can be sped up by introductions of sediments and nutrients. (Shaw et al., 2004).

Temperature and dissolved oxygen samples show stratification in Big Portage Lake in the ice-free season. Water clarity is good, with an average summer Secchi reading of 18.6 feet in 2019. The trophic state is mesotrophic. Such lakes (Exhibit 3) typically have an intermediate amount of nutrients. The deepest levels become devoid of oxygen in late summer and limit coldwater fish. Water quality in Big Portage Lake can be classified as "very good" with respect to phosphorus concentrations. Chlorophyll *a* (a measure of the amount of algae in a lake) was below nuisance levels and well below Wisconsin natural lakes. Nitrogen, chloride, sulfate, calcium, hardness, conductivity, magnesium, sodium, and potassium would all be considered low. Alkalinity (a measure of a lake's buffering capacity against acid rain) was also low. The pH is near neutral.

The *Wisconsin Lake Modeling Suite (WiLMS)* was used as a lake water quality planning and education tool for Big Portage Lake in the *Big Portage Lake Comprehensive Plan* (Hoyman et al. 2012). WiLMS is a computer program into which the user enters information about the lake (e.g., surface area, depth, and nutrient measures) and the watershed (e.g., acreage and cover types). The model also has information about average rainfall, aerial deposition of materials, and cover type characteristics that it uses to help predict nutrient (phosphorus) loading scenarios to the lake. WiLMS predicted that most of the phosphorus delivered to Big Portage Lake comes from wetland cover, the most common cover type in the watershed.

In August 23, 2019 White Water biologists conducted a shoreline conductivity study. This study was conducted to determine if areas of high conductivity were present around the lake. For a summary and results of this study, see Appendix D.

Part 4. Big Portage Lake Littoral Zone and Riparian Area

The littoral zone is a critical part in maintaining a healthy lake ecosystem. This zone can be generally defined as the area nearest to a lake's shore in which it is usually shallowest, warmest and where sunlight can penetrate to the bottom. These factors usually allow for aquatic plants to grow. Aquatic plants provide habitat for invertebrates and fish in lakes. They also provide a food source for wildlife species, dampen the impact of waves, and absorb nutrients that would otherwise be used by algae. Bottom substrates also play an important role in the littoral zone. Substrates can include bedrock, cobble, sand, muck and woody material. These substrates provide habitat for invertebrates, amphibians, crustaceans and fish. Not all substrates are suitable for aquatic plant growth

The shoreline development index (SDI) is a metric used to indicate the amount of potentially productive littoral zone habitat relative to the overall acreage of the lake. The SDI is a quantitative expression derived from the shape of a lake. It is defined as the ratio of the shoreline length to the length of the circumference of a circle of the same area as the lake. A perfectly round lake would have an SDI of 1. Increasing irregularity of shoreline development in the form of embayment's and projections of the shore is shown by SDIs greater than 1. The Shoreline Development Index for Big Portage Lake is 2.0. This number indicates that relative to its size, Big Portage Lake has a smaller amount of potentially productive littoral zone habitat compared to a lake with a more convoluted shoreline. Because of the high water clarity and distribution of rooted plants in Big Portage Lake, the productive littoral zone comprises greater than 80% of the lake. This dynamic area drives the productivity of fish in Big Portage Lake and is the reason the lake can support common loons and other fish-eating animals.

Riparian zones make up the area where aquatic and terrestrial ecosystems converge. The riparian area is a structurally diverse and naturally dynamic ecosystem. It is an area where humans put our homes, beaches, and other structures and is quite sensitive to these human-caused changes. Like the littoral zone, the riparian zone provides shelter and food sources for wildlife, and improves water quality by retarding runoff, reducing erosion and absorbing pollutants. Because of this great importance, riparian areas are protected by the Wisconsin Administrative Code. It requires at least 35 feet of land inland from the ordinary high-water mark (OHW) be a vegetative buffer zone (State of Wisconsin Legislature).

In 2016, the WDNR formulated a protocol called *Lake Shoreland and Shallows Habitat Monitoring* (WDNR 2016). It provides a standard methodology for surveying, assessing, and mapping habitat in lakeshore areas, including the riparian buffer, bank, and littoral zone. White Water biologists applied this methodology to assess the shoreland and shallow water habitat of Big Portage Lake in 2018. Part of the shallow water habitat survey included documenting woody habitat (critical fish and invertebrate habitat). A report of the findings can be found in Appendix E. This information will be useful to Big Portage Lake stakeholders to identify areas on Big Portage Lake that would benefit by protection or restoration. On a broader scale, local and regional resource managers, community stakeholders, and others interested in protecting and enhancing Wisconsin's lakes and rivers will make use of these data sets as they are acquired. Exhibit 4 provides some characteristics and functions of the lake shoreline and suggests ways to maintain this important habitat.

Exhibit 4. Lake shoreline characteristics, functions, and protection & restoration strategy

How can healthy shorelines benefit a lake?

- *Help maintain clean water & water quality*
- *Prevent soil erosion*
- *Provide wildlife with habitat & food.*

What does a healthy shoreline look like?

- *Lots of native vegetation*
- *Varying heights of trees, shrubs, & plants*
- *Down dead trees*
- *Signs of wildlife*

How can you maintain a healthy shoreline?

- *Minimize runoff pollution (for example, fertilizers, pesticides, leaky septic systems)*
- *Protect and encourage native plants.*

Part 5. Big Portage Lake Fisheries

Historic official fish stocking data for Big Portage Lake dates back to 1975. Over the years, various fish surveys have been conducted on Big Portage Lake in order to determine fisheries management for the lake. Fish species present in Big Portage Lake have been: panfish, largemouth bass, smallmouth bass, yellow perch, rock bass, and walleye. There were 24,000 walleyes stocked in 1975. Creel surveys were conducted on Big Portage Lake in 1992, 2006, and 2016/17. In 2014 a panfish survey was conducted by Aqua Tech USA and the WDNR conducted a survey in 2016. The WDNR 2016-17 Ceded Territory Fishery Assessment Report included Big Portage Lake. A summary of the results of these surveys can be found in Appendix F.

Part 6. Big Portage Lake Wildlife

For many reasons, lakes attract a variety of wildlife species. Some of these species require a lake as a prime habitat component. Some live in or near the lake permanently. Others species visit only at times in order to obtain crucial resources. Lakes provide food in the form of plants, insects, fishes, and other organisms. Lakes provide breeding and nesting sites. Lakes provide shelter and protection. Some of the wildlife species that use lakes are common (for example, green frogs, painted turtles, tree swallows, belted kingfishers, mink, and raccoons). In contrast, other lake-dependent wildlife species are relatively rare (for example, common loons, bald eagles, and osprey). In this section we provide a list of animal observations made by lake stewards over the period of 2017 to 2019. We provide information about rare organisms in the region. This section references the frog and toad survey (Appendix G) and the bat survey (Appendix H) conducted on Big Portage Lake. We begin this section by focusing on two species (common loon and bald eagle) that represent the quintessential image of a northern Wisconsin lake. These species, when present also provide a strong indication of a healthy lake.

The common loon (*Gavia immer*) is a large bird with spotted black and white body, and a black/iridescent green head. The loon has distinct calls for guarding territories, communicating with other loons, and warding off threats. Loons spend most of their life in the water and can dive up to 250 feet for food (MNDNR 2017). With legs positioned fairly far back on their body, loons are great swimmers, but not good walkers. Perhaps because of this, nests are built close to shore (Cornell 2017). Nests are made of grasses and twigs and are often placed on a small island or isolated point to avoid predators. Under a newly acquired WDNR permit, BPLROA volunteers plan to place an artificial loon nest platform on Big Portage Lake in 2020. Loons are territorial during the breeding and nesting period. A small lake (12-125 acres) can accommodate only a single pair of breeding loons. Larger lakes may have several pairs, with each pair occupying a different section of the lake (Loon Pres. Comm. 2018). LoonWatch, a program of the Sigurd Olson Environmental Institute, has hundreds of volunteers monitoring loon nests and territories throughout Wisconsin. Common loons are often monitored by lake volunteers in Wisconsin as they are fairly easy to observe and nesting success can be determined. Loons are a good indicator of lake health and can serve as a surrogate for other less easy to monitor organisms.

The bald eagle (*Haliaeetus leucocephalus*) is a Wisconsin Special Concern species and is federally protected by the Bald & Golden Eagle Act (WDNR 2013). Bald eagles live near water and eat small animals, carrion, and fish. Eagles create their nests in tall trees, using sticks and other debris. Eagle territories can be 1 to 2 square miles. In Wisconsin, bald eagle nest and territory surveys are conducted by airplane. In 2017, there were 1,590 known bald eagle nest territories occupied by breeding adults, the highest number ever recorded (NHI 2017).

Big Portage Lake stewards submitted observations of animals observed near the lake from 2017 to 2019. These anecdotal data were provided to BPLOA board members and conveyed to White Water Associates for incorporation in the Adaptive Management Plan (Exhibit 5).

Exhibit 5. Animals reported by Big Portage Lake Stewards 2017 to 2019

Animal	Frequency Reported	Animal	Frequency Reported
Bats	XXXX	Belted Kingfisher	X
Black Bear	XXXX	Common Loons	XXXXX
Black Bear cubs	XX	Nuthatch (unidentified)	XXX
Beaver	XXX	Osprey	X
Eastern Chipmunk	XXX	Owl (unidentified)	XX
Cougar	XXX	White Pelican	X
Coyote	XXX	Purple finch	X
Whitetail Deer	XXXXXXXXX	Raven	XX
Gray Wolf	XXXXX	Robin	X
Gray Squirrels (black variant)	XXX	Ruby-throated Hummingbird	XX
Flying Squirrel	X	Gull (unidentified)	XX
Gray Squirrel (gray variant)	XXXX	Trumpeter Swans	X
Red Squirrel	XXX	Downy Woodpeckers	X
Red Fox	XXXXX	Pileated Woodpecker	XXX
Gray Fox	X	Hairy Woodpecker	X
Moose	X	Turkeys	XXXXXX
Muskrat	XX	Snake (unidentified)	X
River Otter	XXXX	Eastern Garter Snake	XX
Porcupine	XXX	Painted Turtle	X
Raccoon	XXXXX	Snapping Turtle	XXXXXXX
Skunk	XXXXX	Frogs (unidentified)	XX
Blue heron	X	Northern Leopard Frogs	X
Blue Jays	X	American Toad	XX
Black-capped Chickadee	XX	Fish (unidentified)	XX
Common Crow	XX	Minnows (unidentified)	X
Ducks (unidentified)	XXX	Northern Pike	X
Mallard	XX	Rock Bass	X
Common Merganser	XXXXXX	Smallmouth Bass	X
Black Duck	X	Walleye	X
Bald Eagle	XXXXX	Yellow Perch	X
Canada Geese	XX	Leeches	XX
Gold Finches	X	Mystery snail	X
Rose-breasted Grosbeak	X	Native crayfish	X
Ruffed Grouse	X	Native mussels	X

Other rare species and communities exist near Big Portage Lake. The Wisconsin Natural Heritage Inventory (NHI) lists these rare species and communities (Exhibit 6 shows).

Frog and toad surveys were conducted along the Big Portage Lake shoreline in 2018. Specific listening points were selected by lake stewardship volunteers with local knowledge of the lake. Volunteers then surveyed these sites and recorded species and counts. The field data was conveyed to White Water Associates for analysis and reporting. Results of the Big Portage Lake frog and toad survey can be viewed in Appendix G.

Exhibit 6. Rare Species and Communities located near Big Portage Lake (NHI 2020).

Common Name	*Scientific Name*	*State Status**	*Group Name*
Bald eagle	*Haliaeetus leucocephalus*	SC/P	Bird
Boreal chickadee	*Poecile hudsonicus*	SC/M	Bird
Calypso Orchid	*Calypso bulbosa*	THR	Plant
Common Nighthawk	*Chordeiles minor*	SC/M	Bird
Spruce Grouse	*Falcipennis Canadensis*	THR	Bird
Wood Turtle	*Clyptemys insculpta*	THR	Turtle
Connecticut Warbler	*Oporornis agilis*	SC/M	Bird
Boreal Chickadee	*Poecile hudsonicus*	SC/M	Bird
Northeastern Bladderwort	*Utricularia resupinata*	SC	Plant

* **END**=Endangered; **THR**=Threatened; **SC**=Special Concern; **SC/P**=fully protected; **SC/N**=no laws regulating use, possession or harvesting; **SC/H**=take regulated by establishment of open/closed seasons; **SC/FL**=federally protected as endangered or threatened, but not so designated by DNR; **SC/M**=fully protected by federal and state laws under Migratory Bird Act (WDNR 2017).

The Wisconsin Turtle Conservation Program is a WDNR monitoring program designed to promote effective conservation of turtles. In 2019, BPLROA volunteers placed turtle crossing signs on roads around the lake at intersections of roads and creeks to protect turtles moving across roads. In 2020, volunteers are being encouraged to cover turtle nests with wire cages in an effort to limit predation on the eggs and newly hatched turtles.

Part 7. Big Portage Lake Aquatic Invasive Species

Prior to White Water Associates' studies on Big Portage Lake, the WDNR website listed the rusty crayfish (documented in 2001) as the only AIS in the lake. A White Water biologist and Big Portage Lake volunteers monitored the lake for AIS on September 17, 2018 (report in Appendix I). The rusty crayfish and the banded mystery snail were documented during this survey. White Water staff also documented purple loosestrife, reed canary grass, and the aquatic forget-me-not during other work on the lake. The University of Wisconsin-Madison's Aquatic Invasive Species Smart Prevention program classifies Big Portage Lake as "unsuitable" for zebra mussels, based on calcium and conductivity levels (UW-Madison). This means that, if introduced, zebra mussels likely not to become established as a viable population in Big Portage Lake. AIS information is more fully interpreted in Appendix I.

Part 8. Strategic Planning Session for Big Portage Lake

On August 31, 2019, the Big Portage Lake Grant Planning Committee met for a strategic planning session. During that meeting, a SWOT analysis (SWOT stands for strengths, weaknesses, opportunities, and threats) was conducted for Big Portage Lake and its stakeholders. The result if this effort can be reviewed in Appendix J. As historic background for Big Portage Lake, a 56 page history of the lake can be found online at http://www.bigportagelake.org/.

Part 9. Big Portage Lake Area Special Attributes

The BPLROA might consider developing a description of specific environmental, cultural, and aesthetic attributes for the immediate watershed along with an assessment of the threats to the quality of these attributes. These could be included in future iterations of the Big Portage Lake Adaptive Management Plan. One possible organization structure for these attributes could follow Redding (1973) and include three categories: (1) environmental (ecological), (2) cultural and (3) aesthetic. Some resources may display all three conditions and others may contain only one. More complete definitions (Redding, 1973) of the three categories are as follows:

1. Environmental (ecological) attributes are components of the environment and the interactions among all its living and nonliving components that directly or indirectly sustain dynamic, diverse, and viable ecosystems. Included are functional and structural aspects of the environment.
2. Cultural attributes are evidence of past and present habitation that can be used to reconstruct or preserve human lifeways. Included are structures, sites, artifacts, and environments.
3. Aesthetic attributes are perceptual stimuli that provide diverse and pleasant surroundings for human annulment and appreciation. Included are sights, sounds, scents, tastes, and tactile impressions.

The first two attributes (ecological and cultural) are more tangible than the third but aesthetic attributes are important when it comes to how people feel about a feature and are compelled to protect a feature or otherwise act as stewards. The importance of preserving aesthetic resources is emphatically expressed in the National Environmental Policy Act 1969 that requires the "Federal Government to use all practicable means ….. (to) …. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings… and to… preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice" (NEPA Sec. 101 (b) (2, 4)). Aesthetic quality is a subjective attribute. Something that has high aesthetic value for one person may not receive the same consideration from another. Some hold high aesthetic value in a manicured lawn where others prefer a more natural ground cover. Aldo Leopold (1948) expresses his love for nature and its beauty and the need for a land ethic to protect natural beauty and “quality of life.”

As has been outlined in various parts of this Adaptive Management Plan, Big Portage Lake is a high-quality ecosystem with respect to water quality, aquatic plants, fish community, and wildlife habitat. These attributes combine to influence a high aesthetic quality. The next part outlines some of the potential environmental threats to Big Portage Lake and its surroundings.

Part 10. Environmental Threats to Big Portage Lake

As outlined in the previous part, the Big Portage Lake watershed ecosystem has numerous attributes of high ecological and aesthetic significance. These attributes combine to help make Big Portage Lake a unique and special place. Big Portage Lake and its surroundings, however, are subject to environmental threats from a variety of sources. We outline some of these threats in this part of the Big Portage Lake plan. In addition, respondents to the lake user survey (See Part 11 and Appendix K) provided several specific perceived threats to the lake (see Exhibit 7).

Exhibit 7. Threats to Big Portage Lake identified by respondents to the lake user survey and SWOT analysis.

People who responded to the Big Portage Lake User Survey identified concerns regarding threats to the lake. Threats were also discussed in the SWOT analysis (Appendix J). These concerns included:

- Aquatic Invasive Species (AIS)
- Potential AIS contamination from renters using homes on the lake
- Increased human activities on the lake (Jet skis, fireworks)
- Decrease in fishery
- Overharvest of fish
- Degraded water quality
- AIS introduction by dock installers
- Watershed changes – loss of natural shoreline and new development.

Recreational pressure – Big Portage Lake is a recreational lake used by people from near and far. An expanding base of admirers will result in increasing recreational pressures. Increased traffic in and out of the lake increases opportunities for AIS, fuel spills, and other pollution. The lake user survey revealed that 20% of respondents use their boats on other water bodies in Wisconsin indicating a high potential for transfer of AIS.

Development pressure – Big Portage Lake has some areas of residential development as well as areas with predominantly natural vegetation and broad riparian areas. In some areas of the lake, old-style lawns, cropped short and in close proximity to the shore indicate a need for educational effort to inform residents about more ecologically friendly waterfront vegetation. Likewise, well-intended activities meant to "clean up" the shoreline or shallow water of the lake diminish the habitat quality for invertebrates and fish and could be addressed with some targeted education.

Water quality inputs – The water quality and aquatic ecosystem functioning of Big Portage Lake is affected by all inputs of water (groundwater, precipitation, streams, and overland runoff). All of these sources have potential to carry pollutants of various kinds to Big Portage Lake. The small watershed of the lake means that pollution sources are restricted to those near the lake. Big Portage Lake has good water quality and a long record of water quality monitoring.

Non-point source pollution – Surface runoff from the land, roadways, parking lots and other surfaces flows into Big Portage Lake. This runoff carries with it sediment, nutrients (for example, from fertilizers) and contaminants (for example, oils, salts, herbicides) that can have detrimental effects on the Big Portage Lake ecosystem. Known as non-point source pollution (because it does not emanate from a discrete point like an effluent pipe from an industrial site), this kind of runoff can come from lawns, agricultural fields, clear-cuts, and impervious surfaces (for example, roads and paved areas). Sometimes the impact is physical, such as sediment covering gravel spawning areas. Sometimes it is chemical such as excess phosphorus from lawn fertilizers that might invoke an algal bloom. This type of pollution can be best controlled through education and protection of riparian buffers (natural vegetation near the waterways that absorb the pollutants before they reach the water). The small watershed of Big Portage Lake focuses attention of lake stewards who want to minimize non-point source pollution to the area very near the lake.

Aquatic invasive species – Non-native plant and animal species have become an important concern for aquatic, wetland, and terrestrial ecosystems. As more populations of aquatic plant and animal invasive species become established in lakes and streams in the region, the likelihood of additional AIS coming to Big Portage Lake increases. The lake user survey indicated that Big Portage Lake users have some knowledge of AIS present in Vilas County and a few were able to identify AIS. When it comes to non-native aquatic plant invaders, the best defense against establishment is a healthy community of native plants. A diverse native plant community presently exists and is an important factor resisting aquatic invasive plant species establishment. Effective education and diligent monitoring are important factors in avoiding establishment of aquatic invasive species. Once established, an AIS plant species might simply become part of the plant community and not cause demonstrative negative impact. Alternatively, an AIS plant might go through a period of rampant growth and cause recreational or ecological stress.

Riparian ecosystem integrity – Healthy riparian areas (the naturally vegetated land near the water) provide numerous important functions and values to Big Portage Lake. For example, they serve as habitat for many species, contribute important habitat to the lake (e.g., large wood), filter out non-point source pollution from entering the lake, and armors the shores against erosion. Educating riparian owners around Big Portage Lake as to the importance of riparian areas is crucial to the maintenance of these critical areas.

Littoral zone ecosystem quality – Much of the productivity of a lake comes from the shallow water areas known as the littoral zone. This is where plants grow, invertebrates live, fishes spawn, and aquatic birds and mammals spend much of their time. The presence of good aquatic vegetation, diverse substrate, and dead woody material (logs and branches) is crucial to this littoral zone ecosystem. Sometimes the human temptation is to “clean up” these areas, but in fact this process diminishes the habitat quality greatly. As mentioned above, removing native aquatic vegetation runs the risk of providing space (habitat) for non-native invasive plants to establish. It is important to educate landowners and others about how to protect the littoral zone from degradation. Piers and swimming areas impact the littoral zone as well, but can coexist with a quality shallow water habitat if kept to a reasonable level.

Habitat degradation of nearby aquatic and wetland habitats (ponds, streams) – The wetland habitats, streams, small lakes, and ponds in the vicinity of Big Portage Lake all potentially contribute to the high quality of the lake. These smaller ecosystems should not be overlooked in terms of their importance and therefore deserve some special attention. One of the first protective measures to take is to identify where these features are and characterize their size and ecological composition. This informs future protection and restoration efforts.

Part 11. Lake User Survey

In order to maintain the high quality condition of Big Portage Lake, input from the public is needed. This input helps us to understand the needs, knowledge base, concerns and desires of people who use Big Portage Lake. In this regard, a survey was created and distributed to riparian landowners and BPLROA members . The results of this survey are available as Appendix K.

CHAPTER 6

What Goals Guide the Big Portage Lake Adaptive Management Plan?

"Protect the Best and Restore the Rest" has become the credo of successful watershed managers across the country. This simple phrase acknowledges that watershed management is more than identifying the worst areas and trying to rehabilitate them. It recognizes that of equal or greater importance is identifying those areas that are of high or moderate quality in the watershed and establishing mechanisms to maintain that quality. "Protect the Best and Restore the Rest" also implies the importance of identifying imminent threats to watershed health and working to eliminate them. This simple principal is founded on the restoration ecology fact that the most certain way to successfully restore the structure and function of part of a broken watershed ecosystem is to rely on intact areas of the watershed to serve as the donors of healthy "parts" (such as aquatic insect species or good quality water). "Protecting the Best" allows us to "Restore the Rest" more effectively and economically. But, protecting the best is prerequisite.

The primary goal of the *Big Portage Lake Adaptive Management Plan* is to perpetuate the quality of Big Portage Lake and its watershed ecosystem into the future. Sometimes this will mean protecting what is good about the lake and its surroundings and sometimes it may mean restoring some feature that has been degraded. Restoration is reestablishment of the structure and function of an ecosystem including its natural diversity (Cairns 1988; National Research Council 1992). It implies rehabilitating and protecting sufficient components of the ecosystem so that it functions in a more or less natural way, provides habitat for native plants and animals, and supports reasonable human uses.

In an adaptive plan, new goals can be adopted as the plan evolves. We conclude this chapter by presenting a menu of possible goals for future consideration by the BPLOA organized under topical headings.

Restoration – Apply rehabilitation, protection, and education actions under the direction of specific objectives and identified specific areas in the Big Portage Lake watershed.

Research – Gather information that is useful in planning and monitoring restoration actions and devising education programs.

Monitoring – Establish a monitoring system in the Big Portage Lake watershed that will provide data that reveals the quality of the system and establishes methods to evaluate the effectiveness of management efforts.

Cultural Climate – Encourage a cultural and political atmosphere that allows and promotes good watershed stewardship including cooperation between citizens, businesses, public agencies, and municipalities.

Sustainable Economy – Foster an environment that promotes a sustainable economy, provides a diversity of economic options for the residents of the watershed, and does not diminish opportunities for future generations of watershed residents.

Recreation – Promote a sustainable recreation in Big Portage Lake where all citizens (now and in the future) can enjoy the opportunities of the natural and human-sustained environment while respecting the environment and the rights of fellow citizens.

Program Maintenance – Foster a stewardship culture that engages people to donate time, talent, and money sufficient to support the implementation and periodic update of the *Big Portage Lake Adaptive Management Plan*.

In the final chapter of this plan, we present possible objectives and actions that will serve to move toward these goals. This is not an exhaustive treatment, but a starting point, integrated with monitoring so that adaptive management can take place in subsequent years.

CHAPTER 7

What Objectives and Actions Move Us Toward Our Goals?

The Big Portage Lake watershed is healthy, diverse, and productive. Our challenge through this adaptive management plan is to perpetuate that condition into the future. The challenge will be met by a capable set of program partners that are prepared to devote themselves to Big Portage Lake stewardship. These partners include the members of the BPLROA, the Vilas County Land and Water Conservation Department, the ecological scientists of White Water Associates, Inc., the WDNR, and others who care about Big Portage Lake.

Abraham Lincoln is attributed with the following wisdom: "If I had an hour to cut down a tree, I'd spend the first 45 minutes sharpening my ax." Planning and preparation are important for any task, but especially when working with a system as complex as a lake or watershed. The vision and goals described in the previous chapter provide the basis for developing objectives and actions to achieve the desired future for the Big Portage Lake watershed. In keeping with the spirit of an adaptive management plan, we present several actions and associated objectives that can be undertaken as human and financial resources allow in subsequent phases of the program. These are organized under seven headings: (1) management, (2) Education/Communication, (3) Water Quality, (4) Aquatic Plants, (5) Watershed, (6) Fisheries, and (7) Wildlife. The actions and objectives each need to be further developed so that appropriate methodology and accurate estimates of required effort can be described. The BPLROA is in control of the plan. The plan is flexible and allows the insertion of new actions at any point along the path of lake management. The pace of implementation of the plan is also flexible and will be influenced by availability of volunteer time, grant monies, and other factors. The Aquatic Plant Management Plan (Appendix B, Chapter 5) has its own specific set of Actions and Objectives. The Adaptive Management Plan (AMP) and the Adaptive Plant Management Plan (APMP) should be considered together for a comprehensive plan for Big Portage Lake.

1. Management

Action #1-1: Monitor and modify the Adaptive Management Plan (AMP) to reflect practices and priorities for Big Portage Lake. ***Objective:*** To incorporate the most up-to-date information into the Big Portage Lake AMP and monitor its implementation. ***Monitoring:*** Overseen by the BPLROA. ***Status:*** Ongoing. The up-to-date management plan is available as the *Adaptive Management Plan (2020)*. This will replace *Comprehensive Management Plan (2012)* currently in use.
Action #1-2: Update the APM plan approximately every five years or as needed to include new data (e.g., water chemistry, plant point intercept information, watershed, etc.). ***Objective:*** To have current information and management science included in the plan. ***Monitoring:*** The BPLROA oversees activity with the assistance of a consultant. ***Status:*** Ongoing; next update is anticipated for 2025.
Action #1-3: Investigate and pursue grant opportunities for funding assistance on specific projects as appropriate. As an example, the WDNR Healthy Lakes is a program available to qualified lake associations (https://healthylakeswi.com/about/). ***Objective:*** To maintain and improve the health of Big Portage Lake. ***Monitoring:*** Overseen by the BPLROA ***Status:*** Ongoing.
Action #1-4: Maintain the Wallmann-Holtzer Nature Preserve ***Objective:*** To provide a model for maintaining property in its natural state. ***Monitoring:*** The Northwoods Land Trust, Inc. ***Status:*** Ongoing; implemented by BPLROA Board of Directors.
Action #1-5: Explore networking and interaction with other relevant organizations ***Objective:*** To provide a method to access and share information about best practices by collaborating with other organizations. ***Monitoring:*** BPLROA oversees activity ***Status:*** Ongoing; implemented by BPLROA Board of Directors.

2. Education/Communication

Action #2-1: Maintain and develop effective vehicles for education and communication.

Objective: To encourage and solicit stakeholder participation and facilitate the distribution of information about lake and watershed health via multiple vehicles (e.g., website, Facebook, and the newsletter) to ensure reaching a large stakeholder audience.

Monitoring: BPLROA oversees activity and assesses effectiveness.

Status: Ongoing; implemented by the BPLROA Newsletter Editor, Web Master, and Facebook Coordinator.

Action #2-2: Maintain a kiosk at the boat launch to provide relevant information to lake visitors.

Objective: To create more informed and responsible recreational users of Big Portage Lake about the threats of aquatic invasive species and how such introductions can be minimized.

Monitoring: BPLROA should monitor annually to ensure updated educational material is maintained.

Status: Ongoing; implemented by the Boat Landing Monitoring Coordinator.

Action #2-3: Provide education to lake property owners and other stakeholders about healthy aquatic and riparian plant communities.

Objective: To create more informed lake stakeholders concerning relevant topics (e.g., AIS, water quality, watershed issues, etc.) and encourage good lake stewardship.

Monitoring: BPLROA oversees activity and assesses effectiveness.

Status: Ongoing; implemented by the BPLROA Secretary, Newsletter Editor, Web Master, and Facebook Coordinator.

Action #2-4: Distribute information on shoreline preservation and responsible lakefront ownership and management to new property owners and rental property operators

Objective: To raise awareness, encourage good shoreline stewardship and improve the BPL riparian area to those who are new to the lake.

Monitoring: BPLROA oversees activity.

Status: Ongoing; implemented by the BPLROA Secretary.

3. Water quality

Action #3-1: Monitor water quality in the lake and participate in State of Wisconsin programs (e.g., the CLMN) as appropriate. Authorize additional water testing where needed/indicated.

Objective: To provide additional data and detect trends in parameters such as water clarity.

Monitoring: The BPLROA oversees activity.

Status: Ongoing; implemented as part of the BPLROA annual volunteer water testing activities.

Action #3-2: Conduct in depth water quality testing every five years to include parameters outlined in the AMP (Appendix C). Analyze and compare data to the previous surveys.

Objective: To watch for changes and trends in key water quality indicators.

Monitoring: The BPLROA oversees activity with the assistance of a consultant.

Status: Anticipated in 2025. Action included in the *Adaptive Plant Management Plan (2020).*

4. Aquatic Plants

These action items have been consolidated in the *Adaptive Plant Management Plan* (Appendix B, Chapter 5)

5. Watershed

Action #5-1: Monitor Big Portage Lake shoreline for changes.

Objective: To gather information which will be used to inform riparian owners of changes to shoreline stability and health, and encourage landowners to implement good practices.

Monitoring: The BPLROA oversees activity.

Status: Anticipated to begin in 2020. Action included in the *Adaptive Plant Management Plan (2020).*

6. Fisheries

Action #6-1: Maintain a working relationship with WDNR to understand, monitor and manage the Big Portage Lake fishery including spearing

Objective: To support scientific and effective maintenance of a quality fishery.

Monitoring: The BPLROA oversees the activity.

Status: Ongoing. Implemented by the BPLROA Fisheries Committee

Action #6-2: Maintain the WDNR "Fish Stix" program.

Objective: To encourage good shallow water stewardship by lake users and improve the littoral zone quality of Big Portage Lake; to educate landowners; and expand/improve habitat for fisheries.

Monitoring: The BPLROA oversees the activity.

Status: Ongoing. Implemented by the Fisheries Committee.

7. Wildlife

Action #7-1: Encourage lake owners to monitor wildlife on Big Portage Lake and participate in State of Wisconsin wildlife surveys (e.g., bats, loons) and activities.

Objective: To provide data about the status of the lake and riparian area by collecting data about selected wildlife.

Monitoring: The BPLROA oversees activity.

Status: Action found in the *Adaptive Management Plan (2020)*.

Future phases of Big Portage Lake Stewardship will build on the foundation established in this *Adaptive Management Plan*. Additional aspects of the Big Portage Lake watershed ecosystem will be explored. Future phases will include revisions to the adaptive management plan and the aquatic plant management plan.

Big Portage Lake and its watershed serve its human residents well. But, in order for future generations to enjoy all that the watershed can provide, this adaptive plan should be embraced, developed, and implemented. It may seem slow at first, but considerable momentum already exists because of the hard work that has already occurred.

Appendix A
Literature Cited

Literature Cited

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Appendix B

Big Portage Lake Aquatic Plant Management Plan

Big Portage Lake

Aquatic Plant Management Plan

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2020

Big Portage Lake

Aquatic Plant Management Plan

This plan is a product of a WDNR Lake Planning Grant
(Large Scale Planning Grant) awarded to:

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WHITE WATER
ASSOCIATES, INC.

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CHAPTER 1

Introduction

The ***Big Portage Lake Stewardship Program*** results from the efforts of the Big Portage Lake Riparian Owners Association (BPLROA). The Big Portage Lake Stewardship Program views lake stewardship as an ongoing endeavor that is integrated, coordinated, and administered by the Big Portage Lake Riparian Owners Association. The BPLROA takes a broad perspective that allows an appropriate range of geographic scales from which to approach lake stewardship. A discrete "lake specific" focus goes hand-in-hand with waterscape-wide awareness.

This aquatic plant management plan addresses Big Portage Lake in Vilas County, Wisconsin. Despite this specificity, it maintains the waterscape perspective crucial to effective lake stewardship. This is especially important when it comes to preventing introduction and establishment of aquatic invasive species (AIS). The closely related *Big Portage Lake Adaptive Management Plan* (Premo et al. 2020) offers additional overarching waterscape level inspection that allows greater opportunity and efficiency in water resource management and education.

A 2018 systematic survey of aquatic plants using the Wisconsin Department of Natural Resources (WDNR) "point-intercept" method formed an important underpinning of this aquatic plant management plan. An analysis of the plant data along with water quality and other lake information allowed the preparation of the plan.

Aquatic plants rarely get the respect they merit, although this perspective is slowly changing. Many people still refer to an aquatic plant bed as a "weed bed." Many aquatic plants have "weed" in their names (e.g., duckweed, pondweed, or musky weed). Likely this term was borrowed from "seaweed" and not intended as derogatory, but in today's use, "weed" connotes an unwanted, aggressively growing plant. Such is not the case for the vast majority of aquatic plants. In fact, aquatic plants are a vital part of a lake ecosystem, recycling nutrients, providing vertical and horizontal structure, and creating habitat for animal life. Invertebrates, including crustaceans and insects, live on or within this "aquatic forest." Fish find food and shelter within aquatic plant beds. Waterfowl eat parts of plants directly as well as feed on invertebrates associated with the plants. Muskrats eat aquatic plants and particularly love cattails and bulrushes. Otter and mink hunt invertebrates and small vertebrates within the shelter of submergent and emergent beds. In shallow water, great blue herons find fishes among the plants.

In lakes that receive an excess of nutrients (particularly from fertilizers or leaking septic tanks), plant growth can become lush and dominated by only a few species. As these abundant plants die, their decomposition can depress dissolved oxygen levels and diminish suitability for fish. Algae can quickly respond rapidly to nutrient influxes and create nuisance conditions. These phenomena can cause humans to view all aquatic plants in a negative light.

Non-native plant species, transported on boats and trailers or dumped from home aquariums, private ponds and water gardens may proliferate in a water body and negatively influence the community of native species. Eurasian water-milfoil (*Myriophyllum spicatum*) is one of the invasive plant species capable of this kind of population boom. Fortunately, this kind of rampant growth of aquatic invasive plants does not always occur. On occasion, even a native plant species can exhibit extensive growth and results in a population that is viewed by some as a recreational nuisance. The native Southern Naiad (*Najas guadalupensis*) has exhibited this kind of behavior in some northern Wisconsin lakes.

For most lakes, native aquatic plants are an overwhelmingly positive attribute, greatly enhancing the aesthetics of the lake and providing good opportunities for fishing, boating, swimming, snorkeling, sight-seeing, and hunting. In some lakes, even the presence of an aquatic invasive plant species is not a significantly negative phenomenon.

When it comes to aquatic plant management, it is useful to heed the mantra of the medical profession: "First, do no harm." It is both a social and scientific convention that aquatic plant management is more effective and beneficial when a lake is considered as an entire and integrated ecosystem. Actions taken to curtail a specific plant population (for example, herbicide use to treat Eurasian water-milfoil) will invariably impact other desirable native species. Rare plants, important habitat plants, or culturally significant plants (such as wild rice) should always be given careful consideration and protection.

Anyone involved in aquatic plant management should be aware that a permit may be required to remove, add, or control aquatic plants. In addition, anyone using Wisconsin's lakes must comply with the "Boat Launch Law" that addresses transport of aquatic plants on boat trailers and other equipment. A good review of the laws, permits, and regulations that affect management and behavior surrounding aquatic plants can be found in the WDNR guidelines called ***Aquatic Plant Management in Wisconsin***.[1]

This plan follows guidelines in ***Aquatic Plant Management in Wisconsin***. The plan is an adaptive plan (Walters 1986) and as such will be modified as new information becomes available. The WDNR Guidance document outlines three objectives that may influence

[1] *http://www4.uwsp.edu/cnr/uwexlakes/ecology/APM/APMguideFull2010.pdf*

preparation of an aquatic plant management plan (APMP). Currently, the principal motivation for this plan lies in the first two objectives:

- ***Protection*** - preventing the introduction of nuisance or invasive species into waters where these plants are not currently present;
- ***Maintenance*** - continuing the patterns of recreational use that have developed historically on and around a lake; and
- ***Rehabilitation*** - controlling imbalance in the plant community leading to the dominance of a few species, frequently associated with the introduction of invasive non-native species.

In preparation of this APMP, we have followed the first five steps in the seven-step plan outlined in the Guidance Document for developing an aquatic plant management plan:

1. Goal setting – Getting the effort organized, identifying problems to be addressed, and agreeing on the goals;
2. Inventory – Collecting baseline information to define the past and existing conditions;
3. Analysis – Synthesizing the information, quantifying and comparing the current conditions to desired conditions, researching opportunities and constraints, and setting directions to achieving the goals;
4. Alternatives – Listing possible management alternatives and evaluating their strengths, weaknesses and general feasibility;
5. Recommendations – Prioritizing and selecting preferred management options, setting objectives, drafting the plan;
6. Implementation – Formally adopting the plan, lining up funding, and scheduling activities for taking action to achieve the goals;
7. Monitor & Modify – Developing a mechanism for tracking activities and adjusting the plan as it evolves.

Besides this introductory chapter, this plan is organized in six chapters. The study area is described in Chapter 2. Chapter 3 states the purpose and goals for the plan. Chapter 4 presents an inventory and analysis of information that pertain to the plan including the results of the aquatic plant survey. Chapter 5 provides recommendations, actions, and objectives that support the overall goals and establish the stewardship component of plan. Finally, Chapter 6 presents a contingency plan for AIS. A literature cited section follows Chapter 6. Three appendices complete this document. Appendix 1 contains tables and figures for the aquatic plant survey. Appendix 2 presents the Big Portage Lake Riparian Owners Association Plant Monitoring Protocol. Appendix 3 contains a *Review of Big Portage Lake Water Quality*.

CHAPTER 2

Study Area

Big Portage Lake is located in Vilas County about 8.5 miles southwest of Land O' Lakes, Wisconsin. The water body identification code (WBIC) is 1629500. Exhibit 1 is an aerial view of the Big Portage Lake landscape showing the surrounding lakes and a few other water features. This interconnected water landscape is a target for migrating and breeding waterfowl and other birds. Big Portage Lake has value and function in this larger landscape as well as its own watershed.

Descriptive parameters for Big Portage Lake are in Exhibit 2. It is a seepage lake (meaning it has no inlet or outlet). Big Portage Lake has a surface area of about 586 acres and a maximum depth of 40 feet. The shoreline development index is 2.0. The shoreline development index is a quantitative expression derived from the shape of the lake. It is defined as the ratio of the shoreline length to the length of the circumference of a circle of the same area as the lake. A perfectly round lake would have an index of 1. Increasing irregularity of shoreline development in the form of bays and projections of the shore is shown by numbers greater than 1. For example, fjord lakes with extremely irregularly shaped shorelines sometimes have SDI's exceeding 5. Lakes with high shoreline development index values have relatively more productive littoral zone habitat.

Big Portage Lake has a public access site located on the south shoreline of the lake where recreationists frequently launch watercraft. Clean Boats, Clean Waters is a program BPLROA is involved in to educate about aquatic invasive species. We observed a total of 88 piers on the shoreline of Big Portage Lake or about 13 piers per mile of shoreline. The riparian area is dominated by upland (high land), but a large wetland (characterized by wetland vegetation and high water table) area exists on the northwest shore (Exhibit 3). Despite human development, there is a large amount of high quality riparian forest and other habitat surrounding Big Portage Lake.

Exhibit 1. Big Portage Lake and surrounding area.

Exhibit 2. Water Body Parameters.	
Water Body Name	Big Portage Lake
County	Vilas
Township/Range/Section	T42N-R10E-S18
Water Body Identification Code	1629500
Lake Type	Seepage
Surface Area (acres)	586
Maximum Depth (feet)	40
Maximum Length (miles)	0.92
Maximum Width (miles)	0.92
Shoreline Length (miles)	6.8
Shoreline Development Index	2.0
Total Number of Piers (2020 aerial)	88
Number of Piers / Mile of Shoreline	13
Total Number of Homes (2020 aerial)	89
Number of Homes / Mile of Shoreline	13

Exhibit 3. Topographic Map of Big Portage Lake.

CHAPTER 3

Purpose and Goal Statements

This plan approaches aquatic plant management with a healthy dose of humility. We do not always understand the causes of environmental phenomena or the effects of our actions to manage the environment. With that thought in mind, we have crafted a statement of purpose for this plan:

Comprehensive aquatic plant surveys in 2010 and 2018 establish that Big Portage Lake has a healthy and diverse aquatic plant community. This plant community is essential to, and part of, a high quality aquatic ecosystem that benefits the human community. The purpose of this aquatic plant management plan is to maintain a balanced, high quality, and diverse native aquatic plant community in Big Portage Lake.

This purpose is consistent with the mission statement set forth in the 2012 Big Portage Lake Comprensive Management Plan as restated in Chapter 1 of the Big Portage Lake Adaptive Management Plan. Supporting this purpose, the goals of this aquatic plant management plan are:

(1) Monitor and protect the native aquatic plant community;
(2) Monitor for AIS and prevent establishment of new non-native biota;
(3) Monitor and protect the native riparian plant community and rehabilitate where warranted; and
(4) Educate riparian owners and lake users on preventing AIS introduction, reducing nutrient inputs that can alter the plant community, minimizing physical removal of native riparian and littoral zone plants, and living with a lake whose natural healthy state includes aquatic and riparian plants.

The purpose and goals are the foundation for the aquatic plant management plan presented in this document. They inform the objectives and actions outlined in Chapter 5 and are the principal motivation of Big Portage Lake stewards.

CHAPTER 4 Information and Analysis

Our efforts in the Big Portage Lake Stewardship Program have compiled information about historical and current conditions of the Big Portage Lake ecosystem and its surrounding watershed. Of particular importance to this aquatic plant management plan is the aquatic plant survey that was conducted in 2018 using the ***WDNR Protocol for Aquatic Plant Survey, Collecting, Mapping, Preserving, and Data Entry*** (Hauxwell et al. 2010). The results of this comprehensive “point-intercept” aquatic plant survey are presented in this chapter. The aquatic plant data along with other relevant Big Portage Lake information is presented in this chapter under nine respective subheadings: watershed, aquatic plant management history, aquatic plant community description, fish community, water quality and trophic status, water use, riparian area, wildlife, and stakeholders.

Part 1. Watershed

Big Portage Lake and its immediate watershed are very small components of a large-scale (continental) watershed landscape. The continental United States is divided into 18 watershed regions (Exhibit 4). Two watershed regions lie within Wisconsin: the Upper Mississippi and Great Lakes regions. Big Portage Lake is located in the Upper Mississippi region. In turn, the Upper Mississippi region is made up of many sub-regions and smaller components referred to as “basins.” The Wisconsin sub-region (HUC#0707), and the Wisconsin River basin (HUC#070700) contain Big Portage Lake (Exhibit 5). Within the Wisconsin River basin is the Upper Wisconsin sub-basin (HUC#07070001) (Exhibit 6), which can be further divided into watersheds and sub-watersheds. Big Portage Lake is located in the Tamarack Pioneer River watershed (HUC#0707000103) (Exhibit 7). The watershed from which Big Portage Lake receives its surface water runoff is outlined in Exhibit 8.

Exhibit 4. United States watershed regions (USGS, 2015).

Exhibit 5. Wisconsin River basin (HUC#070700) (green). The Upper Wisconsin sub-basin is also visible (USEPA, 2009).

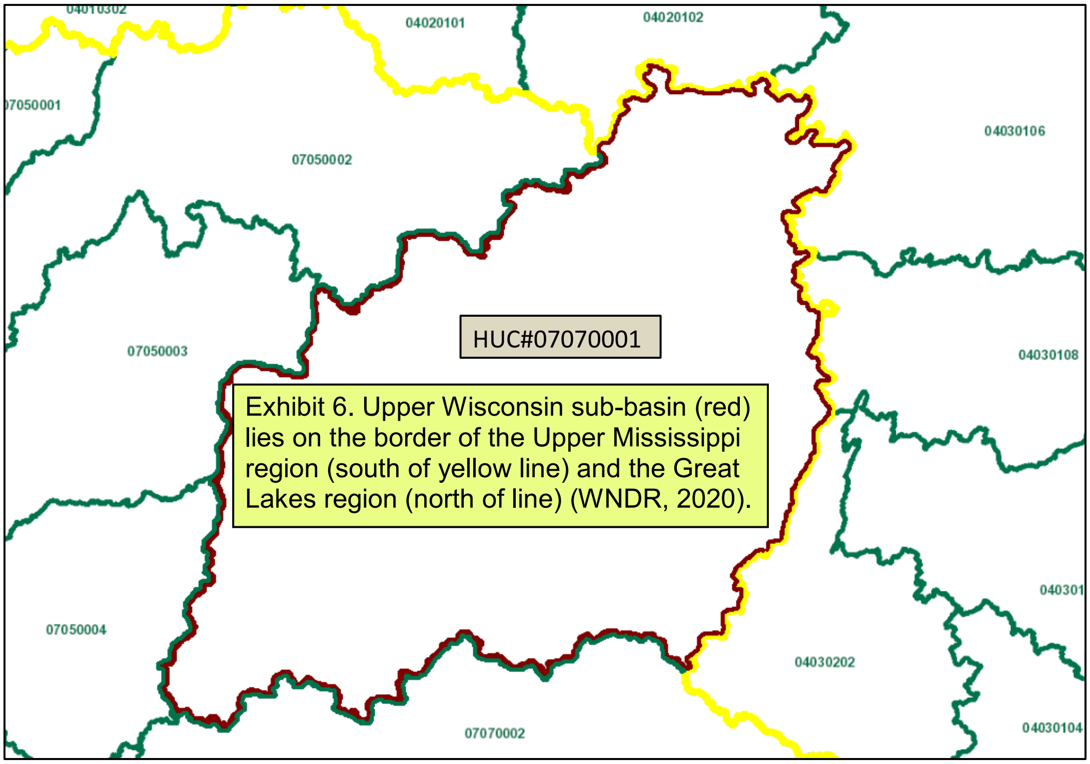


Exhibit 6. Upper Wisconsin sub-basin (red) lies on the border of the Upper Mississippi region (south of yellow line) and the Great Lakes region (north of line) (WNDR, 2020).

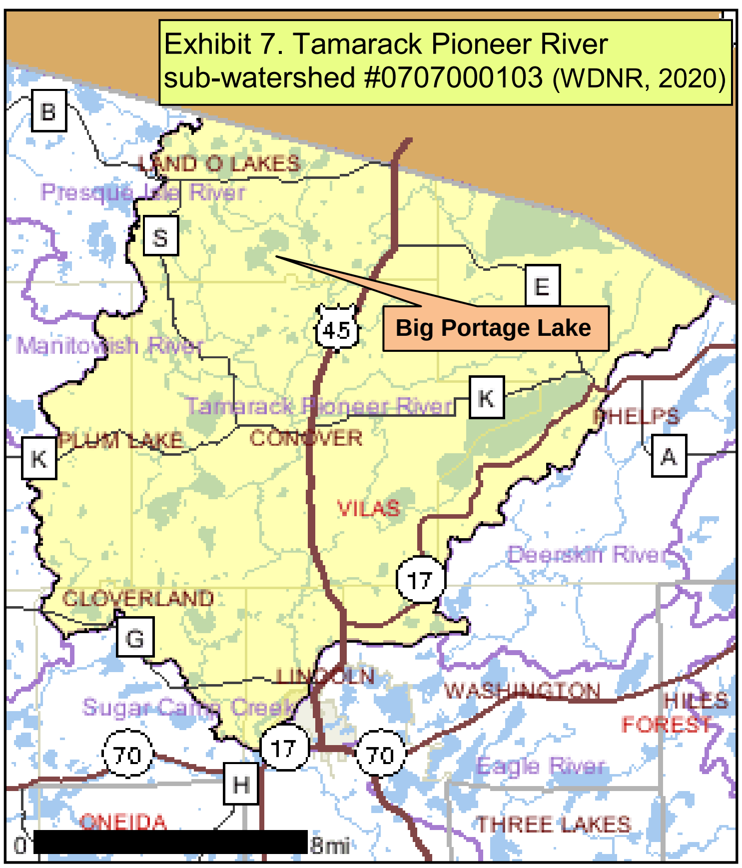


Exhibit 7. Tamarack Pioneer River sub-watershed #0707000103 (WDNR, 2020)

Exhibit 8. Watershed boundary for Big Portage Lake.

The watershed (drainage basin) is all of the land and water areas that drain toward a particular river or lake. A water body is greatly influenced by its watershed. Watershed size, topography, geology, land use, soil fertility and erodibility, and vegetation are all factors that influence water quality. The Big Portage Lake watershed shown in Exhibit 8 is 1,439 acres (including the 586 acre lake surface area). The cover types in the watershed are presented in Exhibit 9. Water and forest cover types comprise the largest percentage of the watershed (about 82%). Surface water is nearly 42 percent of the watershed. Open space/Park represent a small percentage of the cover type (6%). Soil groups A, B, and D is present in the watershed. Soil group A makes up a little over half the watershed. Soil group D has the lowest infiltration capacity, and the highest runoff potential. Conversely, soil group A has the highest infiltration capacity, and the lowest runoff potential. The watershed to lake area ratio is 1:1. Water quality often decreases with an increasing ratio of watershed area to lake area. As the watershed to lake area increases there are more sources and amounts of runoff. In larger watersheds, runoff water can leach more minerals and nutrients and carry them to the lake. The runoff to a lake (such as after a rainstorm or snowmelt) differs greatly among land uses. Forest cover is the most protective as it exports much less soil (through erosion) and nutrients (such as phosphorus and nitrogen) to the lake than agricultural or urban land use.

The *Wisconsin Lake Modeling Suite (WiLMS)* was used as a lake water quality planning and education tool for Big Portage Lake and was part of the 2012 *Comprehensive Management Plan* (Hoyman, et al. 2012). WiLMS is a computer program into which the user enters information about the lake (e.g., surface area, depth, and nutrient measures) and the watershed (e.g., acreage and cover types). The model also has information about average rainfall, aerial deposition of materials, and cover type characteristics that it uses to help predict nutrient (phosphorus) loading scenarios to the lake.

Exhibit 9. Cover Types and Soil Groups of the Big Portage Lake Watershed.

Cover Type	Acres	Percent
Cropland generalized agriculture	0.00	0.00
Pasture/Hay	0.00	0.00
Commercial/Industrial/Transportation	0.00	0.00
Barren Land	0.00	0.00
Shrub; Scrub	3.34	0.00
Grassland ; Herbaceous	0.00	0.00
Open Space/Park	89.63	6.00
Deciduous Forest	449.01	31.00
Evergreen Forest	1.78	0.00
Mixed Forest	120.99	9.00
High-density Residential	0.00	0.00
Low-density Residential	0.00	0.00
Woody Wetland	166.58	12.00
Emergent Wetland	2.00	0.00
Water	605.36	42.00
Total	1438.67	100

Soil Group	Acres	Percent	**Hydrologic Soil Groups** - Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups* based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. Where A has the smallest runoff potential and D the greatest.
A	743.69	52.00	**Group A** is sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.
B	636.06	44.00	**Group B** is silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
C	0.00	0.00	**Group C** soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
D	58.94	4.00	**Group D** soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This soil has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

*(*USDA, Natural Resources Conservation Service 1986*)

Part 2. Aquatic Plant Management History

As far as we can determine, no systematic or large-scale plant management activity has ever taken place in Big Portage Lake. Over the years, no particular nuisance issues have warranted control action. It is our understanding that the plant survey conducted as part of the 2010 WDNR grant was the first effort of its kind on this lake. A survey for curly-leaf pondweed (an aquatic invasive species) was conducted during the same period. A second comprehensive aquatic plant survey was conducted in 2018. Findings from the 2018 survey are presented and discussed in the next section (Part 3) and compared to findings from 2010.

Part 3. Aquatic Plant Community Description

Why do lakes need aquatic plants? In many ways, they are underwater forests. Aquatic plants provide vertical and horizontal structure in the lake just like the many forms and variety of trees do in a forest. Imagine how diminished a forest's biodiversity becomes in the advent of a clear-cut. Similarly, a lake's biodiversity in large part depends on a diversity of plants.

Aquatic plants are beneficial in many ways. Areas with plants produce more food for fish in the form of insect larvae, snails, and other invertebrates. Aquatic vegetation offers fish shelter and spawning habitat. Many submerged plants provide food for waterfowl and habitat for insects on which some waterfowl feed. Aquatic plants further benefit lakes by producing oxygen and absorbing nutrients (phosphorus and nitrogen) from runoff. Aquatic plants also protect shorelines and lake bottoms by dampening wave action and stabilizing sediments.

The distribution of plants within a lake is generally limited by light availability, which is, in turn, controlled by water clarity. Aquatic biologists often estimate the depth to which rooted aquatic plants can exist as about two times the average Secchi clarity depth. For example, if the average Secchi depth is eight feet then it is fairly accurate to estimate that rooted plants might exist in water as deep as sixteen feet. At depths greater than that (in our hypothetical example), light is insufficient for rooted plants to grow. In addition to available light, the type of substrate influences the distribution of rooted aquatic plants. Plants are more likely to be found in muddy or soft sediments containing organic matter, and less likely to occur where the substrate is sand, gravel, or rock. Finally, water chemistry influences which plants are found in a body of water. Some species prefer alkaline lakes and some prefer more acidic lakes. The presence of nutrients like phosphorous and nitrogen also influence plant community composition.

As mentioned earlier, non-native invasive plant species can reach high densities and wide distribution within a lake. This can diminish the native plant community and the related habitat. At times, even a native plant species can reach high population levels and interfere with certain kinds of human recreation. Cases such as these may elicit calls for some kind of plant management. It should be noted, however, that altering aquatic plant communities through hand-pulling, mechanical harvest, herbicides, or other means is expensive (in time and/or money) and by no means permanent. Long-term outcomes of these manipulations are difficult to predict and collateral damage to non-target plant species can be significant. In addition, permits are required in many cases of aquatic plant management.

Aquatic plant surveys were conducted on Big Portage Lake in 2010 and 2018. In both cases, the survey used the WDNR point-intercept protocol. This formal survey assessed the plant species composition on a grid of 653 points distributed evenly over the lake. Using latitude-longitude coordinates and a handheld GPS unit, scientists navigated to the points and used a rake mounted on a pole or rope to sample plants. The plants were identified, recorded, and the information put into a dedicated spreadsheet for storage and data analysis. This systematic survey provides baseline data about the lake and allows some analysis of change in the plant community over the time interval between surveys.

An examination of changes in the aquatic plant community over nearly a decade is robust because the plant surveys were conducted using the same protocol. Future aquatic plant monitoring will allow additional analysis. Changes in a lake environment might manifest as loss of species, change in species abundance or distribution, difference in the relative composition of various plant life forms (emergent, floating or submergent plants), and/or appearance of an AIS or change in its population size. Monitoring can track changes and provide valuable insight on which to base management decisions. In the remainder of this section, we provide a report of the 2018 aquatic plant findings for Big Portage Lake and compare the plant communities of 2010 and 2018. The supporting tables and figures for the aquatic plant survey are in Appendix 1.

Species richness refers to the total number of species recorded. When considering plant species recorded at sampling points only, species richness was lower in 2018 (14 species collected on the rake) when compared to 2010 (23 species collected on the rake). During the surveys, additional plant species observed but not collected at the sampling points are also documented. In 2018, a total of 14 species of aquatic plants were recorded in Big Portage Lake at the sample points but an additional 8 species were seen near shore on the boat survey, indicating a diverse plant community. Table 1 displays summary statistics for the 2018 survey. Table 2 provides a list of the species encountered, including common and scientific name along with summarizing statistics for the 2018 survey.[2] Table 3 compares some summary statistics between

[2] *If you more are interested in learning about the plant species found in the lake, visit the University of Wisconsin Steven Point Freckmann Herbarium website at: http://wisplants.uwsp.edu/ or obtain a copy of "Through the Looking Glass (A Field Guide to the Aquatic Plants in Wisconsin)."*

the 2010 and 2018 surveys. In 2018, the number of species encountered at any given sample point ranged from 0 to 3 and 131 sample points were found to have aquatic vegetation present. The average number of species encountered at these vegetated sites was 1.15 (a reduction since the 1.74 value derived in the 2010 survey). The actual number of species encountered at each of the vegetated sites is graphically displayed on Figure 1. Plant density is estimated by a "rake fullness" metric (3 being the highest possible density). These densities (considering all species) are displayed for each sampling site on Figure 2 and in every sampling point reflect the lowest rake fullness score.

The maximum depth of plant colonization was 27 feet in 2018 (Table 1 and Figure 3). In 2010, maximum depth to rooted vegetation was 19 feet. In 2018, rooted vegetation was found at 131 of the 566 sample sites with depth ≤ the maximum depth of plant colonization (23.14% of sites). These sites are displayed as a black dot within a circle on Figure 4. This indicates that although availability of appropriate depth may limit the distribution of plants, it is not the only habitat factor involved. Substrate is another feature that influences plant distribution (e.g., soft substrate often harbors more plants than hard substrate). Figures 5 presents the substrates encountered during the aquatic plant survey (mud, sand, or rock). Sand is the dominant substrate in the lake.

Table 2 provides information about the frequency of occurrence of the plant species recorded in the lake in 2018. Several metrics are provided, including total number of sites in which each species was found and frequency of occurrence at sites ≤ the maximum depth of rooted vegetation. This frequency metric is standardized as a "relative frequency" (also shown in Table 2) by dividing the frequency of occurrence for a given species by the sum of frequency of occurrence for all plants and multiplying by 100 to form a percentage. The resulting relative frequencies for all species total 100%. The relative frequencies for the plant species collected with a rake in 2010 and 2018 are graphically displayed on Figure 6. This display shows that *Nitella sp.* (Nitella) had the highest relative frequency followed by *Eleocharis acicularis* (Needle spikerush) in 2018. In 2010 *Chara sp.* (Muckgrass) had the highest relative frequency followed by *Najas flexilis* (Slender naiad). *Nitella sp.* had a low relative frequency in 2010. Individual aquatic plant populations naturally fluctuate from year to year for a variety of reasons and reflect the dynamics of a healthy plant community. These fluctuations are typically no cause for concern. Nevertheless, the shift toward Nitella as a dominant plant species is noteworthy and warrants monitoring in the future.

Figure 7 displays sampling sites with emergent and floating aquatic plants. As examples of individual species distributions, we show the occurrences of a few of the most frequently and least frequently encountered plants in Figures 8-14.

"Species richness" is the term given to the total number of species in a given area. For example, the total number of plant species in a lake would be its plant species "richness." Generally speaking, a high species richness means high biodiversity and this is considered a healthy and desirable condition in an ecosystem. But species richness doesn't tell the whole story. As an example, consider the plant communities of two hypothetical ponds each with 1,000 individual plants representing ten plant species (in other words, richness is 10). In the first pond each of the ten species populations is comprised of 100 individuals. In the second pond, Species #1 has a population of 991 individuals and each of the other nine species is represented by one individual plant. Intuitively, we would say that first pond is more diverse because there is more "even" distribution of individual species. The "Simpson Diversity Index" takes into account both richness and evenness in estimating diversity. It is based on a plant's relative frequency in a lake. The closer the Simpson Diversity Index is to 1, the more diverse the plant community. The Simpson Diversity Index for Big Portage Lake aquatic plant community was 0.67 in 2018 (Tables 1 and 3) The 2010 Simpson Diversity Index value was 0.92 (Table 3) which reflected a greater diversity of the plant community at that time. This difference might be attributable in part to the relative dominance of Nitella in 2018.

Another measure of floristic diversity and quality is the *Floristic Quality Index* (FQI). Floristic quality is an assessment metric designed to evaluate the closeness that the flora of an area is to that of undisturbed conditions (Nichols, 1999). Among other applications, it forms a standardized metric that can be used to compare the quality of different lakes (or different locations within a single lake) and monitor long-term changes in a lake's plant community (an indicator of lake health). The FQI for a lake is determined by using the average *coefficient of conservatism* times the square root of the number of native plant species present in the lake. Knowledgeable botanists have assigned to each native aquatic plant a *coefficient of conservatism* representing the probability that a plant is likely to occur in pristine environments (relatively unaltered from presettlement conditions). The coefficients range from 0 to 10, with 10 being assigned to those species most sensitive to disturbance. As more environmental disturbance occurs, the less conservative species become more prevalent.

Nichols (1999) analyzed aquatic plant community data from 554 Wisconsin lakes to ascertain geographic (ecoregional) characteristics of the FQI metric. This is useful for considering how the Big Portage Lake FQI (27.3 in 2018) compares to other lakes and regions.

The statewide medians for number of species and FQI are 13 and 22.2, respectively. Big Portage Lake values are high compared to these statewide values. Nichols (1999) determined that there are four ecoregional-lake types groups in Wisconsin: (1) Northern Lakes and Forests Lakes, (2) Northern Lakes and Forests Flowages, (3) North Central Hardwoods and Southeastern Till Plain Lakes and Flowages, and (4) Driftless Area and Mississippi River Backwater Lakes. Big Portage Lake is located in the Northern Lakes and Forests Lakes group. Nichols (1999) found species numbers for the Northern Lakes and Forests Lakes group had a median value of 13. Big Portage Lake data is consistent with that find. Finally, the Big Portage Lake FQI is higher than the median value for the Northern Lakes and Forests Lakes group (24.3). These findings support the contention that the Big Portage Lake plant community is healthy and diverse. As with the Simpson Diversity Index value, we observe a reduction of the FQI value between the 2010 and 2018 surveys (Table 3). This also warrants continued monitoring.

It should be noted that the water clarity of Big Portage Lake has trended towards greater clarity (mean Secchi reading of 13.6 feet in 2010 and 20.2 feet in 2018). This increased water clarity is likely a factor in the differences in the plant community detected during the 2010 and 2018 aquatic plant surveys, although other factors may also be involved.

We observed no aquatic plants in Big Portage Lake that would be considered a nuisance-level population density/distribution. Reed canary grass (*Phalaris arundinacea*) was observed in the aquatic plant survey (2018). It is considered a *restricted* invasive species in Wisconsin. The voucher was sent in and confirmed by Dr. Freckmann at the University of Wisconsin-Stevens Point herbarium in 2019. Purple loosestrife and the aquatic forget-me-not were also found along the shoreline during the conductivity survey in August, 2019. A detailed report of these findings can be found in Appendix I of the Big *Portage Lake Adaptive Management Plan*.

Part 4. Fish Community

Many fish surveys have been conducted on Big Portage Lake. The last time fish species were stocked was in 1975. For more fisheries information, see Appendix F of the *Big Portage Lake Adaptive Management Plan*. The WDNR Lake Pages website (http://dnr.wi.gov/lakes/lakepages/) indicates that the bottom is comprised of 70% sand, 15% gravel, 15% rock, and 0% muck and that fish species present include panfish, largemouth bass, smallmouth bass, yellow perch, rock bass, and walleye.

Part 5. Water Quality and Trophic Status

Big Portage Lake is a 586 acre seepage lake with a max depth of 40 feet. Existing water quality data was retrieved from the WDNR SWIMS database (1989 to present). Water quality information is fully interpreted in Appendix 3. Temperature and dissolved oxygen samples showed stratification in the lake. Water clarity is "very good," with a 2018 average Secchi reading of 18.6 feet. Over the past decade, water clarity has steadily increased. The trophic state is mesotrophic. Water quality would be classified as "very good" with respect to phosphorus concentrations. The pH of Big Portage Lake ranged from 6-7.9 SU in the years sampled.

Part 6. Water Use

Big Portage Lake recreationists frequently launch watercraft from the improved boat ramp at the South side of the lake (see Exhibit 1). There is no State of Wisconsin ownership surrounding the lake, however, the island located in the northern part of Big Portage Lake is owned by the State of Wisconsin.

Part 7. Riparian Area

Part 1 (Watershed) describes the larger riparian area context of Big Portage Lake. The Big Portage Lake riparian area can be appreciated by viewing aerial photography (Exhibit 1) and the topographic map in Exhibit 3. The lake is generally surrounded by forested habitat. Instead, an upland mixed conifer and deciduous forest predominates. Recent aerial photography reveals 89 houses on the lake. This intact riparian area provides numerous important functions and values to the lake. It effectively filters runoff to the lake. It provides excellent habitat for birds and mammals. Trees that fall into the lake from the riparian zone contribute important habitat elements to the lake. Educating riparian owners as to the value of riparian areas is important to the maintenance of these critical areas.

The WDNR, in 2016, formulated a protocol called *Lake Shoreland and Shallows Habitat Monitoring* (WDNR, 2016). It provides a standard methodology for surveying, assessing, and mapping habitat in lakeshore areas, including the Riparian buffer, Bank, and Littoral Zones (WDNR, 2016). In 2018, a shoreland and shallow water assessment was conducted on Big Portage Lake. This information will be useful to local and regional resource managers, community stakeholders, and others interested in protecting and enhancing Wisconsin's lakes and rivers (WDNR, 2016). Part of the survey documented woody habitat. A detailed report can be found in Appendix E of the *Big Portage Lake Adaptive Management Plan*.

Part 8. Wildlife

Bald Eagle and Common Loon studies have been conducted by the WDNR and volunteers on other lakes as part of programs such as LoonWatch. Rare species and communities have also been identified by the WDNR. Big Portage Lake volunteers have also submitted data on wildlife. These data are presented in Exhibit 5 of the *Big Portage Lake Adaptive Management Plan.*

A frog and toad survey was conducted on Big Portage Lake by volunteers as part of this lake study. Results are presented in Appendix G of the adaptive plan. A bat survey was conducted by July 9 and September 9, 2017 and July 5 and 21, 2018 and also August 7, 2018. The results of this survey can be found Appendix H of the Adaptive Management Plan**.**

In the future, it would be desirable to monitor indicator species of wildlife such as eagles, osprey, and loons. The WDNR monitors bald eagle nests and found high numbers (172 nests) in Vilas County (WDNR, 2018). Also of importance would be monitoring the populations of aquatic invasive animal species that already exist in the lake (rusty crayfish and banded mystery snail). It is also essential to monitor the lake for presence of new invasive wildlife species (e.g., spiny water flea and zebra mussels) and fish (for example, rainbow smelt or common carp).

Big Portage Lake is currently designated as an *area of special natural resource interest* (ASNRI) (WDNR, 2012a). A water body designated as an Area of Special Natural Resource Interest can be any of the following: WDNR trout streams; Outstanding or Exceptional Resource Waters (ORW/ERW); waters or portions of waters inhabited by endangered, threatened, special concern species or unique ecological communities; wild rice waters; waters in ecologically significant coastal wetlands along Lake Michigan and Superior; or federal or state waters designated as wild or scenic rivers (WDNR, 2012a). Big Portage Lake is considered an ASNRI because of its sensitive areas and priority navigable waters for walleye (Exhibit 10). The Wisconsin Natural Heritage Inventory (NHI) lists plants and animals as rare or sensitive species and/or communities that are considered high-quality and significant natural features (Exhibit 11). They are found in the same town/range as Big Portage Lake (NHI, 2020).

Part 9. Stakeholders

At this point in the plant management planning process, the BPLROA has represented Big Portage Lake stakeholders. Additional interested citizens are invited to participate as the plan is refined and updated in order to broaden input and encourage participation in stewardship. The BPLROA solicited input from Big Portage Lake residents to understand the knowledge base, educational needs, concerns, and desires. Results of the lake user survey are presented in the ***Big Portage Lake Adaptive Management Plan*** (Premo et al. 2020).

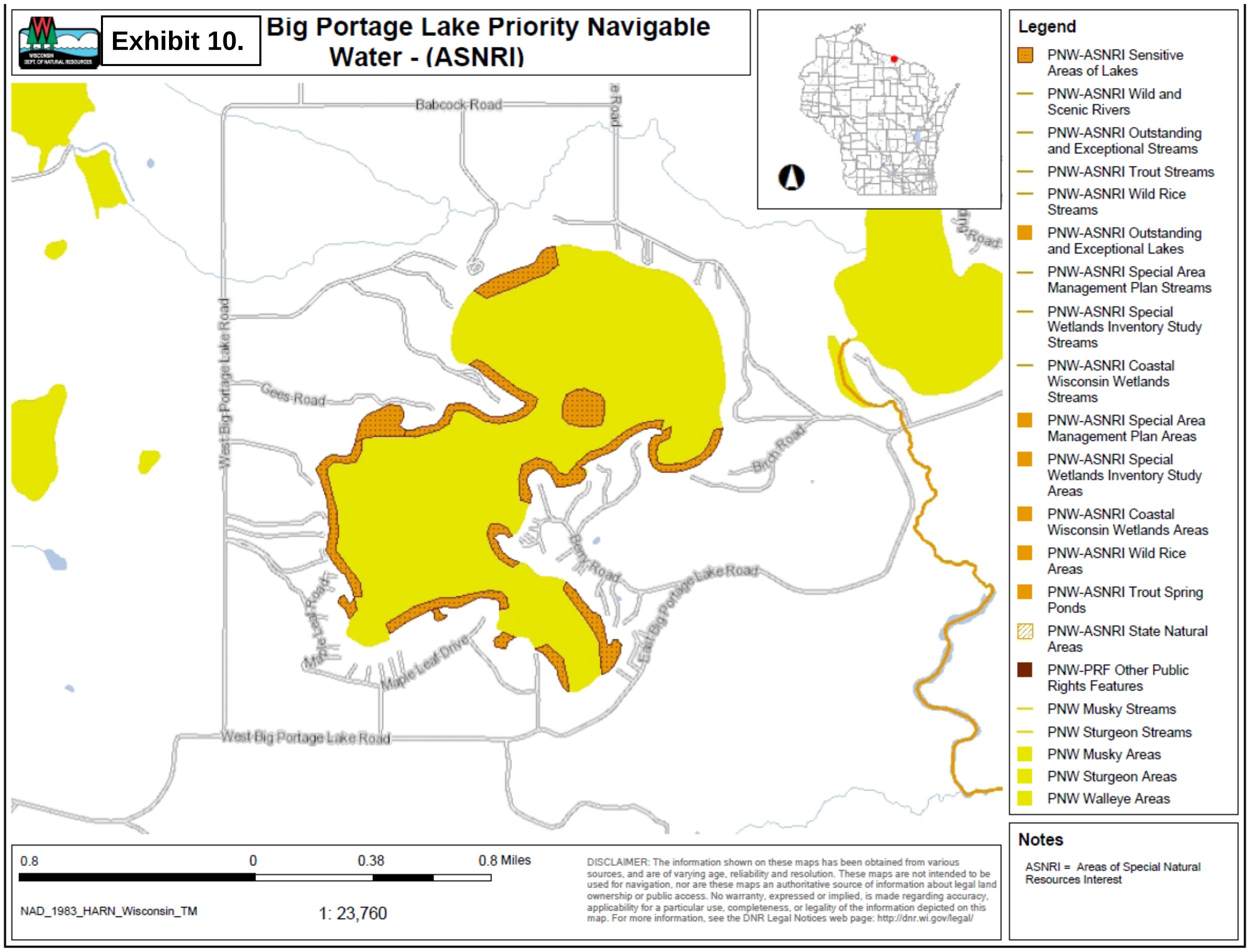


Exhibit 11. Rare Species and Communities located near Big Portage Lake.

Common Name	*Scientific Name*	*State Status**	*Group Name*
Bald eagle	*Haliaeetus leucocephalus*	SC/P	Bird
Boreal chickadee	*Poecile hudsonicus*	SC/M	Bird
Calypso Orchid	*Calypso bulbosa*	THR	Plant
Common Nighthawk	*Chordeiles minor*	SC/M	Bird
Spruce Grouse	*Falcipennis Canadensis*	THR	Bird
Wood Turtle	*Clyptemys insculpta*	THR	Turtle
Connecticut Warbler	*Oporornis agilis*	SC/M	Bird
Boreal Chickadee	*Poecile hudsonicus*	SC/M	Bird
Northeastern Bladderwort	*Utricularia resupinata*	SC	Plant

* **END**=Endangered; **THR**=Threatened; **SC**=Special Concern; **SC/P**=fully protected; **SC/N**=no laws regulating use, possession or harvesting; **SC/H**=take regulated by establishment of open/closed seasons; **SC/FL**=federally protected as endangered or threatened, but not so designated by DNR; **SC/M**=fully protected by federal and state laws under Migratory Bird Act.

CHAPTER 5

Recommendations, Actions, and Objectives

In this chapter we provide recommendations for specific objectives and associated actions goals stated in Chapter 3 of this APM Plan and re-stated here for convenient reference:

(1) Monitor and protect the native aquatic plant community;

(2) Monitor for AIS and prevent establishment of new non-native biota;

(3) Monitor and protect the native riparian plant community and rehabilitate where warranted; and

(4) Educate riparian owners and lake users on preventing AIS introduction, reducing nutrient inputs that can alter the plant community, minimizing physical removal of native riparian and littoral zone plants, and living with a lake whose natural healthy state includes aquatic and riparian plants.

Big Portage Lake is a healthy and diverse ecosystem. This is an enviable position from which to conduct stewardship. Yet, there are threats to the quality of the lake and the BPLROA endeavor to minimize those threats. We outline in this section a set of actions and related management objectives that will actively engage lake stewards in the process of management.

At this time, we recommend no direct plant management (such as harvesting or chemical treatments) of plant populations. Big Portage Lake is ecologically healthy. Plant management intended to improve specific human recreational activities or a desired aesthetic stems from diverse personal opinions not ecological benefits. For this reason, it is difficult to arrive at consensus as to plant management approaches. Some actions are expensive. No plant management actions (even those directed at AIS plants) result in a permanent "fix" to a perceived problem (periodic re-treatments are always needed). All plant management activities have negative and unpredictable environmental impacts. Because native aquatic vegetation is unavoidably impacted, any plant management activity renders the lake more susceptible to aquatic invasive plant species that have evolved to exploit disturbed habitat.

The actions in the following table are presented in tabular form. Each "action" consists of a set of four statements: (1) a declarative "action" statement that specifies the action (2) a statement of the "objective" that the action serves, (3) a "monitoring" statement that specifies the party responsible for carrying out the action and maintaining data, and (4) a "status" statement that suggests a timeline/calendar and indicates status (not yet started, ongoing, or completed).

Additional lake actions and objectives for Big Portage Lake are included in the Adaptive Management Plant (Chapter 7). The Adaptive Management Plan (AMP) and the Adaptive Plant Management Plan (APMP) should be considered together for a comprehensive plan for Big Portage Lake.

Action #1: Update the *Aquatic Plant Monitoring Protocol (2013)* (found in Appendix 2 of the APMP).

Objective: To incorporate the most up-to-date information into the Big Portage Lake APMP and monitor its implementation.

Monitoring: Overseen by the BPLROA.

Status: Anticipated in 2020. To be implemented by the Shoreline Monitoring Program Co-chair.

Action #2: Update the Aquatic Invasive Species Rapid Response Plan (this is Appendix E of the *2013 Aquatic Plant Monitoring Manual*).

Objective: To be prepared for AIS discovery and efficient response.

Monitoring: The BPLROA oversees.

Status: Anticipated in 2020. To be implemented by the Shoreline Monitoring Program Co-chair.

Action #3: Conduct a quantitative plant survey every five years using WDNR Point-Intercept Methodology. Analyze and compare data to the previous surveys.

Objective: To watch for changes in species diversity, floristic quality, plant abundance, and plant distribution and to check for the occurrence of non-native, invasive plant species (including the existing populations of canary reed grass, Eurasian marsh thistle, non-native forget-me-not and purple loosestrife).

Monitoring: The BPLROA oversees activity with the assistance of a consultant.

Status: Anticipated in 2025. Action included in the *Adaptive Plant Management Plan (2020)*.

Action #4: Update the APMP approximately every five years or as needed to reflect information from plant intercept studies.

Objective: To have current information and management science included in the plan.

Monitoring: The BPLROA oversees activity with the assistance of a consultant.

Status: Anticipated in 2025. Action included in the *Adaptive Plant Management Plan (2020)*.

Action #5: Monitor Big Portage Lake for aquatic invasive plant species and changes in aquatic plants; and note the location and changes to invasive plant species already identified on the lake to include newly discovered purple loosestrife and non-native forget-me-not.

Objective: To understand the lake's biotic community, provide for early detection of AIS and continue monitoring any existing populations of AIS.

Monitoring: The BPLROA oversees activity.

Status: Ongoing. Monitoring is conducted by the Shoreline Monitoring Program participants as outlined in the *Aquatic Plant Management Manual (2013)* (found in Appendix 2 of the APMP).

Action #6: Participate in the State of Wisconsin Clean Boats/Clean Waters Program

Objective: To prevent the introduction of aquatic invasive species into Big Portage Lake; and to educate boaters on Big Portage Lake about responsible boating practices.

Monitoring: The BPLROA oversees activity.

Status: Ongoing. This program is coordinated by the Boat Landing Monitoring Coordinator.

Action #7: Identify resources and expand boat landing monitoring capabilities where possible.

Objective: To prevent the introduction of aquatic invasive species (AIS) into Big Portage Lake by identifying funding for programs des igned to prevent AIS introduction at the boat landing (e.g., paid monitors and electronic boat landing monitoring).

Monitoring: The BPLROA oversees activity

Status: Ongoing. This is coordinated by the Boat Landing Monitoring Coordinator.

CHAPTER 6 Contingency Plan for AIS

On September 2013, the Big Portage Lake Riparian Owners Association published "Aquatic Plant Monitoring," a protocol based on the March 2012 Citizen Lake Network Monitoring protocol. This thorough document is included as Appendix 2 of this Aquatic Plant Management Plan. Since 2013, it has proven to be an effective and efficient guide for the volunteer aquatic plant monitoring on Big Portage Lake. In discussion with the BPLOA Board, it was determined that an important Action to be included in Chapter 5 of this document would call for a near future update of the Aquatic Plant Monitoring document. To augment that update, we have prepared this Chapter 6 to provide additional useful information to the BPLOA members tasked with revising their monitoring document.

Unfortunately, sources of aquatic invasive plants and other AIS are numerous in Wisconsin. Some source lakes are close to Big Portage Lake. There is an increasing likelihood of accidental introduction of AIS through conveyance of life stages by boats, trailers, and other vectors. It is important for the Big Portage Lake stakeholders and other lake stewards to be prepared for the contingency of aquatic invasive plant species colonization in Big Portage Lake.

For riparian owners and users of a lake ecosystem, the discovery of AIS is a tragedy that elicits an immediate desire to "fix the problem." Although strong emotions may be evoked by such a discovery, a deliberate and systematic approach is required to appropriately and effectively address the situation. An aquatic plant management plan (one including a contingency plan for AIS) is the best tool by which the process can be navigated. In fact the APM plan is a requirement in Wisconsin for some kinds of aquatic plant management actions. One of the actions outlined in the previous chapter was to establish an Aquatic Invasive Species Rapid Response Team. This team and its coordinator are integral to the management process. It is important for this team to be multi-dimensional (or at least have quick access to the expertise that may be required). AIS invade not just a single lake, but an entire region since the new infestation is an outpost from which the AIS can more easily colonize other nearby water bodies. For this reason it is strategic for the Rapid Response Team to include representation from regional stakeholders.

Exhibit 12 provides a flowchart outlining an appropriate rapid response to the suspected discovery of an aquatic invasive plant species. The response will be most efficient if an AIS

Rapid Response Team has already been established and is familiar with the contingency plan. In the remainder of this chapter we further describe the approach.

When a suspect aquatic invasive plant species is found, either the original observer or a member of the Rapid Response Team (likely the coordinator) should take digital photo(s) of the plant in the setting where it was found (if possible, try to capture details such as flowers, leaf shape, leaf and stem arrangement, and fruits and include a common object in the photo for scale).

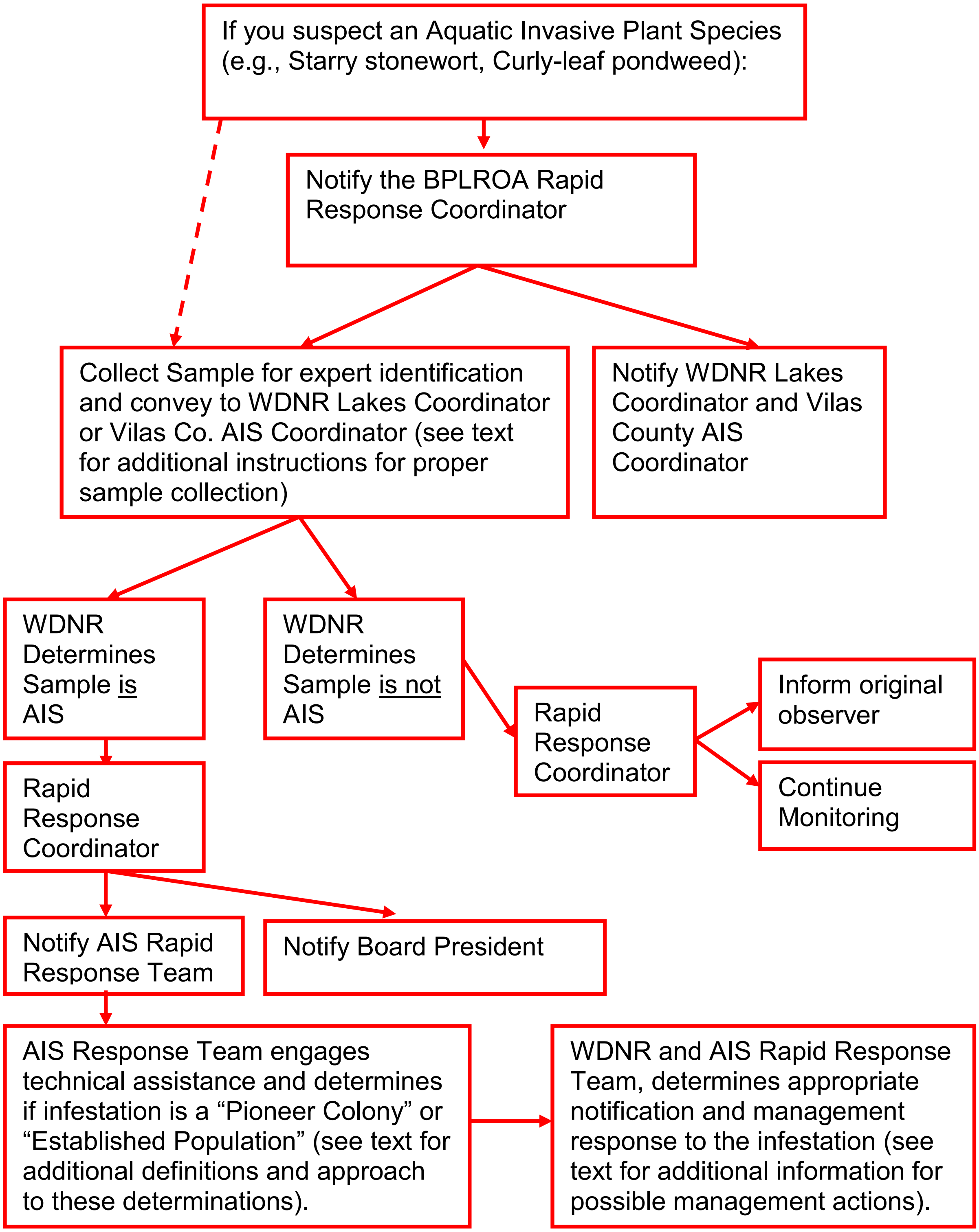
Next, the observer or team coordinator should collect an entire plant specimen including roots, stems, and flowers (if present). If plants are numerous, collect several. The sample should be placed in a sealable bag with a damp paper towel. Place a label in the bag written in pencil with date, time, collector's name, lake name, location, town, and county. Attach a lake map to the bag that has the location of the suspect AIS marked and GPS coordinates recorded (if GPS is available). The sample should be placed on ice in a cooler or in a refrigerator. Deliver the sample to the WDNR Lakes Management Coordinator (Kevin Gauthier in Woodruff) or the Vilas County AIS Coordinator (Alan Wirt) as soon as possible (at least within four days). The WDNR or their botanical expert(s) will determine the species and confirm whether or not it is an aquatic invasive plant species.

If the suspect specimen is determined to be an invasive plant species, the next step is to determine the extent and density of the population since the management response will vary accordingly. The Rapid Response Team should conduct (or have its consultant conduct) a survey to define the colony's perimeter and estimate density. If less than five acres (or <5% of the lake surface area), it is designated a "Pioneer Colony." If greater than five acres (or >5% of the lake surface area) then it is designated an "Established Population." Once the infestation is characterized, "at risk" areas should also be determined and marked on a map. For example, nearby boat landing sites and areas of high boat traffic should be indicated.

When "pioneer" or "established" status has been determined, it is time to consult with the WDNR Lakes Coordinator to determine appropriate notifications and management responses to the infestation. Determining whether hand-pulling or chemical treatment will be used is an important and early decision. Necessary notifications of landowners, governmental officials, and recreationists (at boat landings) will be determined. Whether the population's perimeter needs to be marked with buoys will be decided by the WDNR. Funding sources will be identified and consultants and contractors will be contacted where necessary. The WDNR will determine if further baseline plant survey is required (depending on type of treatment). A post treatment monitoring plan will be discussed and established to determine the efficacy of the selected treatment.

Once the Rapid Response Team is organized, one of its first tasks is to develop a list of contacts and associated contact information (phone numbers and email addresses). At a minimum, this contact list should include: the Rapid Response Coordinator, members of the Rapid Response Team, County AIS Coordinator, WDNR Lakes Management Coordinator, Lake Association or Lake District Presidents (or other points of contact), local WDNR warden, local government official(s), other experts, chemical treatment contractors, and consultant(s).

Exhibit 12. Aquatic Invasive Plant Species Rapid Response



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Appendix 1

Aquatic Plant Survey Tables and Figures

Table of Contents

Table 1. Summary statistics for the 2018 point-intercept aquatic plant surveys for Big Portage Lake.

Summary Statistic	Value	Notes
Total number of sites on grid	653	Total number of sites on the original grid (not necessarily visited)
Total number of sites visited	651	Total number of sites where the boat stopped, even if much too deep to have plants.
Total number of sites with vegetation	131	Total number of sites where at least one plant was found
Total number of sites shallower than maximum depth of plants	566	Number of sites where depth was less than or equal to the maximum depth where plants were found. This value is used for Frequency of occurrence at sites shallower than maximum depth of plants.
Frequency of occurrence at sites shallower than maximum depth of plants	23.14	Number of times a species was seen divided by the total number of sites shallower than maximum depth of plants.
Simpson Diversity Index	0.67	A nonparametric estimator of community heterogeneity. It is based on Relative Frequency and thus is not sensitive to whether all sampled sites (including non-vegetated sites) are included. The closer the Simpson Diversity Index is to 1, the more diverse the community.
Maximum depth of plants (ft.)	27.00	The depth of the deepest site sampled at which vegetation was present.
Number of sites sampled with rake on rope	403	
Number of sites sampled with rake on pole	199	
Average number of all species per site (shallower than max depth)	0.27	
Average number of all species per site (vegetated sites only)	1.15	
Average number of native species per site (shallower than max depth)	0.27	Total number of species collected. Does not include visual sightings.
Average number of native species per site (vegetated sites only)	1.15	Total number of species collected including visual sightings.
Species Richness	14	
Species Richness (including visuals)	22	
Floristic Quality Index (FQI)	27.3	

Table 2. Plant species recorded and distribution statistics for the 2018 Big Portage Lake aquatic plant survey.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
Nitella	*Nitella sp.*	14.31	61.83	53.64	81	81	1.00
Needle spikerush	*Eleocharis acicularis*	3.53	15.27	13.25	20	23	1.00
Slender naiad	*Najas flexilis*	3.18	13.74	11.92	18	18	1.00
Wild celery	*Vallisneria americana*	1.94	8.40	7.28	11	11	1.00
Small purple bladderwort	*Utricularia resupinata*	0.88	3.82	3.31	5	6	1.00
Bald spikerush	*Eleocharis erythropoda*	0.71	3.05	2.65	4	23	1.00
White water lily	*Nymphaea odorata*	0.53	2.29	1.99	3	5	1.00
Variable pondweed	*Potamogeton gramineus*	0.35	1.53	1.32	2	2	1.00
Creeping spearwort	*Ranunculus flammula*	0.35	1.53	1.32	2	5	1.00
Spiny spored-quillwort	*Isoetes echinospora*	0.18	0.76	0.66	1	1	1.00
Dwarf water-milfoil	*Myriophyllum tenellum*	0.18	0.76	0.66	1	1	1.00
Small pondweed	*Potamogeton pusillus*	0.18	0.76	0.66	1	1	1.00
Three-way sedge	*Dulichium arundinaceum*	0.18	0.76	0.66	1	9	1.00
Floating-leaf bur-reed	*Sparganium fluctuans*	0.18	0.76	0.66	1	5	1.00
Wiregrass sedge	*Carex lasiocarpa*				Visual	4	
Brown-fruited rush	*Juncus pelocarpus f. submersus*				Visual	4	
Waterwort	*Elatine minima*				Visual	3	
Common rush	*Juncus effuses*				Visual	3	
Sedge	*Carex sp.*				Visual	2	
Water horsetail	*Equisetum fluviatile*				Visual	2	
Rattlesnake manna grass	*Glyceria Canadensis*				Visual	1	
Spatterdock	*Nuphar variegate*				Visual	1	
Fringed sedge	*Carex crinita*				Boat Survey		
Northwest territory sedge	*Carex utriculata*				Boat Survey		

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Table 2. Continued.

Common name	Scientific name	Frequency of occurrence at sites less than or equal to maximum depth of plants	Frequency of occurrence within vegetated areas (%)	Relative Frequency (%)	Number of sites where species found	Number of sites where species found (including visuals)	Average Rake Fullness
European marsh thistle	*Cirsium palustre*				Boat Survey		
Golden hedgehyssop	*Gratiola aurea*				Boat Survey		
	Iris sp.				Boat Survey		
Reed canary grass	*Phalaris arundinacea*				Boat Survey		
Common reed	*Phragmites australis*				Boat Survey		
Common arrowhead	*Sagittaria latifolia*				Boat Survey		
Blackgirdle bulrush	*Scirpus atrocinctus*				Boat Survey		
Woolgrass	*Scirpus cyperinus*				Boat Survey		
Cattail	*Typha sp.*				Boat Survey		

Frequency of occurrence within vegetated areas (%): Number of times a species was seen in a vegetated area divided by the total number of vegetated sites.

Voucher specimens were sent to Dr. Freckmann (U.W. Stevens Point) and were confirmed January, 2019.

***Phalaris arundinacea* is a "Restricted" species in Wisconsin.**

Table 3. Comparison of summary statistics for 2010 and 2018 point-intercept aquatic plant surveys in Big Portage Lake.

Summary Statistic	2010	2018
Total number of sites on grid	653	653
Total number of sites visited	369	651
Total number of sites with vegetation	118	131
Total number of sites shallower than maximum depth of plants	361	566
Frequency of occurrence at sites shallower than maximum depth of plants	32.69	23.14
Simpson Diversity Index	0.92	0.67
Maximum depth of plants (ft.)	19.00	27.00
Number of sites sampled with rake on rope	185	403
Number of sites sampled with rake on pole	182	199
Average number of all species per site (shallower than max depth)	0.57	0.27
Average number of all species per site (vegetated sites only)	1.74	1.15
Average number of native species per site (shallower than max depth)	0.57	0.27
Average number of native species per site (vegetated sites only)	1.74	1.15
Species Richness	23	14
Species Richness (including visuals)	24	22
Floristic Quality Index (FQI)	40.8	27.3

Figure 1. Number of plant species recorded at Big Portage Lake sample sites (2018).

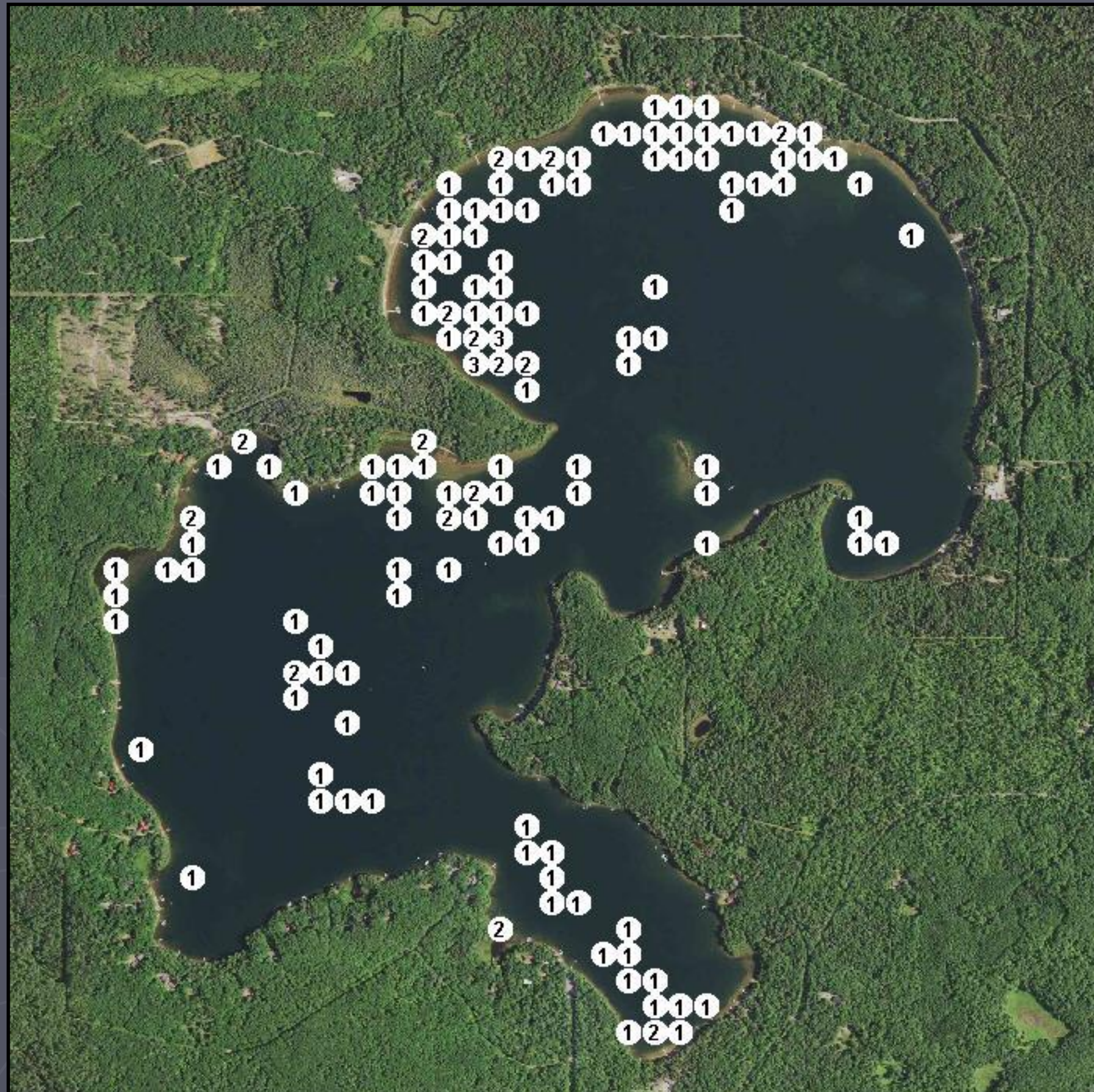
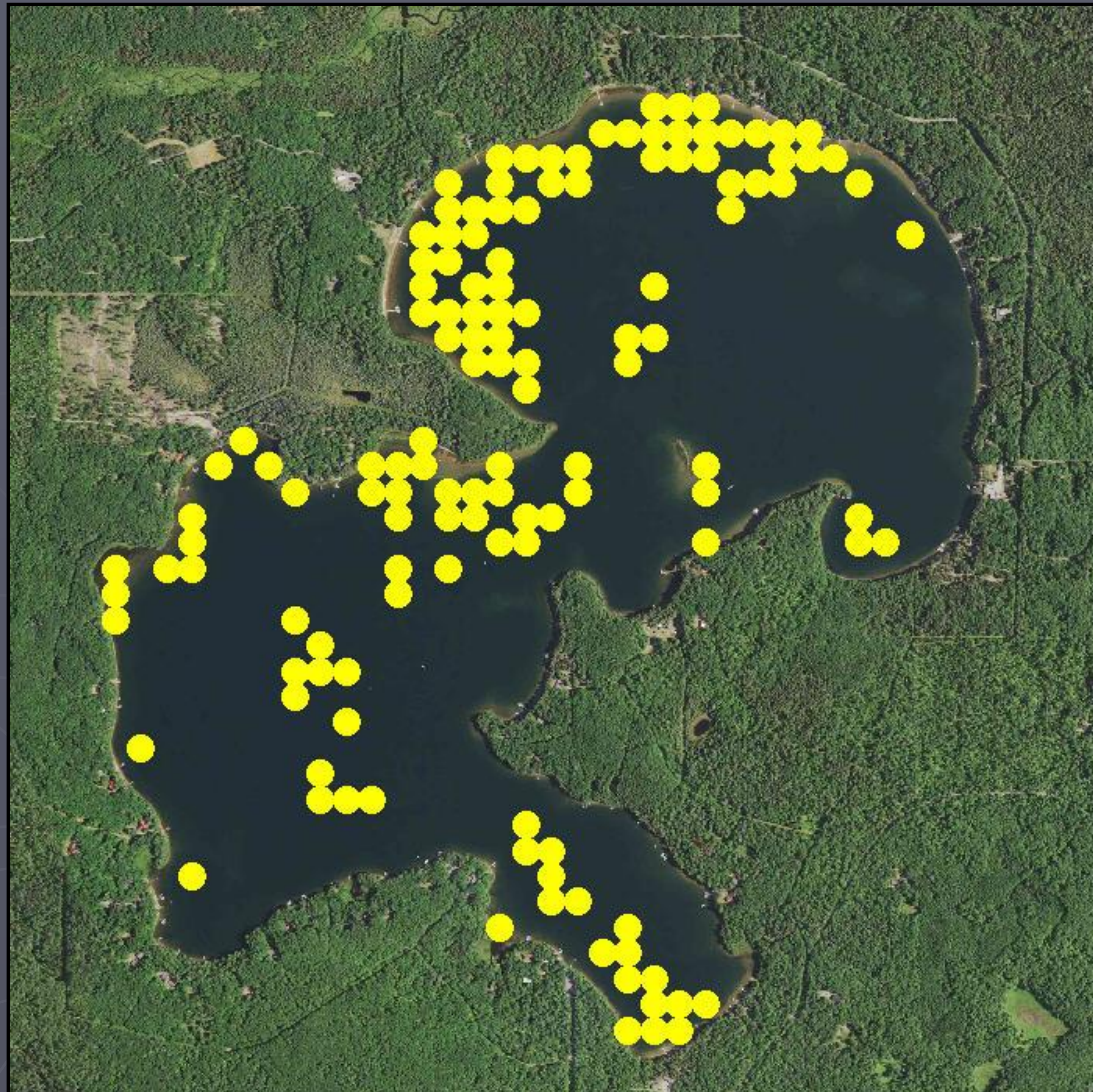


Figure 2. Rake fullness ratings for Big Portage Lake sample sites (2018).



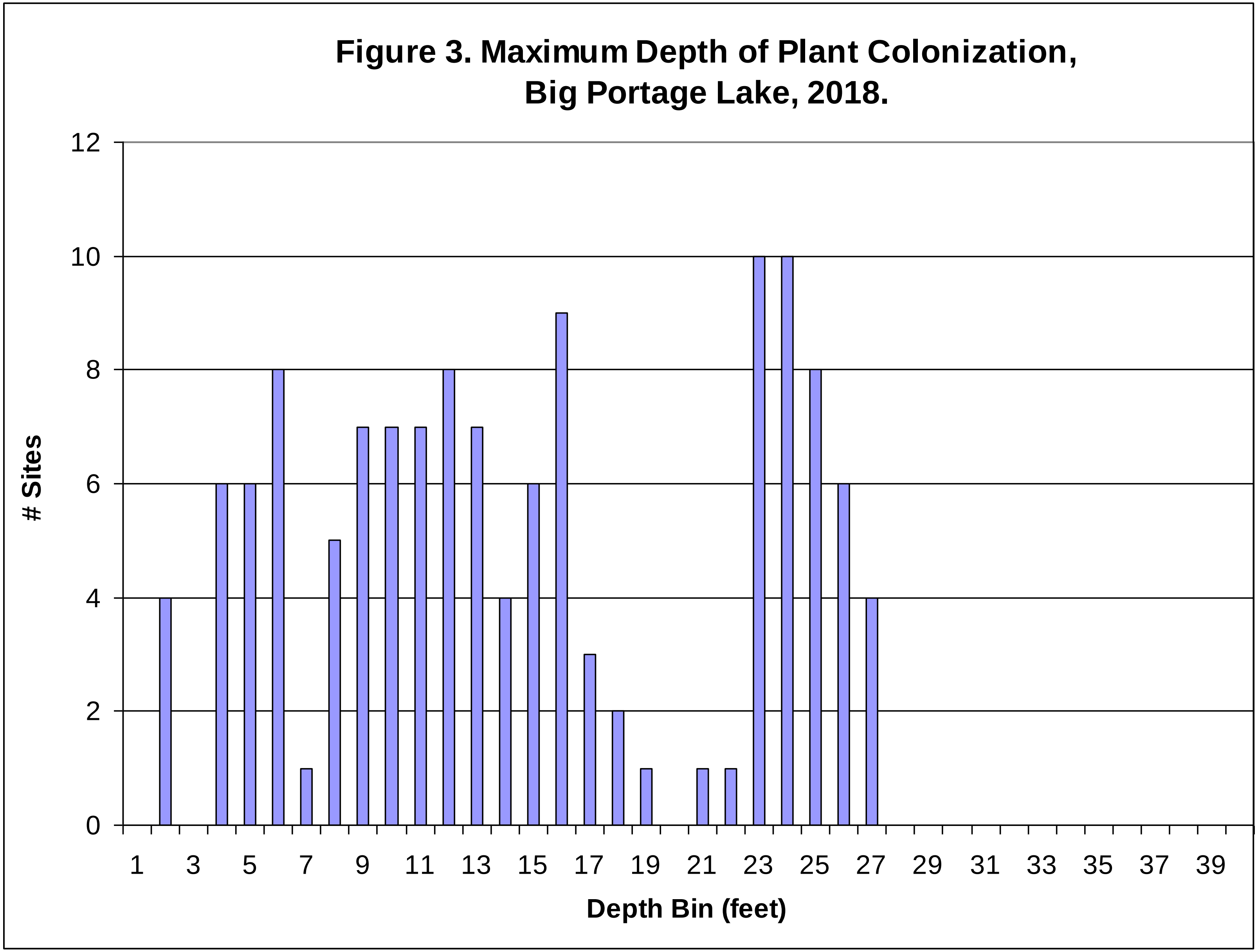


Figure 3. Maximum Depth of Plant Colonization,
Big Portage Lake, 2018.
12
10
8
6
4
2
0
Sites
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
Depth Bin (feet)

Figure 4. Big Portage Lake sampling sites less than or equal to maximum depth of rooted vegetation (2018).

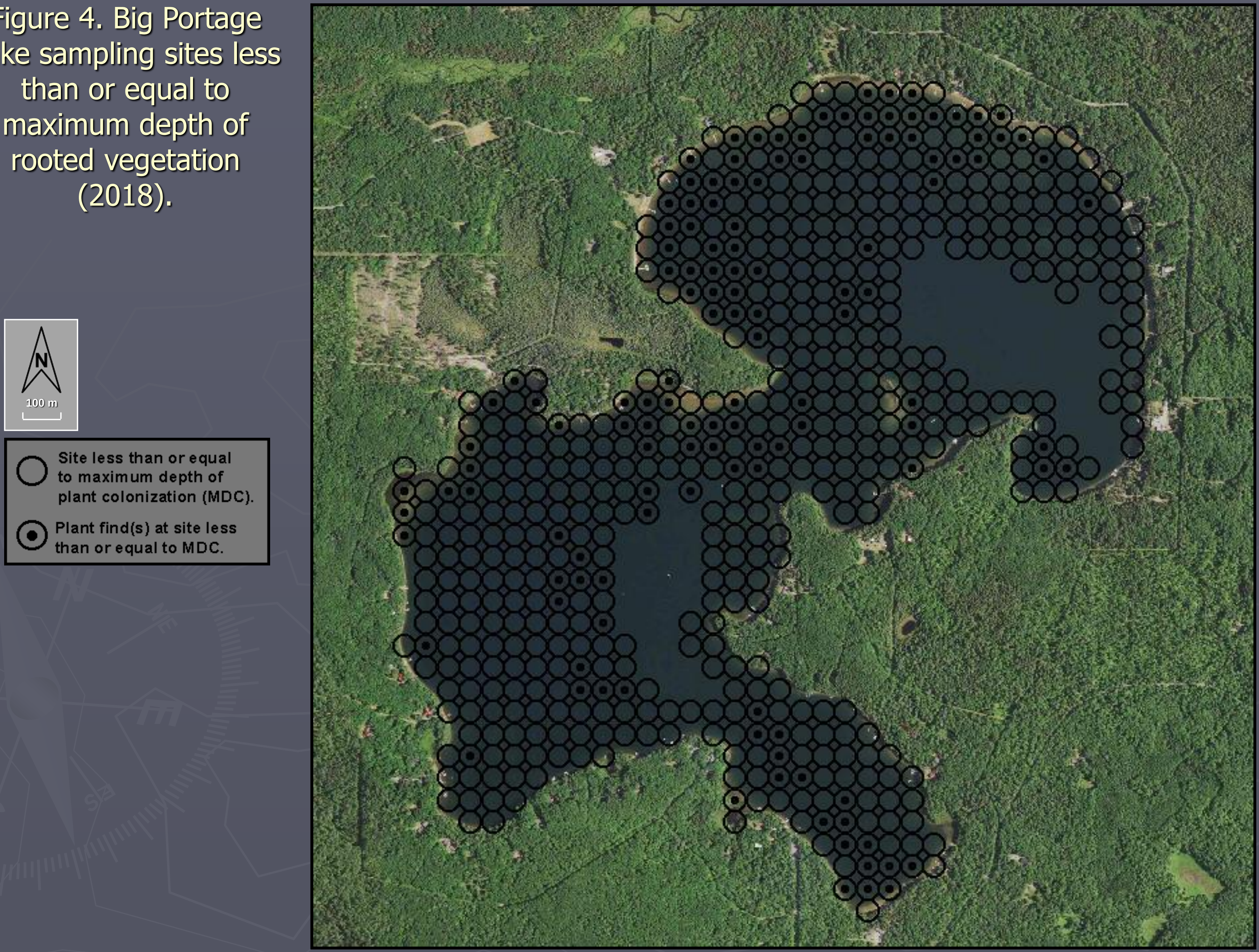
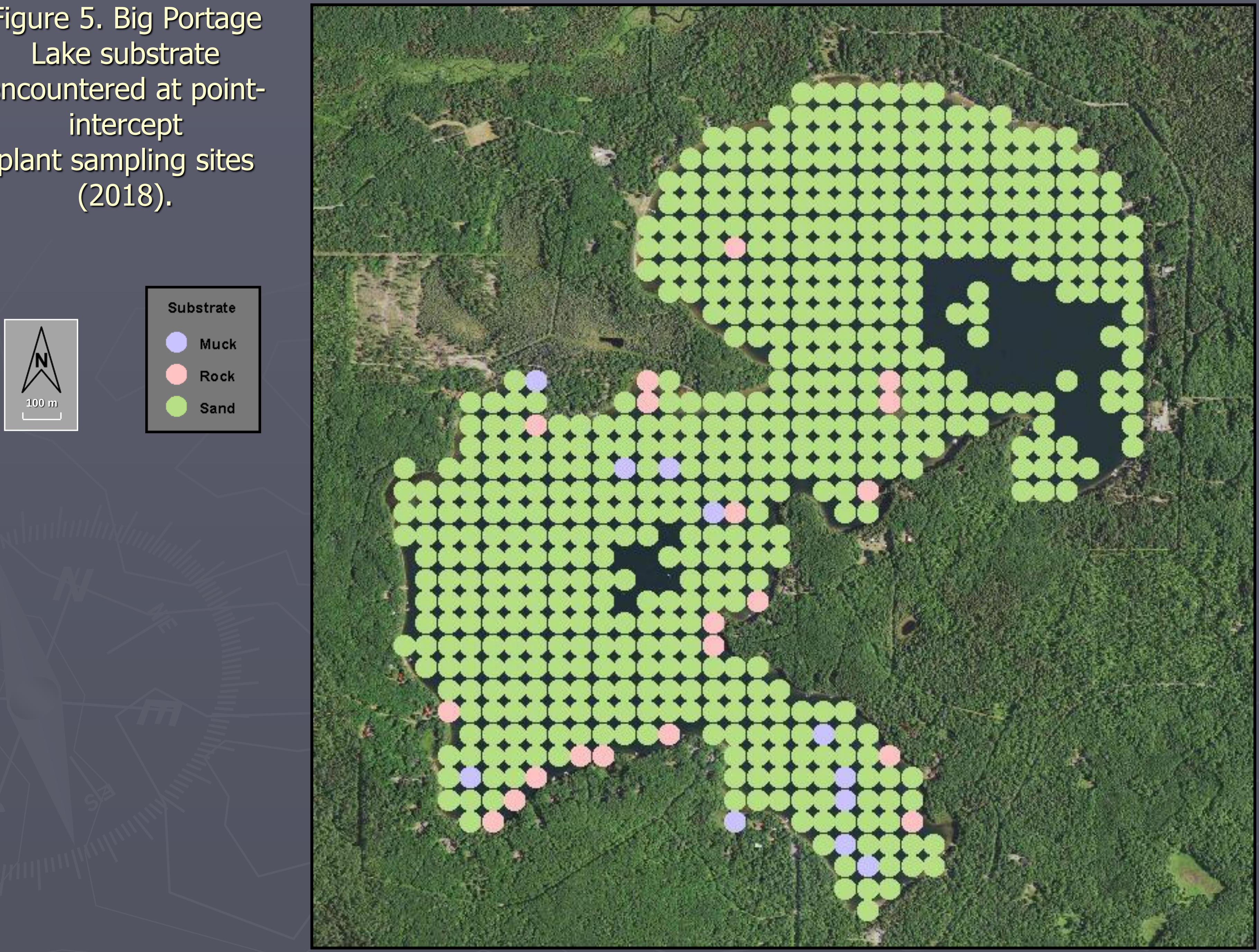


Figure 5. Big Portage Lake substrate encountered at point-intercept plant sampling sites (2018).



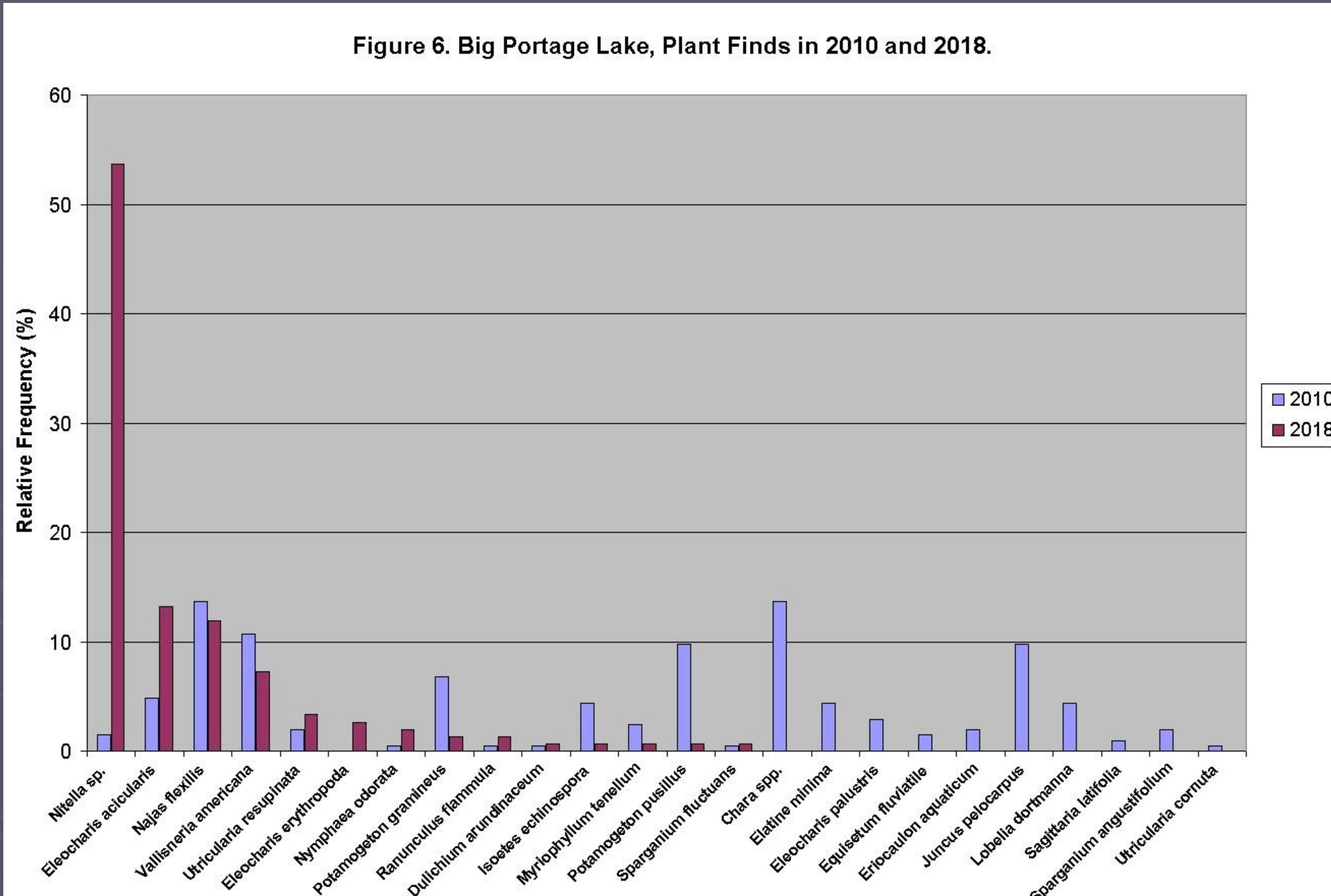


Figure 6. Big Portage Lake, Plant Finds in 2010 and 2018.
Relative Frequency (%)
60
50
40
30
20
10
0
2010
2018
Nitella sp.
Eleocharis acicularis
Najas flexilis
Vallisneria americana
Utricularia resupinata
Eleocharis erythropoda
Nymphaea odorata
Potamogeton gramineus
Ranunculus flammula
Dulichium arundinaceum
Isoetes echinospora
Myriophyllum tenellum
Potamogeton pusillus
Sparganium fluctuans
Chara spp.
Elatine minima
Eleocharis palustris
Equisetum fluviatile
Eriocaulon aquaticum
Juncus pelocarpus
Lobelia dortmanna
Sagittaria latifolia
Sparganium angustifolium
Utricularia cornuta

Figure 7. Big Portage Lake point-intercept plant sampling sites with emergent and floating aquatic plants (2018).

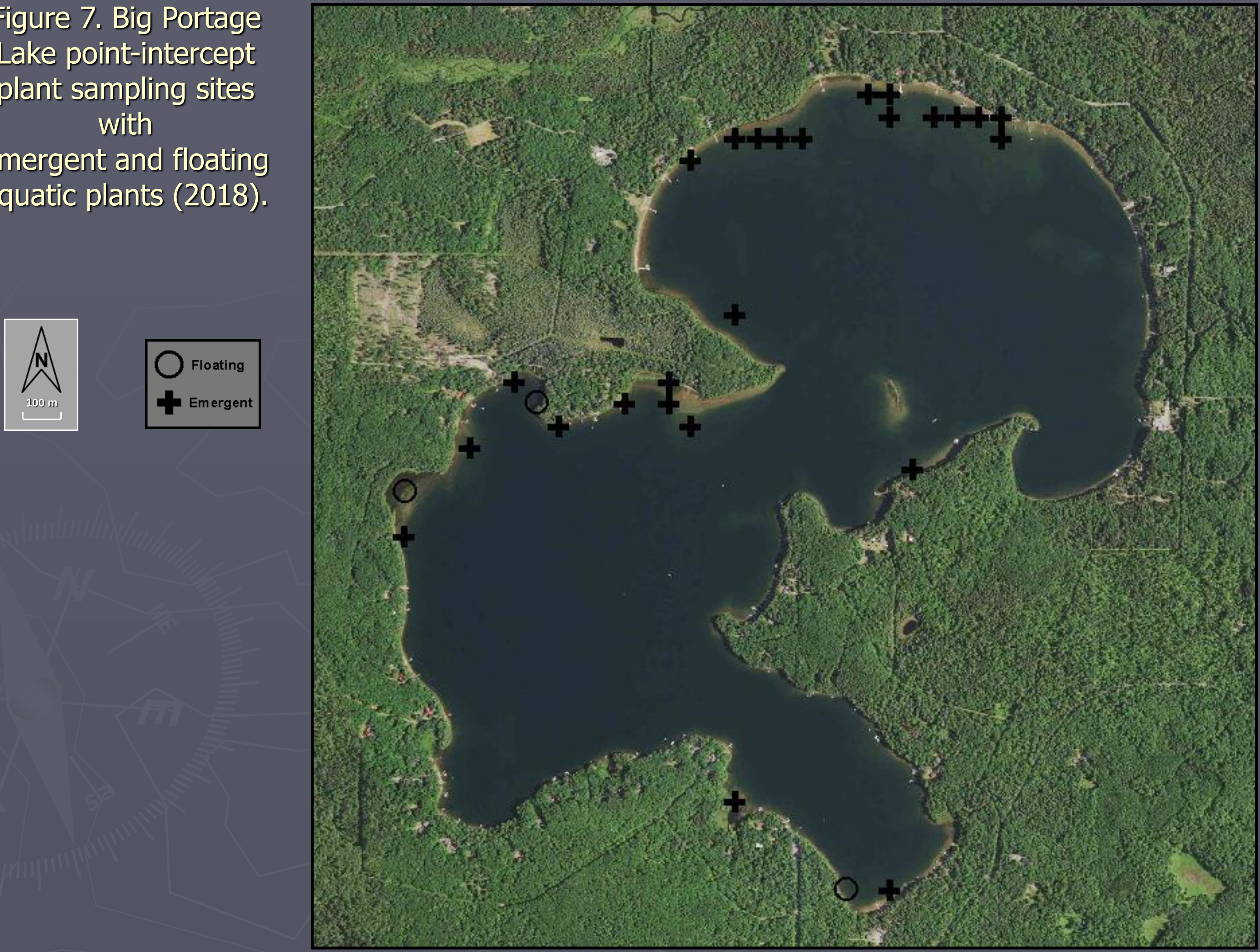


Figure 8. Distribution of plant species, Big Portage Lake (2018).

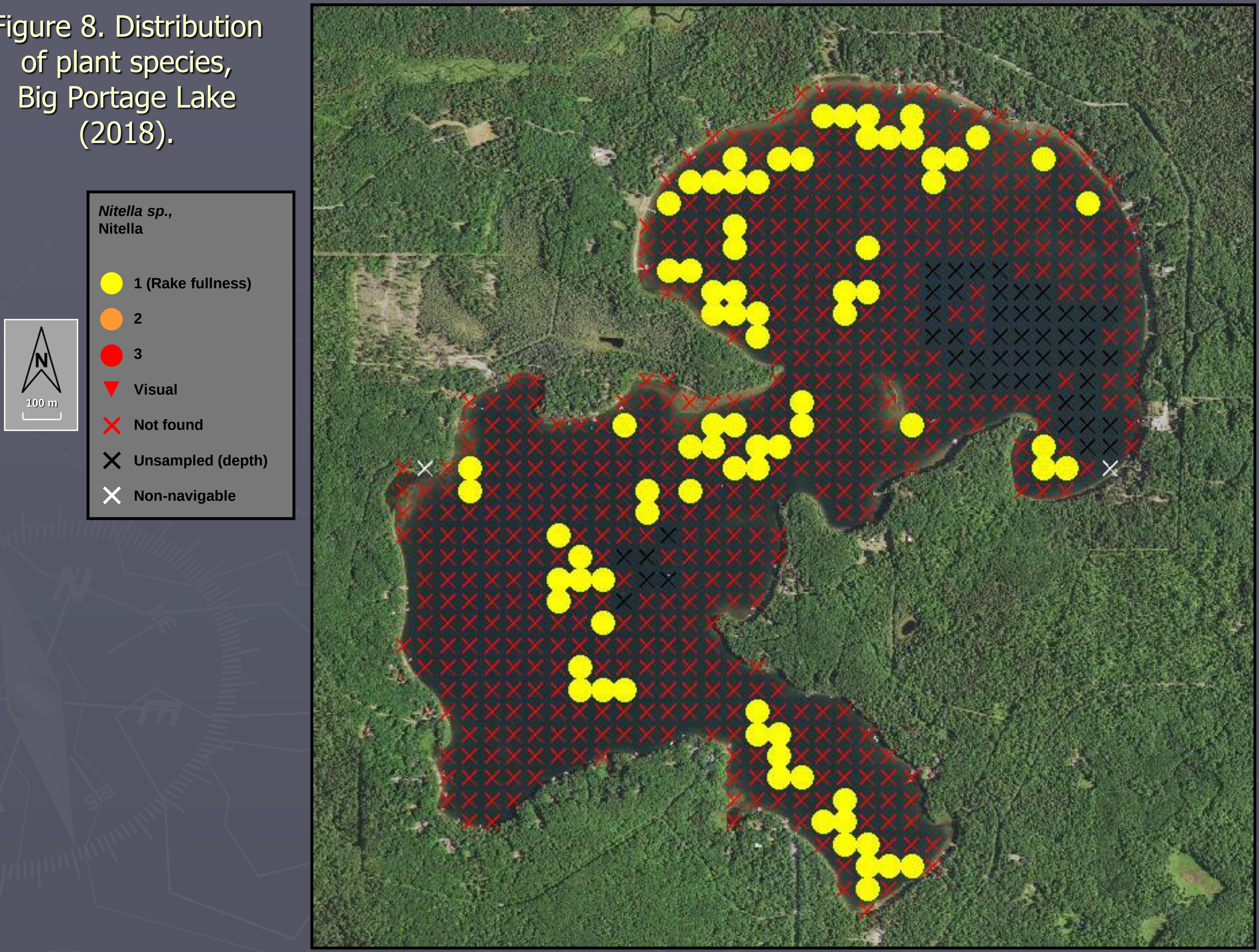


Figure 9. Distribution of plant species, Big Portage Lake (2018).

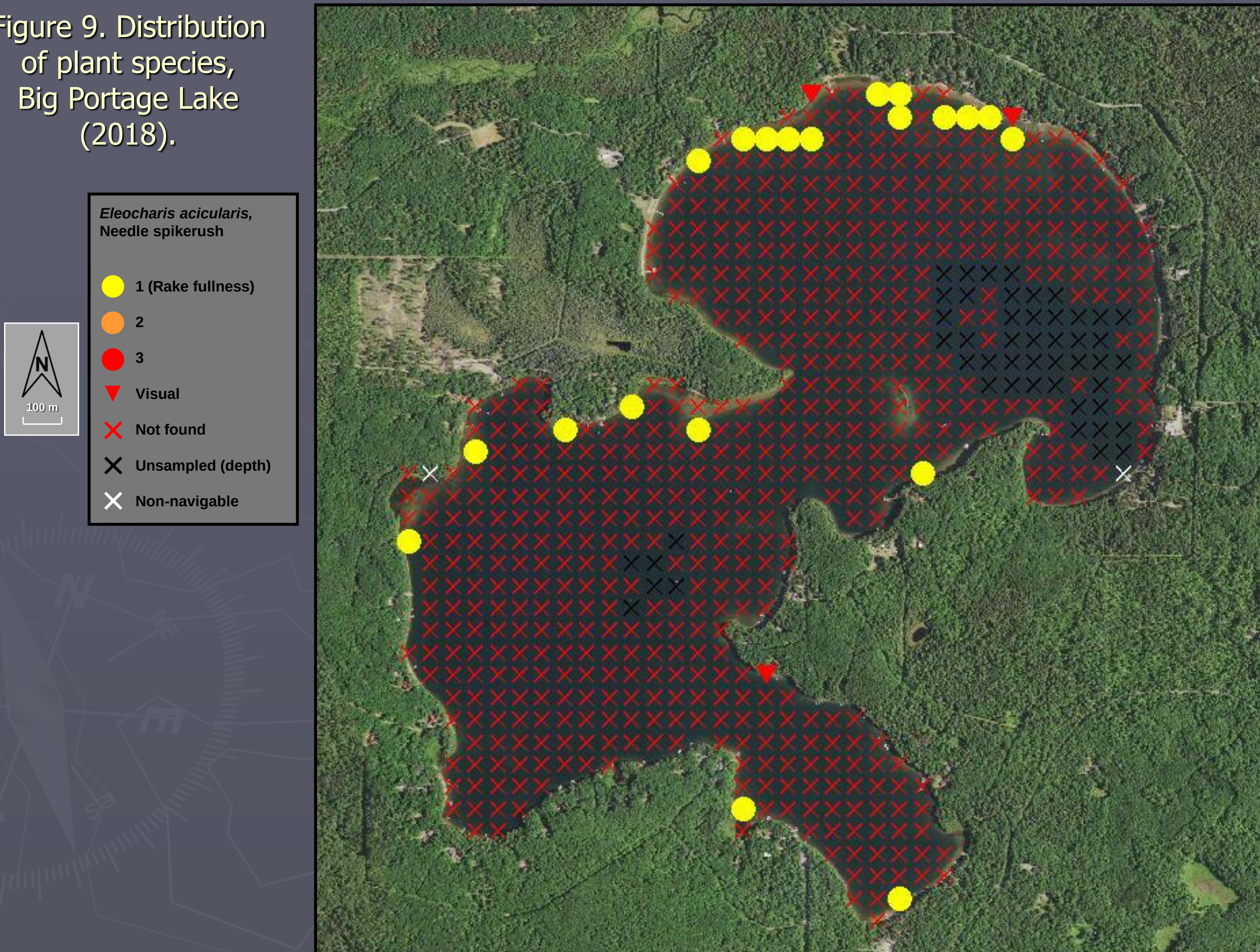
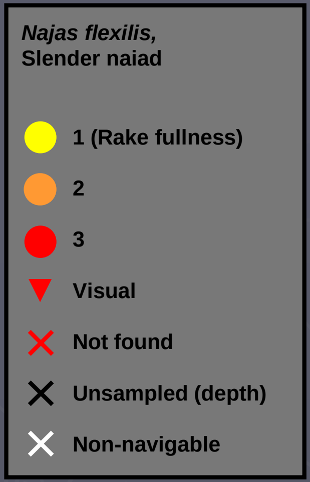


Figure 10. Distribution of plant species, Big Portage Lake (2018).



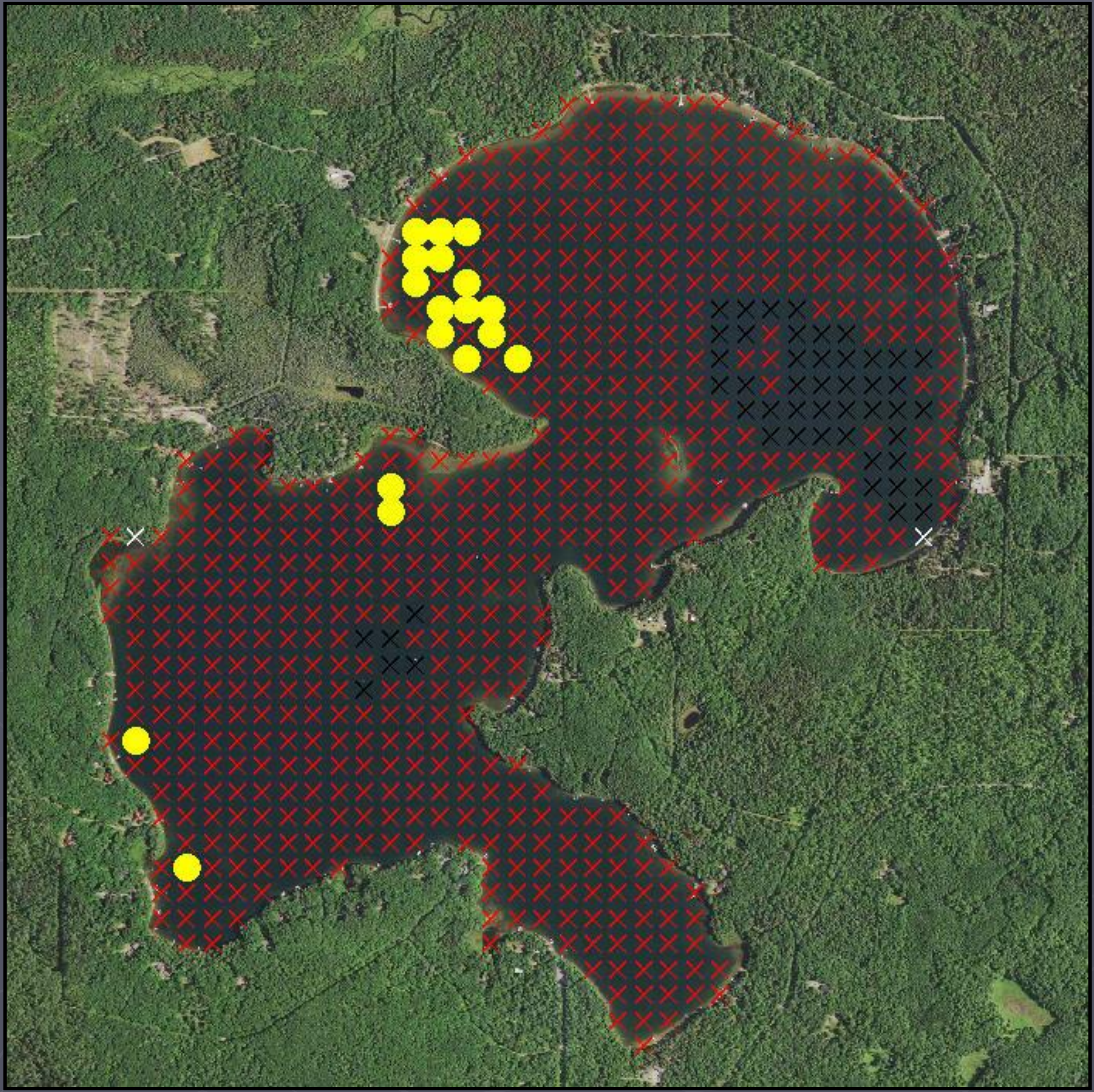


Figure 11. Distribution of plant species, Big Portage Lake (2018).

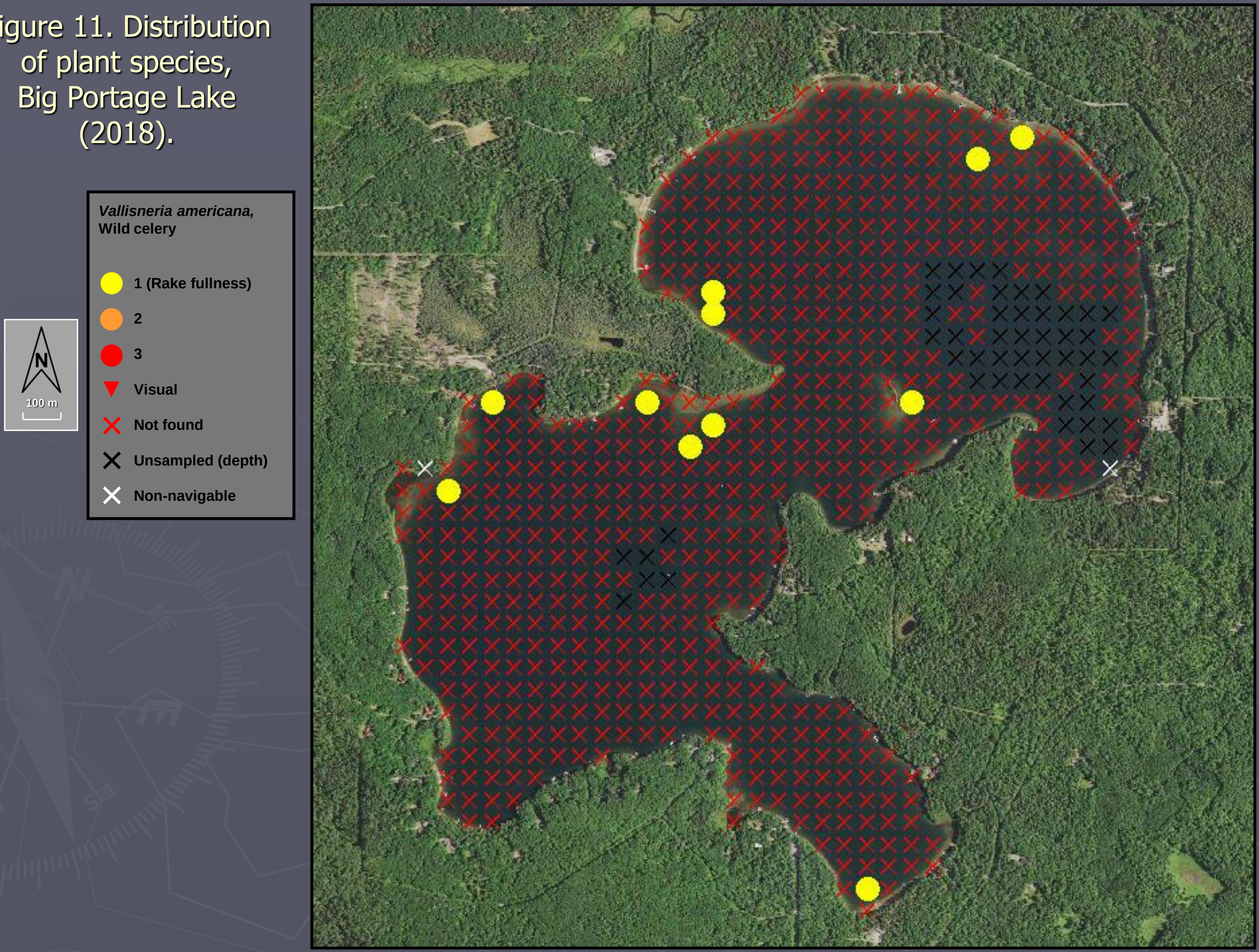


Figure 12. Distribution of plant species, Big Portage Lake (2018).

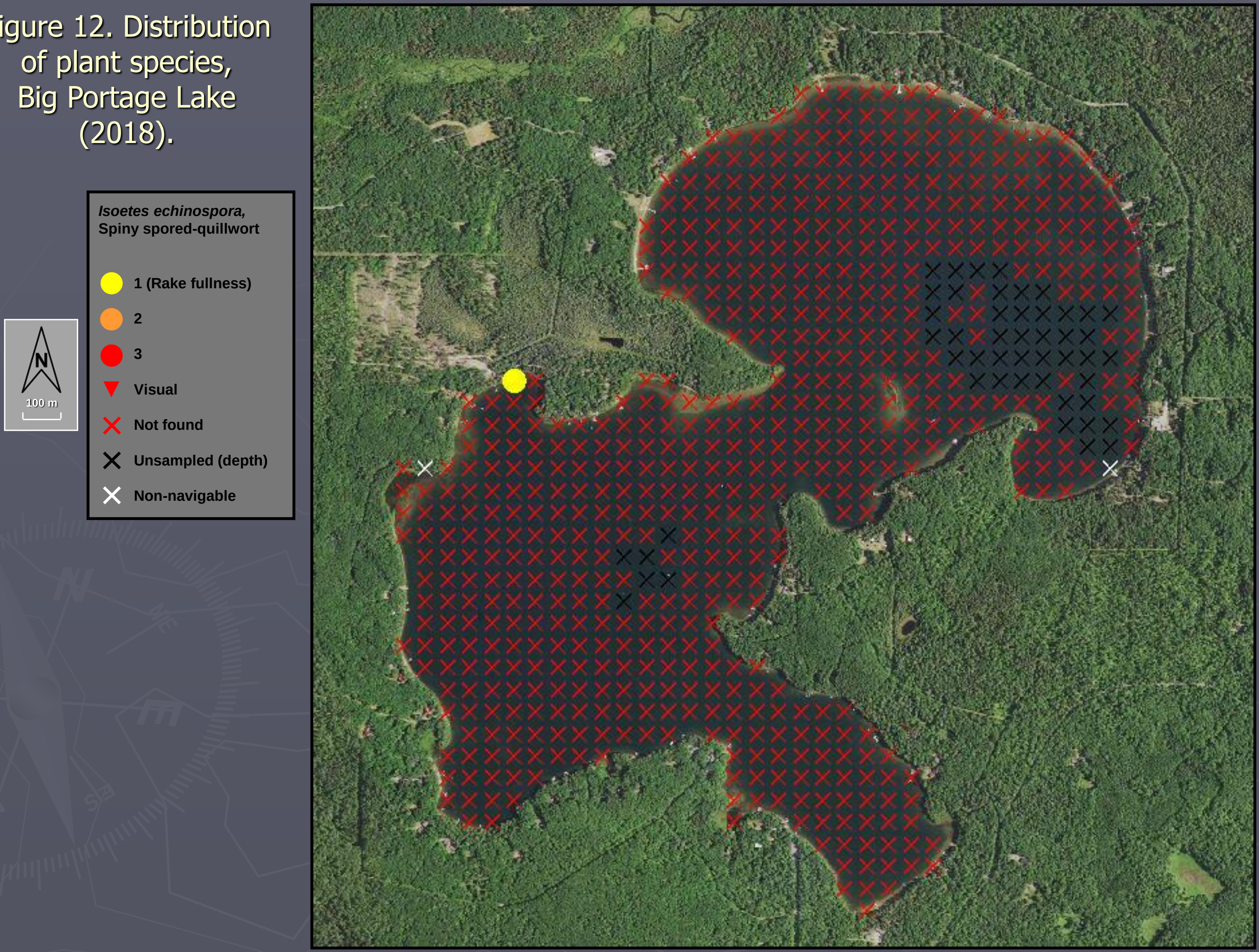


Figure 13. Distribution of plant species, Big Portage Lake (2018).

***Potamogeton pusillus*, Small pondweed**

- 1 (Rake fullness)
- 2
- 3
- Visual
- Not found
- Unsampled (depth)
- Non-navigable

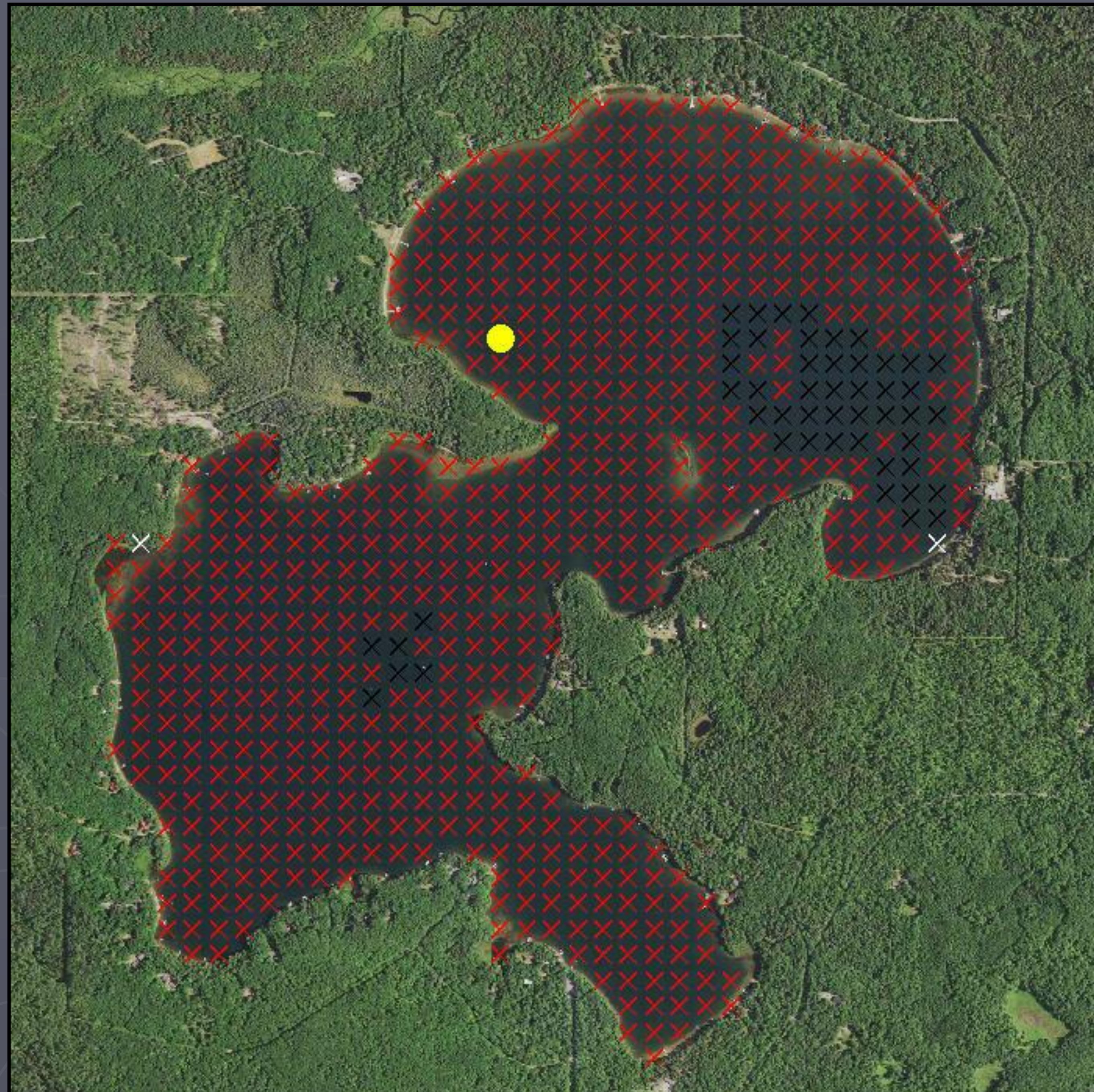
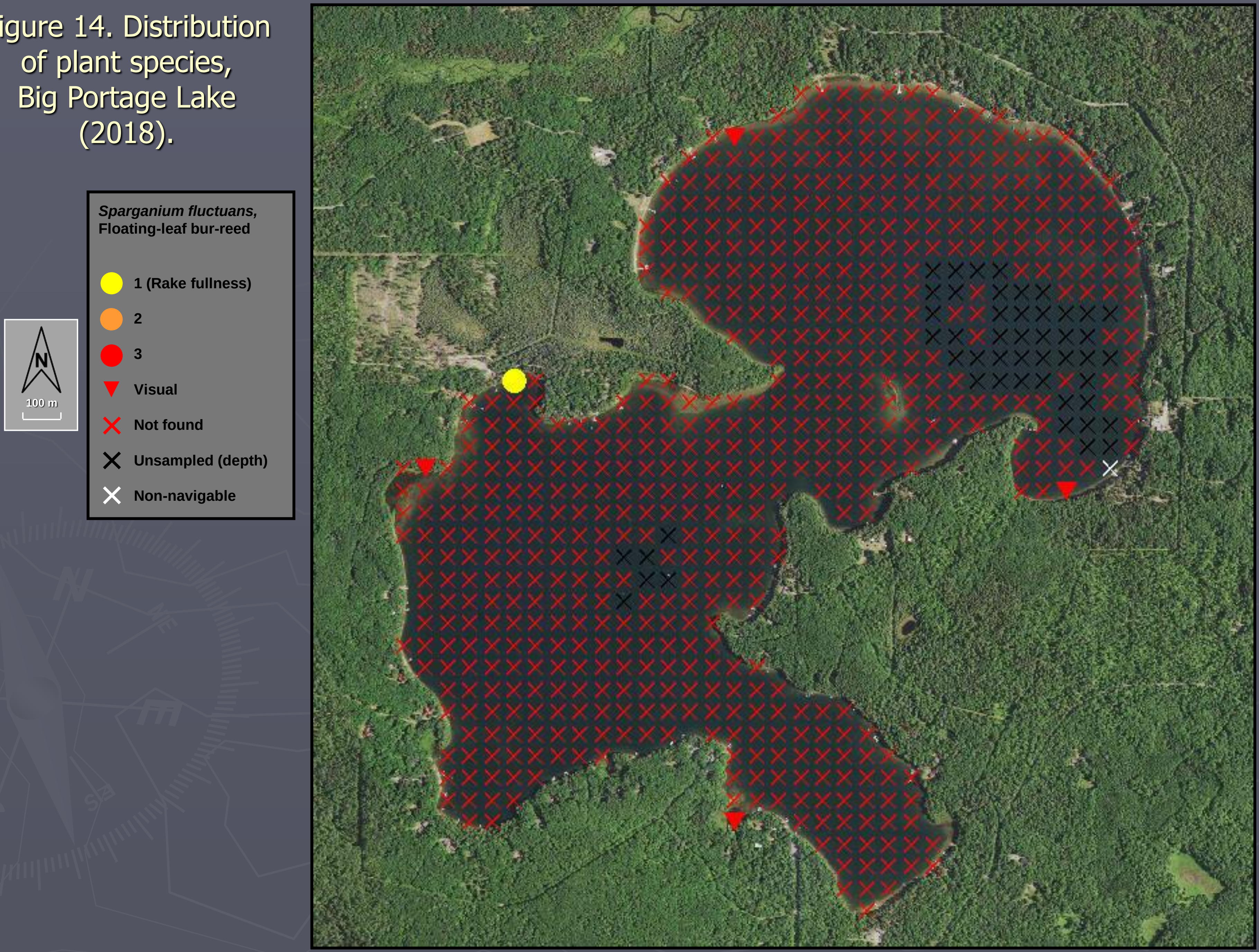


Figure 14. Distribution of plant species, Big Portage Lake (2018).



Appendix 2

Big Portage Lake Riparian Owners Association

Aquatic Plant Monitoring Protocol

BPLROA Big Portage Lake

Riparian Owners Association

AQUATIC PLANT MONITORING

9/10/2013

This protocol is based on the March 2012 Citizen Lake Network Monitoring (CLNM) protocol.

TABLE OF CONTENTS

INTRODUCTION

A mission statement for Big Portage Lake was developed as part of the strategic lake monitoring plan. This mission statement is important because it summarizes what we want to accomplish for our lake.

Mission Statement

> *To preserve and protect the natural environment and quality of Big Portage Lake for current and future generations, through continued education and involvement of stakeholders monitoring of the lake environment, and being prepared to respond to change.*

Goals and management actions were developed to help us accomplish our mission. One goal specifically addressed aquatic invasive species (AIS):

> *Management Goal 3: Prevent Aquatic Invasive Species Introductions to Big Portage Lake.*
>
> > *Management Action: Coordinate annual volunteer monitoring for Aquatic Invasive Species*

This plan was developed to help us accomplish this goal for Big Portage Lake. Most of the information was adopted from the March 2012 Citizen Lake Network Monitoring (CLNM) protocol found on their website: http://dnr.wi.gov/lakes/CLMN/.

AQUATIC PLANT MONITORING PROTOCOL

At Big Portage Lake, we are focusing on prevention monitoring for Eurasian Water Milfoil, Curly-leaf Pondweed, Purple Loosestrife and Hydrilla.

OVERVIEW

Zones. The lake will be divided into seven or more monitoring zones depending on the availability of volunteers. The list of current volunteers and their assigned zones are found in Table 1.

Table 1: Monitoring Volunteers and Zones

Name	Assigned Zone	Description
Dale Ekkela	A to B	Deerwood Resort to bay at 5310
Dave Leifeit	B to C	5314 Maple Leaf Lane to 5704 Private Road
Tom Gratz	C to D	5704 Private Road to 5205 Gees Road
Forrest Muehlethaler	D to E	5205 Gees Road to 5860 Hron Lane
Bob Wannemaker	E to F	5860 Hron Lane to 5975 Big Portage Lake Road
Jules Eberhardt	F to G	5975 Big Portage Lake Road to Alt's Point
Dale Reilley	G to H	Alt's Point to East Bay Point
Dan Johns	H to A	East Bay Point to Deerwood Resort

Sweep Frequency. Volunteers will conduct at least three sweeps of their assigned zones: early season (May 15 – June 15); mid-season (July 15 – August 15); and late season (September 15 – October 15). Any volunteer unable to conduct his sweep, should contact the Monitoring Coordinator, Dan Johns, as soon as possible so a substitute can be identified to conduct the sweep.

Reporting. Within one week of the completion of each sweep, volunteers will report findings (electronically, if possible) to the Big Portage Lake Riparian Association (BPLROA) AIS Monitoring Coordinator, Dan Johns. The report will include the date the sweep was conducted, the locations monitored, as well as the findings. Negative findings will be reported.

Any suspected findings of aquatic invasive species (AIS) plants are to be immediately reported to the Big Portage Lake Riparian Association (BPLROA) AIS Monitoring Coordinator.

Monitoring activities and findings (including negative findings) will be reported to the Wisconsin Department of Natural Resources (WDNR) by the Big Portage Lake Riparian Association (BPLROA) AIS Monitoring Coordinator at least annually, using established reporting forms. Reporting forms are found on the DNR website at www.DNR.wi.gov/lakes/monitoring/forms.aspx.

Records. Records will be compiled and maintained by the BPLROA AIS Monitoring Coordinator to include the date, location and findings of all monitoring activities; and the time expended by each volunteer conducting monitoring activities.

Follow up. Confirmed AIS findings will be addressed as outlined in the Contingency Response Plan (provided in this manual).

WHEN TO MONITOR

General. Big Portage Lake Volunteers should conduct at least three sweeps of their assigned zones: early season (May 15 – June 15); mid-season (July 15 – August 15); and late season (September 15 – October 15). Additional monitoring is not discouraged.

Eurasian Water Milfoil (EWM). The first half of the summer is especially important because EWM is at its greatest biomass.

Curly-leaf Pondweed (CLP). CLP is at its peak in May and June. If you notice plants that suddenly disappear in late June or early July, it may be CLP. You can also check for CLP in late fall since new plant will be growing at this time and the native pondweeds are dying back.

Purple Loosestrife (PL). The best time to identify and look for purple loosestrife is when it is in bloom (from mid-July through September).

Hydrilla. Hydrilla grows from ice-off to mid-September.

WHERE TO LOOK

General. BPL Monitors will look at the perimeter shoreline of the lake from the shore to the maximum observable depth where plant can be expected to grow with emphasis on the shore to a ten foot depth.

Floating Plants. Consider the direction of the prevailing winds and where are plants and debris likely to be. Go to the areas where you have seen piles of plants and debris.

Eurasia Water Milfoil (EWM). EWM will grow throughout the entire lake where water depths are less than 20 feet. Check the perimeter of the lake for fragments. When checking for rooted plants, look for EWM in both sandy and mucky areas. (See Appendix A for additional information on recognizing EWM.)

Curly-leaf Pondweed (CLP). CLP will grow throughout the entire lake where water depths are less than 15 feet. CLP will grow in a variety of sediment conditions, but will do the best in areas with a mucky bottom. (See Appendix B for additional information on recognizing CLP.)

Purple Loosestrife (PL). PL is a wetland perennial that spreads mainly by seed, but can also spread from root or stem segments. Optimum substrates for growth are moist soils of neutral to slightly acidic pH, but the plants can exist in a wide range of soil types. (See Appendix C for additional information on recognizing PL.)

Hydrilla. Hydrilla can thrive in lower light conditions. Hydrilla can grow in water more than 20 feet deep.

PROCEDURE

1. **Monitor Shorelines.** Look for floating plant fragments in shallow water and in piles of washed up plant fragments along the shore. It is especially important to check piles of plants and debris after storms and high boat traffic times, as this is when plant fragments will be at the heaviest.
2. **Monitor shallow-water areas**. Boat or walk around the shoreline and look for EWM and CLP in the shallow water areas
3. **Monitor deep water areas.** Once you have monitored near shore areas, go out in your boat and observe plants in the deeper water areas. It will be easiest to see the plants if you are wearing polarized sunglasses and/or using an Aqua-view scope. Clear, calm weather is best for sampling. Sunny skies make it easier to see into the water. Snorkeling is also a great way to observe deeper areas.

COLLECTING SUSPECT PLANTS

Use a long-handled rake to collect plants that are hard to reach or difficult to identify. In deeper areas, you can lower the rake to the bottom of the lake and drag the rake along. Pull the rope so the rake pulls across several feet of the lake bed. This will also allow you to collect plants that are not readily visible from the lake's surface.

Do not throw plant that you collect back into the lake. Dispose of them on shore. If you toss back plants, you may inadvertently spread plants to different location on the lake.

1. **Records.** When sampling, you should keep records about your activities:
    - When collecting samples, measure the depth at the sampling site. This can be done with a depth finder or an anchor attached to a line with depth increments.
    - Record the sediment type (based on how the rake feels when in contact with the bottom) at each site where plants are samples as: mucky, sandy or rocky.
2. **Record Location.**
    - Record your position on your map, using GPS coordinates, if possible.
    - The monitor will also be provided with marker buoys that can be dropped at the location if not in a high boat traffic area.
3. **Sampling.** Gently pull the plant from the lake bottom. Be sure to collect as much of the plant as possible, paying special attention to getting the leafy and flowering portion, if present. Try not to break up or rip the plant (the pieces can float away and start new plants).
4. **Labeling.** If a collected plant is to be preserved for analysis, it should be labeled correctly. Use a permanent marker and record the following information on a Ziploc baggie:
    - Date
    - Water body

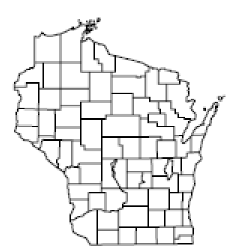
- Description of where the sample was found. Note the “suspect” plant’s location on your map, making sure you can find the spot again. Record the GPS position, if applicable.

5. **Packaging.** Put the sample in the labeled baggie
6. **Preservation.** Keep the sample in a cool place (a cooler or refrigerator at home) until it can be submitted/transported.
7. **Forms.** Fill out an Aquatic Invasive Plant Incident Report, form 3200-125, for any sample to be submitted.
8. **Submission.** Take the plant and the BPLROA Monitoring Coordinator or local DNR CLMN contact. Suspect plants will go to a herbarium for vouchering. DNR staff can transport plants to the herbarium for the lake group.
9. If you cannot transport the plant in a timely manner, you should prepare and mail the plant to the CLMN contact.
    - Preservation
        - Rinse the plant under running tap water or in a large pan of water (to slow rotting)
        - Blot the plant dry with a paper towel
        - Spread the plant out on a dry paper towel or newspaper; try to spread the leaflets apart to help with identification.
        - Cover with a dry paper towel and press in a catalog or phone book for about a week.
    - When the plant is dry, place it between sheets of thin cardboard (like a cereal box).
    - Make a copy of the map and reporting forms for your records.
    - Complete a label and form 3200-125
    - Mail the plant, map and the reporting form to the local CLMN contact.

Example of Plant Label:

Project Name: Citizen Lake Monitoring Network

(Scientific Name & authority)



Common Name:
Lake Name:
Water Body ID code#:
County:
Collected by:
Date:
Depth:
Location and Habitat:

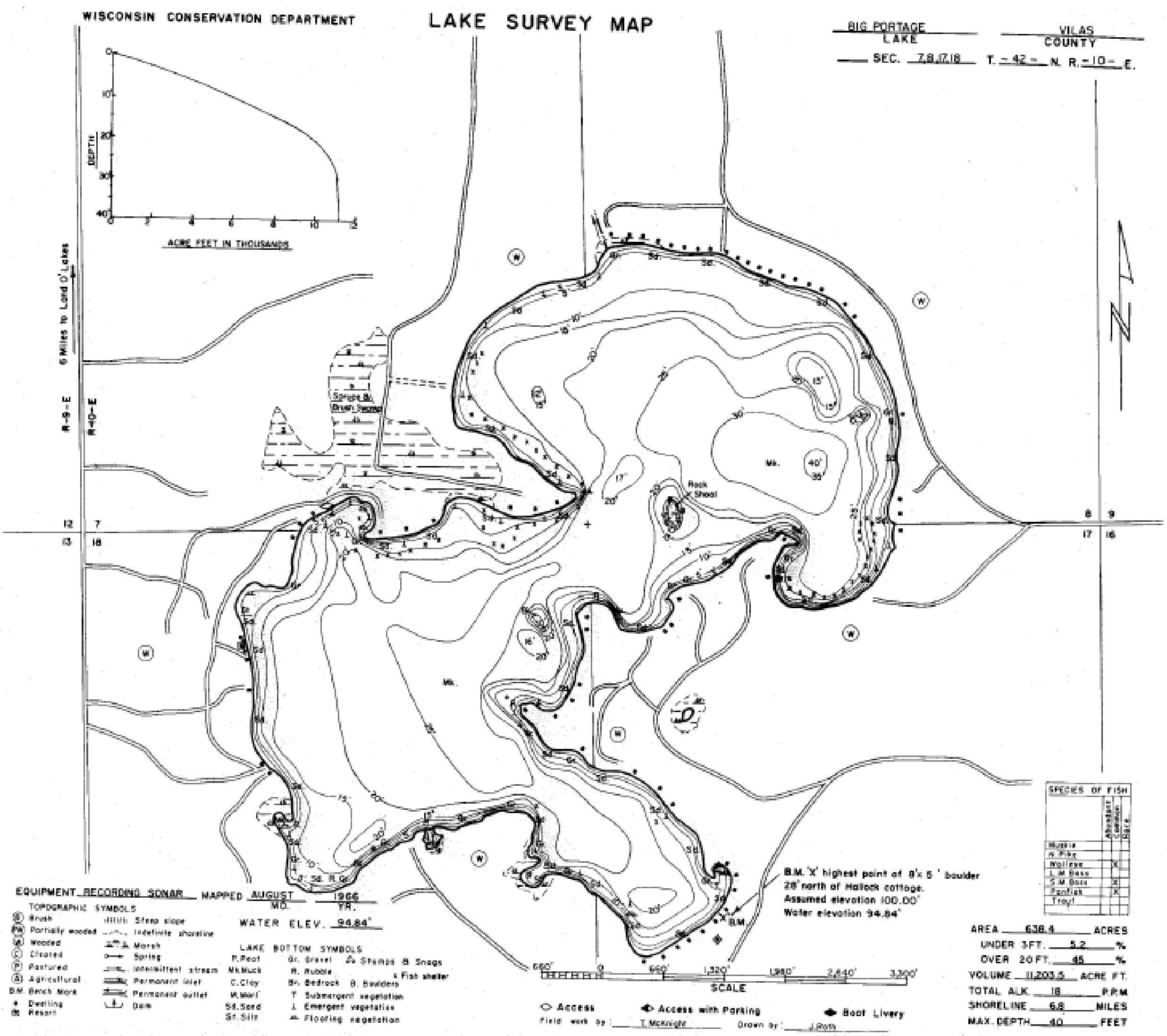
REPORTING

1. **Report each sweep**
   - Within one week of each sweep conducted, report findings (including negatives) to the BLPOA Monitoring Coordinator.
2. **Suspected AIS Plant Finding**
   - Any suspected AIS plant finding should be reported as soon as possible to the BPLROA Monitoring Coordinator
   - The Monitoring Coordinator will notify the Vilas County AIS Coordinator in Eagle River and the DNR Lake and APM Coordinator in Rhinelander.
   - The BPLROA Monitoring Coordinator will submit an Aquatic Invasives Plant Incident Report (Form 3200-125).
3. **End of Season Reports**
   - All monitors will complete an Aquatic Invasives Surveillance Monitoring End of Season Report (Form 3200-133) and submit it to the BPLROA Monitoring Coordinator by October 15, each year.
   - The report will include data for the assigned monitoring zone.
4. **Report Submission**
   - The BPLROA Monitoring Coordinator will report data on the WDNR website at http://dnr.wi.gov/lakes/CLMN
   - Procedure
     i. (click "Enter Data" on the left side bar).
     ii. If you don't have a user ID and password, click "Request a Wisconsin User ID and Password", then email Jennifer at Jennifer.filbert@wisconsin.gov with your User ID and what monitoring you are involved in. Jennifer will set up your accounts and email you back. Once you receive a confirmation email, you can log in. Once you are logged in, to go the "Submit Data" tab and click "Add New" to start entering data. Choose the AIS monitoring project for your lake in the Project dropdown box.
     iii. For prevention monitoring, report your results using the Aquatic Invasives Surveillance Monitoring Report, Form 3200-125.
     iv. Frequency. You can report your results as often as you wish, but be sure to at least report results once a year at the end of the monitoring season.
     v. If you have any questions about reporting, contact your local DNR CLMN contact.

FORMS

The original WDNR forms used are found at http://dnr.wi.gov/lakes/monitoring/forms.aspx. For your convenience a copy of the following forms are included:

- Map of Big Portage Lake
- Aquatic Invasives Surveillance Monitoring End of Season Report (Form 3200-133)
- Aquatic Invasives Plant Incident Report (Form 3200-125)
- Purple Loosestrife Watch Reporting Procedures


WISCONSIN CONSERVATION DEPARTMENT
LAKE SURVEY MAP
BIG PORTAGE
LAKE
VILAS
COUNTY
SEC. 7,8,17,18
T. - 42 - N. R. - 10 - E.
DEPTH
ACRE FEET IN THOUSANDS
6 Miles to Land O' Lakes
R-9-E
R-10-E
Spruce & Brush Swamp
Rock Shoal
Mk.
EQUIPMENT RECORDING SONAR
MAPPED AUGUST 1966
MO. YR.
WATER ELEV. 94.84'
TOPOGRAPHIC SYMBOLS
Brush
Partially wooded
Wooded
Cleared
Pastured
Agricultural
B.M. Bench Mark
Dwelling
Resort
Steep slope
Indefinite shoreline
Marsh
Spring
Intermittent stream
Permanent inlet
Permanent outlet
Dam
LAKE BOTTOM SYMBOLS
P. Peat
Mk. Muck
C. Clay
M. Marl
Sd. Sand
St. Silt
Gr. Gravel
R. Rubble
Br. Bedrock
B. Boulders
Stumps & Snags
Fish shelter
Submergent vegetation
Emergent vegetation
Floating vegetation
B.M. 'X' highest point of 8'x 5' boulder
28' north of Hallock cottage.
Assumed elevation 100.00'
Water elevation 94.84'
SCALE
Access
Access with Parking
Boat Livery
Field work by: T. McKnight
Drawn by: J. Roth
SPECIES OF FISH
Muskie
N. Pike
Walleye
L.M. Bass
S.M. Bass
Panfish
Trout
AREA 638.4 ACRES
UNDER 3 FT. 5.2 %
OVER 20 FT. 45 %
VOLUME 11,203.5 ACRE FT.
TOTAL ALK. 18 P.P.M.
SHORELINE 6.8 MILES
MAX. DEPTH 40 FEET

State of Wisconsin
Department of Natural Resources
Wisconsin Lakes Partnership

Aquatic Invasives Surveillance Monitoring
End of Season Report

Form 3200-133 (02/10)
Previously Form 3200-124
Previously Form 3200-124

This monitoring is designed to help detect new invasive species on your lake, so DNR can be alerted and lake residents and/or professionals can respond appropriately. The purpose of the DNR collecting this data is to let us know what methods trained citizens and professionals use when actively looking for aquatic invasive species. You are often the ones to alert us of new invasives in our waters. Remember for surveillance monitoring, a report of "no invasive" at a location is just as important as finding an invasive. One cannot confidently state that the invasive is not present in an area if no one has looked and reported their findings. Knowing where invasives are not, as well as where they are, is extremely important in being able to track and understand their spread. Knowing how often monitors are looking for species and what they are finding is very important information.

Notice: Information on this voluntary form is collected under ss. 33.02 and 281.11, Wis. Stats. Personally identifiable information collected on this form will be incorporated into the DNR Surface Water Integrated Monitoring System (SWIMS) Database. It is not intended to be used for any other purposes, but may be made available to requesters under Wisconsin's Open Records laws, ss. 19.32 - 19.39, Wis. Stats.

Data Collectors

Primary Data Collector Name	Phone Number	Email

Additional Data Collector Names

Total Paid Hours Spent (# people x # hours each)	Total Volunteer Hours Spent (# people x # hours each)

Monitoring Location

Waterbody Name	Township Name	County	Boat Landing (if you only monitor at a boat landing)

Dates Monitored

Start Date (when you first monitored this season)	End Date (when you last monitored this season)

Did at least some data collectors monitor in... May? June? July? August? (circle all that apply)

Did you monitor…	Did you…
All Beaches and Boat Landings? Frequently Some of the Time Not Often/Never	Walk along the shoreline? Frequently Some of the Time Not Often/Never
Perimeter of whole lake? Frequently Some of the Time Not Often/Never	Observe entire shallow water area (up to 3 feet deep)? Frequently Some of the Time Not Often/Never
Docks or piers? Frequently Some of the Time Not Often/Never	Use rake to extract plant samples? Frequently Some of the Time Not Often/Never
Other: ______________________________	Check underwater solid surfaces (boat hulls, dock legs, rocks)? Frequently Some of the Time Not Often/Never
	Other: ______________________________

Did you find…(even if not a new finding for the lake or stream)

Banded Mystery Snail?	Yes	No	Did not look for	Hydrilla?	Yes	No	Did not look for
Chinese Mystery Snail?	Yes	No	Did not look for	Purple Loosestrife?	Yes	No	Did not look for
Curly-Leaf Pondweed?	Yes	No	Did not look for	Rusty Crayfish?	Yes	No	Did not look for
Eurasian Water Milfoil?	Yes	No	Did not look for	Spiny Waterfleas?	Yes	No	Did not look for
Fishhook Waterfleas?	Yes	No	Did not look for	Zebra Mussels?	Yes	No	Did not look for
Freshwater Jellyfish?	Yes	No	Did not look for	Other?: ____________			

If you find an aquatic invasive

If you find an aquatic invasive and it is not listed at http://dnr.wi.gov/lakes/AIS fill out an incident report for the species. Then bring the form, a voucher specimen if possible, and a map showing where you found it to your regional DNR Citizen Lake Monitoring Coordinator as soon as possible (to facilitate control if control is an option).

If you don't find an aquatic invasive

If you submit your data online, that is all you need to do. Otherwise, please mail a copy to your regional DNR Citizen Lake Monitoring Coordinator. http://dnr.wi.gov/lakes/contacts

Septembe

State of Wisconsin
Department of Natural Resources
Wisconsin Lakes Partnership

Aquatic Invasive Plant Incident Report
Form 3200-125 (R 2/10)

The purpose of this form is to notify DNR of a new species of AIS in a waterbody. Only use if you found an aquatic invasive plant on a lake where it hasn't been found previously.

To find where aquatic invasives have already been found, visit: http://dnr.wi.gov/lakes/ais.

Notice: Information on this voluntary form is collected under ss. 33.02 and 281.11, Wis. Stats. Personally identifiable information collected on this form will be incorporated into the DNR Surface Water Integrated Monitoring System (SWIMS) Database. It is not intended to be used for any other purposes, but may be made available to requesters under Wisconsin's Open Records laws, ss. 19.32 - 19.39, Wis. Stats.

Primary Data Collector

Name	Phone Number	Email

Monitoring Location

Waterbody Name	Township Name	County

Boat Landing (if you only monitor at a boat landing)

Date and Time of Monitoring or Discovery

Monitoring Date	Start Time	End Time

Information on the Aquatic Invasive Plant Found (Fill out one form for each species found.)

Which aquatic invasive plant did you find?: ☐ Curly-leaf Pondweed ☐ Eurasian Water-milfoil ☐ Purple Loosestrife ☐ Brittle Naiad ☐ Hydrilla ☐ Brazilian Waterweed ☐ Yellow Floating Heart

Where did you find the invasive plant?

Latitude: Longitude:

Approximately how large an area do the plants occupy?
☐ A Few Plants ☐ One or a few beds ☐ Many beds ☐ A Whole Bay or Portion of Lake
☐ Widespread, covering most shallow areas of lake ☐ Don't know (e.g. didn't check the whole lake)

Was the plant floating or rooted? ☐ Floating ☐ Rooted

Estimated percent cover in the area where the invasive was found (optional)

Substrate cobble, %	Substrate muck, %	Substrate boulders, %	Substrate sand, %	Bottom covered with plants, %

Voucher Sample

Did you collect a sample of the plant (a voucher specimen) and bring it to your local DNR office? If so, which office?

☐ Rhinelander ☐ Spooner ☐ Green Bay ☐ Oshkosh ☐ Did not take plant sample to a DNR office
☐ Fitchburg ☐ Waukesha ☐ Eau Claire ☐ Superior ☐ Other Office ________________

Please collect up to 5-10 intact specimens. Try to get the root system, all leaves as well as seed heads and flowers when present. Place in ziplock bag with no water. Place on ice and transport to refrigerator. Bring samples, a copy of this form, along with a map showing where you found the suspect plants to your regional AIS or Citizen Lake Monitoring Coordinator at the DNR.

For DNR AIS Coordinator to fill out

AIS Coordinator(s) or qualified field staff who verified the occurrence: ____________________

Statewide taxanomic expert who verified the occurrence: ____________________
(for list see http://dnr.wi.gov/invasives/aquatic/whattodo/staff/AisVerificationExperts.pdf)

Was the specimen confirmed as the species indicated above? ☐ Yes ☐ No — If no, what was it?

Herbarium where specimen is housed: ____________________ Herbarium Specimen ID: ________________

Have you entered the results of the voucher in SWIMS? ☐ Yes ☐ No

AIS Coordinator: Please enter the incident report in SWIMS under the Incident Report project for the county the AIS was found in. Then, keep the paper copy for your records.

Purple Loosestrife Watch: Reporting Procedures

Where & When to Look

Purple Loosestrife is primarily a wetland plant. For this reason, you are most likely to find purple loosestrife growing in a wetland, or adjacent to marshes, lakes, ponds, rivers, or streams. Because of purple loosestife's extreme hardiness it can also be found growing in ditches along roadways, lowlands, mud holes and drier sites like prairies and agricultural land. **A good rule of thumb is: any site where there are wet soils or standing water at any time during the year is potential purple loosestrife habitat.** Purple loosestrife also needs full sunlight to thrive, so shaded areas are typically not considered to be good habitat.

As a volunteer watcher, the best places for you to look for purple loosestrife are along lakeshores, wetlands, banks of rivers or tributaries, and in the ditches along roadways. Purple loosestrife blooms from about mid July through mid September. **For this reason, August is the best time to look for purple loosestrife.** Before monitoring, you should become familiar with the characteristics of purple loosestrife so that you don't confuse it with native look-alikes plants like fireweed, which bloom at the same time. Please refer to the new state purple loosestrife brochure or the brochure "Purple Loosestrife: What You Should Know, What You can Do" for information on identifying both the weed and similar native plants.

When to Report

- If you discover a new patch any size, any where, even just one plant (Consider personally treating very small infestations!)
- If you are unclear as to whether a site has or has not been reported previously.

How to Report

Fill out the form, detach, fold in half, stamp and mail to the Wisconsin Purple Loosestrife Control Coordinator or fax to 608-221-6353. If you have multiple forms to turn in, place all in an envelope and mail to the address on reverse. A copy of the form will be forwarded to your local DNR Purple Loosestrife Coordinator.

State of Wisconsin
Department of Natural Resources

Purple Loosestrife Volunteer Watch Report

Form 3200-119 (5/03)

Notice: Information provided on this form is voluntary, and authority for its use is identified in s. 23.11, Wis. Stats. Personally identifiable information, including such data as volunteer name, address, etc. will be used for DNR program research and management and is not intended to be used for other purposes. Wisconsin's Open Records law requires the Department to provide this information upon request [ss. 19.31 - 19.69, Wis. Stats.].

Purple Loosestrife Location Information

Report Date	County	Township	Range	E / W	Section(s)
		N			

☐ Lake ______________________ ☐ Marsh/Wetland ______________________

☐ River ______________________ ☐ Roadside Ditch ______________________

☐ Other ____

Nearest Road or Intersection	OR	GPS Coordinates	
		Latitude: DEG MIN SEC N	Longitude: DEG MIN SEC W

Land Ownership (Check One): ☐ Public ☐ Private ☐ State ☐ County ☐ Unknown

Are you the owner? ☐ Yes ☐ No | If No, Name of Owner

Directions to Find the Site

Approximate No. of Plants/Clumps	Infestation Acreage
☐ 1-10 ☐ 11-49 ☐ 50+	☐ Less than ½ acre ☐ 1/2 -1 acre (size of football field) ☐ 1-10 acres ☐ More than 10 acres

Loosestrife Density	Has the site been treated?	If so, how? (Check All That Apply)
☐ Less than 50% ☐ More than 50%	☐ Yes ☐ No ☐ Unknown	☐ Pulled ☐ Cut ☐ Chem ☐ Bio ☐ Unknown

Volunteer Information

Name		Telephone Number or E-Mail Address
Street Address		
City	State	ZIP Code

CONTACTS

1. **Daniel Johns, BPLROA Monitoring Coordinator**
   715-547-3766
   Dljohns46@gmail.com

2. **Ted Ritter, Vilas County AIS Coordinator**
   715-479-3738

   Responsibility: Report findings of confirmed invasive plants to the Vilas County AIS Coordinator.

3. **Kevin Gauthier, Sr., Lake Coordinator, Wisconsin DNR**
   715-365-8937
   Kevin.gauthiersr@Wisconsin.gov

   Responsibility: Administering the DNR's lake programs. Can provide assistance with:
   - Lake management education, technical and information assistance
   - Glean Boats, Clean Waters Watercraft Inspection
   - Citizen Lake Monitoring Network
   - Aquatic Plant Management (APM)

4. **Sandra Wickman, Water Resources Management Specialist, Wisconsin DNR**
   715-365-8951

   Responsibility: Primary contact for Citizen Lake Monitoring Network. Can provide assistance with:
   - Education on lkae issues
   - Supplies, reporting forms, mailings and awards
   - Data entry into the Surface Water Integrated Monitoring System (SWIMS)
   - Equipment repairs and replacement
   - Training
   - Vouchering of AIS

5. **Diane Daulton, Water Resources management Specialist, Wisconsin DNR**
   715-685-2911

6. **Carolyn Scholl, County Conservationist, Vilas County**
   715-479-3747

7. **Mariquita Sheehan, Lake Conservation Specialist, Vilas County**
   715-479-3747

8. **Gretchen Watkin, Vilas County**
   715588-3303

9. **Vilas County Courthouse.** Deliver plant samples for Identification to Vilas County Courthouse in Eagle River, Land & Water Conservation Department

WHAT YOU WILL NEED

EQUIPMENT/SUPPLIES

Effective plant monitoring will be most efficient if the following equipment and supplies are obtained and used:

- Boat
- Personal flotation device
- Long handled rake with attached rope
- Lake map for marking suspect plant beds and keeping track of where you have been
- Pencil for marking on the map
- Clip board for writing
- Ziploc bags
- Waterproof sharpie pen (to write on Ziploc bags)
- Cooler to keep plants in
- GPS (optional)
- Polarized sunglasses (optional)
- Aqua-view scope (optional) (see section on how to construct)
- A copy of the appropriate form (s)
- Reference materials and books to aid in the identification of plants

It is often convenient to collect store appropriate materials and supplies in a tub that can be take with you when you conduct your monitoring activities/sweeps.

PLANT RAKES

A thatching rake can be used or you can make a 2 headed garden.

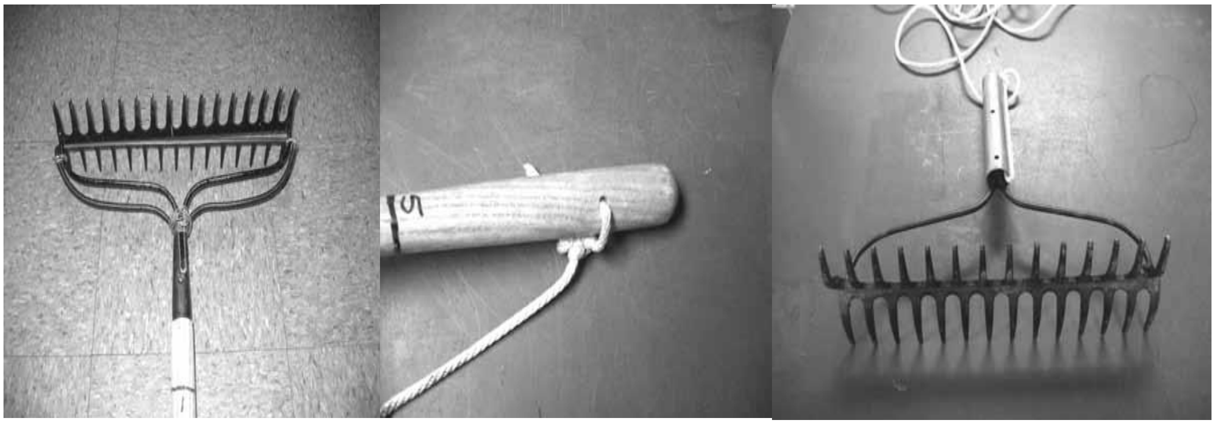
Tie the rope to the boat when in use. That way you will not lose the rake.

<u>Supplies</u>

- 2 garden rakes
- Rope of appropriate length (20-25 feet)

<u>Directions</u>

1. Disconnect the head from one rake and wire or weld the rakes heads together, teeth facing out.
2. Drill a hole in the end of the handle and tie a rope to it.
3. If you need to make the rake heavier, you can attach weights.
4. If you do not like a long handle on the rake, you can cut off the handle and attach the rope directly to the rake heads. If you do this, it is necessary to use weights.



MAP

Basic lake maps can be generated through the DNR website. Make copies of the maps to record locations where plants are found. Maps submitted with data should include: Lake Name, county, sites monitored, date(s), volunteer(s), and any additional observations.

The Surface Water Viewer (http://dna.wi.gov/lakes/lakepages/search.aspx) is an interactive map that can be used to document monitoring sites.

If you have a GPS unit, you may want to mark in the locations monitored on the map using the GPS location.

AQUA-VIEW SCOPE

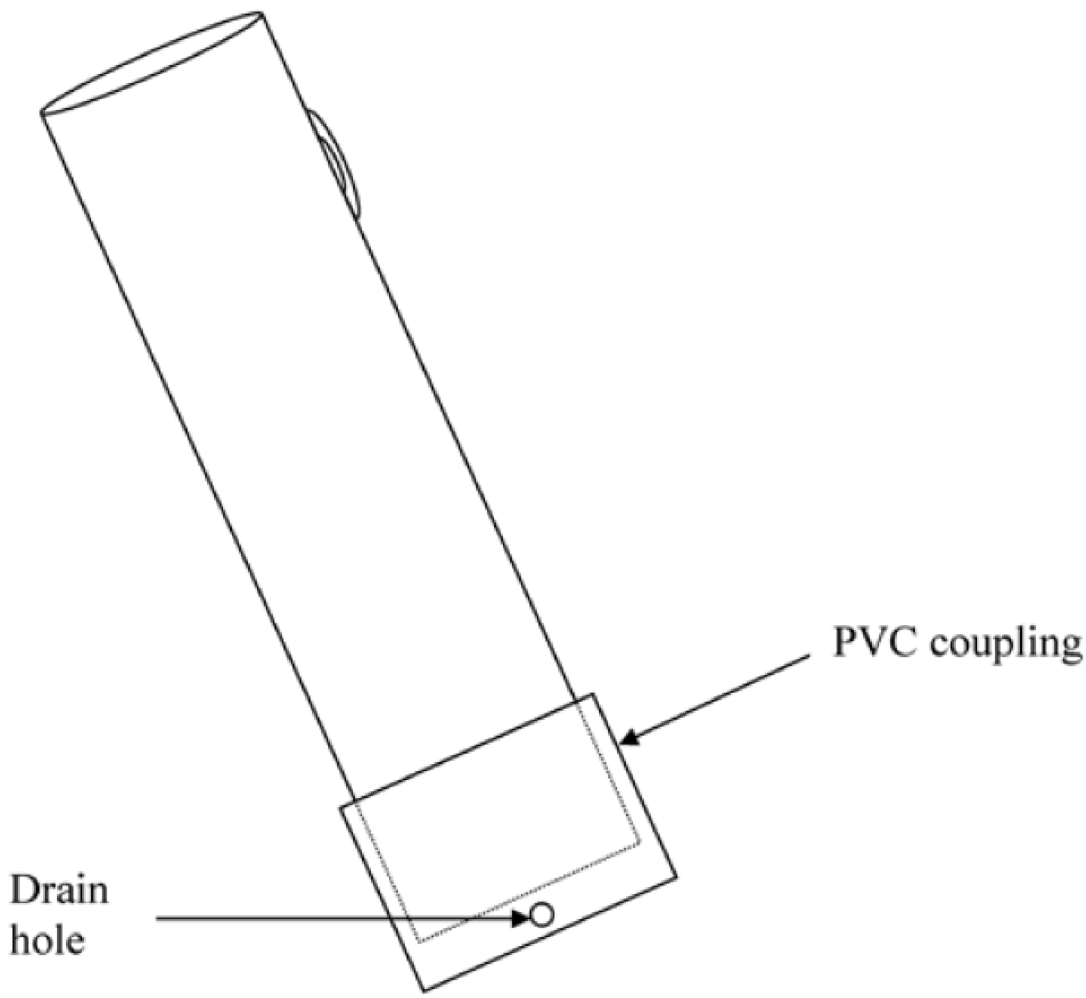
An Aqua-view scope can be used as an aid for viewing plants in the water. You can construct your own.

Supplies needed

- One 3 foot section of 4” diameter plastic pipe. We use ABS pipe because it is black and lighter than PVC pipe. If you are unable to find ABS pipe, PVC pipe will work just fine. Your hardware store may have a short piece of pipe they will sell you. You may purchase a 10 foot piece of pipe and cut it.
- One or two 5 ½ “ pull handles (one is usually sufficient)
- Screws if not supplied with handle
- One 4” ABS coupler
- One 4 3/8” diameter lexan disk. Lexan is non-breakable plexi-glass that we had cut at the local glass repair shop. (You can use plexi-glass for the disk but it is difficult to cut into a circle.)
- Clear silicone rubber sealant
- Drill and screw drive
- Weather stripping for around the top of the scope. Marine and automotive weather strip tape works well.

Directions

1. Cut a 3 section of 4" diameter ABS or PVC pipe. The cut must be straight and square to the pipe. If you cannot find a pipe with a black interior, you can paint the inside a flat black. If the pipe is shiny on the inside, rough it up using sandpaper or steel wool to reduce glare.
2. Attach one or two handles on either side of the pipe about 4 inches from one end. If you are using PVC pipe you will have to drill pilot holes.
3. Run a bead of clear silicone rubber sealant on the bottom of the squared off end of pipe. Place the lexan disk on the bead of sealant.
4. Smear a small amount of silicone sealant on the outside of the pipe ½ inch from the end of the pipe with the lexan. Slide the coupling over the end and give it a slight twist to distribute the sealant evenly. Slide the coupling on as far as it will go. The collar will extend out beyond the lexan disk protecting it from scratching.
5. Drill two small (1/4 ") holes on opposite sides of the collar close to the lexan so that air will not be trapped in the open end of the coupler when you put the view scope into the water.
6. Place weather stripping around the top of the open end of the scope (the side you look into). The weather stripping has a sticky side that sticks to the plastic and the foam makes it a little more comfortable for your face to rest against.



APPENDIX A: EURASIAN WATER MILFOIL

OVERVIEW

Eurasian water-milfoil (EWM) is a submerged aquatic plant that poses a serious threat to a lake's native aquatic plants and the animals that depend on these diverse ecosystems. Since it is not native to Wisconsin or the United States, it has very few natural predators. EWM can form thick underwater stands of tangled stems and vast mats of vegetation at the water's surface. It can crowd out native plants and become so thick that the larger fish cannot swim through the tangled mats. When EWM mats get well established, channels are needed to allow access from the shoreline out into deeper water areas. EWM is now one of the most troublesome submerged aquatic plants in Wisconsin.

There are 11 native water-milfoil species in North America. Of these 11 native species, seven are native to Wisconsin. The native water-milfoils are not as aggressive as the exotic water-milfoil and they have natural predators. Some Wisconsin species of water-milfoil are quite rare and are on the Wisconsin Threatened and Endangered species list.

EWM is native to Europe, Asia and northern Africa. It may have been brought in to the United States via aquaculture and the aquarium trade. The first authenticated record of EWM in the United States was in 1942 in a Washington D.C. pond. In 2007 it was found in 48 of the 50 states. EWM was first documented in Wisconsin in the 1960's. The list of waterbodies in Wisconsin where EWM has been verified can be found at http://dnr.wi.gov/lakes/invasives/.

Early identification of the plant makes control much easier, and can help prevent the spread into other waterbodies. If you detect the invasives early enough, you may be able to prevent them from spreading throughout your lake system. It is cheaper to control small patches of invasives than to control invasives that have taken over an entire lake system. Once invasives are established in a lake, they are nearly impossible to eradicate.

LIFE CYCLE

EWM is an evergreen plant. The plant remains alive over the winter and starts growing when water temperatures reach 50o F (Bode, J. et al. 1992). EWM begins growing earlier in the season than the native water-milfoils. This makes early spring chemical treatment an option for control of EWM as it is more selective for EWM than late spring or summer treatments. In spring and summer, EWM can grow up to two inches a day. If EWM plant growth reaches the surface of the lake, the plant will continue to grow and can form a canopy over the surface of the lake often making the area nearly impassable with a motor boat. This canopy can also shade out native plants. Excessive growth affects recreational use by interfering with swimming, fishing, and boating and reducing the aesthetics of the lake. EWM grows in water depths ranging from less than one-foot to over 20-feet. Thick beds can form in water depths from 3 to 20 feet deep (Smith, C and J. Barko, 1990), but most commonly reach nuisance levels in water depths of 6-15 feet. EWM is tolerant of disturbance and can grow in most water conditions. One way to protect your lake from EWM or other invasives is to maintain native aquatic plant beds.

EWM produces seeds and runners, but the main method of spread is through plant fragmentation (vegetative propagation) by boats and wave action. In the late summer and early fall, auto fragmentation may occur. Auto fragmentation is when the plant “breaks itself into smaller pieces”. Plant cells at leaf nodes and side-branch connections become weak, die and break off. These newly formed fragments float to new locations where they fall to the substrate, root and establish new beds of EWM.

IDENTIFICATION

Shown is a picture of EWM (*Myriophyllum spicatum*, pronounced MIR-ee-ah-FILL-um spi-KAY-tum). Also shown is northern water-milfoil (*Myriophyllum sibiricum*, pronounced MIR-ee-ah-FILL-um si-BIR-I-cum). Northern water-milfoil is the Wisconsin native that is sometimes confused with EWM. There is also a fact sheet on water-milfoil turions (overwintering buds). Several of the native water-milfoil species produce turions. EWM does not produce turions, so if you see turions in the fall, or turion leaves in the spring, you do not have EWM.

EWM has been known to hybridize with northern water-milfoil. The hybrids cannot be distinguished by visual characteristics, but rather have to be identified through DNA analysis. If you suspect that you have the hybrid, please contact your local Aquatic Plant Management staff http://dnr.wi.gov/lakes/contacts for assistance.

Refer to pictures to see the characteristics listed below:

Eurasian Water-milfoil (EWM) Characteristics

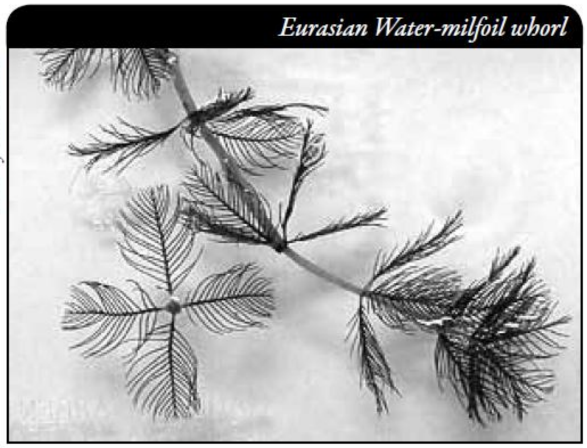
- Delicate feather-like leaves
- Leaves are arranged in whorls (circles), 3 to 5 leaves around the stem
- Usually 12-21 leaflet pairs per leaf
- Lower leaflets pairs are about the same length as upper leaflet pairs
- Leaves are fairly limp when pulled out of the water
- In the summer, the plants can be 20 feet tall
- In the summer, the distance between the leaf whorls can be several inches
- Upper part of the plant stem often has a pink or reddish color. (Some native species of water-milfoils may also have pink stems.)
- EWM does not produce turions (overwintering buds)
- Adventitious roots (roots growing along the stem) develop on EWM in late summer to early fall

Northern Water-milfoil Characteristics

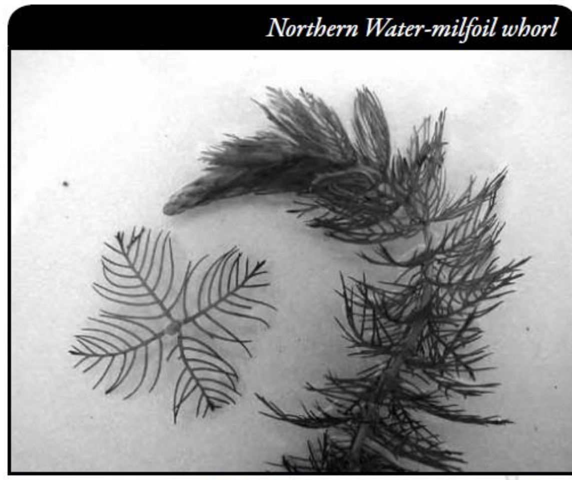
This is the native water-milfoil that is most often confused with EWM.

- Rigid feather-like leaves
- Leaves are arranged in whorls (circles), 4-6 leaves around the stem
- Usually 7-10 leaflet pairs per leaf
- Lower leaflet pairs are longer than upper ones, creating a Christmas tree shape
- Leaves are usually stiff when pulled out of the water
- In the summer, the plants can reach 10-12 feet in height
- In the summer, the distance between the leaf whorls is quite short

• Stems are often whitish or whitish-green in color
• Most native water-milfoils produce turions (overwintering buds), EWM does not
• Adventitious roots (roots growing along the stem) develop on Northern water-milfoil in late summer to early fall

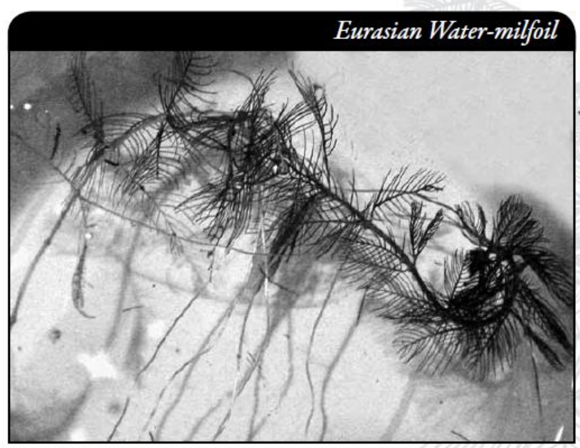


EWM whorl showing four leaves with leaflets. On each leaf, lower leaflet pairs are about the same length as upper leaflet pairs.



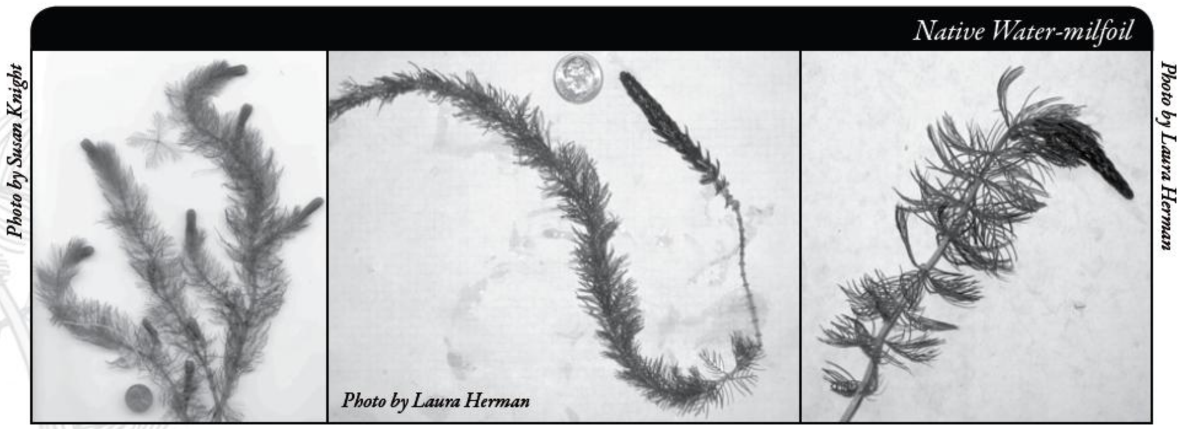
Northern water-milfoil whorl showing four leaves with leaflets. On each leaf, lower leaflet pairs are longer than upper leaflet pairs, creating a Christmas tree shape.

Northern water-milfoil on the left. EWM on the right. Northern water-milfoil leaves are stiff when pulled out of water. EWM leaves are limp when pulled out of water.

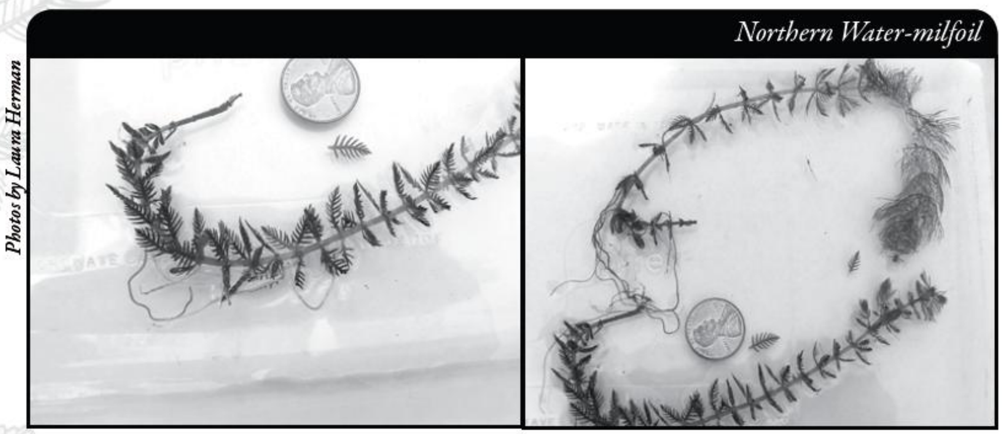


EWM often develops adventitious roots along its stem.

Shown below are turions on whorled water-milfoil and northern water-milfoil.
EWM **does not** form turions.



Several native species of water-milfoil form turions (winter buds).



Northern water-milfoil turion leaves.

In the spring the winter turion will "expand" revealing the turion leaves. New summer leaves will start growing from the top of the turion. The summer leaves have a different look than the winter turion leaves. EWM does not produce turions.

APPENDIX B: CURLY LEAF PONDWEED

OVERVIEW

Curly-leaf pondweed is a non-native submerged aquatic plant. Its unique ability to thrive in cool water allows it to out-compete other aquatic plants. Curly-leaf pondweed can grow under the ice while most plants are dormant, but then dies back in mid-July when other plants are just reaching peak growth. This mid-summer die-off can cause dense mats of dying vegetation on the lake surface. When the plants die, nutrients such as phosphorus are released into the water, fueling algal blooms.

Curly-leaf pondweed is one of 80 pondweed species found throughout the world. It is native to the fresh waters of Eurasia, Africa and Australia. This aquatic plant was accidentally introduced into the United States when the common carp was brought in during the mid-1800's. It is thought to have made its way to Wisconsin in 1905 along with fish imported from Europe. DNR staff have just recently begun tracking lakes with curlyleaf pondweed, so there is not yet a complete listing of water bodies in Wisconsin with curly-leaf pondweed. The information currently available on water bodies known to have curly-leaf pondweed can be found at http://dnr.wi.gov/lakes/invasives/.

Early identification of the plant makes control much easier, and can help prevent the spread into other waterbodies. If you detect the invasives early enough, you may be able to prevent them from spreading throughout your lake system. It is cheaper to control small patches of invasives than to control invasives that have taken over an entire lake system. Once invasives are established in a lake, they are nearly impossible to eradicate.

LIFE CYCLE

Curly-leaf pondweed has a unique life cycle. Unlike most of our native aquatic plants that come out of dormancy in spring and reach their maximum growth in late summer or early fall, curly-leaf pondweed normally begins growing in the fall. Depending upon snow cover and winter severity, curly-leaf pondweed may be dormant or actively growing under the ice. Curly-leaf pondweed has a large growth spurt from ice out to early spring.

Its natural inclination for low water temperatures helps it avoid competition with other plant species. Its fast, early spring growth allows the stems to reach the water's surface before any other plant. By late spring, a dense canopy of curly-leaf can form, blocking sun light from reaching other plants.

Curly-leaf pondweed plants usually complete their life cycle in June or July. When they die back, they can form dense mats of dying vegetation on the surface. If you notice that plants on your lake are dying back in June or early July, you will want to check to see if it is curly-leaf pondweed.

Turions and seeds are formed on the plants before they die. A turion is a dormant shoot segment (vegetative bud) that can form most anywhere on the plant. It is a hard structure that looks a little bit like a burr or pinecone. Although the plants also produce seeds, the turions are probably the most reliable form of reproduction. The turion falls to the bottom of the lake as the plant dies and begins to decay. Most of the turions begin to sprout in fall, responding either to the shortening day length or to water temperature. However, some turions will actually sprout in the spring and some will lie dormant in the sediment until environmental conditions are favorable to sprouting (turions can remain dormant for years).

For the plants that sprout in the fall, the initial growth form is a winter foliage that stays green (sometimes dormant or sometimes actively growing) even under the ice. The curlyleaf pondweed foliage in winter to early spring are quite narrow and lack the wavy edges. A few days after ice off, curly-leaf pondweed begins to grow more rapidly and attain its spring foliage (lasagna noodle wavy edges with the crispy appearance). Those turions that sprout in the spring also have the narrow “non-wavy” leaves when the plant first sprouts, then the wavy leaves develop as the plant grows.

Curly-leaf pondweed is tolerant of disturbance and can grow in most water conditions. One way to protect your lake from curly-leaf pondweed and other invasives is to protect and maintain native aquatic plant beds.

The turions are sometimes carried in muck attached to an anchor or dropped in the bottom of your boat. These turions can sprout and grow new curly-leaf pondweed colonies. Be sure to remove all aquatic plants from boating equipment, including your trailer, boat, motor/propeller and anchor before launching and after leaving the water. By removing aquatic plants from boating equipment and encouraging others to do the same, you can help protect Wisconsin lakes from curly-leaf pondweed and other invasives.

IDENTIFICATION

Pictured is an example of curly-leaf pondweed (*Potomogeton crispus*, pronounced POT-a-mo-JEE-ton CRISP-us). Curly-leaf pondweed can be confused with Clasping-leaf pondweed (*Potamogeton richardsonii*). Clasping-leaf pondweed does not have toothed leaf edges nor does it produce turions.

Curly-leaf pondweed Characteristics

• Alternate leaves that are minutely toothed (you may need a magnifying glass to see the teeth).
• Leaf edges are wavy and have a crispy appearance – hence the name. The leaves are often described as mini “lasagna noodle” looking leaves.
• Most leaves have a prominent red-tinged mid-vein.
• The stem is slightly flattened.
• No floating leaves. (Some native pondweeds produce specialized floating leaves that are thicker than submerged leaves and often have a waxy feel.)
Northern water-milfoil turion leaves.
• A short flower stalk may rise above the water’s surface in spring, though the rest of the plant is submersed.
• Turions are produced and drop to the lake bottom when the plants decay in late summer. Turions are vegetative reproductive buds that are very rigid and resemble small pinecones.
• In winter and very early spring, the leaves on the plant are quite narrow and lack the wavy edges.

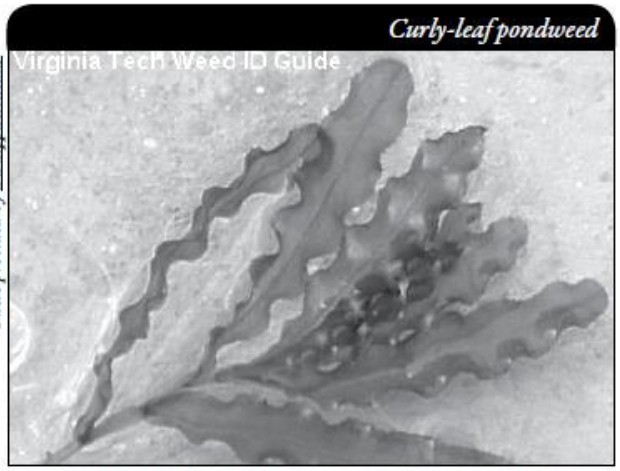


Photo provided by www.ppws.vt.edu/

Curly-leaf pondweed leaves are often light green and fairly transparent.

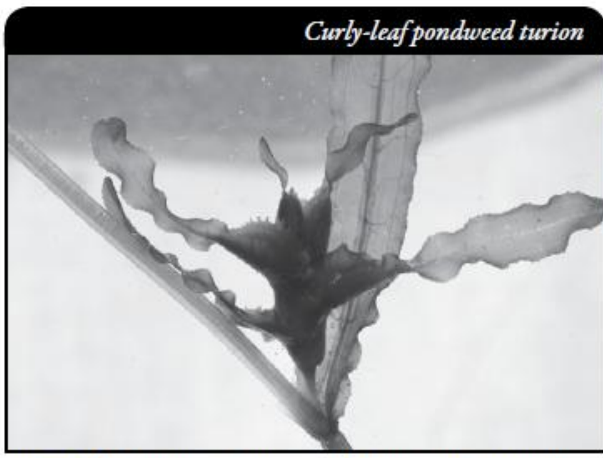


Photo by Frank Koshere

Curly-leaf pondweed turion with leaves still attached. The leaves will eventually rot and fall off of the turion.

Photo by Susan Knight

Note the "lasagna-like" wavy leaves of curly-leaf pondweed.

Photo provided by www.mlsvа.org

Potamogeton richardsonii (Clasping-leaf pondweed)

APPENDIX C: PURPLE LOOSESTRIFE

You may not have paid much attention to the vegetation growing along the shores of your lake in the past. You may have fished the lake or boated for years vaguely remembering the greenery along the shoreline as a pleasing array of grass-like plants, water lilies, or any of a number of common shoreline plants. Have you noticed any changes lately? Are there plants you don't recall seeing in the past? Or maybe you've noticed there is more of one certain type of plant. If you haven't looked for these changes, you should since they may be signs of invasive plants moving in. Not knowing friend from foe, you should be concerned whenever you see a new face or a dramatic increase in any plant. You should definitely sound the alarm if lake edges that were once green with cattails or other plants have suddenly erupted in massive amounts of pink-purple in mid to late summer; almost a sure sign that purple loosestrife has established. It would be even better to recognize and remove the first of these plants before they bloom…and set seed.

OVERVIEW

Purple loosestrife is an attractive wetland perennial plant originating in Europe and Asia that has become a real threat to wetland communities across temperate North America. It was introduced without the specialized insects and diseases that help control it at home. Freed from its natural controls, it grows faster and taller than most of our native wetland plants. Once established on a lakeshore or adjacent wetland, it often shades out all but the tallest of its competitors, and can replace large numbers of native plants where it becomes established. This should concern you since it can dramatically change the health of your lake's edge - and how you and wildlife are able to use the lake system. As native plants decline, so do the other species that depend on them!

The plant's habit and vigor also result in large numbers of small seeds that are easily dispersed to wetlands everywhere via moving water, on the feet of migrating birds, or in the cleats of muddy boots or tires. The seeds germinate on open, moist soil, creating first year flowering plants that produce many more thousands of seeds! Thus, loosestrife quickly creates large seed banks that make the plant virtually impossible to eliminate (so remove those young plants before flowering, if you can!) Lots of easily dispersed seeds also virtually ensure its spread. The information currently available on sites where purple loosestrife grows can be found at http://dnr.wi.gov/lakes/invasives/.

LIFE CYCLE

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.

Most of the seeds fall near the parent plant, but water, animals, boats, and humans can transport the seeds long distances. Seed germination is restricted to open, wet soils with a wide range of pH. Germination requires high temperatures, but seeds can remain viable in the soil for many years. Even seeds submerged in water can live for approximately 20 months.

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

Vegetative spread through disturbances is also characteristic of purple 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'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.

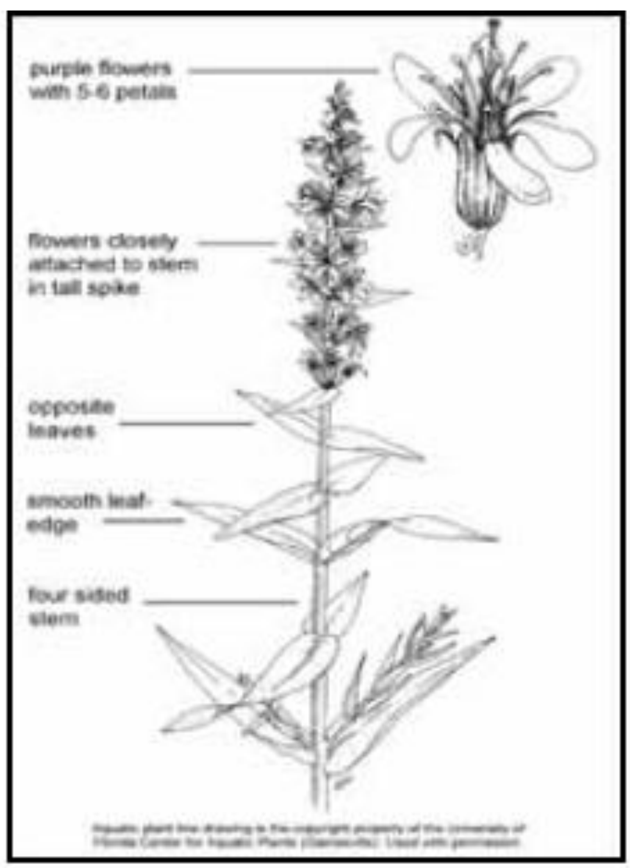
IDENTIFICATION

Shown is an example of Purple Loosestrife (*Lythrum salicaria*, pronounced (LITH-rum sal-i-CARE-ee-a), as well as pictures of purple loosestrife and native look-a-likes.

Purple loosestrife can be confused with a number of other purple-spiked flowers including gayfeather, blue vervain and fireweed.

Purple Loosestrife Characteristics

• Semi-woody, hardy perennial with a dense bushy growth of 1-50 stems.
• Leaves are usually opposite, but can be found whorled or even alternate.
• Leaves attached directly to the stem. They do not have petioles (leaf stalks). Leaves are lance-shaped and 1-4 inches long with smooth edges.
• Stems are square (four-sided) or many sided (five or six-sided). Plants can grow 3-7 feet tall.
• Flowers are purple to pink in color; have 5-6 petals; and form on spikes. Flowers bloom from the bottom of the spike to the top of the spike.
• Flowers bloom July–September, with blooming occurring earlier in southern Wisconsin than in northern Wisconsin.



APPENDIX D: HYDRILLA

OVERVIEW

Hydrilla is a submerged aquatic plant native to Asia and northern Australia and is considered to be the most problematic aquatic plant in the United States. In areas of North America where hydrilla has been introduced it has formed dense canopies that shade out native vegetation and destroy fish and wildlife habitat. The hydrilla canopy has detrimental impacts on fisheries as well as recreation and creates harsh conditions for other species by decreasing oxygen under the canopy mats and increasing water temperature and pH. The plant can grow several inches a day and once introduced and established, can easily spread to other waterbodies through boating and fishing activities. In areas where hydrilla, Eurasian water-milfoil and Brazilian elodea co-exist in a waterway, hydrilla out competes the other two noxious weeds (Washington State Department of Ecology, 2006).

Hydrilla has very effective methods of reproducing. It produces seeds (although seedlings are rarely seen in nature) and can sprout new plants from root fragments or stem fragments containing as few as two whorls of leaves. Hydrilla also produces structures called turions and tubers. Turions are compact "buds" produced along the leafy stems. They break free of the parent plant and drift or settle to the bottom to start new plants. Turions are ¼ inch long, dark green, and appear spiny. Tubers are underground and form at the end of roots. They are small, potato-like, and are usually white or yellowish. Tubers may remain dormant for several years in the sediment. Hydrilla produces an abundance of tubers and turions in the fall. The hydrilla variety found in the state of Washington will also make tubers in the spring and will produce nondormant turions throughout the growing season. Hydrilla tubers and turions can withstand ice cover, drying, herbicides, and ingestion and regurgitation by waterfowl (Washington State Department of Ecology, 2006).

Hydrilla was first introduced to the United States in the mid to late fifties by the aquarium trade. This hardy, tolerant plant does well in a variety of growing conditions which makes it a perfect plant to sell in the nursery and aquarium industry. Hydrilla was first found in a waterway in south Florida in 1960. Currently Florida spends twenty million dollars annually on hydrilla control. Introduction to small ponds in California in 1976 have been traced to a contaminant of waterlily shipments. Today, it is found in many states in the U.S.

In 2007, hydrilla was discovered in a man-made pond in Wisconsin in Marinette County. It is the only known occurrence of the plant in Wisconsin. The introduction is thought to have been by nursery stock that was introduced into the pond. Luckily, the population was caught early and it is believed to have been eradicated after the pond was chemically treated, drained and allowed to freeze over the winter. The expansion of this plant will not be restricted by the Wisconsin climate. In Russia the plant grows up to the 50° N latitude, which is equivalent to the border of Canada and the United States. Because Hydrilla can be easily confused with our native elodea (*Elodea canadensis* and *Elodea nuttallii*) it can be easily overlooked. Volunteers trained in the identification of hydrilla and its look-a-likes are essential to prevent the spread of this non-native plant.

Life Cycle

Hydrilla continues to be sold through aquarium supply dealers and over the internet even though the plant is on the U.S. Federal Noxious Weed List. Commercially, it is often named "anacharis."

Eradication of established populations of hydrilla is very difficult and may be impossible.

LIFE CYCLE

Hydrilla is a submersed perennial that looks a great deal like our native elodea. This close resemblance makes monitoring for hydrilla difficult. Another factor that makes identification difficult is that hydrilla can be either monoecious (both male and female flowers on the same plant) or dioecious (male and female flowers on different plants). Each has unique growth characteristics. The monoecious plants tend to be more delicate and grow laterally and spread, carpeting the bottom before lifting to the surface. In the U.S., monoecious plants tend to be north of the Carolinas. It is believed that the Wisconsin plant is the monoecious form. In the monoecious form, female flowers are solitary and white and float on the surface with threadlike stalks. Male flowers are tiny, greenish and attached to leaf axils toward the stem tips. Flowers are not always found on the plant.

Hydrilla forms a dense canopy, 80% of the biomass of the plant is in the upper two feet of the water column. While it does provide structure and food for insects and other macro-invertebrates, it also creates vast monotypic stands and can out-compete native aquatic plants.

Hydrilla grows rooted to the bottom, submersed in either still or flowing water. Sometimes fragments will break loose and the plant will survive in a free floating stage. The depth of growth depends on substrate and water clarity, but it can grow in a few inches of water or in water more than twenty feet deep. Stem lengths of up to 30 feet have been found in Florida. It will grow in low or high nutrient conditions.

Hydrilla has great reproductive potential. The plant spreads readily through fragmentation but it also reproduces by growth of turions and subterranean tubers. The tubers can remain viable for more than four years. Southern U.S. populations overwinter as perennials while northern U.S. populations overwinter and re-grow from tubers. Research suggests that the monoecious strain is better adapted to the temperate climate because it can form tubers quickly during short photoperiods (Spencer and Anderson, 1986; Van, 1989) and also during long photoperiods (Van, 1989).

New plants can sprout from stem fragments. Langeland and Sutten (1980) found that more than 50% of fragments with three whorls of leaves can sprout and grow a new plant which in turn can start a new population. In fact almost 50% of hydrilla fragments that have a single whorl of leaves can sprout and grow a new plant. This means that small amounts of hydrilla on boat trailers, bait buckets, draglines, and from aquariums can grow into new plants, spreading the plant from place to place.

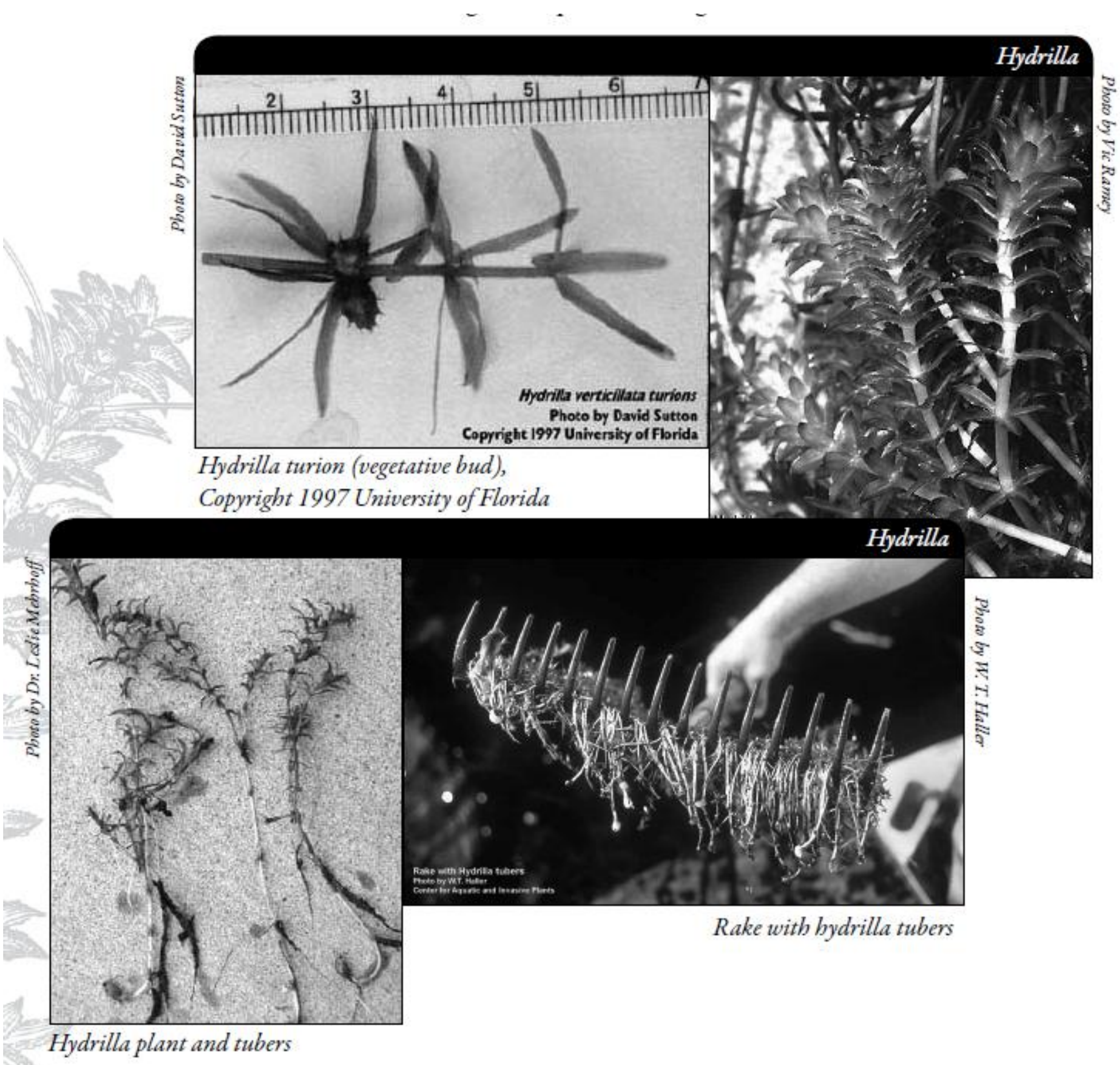
IDENTIFICATION

Hydrilla (*Hydrilla verticillata*, pronounced hi-DRILL-ah ver-TI-si-LAH-ta) closely resembles our native elodea species (*Elodea canadensis* and *Elodea nuttallii*) and Brazilian elodea (*Egeria densa*) which is native to South America.

Hydrilla (Hydrilla verticillata) characteristics

• Submersed stems are slender (1/32 inch thick) and can be up to 30 feet in length.
• Small green leaves (1/2 to 3/4 inches long) with pointed tips.
• Leaves are normally arranged in whorls of 4 to 8. Leaves have been found in whorls with as few as 3 and as many as 12 leaves. If the plant is growing very quickly, there may be significant distances between whorls – this allows it to reach the surface of the water more quickly.
• Leaves are attached directly to the stem.
• Toothed margins of leaves usually visible without magnification – (on some plants this is only obvious on the lower parts of the plant).
• Leaf axils (junction of the leaf stalk and stem) have pairs of minute scales (squamulae intravaginales) up to 0.5 mm long, fringed with finger-like orange brown hairs. These are visible with magnification on some mature leaves and branch points.
• Midrib (on the back of leaf) is often red.
• Often there are one or more sharp teeth along the midrib of the leaf, making the plant feel rough.
• Female flowers are solitary, tiny and white. They float on the surface on long (up to 4 inch) threadlike stalks. The stalks are attached at leaf axils near the stem tips.
• Male flowers are tiny and green. They are closely attached to leaf axils toward the stem tips until they break loose and rise to the surface where they float free. The male flowers fertilize the female flowers by bumping into them.
• Adventitious roots develop only at nodes with dormant axillary buds or branches.
• Plants often produce a mat of creeping above and below ground stolons that develop subterranean turions at the tips (referred to as tubers). Tubers are tough, whitish to brown-black, plump, ovoid, 4-15 mm long, and remain attached until parent stolon decomposes.
• Plant produces turions. Turions are compact buds produced in the leaf axils. The turions are dark green, cylindrical, up to . inch round (see photo below), and appear shiny. Turions survive near freezing temperatures. Suddenly removing dense canopies of hydrilla by mechanical harvesting or herbicide treatment may stimulate turion germination.
• The monoecious form of hydrilla has a complete die-back in winter.
• The monoecious form that grows north of the Carolinas has a growth habit similar to native elodea. It tends to grow carpet-like, along the bottom of the lake.


Hydrilla
Photo by Michigan Sea Grant

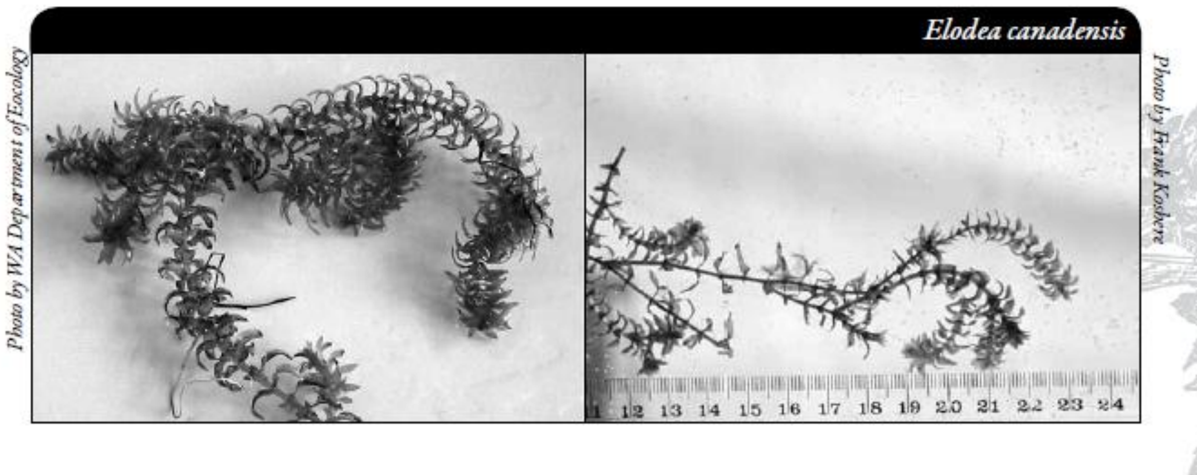


Elodea canadensis (native) characteristics

This is an aquatic plant native to Wisconsin that can easily be confused with hydrilla.

- Submersed stems are slender and up to three feet in length.
- Small, dark green, lance-shaped leaves (6-17 mm long, 1-5 mm wide)
- Leaves usually peppered with large dark cells (visible with low magnification)
- Leaves are most often arranged in whorls of three. Occasionally you will find leaves in whorls of two near the base of the plant. On occasion you may find leaves in whorls of four. Leaves tend to be more crowded toward the stem tip.
- Leaves are attached directly to the stem
- Leaf margins not visibly saw-toothed
- Midrib (on the back of the leaf) is green.
- Midrib does not have spines (hydrilla has spines)

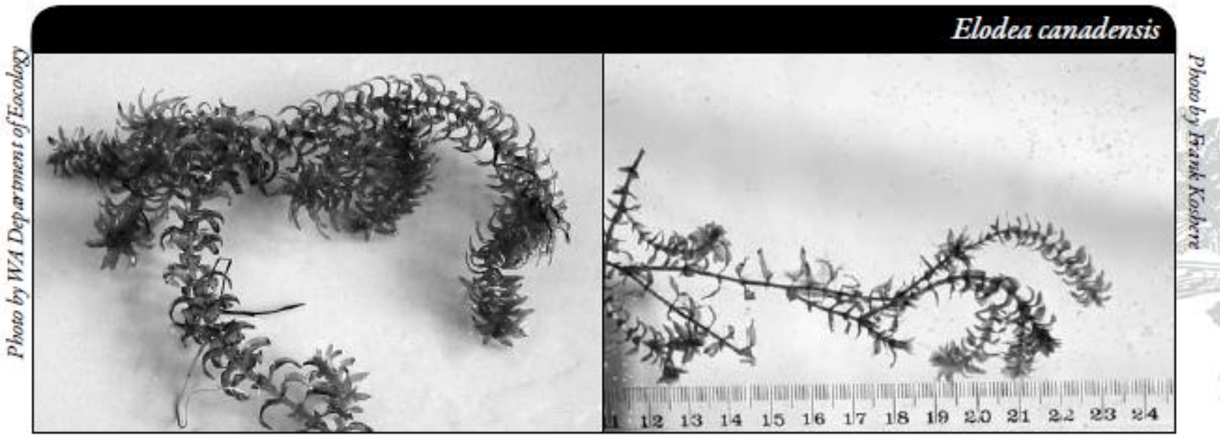
• Male and female flowers are on separate plants. Female flowers have three small white petals with a waxy surface. Flowers are raised to the surface of the water on a long, slender stalk
• Adventitious roots develop only at nodes with dormant axillary buds or branches
• Roots in substrate are more wiry than those of hydrilla or Brazilian elodea
• Reproduces by stolons, stem fragments and terminal turions (turions produced at the end of the growing stem)
• Does not produce tubers (underground vegetative structures)
• Overwinters as an evergreen plant.



Elodea nuttallii (native) characteristics
This is an aquatic plant native to Wisconsin that can easily be confused with hydrilla. One needs to look closely at *Elodea nuttallii* to distinguish it from *Elodea canadensis*. *E. nuttallii* is more delicate in structure with finer stems and narrower leaves.

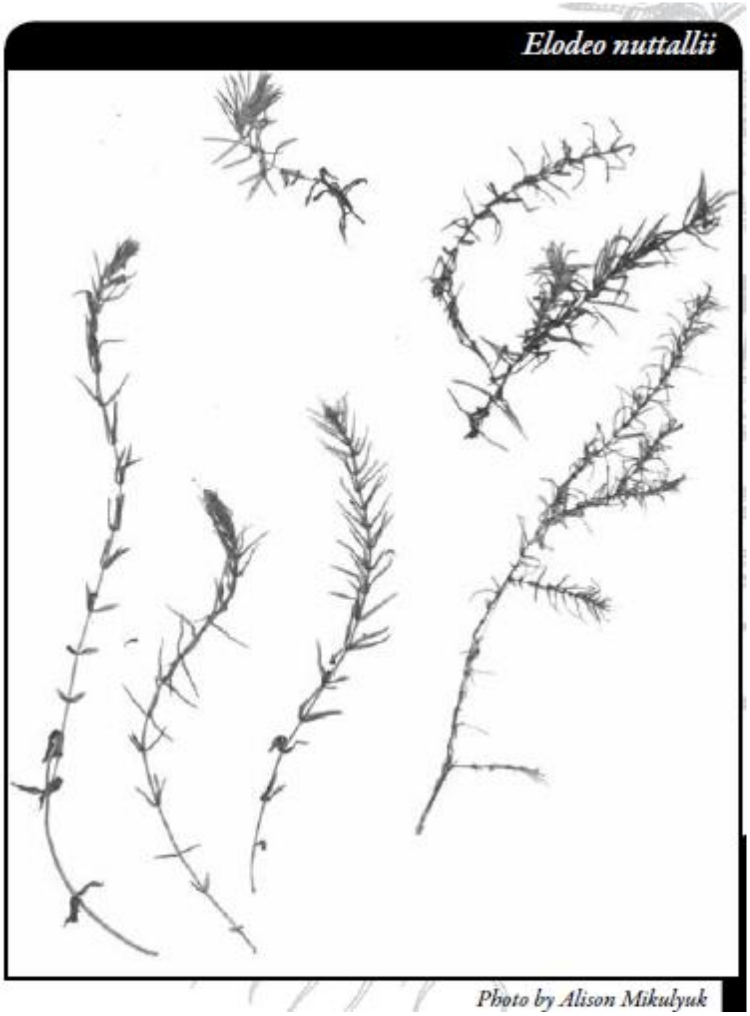
• Submersed stems are slender and up to three feet in length
• Small, pale to dark green, lance-shaped leaves (6-13 mm long and less than 1.5 mm wide); leaf tip is tapered to a slender point
• Leaves are most often arranged in whorls of three. Occasionally you will find leaves in whorls of two near the base of the plant. On occasion you may find leaves in whorls of four. Leaves tend to be more evenly spread out on the plant as compared to *E. canadensis*
• Leaves not densely overlapping toward stem tip as seen in *Elodea canadensis*
• Leaves are attached directly to the stem
• Leaves very finely toothed along the edges, but evident only with magnification
• Midrib (on the back of the leaf) is green
• Midrib does not have spines (hydrilla has spines)
• Male and female flowers are on separate plants. Female flowers have three small white petals with a waxy surface. Flowers are raised to the surface of the water on a long, slender stalk. Male flowers more common in *E. nuttallii* and in *E. Canadensis*
• Adventitious roots develop only at nodes with dormant axillary buds or branches
• Roots in substrate are more wiry than those of hydrilla or Brazilian elodea
• Reproduces by stolons, stem fragments and terminal turions (turions produced at the end of the growing stem)
• Does not produce tubers (underground vegetative structures)

• Overwinters as an evergreen plant



Brazilian Elodea (Egeria densa) (non-native) characteristics
This plant is native to South America and was brought to the United States as an aquarium plant.

• Plants typically look larger and leafier than hydrilla or common elodea.
• Submersed stems are erect, cylindrical, and frequently branched. Stems can reach 15 feet in length.
• Leaves and stems are a bright green. Short internodes between leaves give the plant a very leafy appearance.
• Leaves are 1.5-4 cm long, up to 5 mm wide.
• Leaves often curve downwards.
• Leaves are arranged in whorls of four to six leaves (some references say three to eight leaves in each whorl).
• The lower leaves on the plant are often opposite or in whorls of 3, while the middle and upper leaves are in whorls of 4 to 6.
• Leaves are attached directly to the stem.
• Leaves are minutely serrated.
• Midrib is smooth or minutely toothed.
• Male and female flowers are on separate plants. The 18-25 mm white flowers have three petals and float or rise above the surface of the water on thread like stems.
• Plant reproduces by stolons and stem fragments
• Does not produce turions.
• Does not produce tubers.
• Plant overwinters (dormant under the ice).
• In the spring, the plant can grow from the root crown.
• Adventitious roots are freely produced from double nodes on the stem.


Elodeo nuttallii
Photo by Alison Mikulyuk

APPENDIX E: RAPID RESPONSE PLAN

INTRODUCTION

Diligent monitoring must be followed by prompt responsive measures to eradicate or control AIS plants, if found. This response plan will ensure that prompt action is taken if AIS are found in Big Portage Lake.

With the limited exception of small plots that can be removed manually, eradication and control procedures require coordination with, and permits by, the WDNR. The response plan needs to be individually developed based on specific circumstances (e.g., species found, location, spread, time of year, etc.).

BPLROA will adhere to the following outline adopted from the Aquatic Plant Management Guide found at http://www4.uwsp.edu/cnr/uwexlakes/ecology/APM/Preface_TOC.pdf.

PERMITS

Manual removal of nonnative or invasive plants found in public waters can be done without a permit when performed in a manner that does not harm the native aquatic plant community.

For treatments other than manual removal on public waters there is a state-wide "Response for Early Detection of EWM Field Protocol" ready to be put into action to control pioneer populations of AIS before they become established. A pioneer population is a small population of AIS in the early stages of colonization in a particular water body. For rooted aquatic plants, a pioneer population is a localized bed that has been present less than 5 years and is less than 5 acres in size or less than 5% of the lake littoral area, whichever is greater.

PROCEDURE

The response procedure is a collaborative venture between the WDNR, other agencies and the BPLROA.

1. **Report**. The initial step is prompt reporting of suspected AIS plants to the BPLROA Monitoring Coordinator.
    a. Notify the BPLROA Monitoring Coordinator
    b. The BPLROA Monitoring Coordinator will, in turn, notify the appropriate WDNR contacts.
2. **Collect Sample**
    a. Collect an entire intact specimen of the sample, including roots and stems
    b. Place the sample in a sealable bag.
    c. Ice or refrigerate the sample
    d. Label the sample with the date, collector's name, lake name, town, county
    e. Attach a lake map with location marked and GPS recorded.
3. **Sample Analysis**
    a. Submit sample to WDNR for analysis within 3 days

b. If sample is confirmed as AIS
    i. If AIS does not hinder lake access or boat traffic, place buoys on the infestation perimeter. If it does hinder lake access, complete Form 8700-058 and obtain direction from WDNR lakes team
    ii. Notify warden and town chairman of infestation and buoy placement. Place notice and map in lake kiosk
    iii. Submit marker application and permit (form 8700-058), lake map with location marked and buoy photo to the town manager
    iv. Complete rapid response grant application (Form 8700-307) and submit to WDNR lakes team
    v. WDNR will determine need for a lake visit
c. If sample is not AIS, then continue monthly monitoring

4. **Assemble a Response Team**. If AIS is confirmed, the BPLROA Monitoring Coordinator will assemble a response team
    a. *Team Leader.* BPLROA Monitoring Coordinator will serve as team leader. The leader will be the main contact person for BPLROA to implement and coordinate the response plan.
    b. *WDNR.* The team should include an agency contact from the WDNR and may include others as appropriate (e.g., county personnel)
    c. *Monitors.* The team will include monitors who will conduct AIS surveillance. They will track and report EWM throughout the response project. This should include someone who can run a GPS unit for accurate mapping. It may also include SCUBA divers and snorkelers who can double as hand pullers.
    d. *Secretary*. The team leader will designate an individual as secretary. This individual will be responsible for minutes from any response team meetings, filing reports and maintaining records. The secretary will also coordinate communication to include: writing newsletter articles and press releases (as needed).
    e. *Treasurer.* The team leader will designate a treasurer to coordinate fiscal issues such as grants, bank accounts and the checkbook.
    f. *Training Coordinator*. The team leader will designate an individual to be responsible for training/providing information (e.g., newsletter articles) to lake residents, users and the community about AIS, prevention measures and the status of the response project.
    g. *Consultants*. The team leader will identify consultants/contractors as needed to augment the team for surveys, monitoring, planning or applying herbicides.
        i. A certified applicator is needed for herbicide applications
        ii. Ideally, the certified applicator is different from any consultants hired to help with planning.
5. **Coordinate with DNR who will develop a response plan**
    a. Consult with BPLROA and develop a response plan including appropriate control methods, pre- and post- control monitoring, follow-up control and reporting requirements eligibility for an AIS Early Detection and Response grant.
    b. Determine BPLROA eligibility for an AIS Early Detection and Response grant
    c. Provide on-site supervision/observation of control treatments when possible
    d. Provide technical assistance as needed throughout the project
    e. Review the report and authorize grant reimbursement, when appropriate.

6. **Conduct or contract for control of the AIS as authorized by DNR in the response plan**
7. **Complete grant application for the project and submit to the DNR**
    a. Fulfill DNR reporting requirements
    b. Apply for permits as needed
8. **Post landings with signs identifying the AIS present in the lake**
9. **WDNR will determine lake management strategy**
    a. *Pioneer Colony (Less than 5 acres or 5% of surface area)*
        i. Conduct sampling to define perimeter and density of colony
        ii. Identify at risk areas (boat launch)
        iii. WDNR approves grant and assigns start date. A rapid response grant project may begin before receiving grant paperwork.
        iv. Notify property owners
        v. Place notice in kiosk
        vi. Contact appropriate treatment operator. BPLROA to agree on cost and contract
        vii. Initiate AIS treatment
    b. *Established Population(Greater than 5 acres or 5% of surface area)*
        i. Place notice on landing and notify property owners
        ii. Hire a consultant to prepare and conduct a point-intercept aquatic plant management plan (APMP) to establish a baseline
        iii. Submit APMP to WDNR 60 days prior to applying for a control grant
        iv. WDNR approves APMP and recommends a treatment plan for the following spring
        v. Apply for a control grant
        vi. Contact appropriate treatment operator. BPLROA to agree on cost and contract
        vii. Initiate plant baseline survey, if needed
10. **Pay all costs as defined in the response plan**
    a. Request reimbursement for the state's share of the project through the AIS Early Detection and Response grant.
    b. Request a 25% cash advance when signing the final grant agreement
11. **Post treatment follow-up.** There may not be a need for a formal evaluation of the treatment for small, pioneer populations, but this will be determined by the DNR lake coordinator.
    a. *Pioneer Colony (Less than 5 acres or 5% of surface area)*
        i. Perform rake sampling of treated area monthly for at least on season year after EWM is no longer detected
        ii. Keep buoys and landing signage in place until treated area is free of EWM for two season years
        iii. Continue monthly lake monitoring, education and inspection programs
        iv. Develop an aquatic plant management plan
    b. *Established Population (Greater than 5 acres or 5% of surface area)*
        i. Consultant conducts a post treatment plant survey in mid-July to mid-August
        ii. Compare results with pre-treatment survey
        iii. WDNR assesses effectiveness of treatment and recommends next steps
        iv. Continue monthly lake monitoring, education and inspection programs

v. Keep buoys and landing signage in place

12. **Update Aquatic Plant Management Plan (APM)**
    a. Update APM to ensure long term monitoring for AIS
    b. If not successful at initial control, begin planning for a large-scale manipulation or ongoing management for AIS.

Suspect AIS Found

1. Notify BPLROA Coordinator who will coordinate rapid response efforts
2. Notify BPLROA Board

Sample Collection

1. Collect entire specimen including roots and stems
2. Place in sealable bag
3. Ice or refrigerate
4. Label with date, collector's name, lake name, town, county
5. Attach lake map with location marked and GPS recorded

Analyze Sample

Submit to WDNR for analysis within 3 days

Sample confirmed as AIS

1. Notify BPLROA Board
2. If AIS does not hinder access or boat traffic, place buoys on the infestation perimeter. If location blocks lake access obtain direction from WDNR lakes team before placing buoys.
3. Notify warden and town chairman of infestation and buoy placement. Place notice and map in kiosk
4. Submit marker application and permit (form 8700-058), lake map with location makred and buoy photo to the town manager
5. Complete rapid response grant application (Form 8700-307) and submit to WDNR lakes team
6. WDNR will determine need for a lake visit

Sample is not EWM

Return to monthly monitoring

Respond to AIS

1. Assemble Team
2. Develop a response Plan
3. Contract for AIS Control
4. Complete grant application
5. Post lake
6. Treat lake and pay costs associated with treatement
7. Evaluate treatment
8. Update APM plan

WDNR Determines Management Strategy

Pioneer Colony

(Less than 5 acres or 5% of surface area)

1. Conduct sampling to define perimeter and density of colony
2. Identify at risk areas (boat launch)
3. WDNR approves grant and assigns start date. A rapid response grant project may begin before receiving grant paperwork.
4. Notify property owners
5. Place notice in kiosk
6. Contact appropriate treatment operator. BPLROA to agree on cost and contract
7. Initiate AIS treatment

Established Population

(Greater than 5 acres or 5% of surface area)

1. Place notice on landing and notify property owners
2. Hire a consultant to prepare and conduct a point-intercept aquatic plant management plan (APMP) to establish a baseline
3. Submit APMP to WDNR 60 days prior to applying for a control grant
4. WDNR approves APMP and recommends a treatment plan for the following spring
5. Apply for a control grant
6. Contact appropriate treatment operator. BPLRoA to agree on cost and contract
7. Initiate plant baseline survey

Post Treatment

Pioneer Colony

(Less than 5 acres or 5% of surface area)

1. Perform rake sampling of treated AIS area monthly for at least on season year after is no longer detecgted
2. Keep buoys and landing signage in place until treated area is free of AIS for two season years
3. Continue monthly lake monitoring, education and inspection programs
4. Develop an aquatic plant management plan

Established Population

(Greater than 5 acres or 5% of surface area)

1. Consultant conducts a post treatment plant survey in mid-July to mid-August
2. Compare results with pre-treatment survey
3. WDNR assesses effectiveness of tratment and recomments next steps
4. Continue monthly lake monitoring, education and inspection programs
5. Keep buoys and landing signage in place

APPENDIX F: EXCERPTS FROM LAKE MANAGEMENT PLAN

The following pages are taken from the *Big Portage Lake (Vilas County, Wisconsin) Comprehensive Management Plan (*November 2012), prepared by Onterra, LLC, sponsored by the Big Portage Lake Riparian Owners Association and funded by a WDNR Grant Program. The entire report is found at http://www.bigportagelake.org/management_plan.php

Appendix 3

Review of Big Portage Lake Water Quality

Note: This document is available as Appendix C of the

Big Portage Lake Adaptive Management Plan

(starts on following page)

Appendix C
Big Portage Lake Review of Water Quality

Appendix C

Review of Big Portage Lake Water Quality

Table of Contents

Review of Big Portage Lake Water Quality

Prepared by Angie Stine, B.S., White Water Associates, Inc.

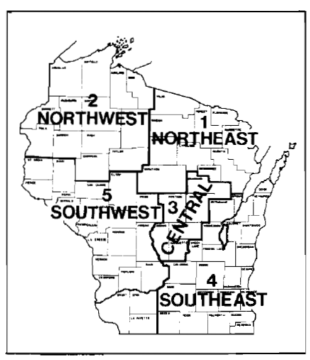
Introduction

Big Portage Lake is located in Oneida County, Wisconsin. It is a 586 acre seepage lake with a maximum depth of 40 feet. The Waterbody Identification Code (WBIC) is 1629500. The purpose of this review is to assemble and interpret water quality data for Big Portage Lake in order to establish a baseline against which future water quality monitoring can be compared. Water quality data were retrieved from the Wisconsin DNR SWIMS database (WDNR 2019) from 1989 to present. Secchi disk measurements have been collected by Citizen Lake Monitoring Network (CLMN) volunteers from 1991-2019. Chlorophyll *a* and total phosphorus were collected since 1997 and 1996, respectively by CLMN volunteers.

Comparison of Big Portage Lake with other datasets

Lillie and Mason's *Limnological Characteristics of Wisconsin Lakes* (1983) is an excellent resource for evaluating and comparing water quality measures from lakes in northern Wisconsin. For their treatment, Wisconsin is divided into five regions. Vilas County lakes are in the Northeast Region (Figure 1). Water quality measures from a lake of interest can be compared to other lakes within the region using this resource.

Figure 1. Wisconsin regions in terms of water quality.



Temperature

Measuring the temperature of a lake at different depths will determine the influence it has on the physical, biological, and chemical aspects of the lake. Lake water temperature influences the rate of decomposition, nutrient recycling, lake stratification, and dissolved oxygen (D.O.) concentration. Temperature can also affect the distribution of fish species throughout a lake. Figure 2 present water temperature profiles for May. These samples show very little stratification during May. In June (Figure 3), the temperature profiles show some stratification from surface to bottom depending on the year. In July and August, temperature profiles show definite stratification (Figure 4 and 5). During this time, the lake usually stratified between 20 and 25 feet. In September and October (Figure 6), temperature profiles showed little stratification and show the same temperature throughout.

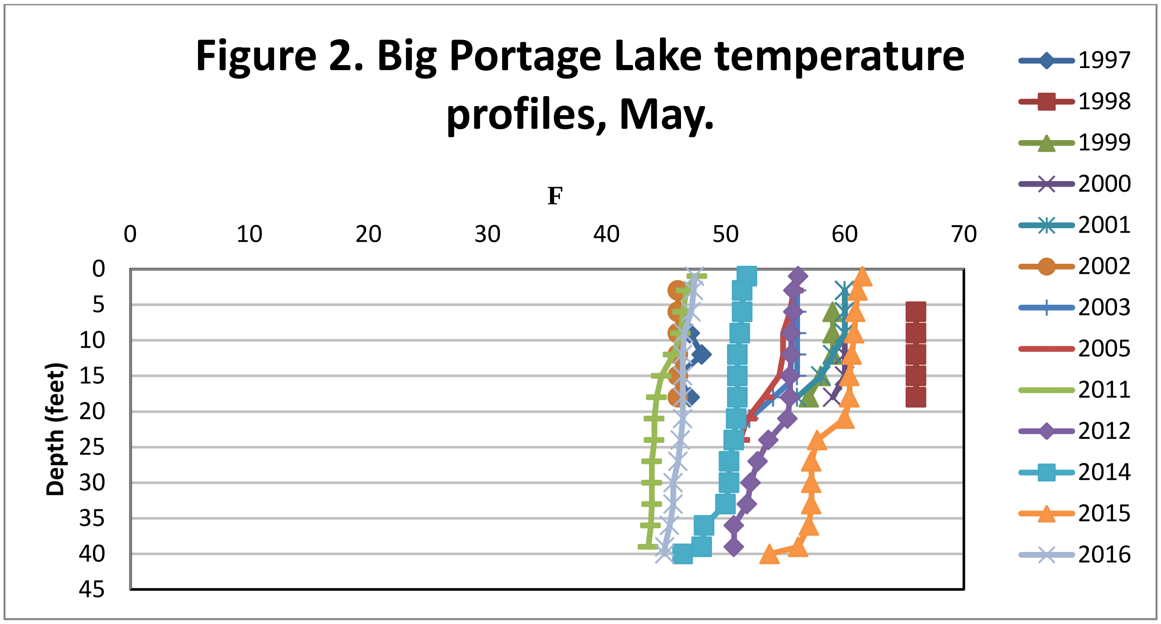


Figure 2. Big Portage Lake temperature profiles, May.

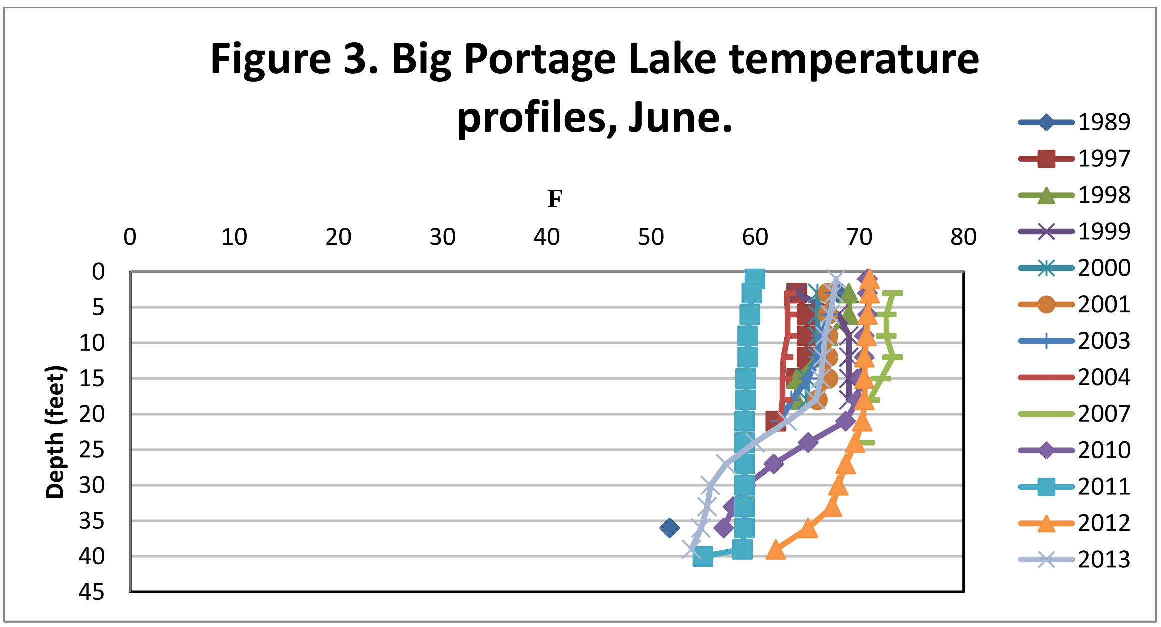


Figure 3. Big Portage Lake temperature profiles, June.

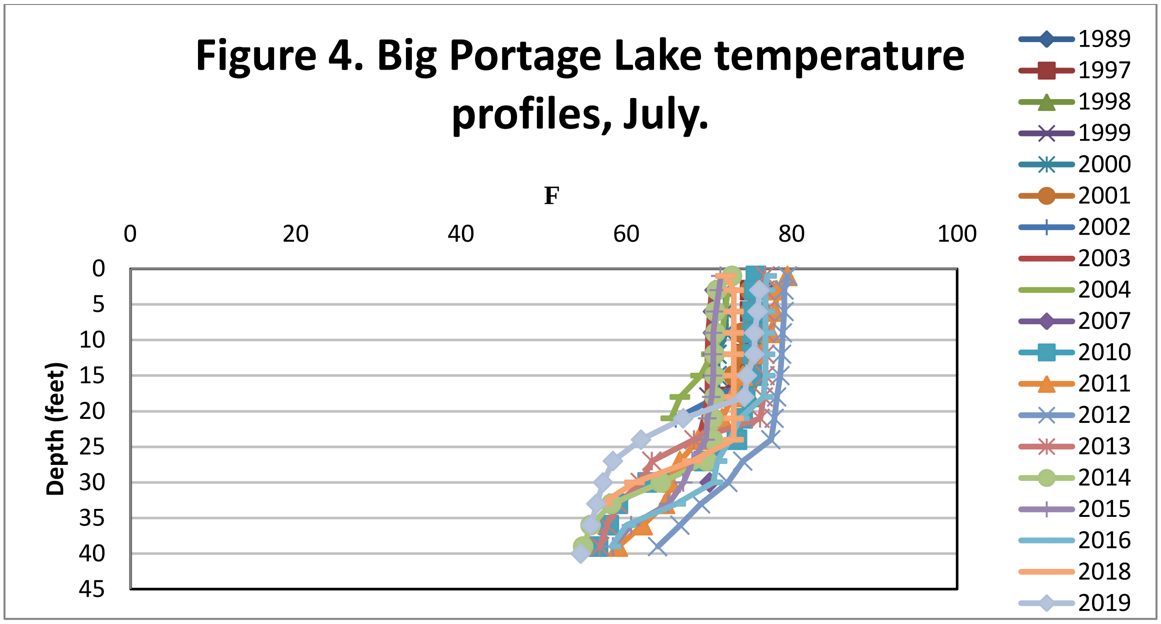


Figure 4. Big Portage Lake temperature profiles, July.
F
0
20
40
60
80
100
Depth (feet)
0
5
10
15
20
25
30
35
40
45
1989
1997
1998
1999
2000
2001
2002
2003
2004
2007
2010
2011
2012
2013
2014
2015
2016
2018
2019

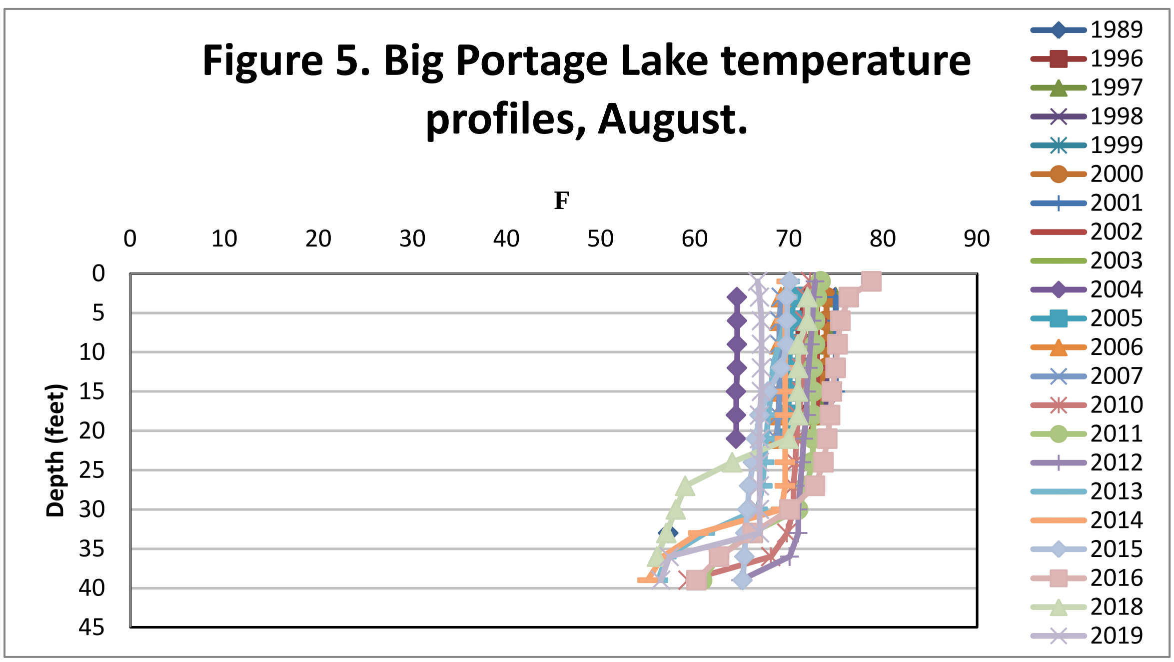


Figure 5. Big Portage Lake temperature profiles, August.
F
0
10
20
30
40
50
60
70
80
90
Depth (feet)
0
5
10
15
20
25
30
35
40
45
1989
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
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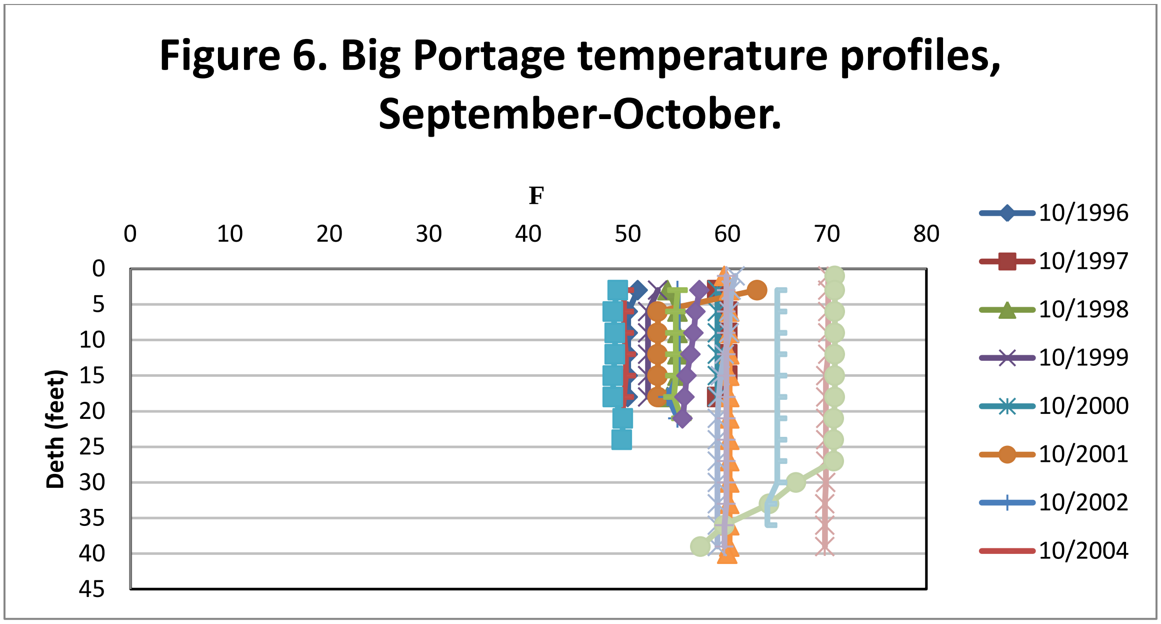
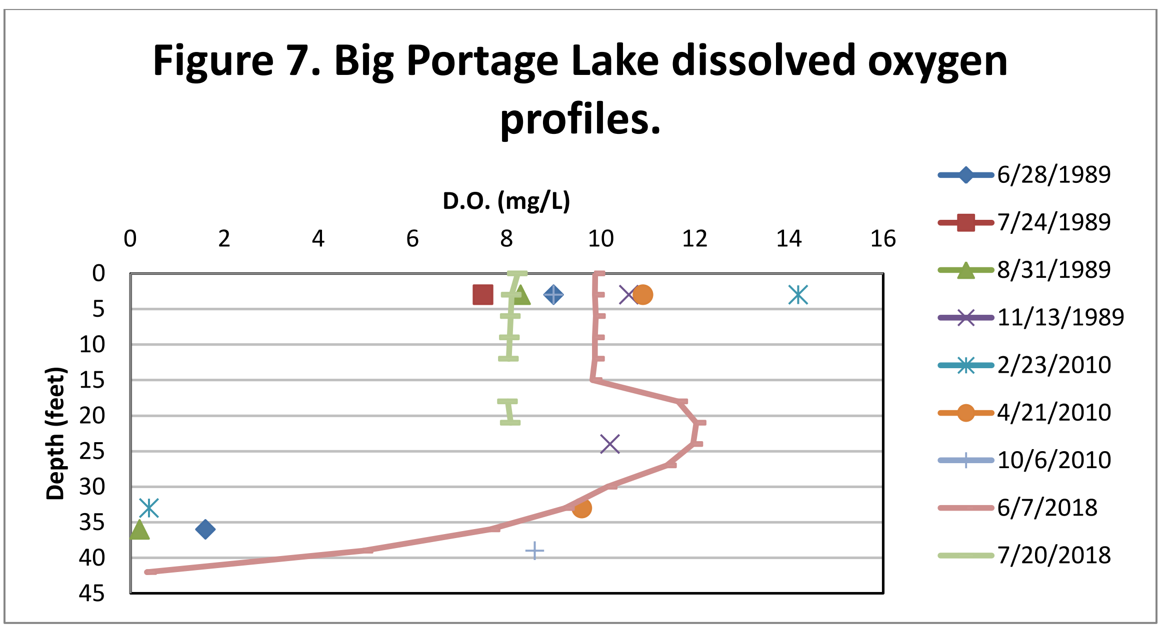
2013
2014
2015
2016
2018
2019



Dissolved Oxygen

The dissolved oxygen (D.O.) content of lake water is vital in determining presence of fish species and other aquatic organisms. Dissolved oxygen also has a strong influence on the chemical and physical conditions of a lake. The amount of dissolved oxygen is dependent on the water temperature, atmospheric pressure, and biological activity. Oxygen levels are increased by aquatic plant photosynthesis, but reduced by respiration of plants, decomposer organisms, fish, and invertebrates. The amount of D.O. available in a lake, particularly in the deeper parts of a lake, is critical to overall health. Big Portage Lake D.O. profiles are displayed in Figure 6. D.O. levels were between 8.23 and 9.2 mg/L from June to September at the surface (Figures 7). Depending on the time of season, D.O. levels began to drop around 30 feet.

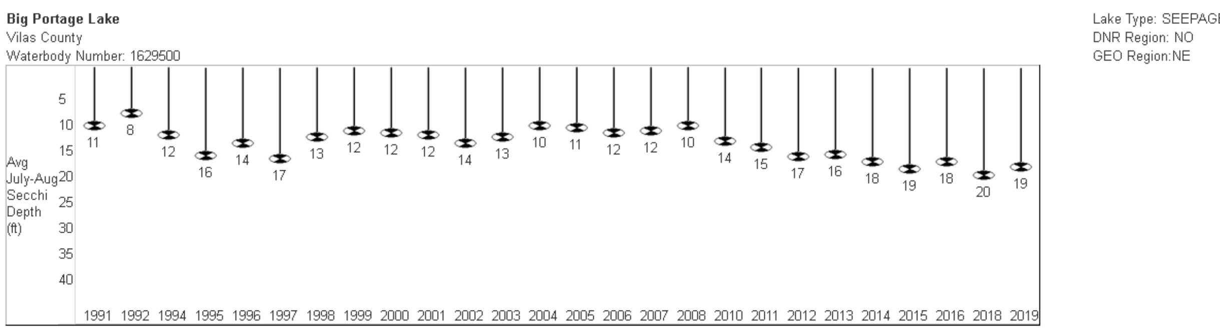


Water Clarity

Water clarity has two main components: turbidity (suspended materials such as algae and silt) and true color (materials dissolved in the water) (Shaw et al., 2004). Water clarity gives an indication of the overall water quality in a lake. Water clarity is typically measured using a Secchi disk (black and white disk) that is lowered into the water column on a tether. The depth at which the disk disappears is noted and then the disk is slowly brought up to where it is just visible again and the depth noted. The mean value between these two measures is recorded as the Secchi depth.

Figure 8 displays the July and August mean Secchi depths from 1991, 1992, 1994-2019. Big Portage Lake's most recent Secchi depth categorizes it as "very good" with respect to water clarity (Table 1). The shallowest mean Secchi depth was 10.5 feet in 2004, and the deepest mean reading was at 20.2 feet in 2018 (Figure 9).

Figure 8. Big Portage Lake Secchi depth averages (July and August only).



Past secchi averages in feet (July and August only).

(WDNR, 2019)

Table 1. Water clarity index (Shaw et al., 2004).

Water clarity	Secchi depth (ft.)
Very poor	3
Poor	5
Fair	7
Good	10
Very good	20
Excellent	32

Figure 9. Big Portage Lake's July and August Secchi Data: Mean, Min, Max, and Secchi Count (1991 -2019) *(WDNR, 2019).*

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1991	10.65	10.25	11	5
1992	8.18	1.75	11.8	3
1994	12.42	11.5	13.5	3
1995	16.38	11.5	20.5	4
1996	14	11.5	16.75	6
1997	17.06	15.5	18	4
1998	12.8	10	17.5	5
1999	11.69	10.25	14	4
2000	12.04	10.5	14.25	6
2001	12.38	12	13	6
2002	14	12	16	4
2003	12.75	11.5	15.5	4
2004	10.5	8.5	12.5	2
2005	11	11	11	2
2006	12	9	15	2
2007	11.5	10	13	2
2008	10.5	9	12	2
2010	13.61	12.75	14	7
2011	14.85	13.25	18	5
2012	16.63	13.5	18.5	4
2013	16.25	14.25	17.5	3
2014	17.58	17	18	3
2015	19	18	20	3
2016	17.5	15.5	19.5	2
2018	20.2	17	24	5
2019	18.6	17	20	5

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Turbidity

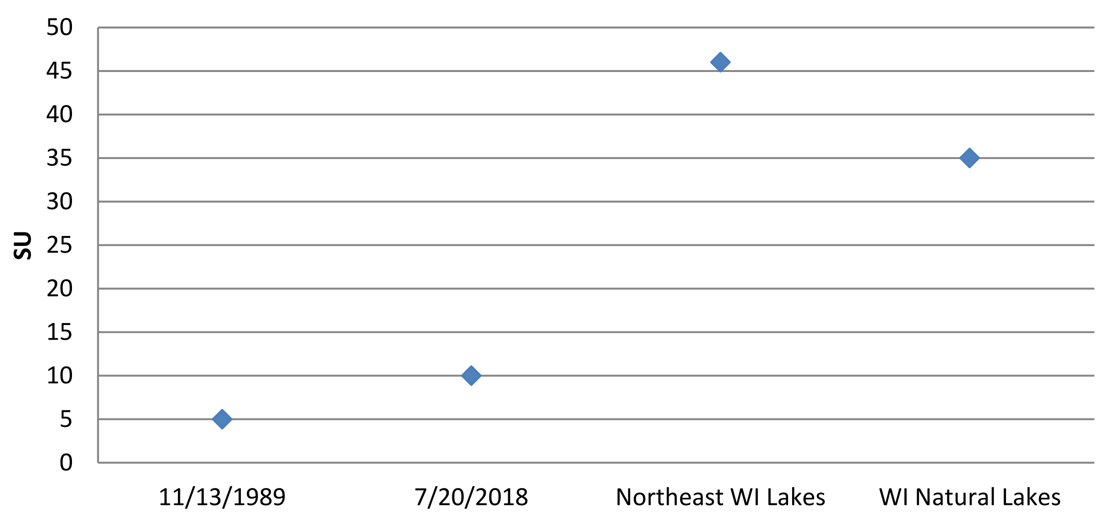
Turbidity is another measure of water clarity, but is caused by suspended particulate matter rather than dissolved organic compounds (Shaw et al., 2004). Particles suspended in the water dissipate light and reduce the depth to which the light can penetrate. This affects the depth at which plants can grow. Turbidity also affects the aesthetic quality of water. Water that runs off the watershed into a lake can increase turbidity by introducing suspended materials. Turbidity caused by algae is the most common reason for low Secchi readings (Shaw et al., 2004). In terms of biological health of a lake ecosystem, measurements less than 10 Nephelometric Turbidity Units (NTU) represent healthy conditions for fish and other organisms. Big Portage Lake turbidity has not been tested, and should be included in future water quality sampling.

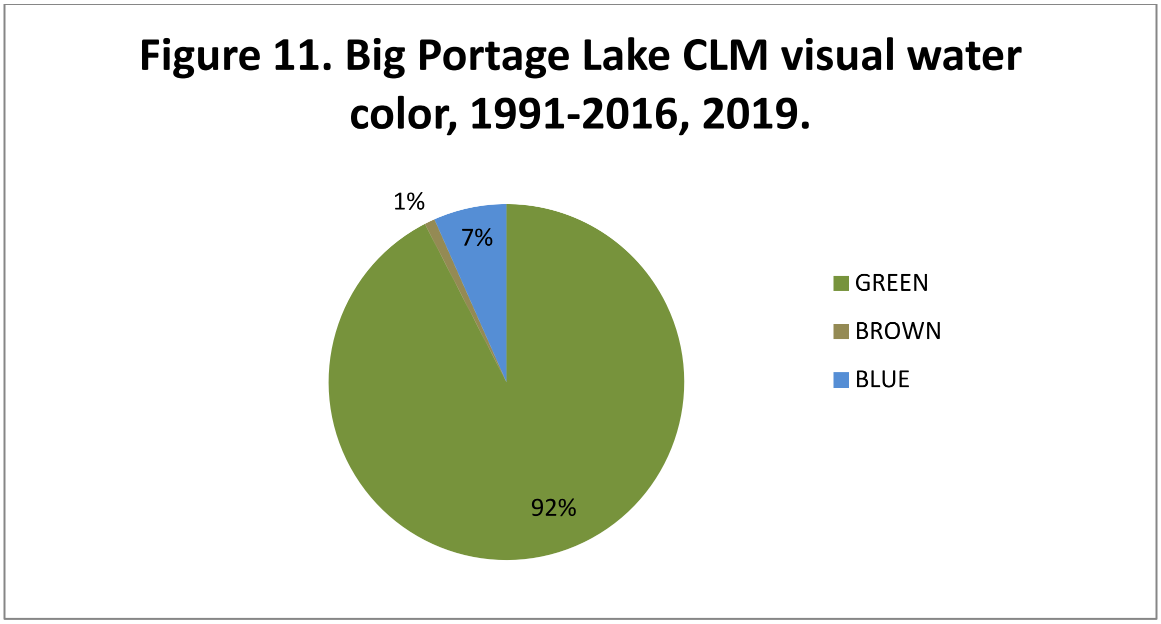
While checking Secchi depth, CLMN volunteers also rate the water clarity and describe the water as "clear" or "murky." In the years that were sampled (1995-2016) Big Portage Lake had a water column appearance of "clear" 99% of the time.

Water Color

Color of lake water is related to the type and amount of dissolved organic chemicals. Its main significance is aesthetics, although it may also influence light penetration and in turn affect aquatic plant and algal growth. Many lakes have naturally occurring color compounds from decomposition of plant material in the watershed (Shaw et al., 2004). Units of color are determined from the platinum-cobalt scale and are therefore recorded as Pt-Co units. Shaw states that a water color between 0 and 40 Pt-Co units is low. Big Portage Lake color has been analyzed in 1989 and 2018 (Figure 10). CLMN also recorded their perceptions of water color in Big Portage Lake. Volunteers indicated the water appeared "green" in color 92% of the time and 7% of the time they indicated the water appeared "blue" in color (Figure 11).

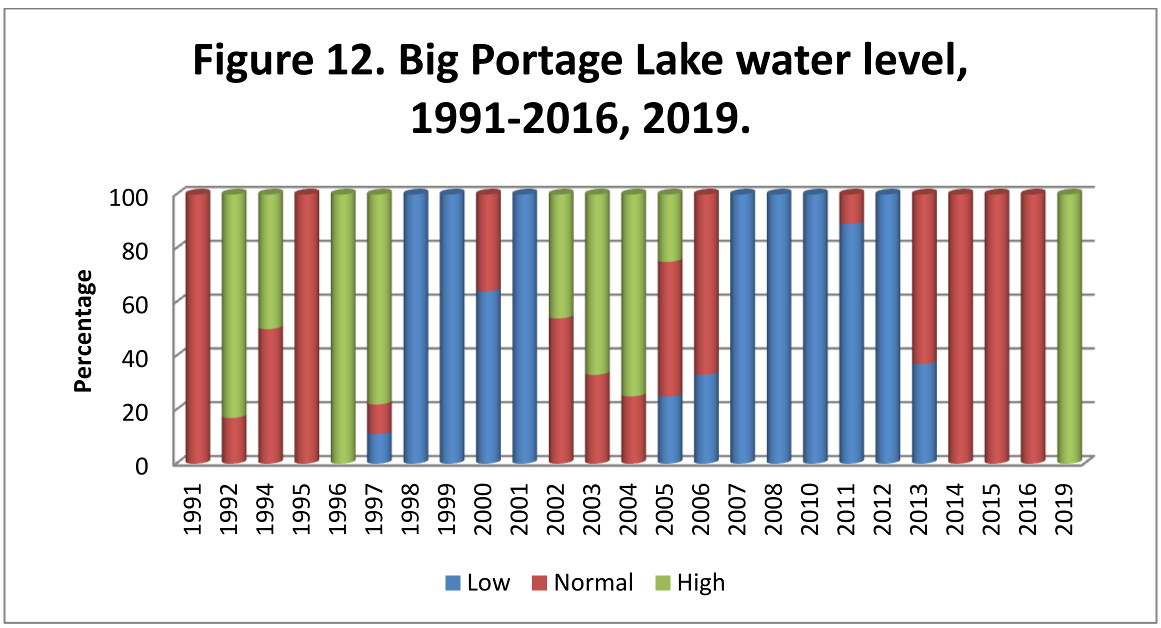
Figure 10. Big Portage Lake color.





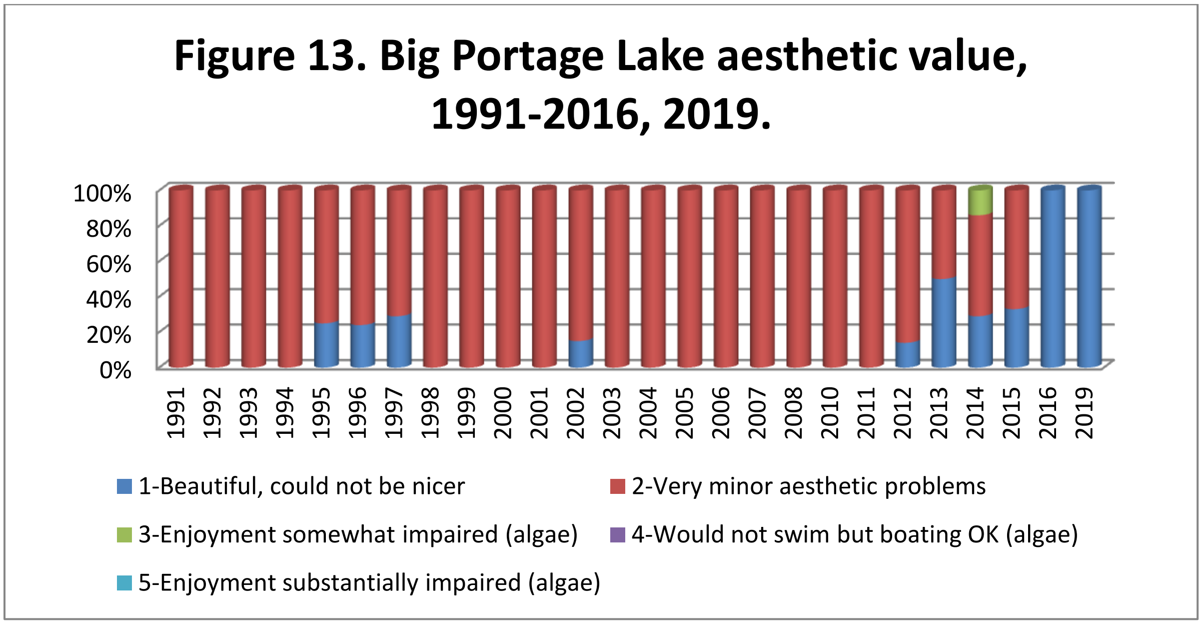
Water Level

When CLMN volunteers collect Secchi depth readings, they also record the lake level as "high," "normal," or "low." Figure 12 indicates that in 1996 and 2019 the water level in Big Portage Lake appeared "high."



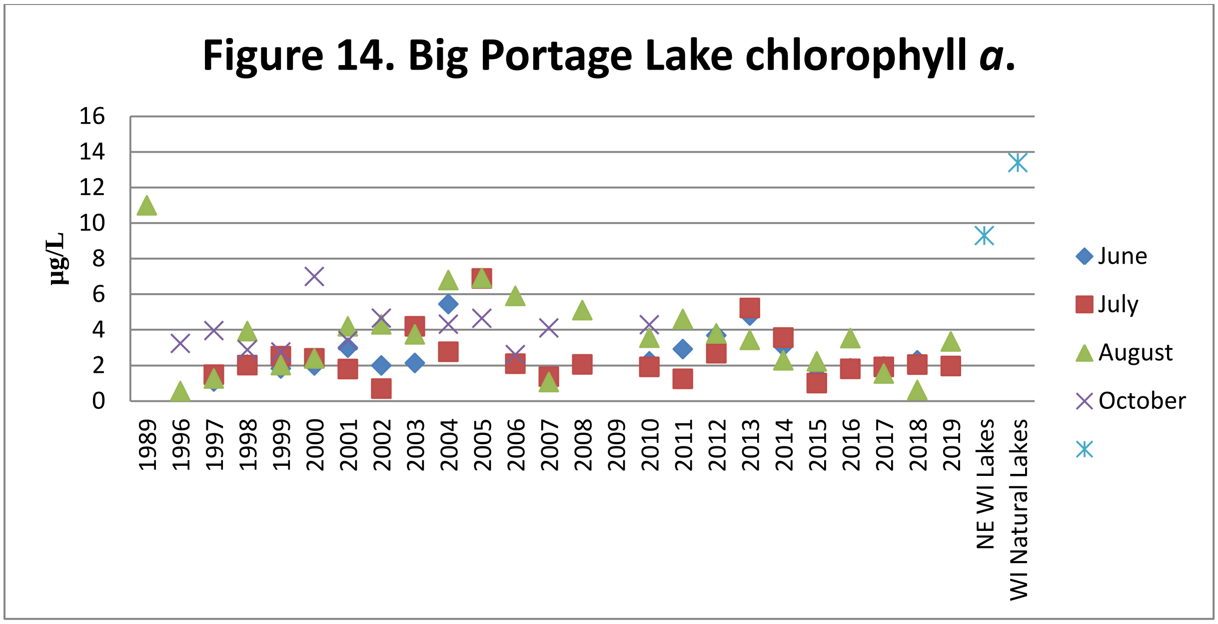
User Perceptions

The CLMN also record their perceptions of the water, based on the physical appearance and the recreational suitability. These perceptions can be compared to water quality parameters to see how the lake user would experience the lake at that time. When interpreting the transparency data, we see that when the Secchi depth decreases, the rating of the lake's physical appearance also decreases. These perceptions of recreational suitability are displayed by year in Figure 13. In 2016 and 2019, 100% of CLMN volunteers recorded Big Portage Lake to be "beautiful could not be better."



Chlorophyll *a*

Chlorophyll *a* is the photosynthetic pigment that makes plants and algae green. Chlorophyll *a* in lake water is an indicator of the amount of algae. Chlorophyll *a* concentrations greater than 10 µg/L are perceived as a mild algae bloom, while concentrations greater than 20 µg/L are perceived as a nuisance. Chlorophyll *a* values were below nuisance levels and well below the average levels for Wisconsin natural lakes (Figure 14).



Phosphorus

In more than 80% of Wisconsin's lakes, phosphorus is the key nutrient affecting the amount of algae and plant growth. If phosphorus levels are high, excessive aquatic plant growth can occur.

Phosphorus originates from a variety of sources, many of which are related to human activities. Major sources include human and animal wastes, soil erosion, detergents, septic systems and runoff from farmland or lawns (Shaw et al., 2004). Phosphorus provokes complex reactions in lakes. An analysis of phosphorus often includes both soluble reactive phosphorus and total phosphorus. Soluble reactive phosphorus dissolves in the water and directly influences plant growth (Shaw et al., 2004). Its concentration varies in most lakes over short periods of time as plants take it up and release it. Total phosphorus is considered a better indicator of a lake's nutrient status than soluble reactive phosphorus because its levels remain more stable (Shaw et al., 2004). Total phosphorus includes soluble phosphorus and the phosphorus in plant and animal fragments suspended in lake water. Ideally, soluble reactive phosphorus concentrations should be 10 µg/L or less at spring turnover to prevent summer algae blooms (Shaw et al., 2004). A concentration of total phosphorus below 20 µg/L for lakes should be maintained to prevent nuisance algal blooms (Shaw et al., 2004).

Big Portage Lake total phosphorus values were considered "excellent" to "very good," (Figure 15) and are comparable to the region and state values (Figure 16).

Figure 15. Big Portage Lake total phosphorus (average June, July, August).

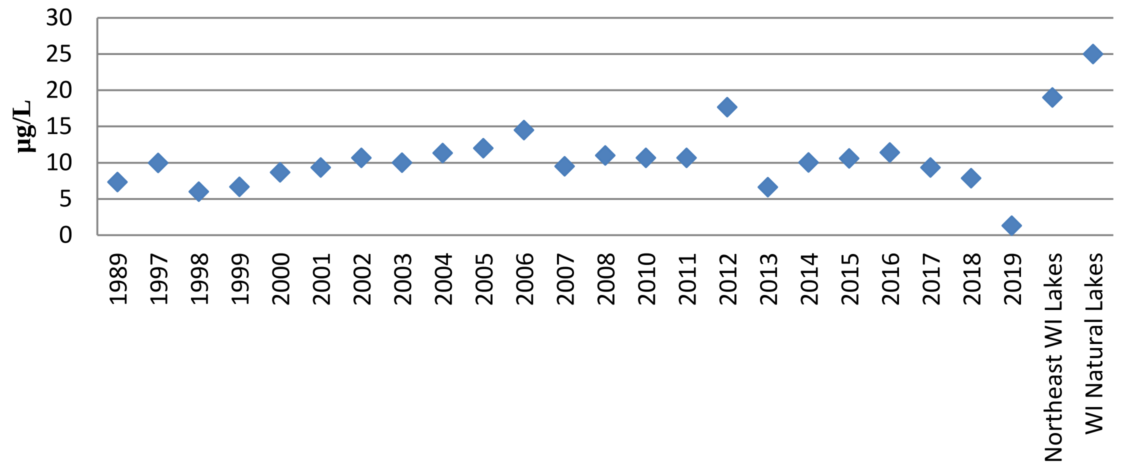
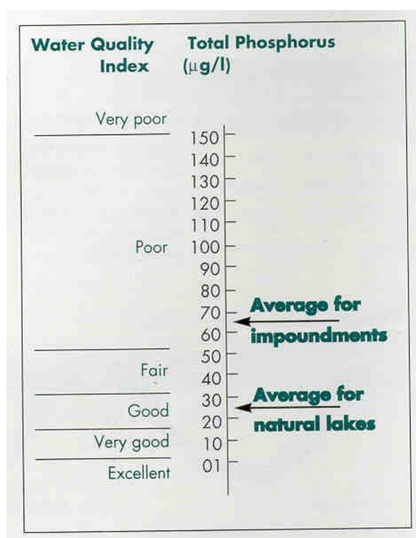


Figure 16. Total phosphorus concentrations for Wisconsin's natural lakes and impoundments (Shaw et al., 2004).



Trophic State

Trophic state is another indicator of water quality (Carlson, 1977). Lakes are typically divided into three categories based on trophic state – oligotrophic, mesotrophic, and eutrophic. These categories reflect a lake's nutrient and clarity levels (Shaw et al., 2004).

Trophic State Index (TSI) was calculated by the WDNR using only Secchi measurements, chlorophyll *a*, and total phosphorus collected from the CLMN. Figure 17, classifying Big Portage Lake as "mesotrophic" (Table 2).

Figure 17. Big Portage Lake Trophic State Index, (1989-2019). *(WDNR, 2019a)*

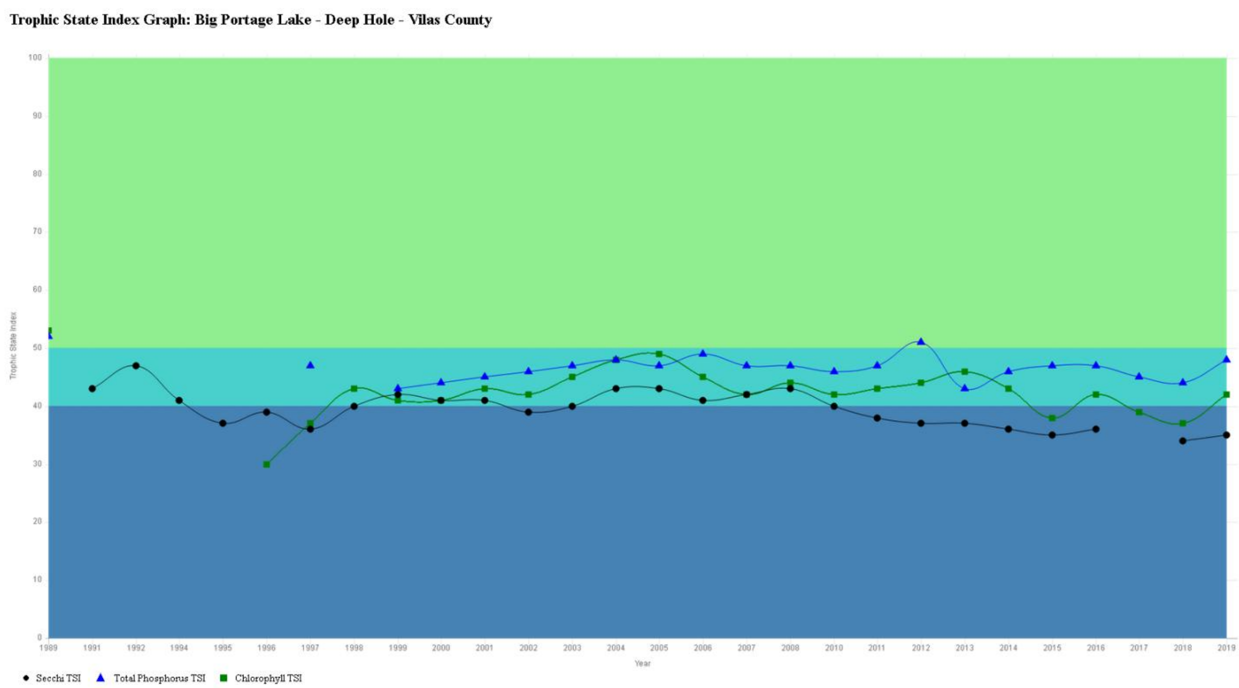


Table 2. Trophic State Index.	
30-40	**Oligotrophic:** clear, deep water; possible oxygen depletion in lower depths; few aquatic plants or algal blooms; low in nutrients; large game fish usual fishery
40-50	**Mesotrophic:** moderately clear water; mixed fishery, esp. panfish; moderate aquatic plant growth and occasional algal blooms; may have low oxygen levels near bottom in summer
50-60	**Mildly Eutrophic:** decreased water clarity; anoxic near bottom; may have heavy algal bloom and plant growth; high in nutrients; shallow eutrophic lakes may have winterkill of fish; rough fish common
60-70	**Eutrophic:** dominated by blue-green algae; algae scums common; prolific aquatic plant growth; high nutrient levels; rough fish common; susceptible to oxygen depletion and winter fishkill
70-80	**Hypereutrophic:** heavy algal blooms through most of summer; dense aquatic plant growth; poor water clarity; high nutrient levels

(WDNR, 2019b)

Researchers use various methods to calculate the trophic state of lakes. Common characteristics used to make the determination are: total phosphorus (important for algae growth), chlorophyll *a* concentration (a measure of the amount of algae present), and Secchi disk readings (an indicator of water clarity) (Shaw et al., 2004) (Table 3).

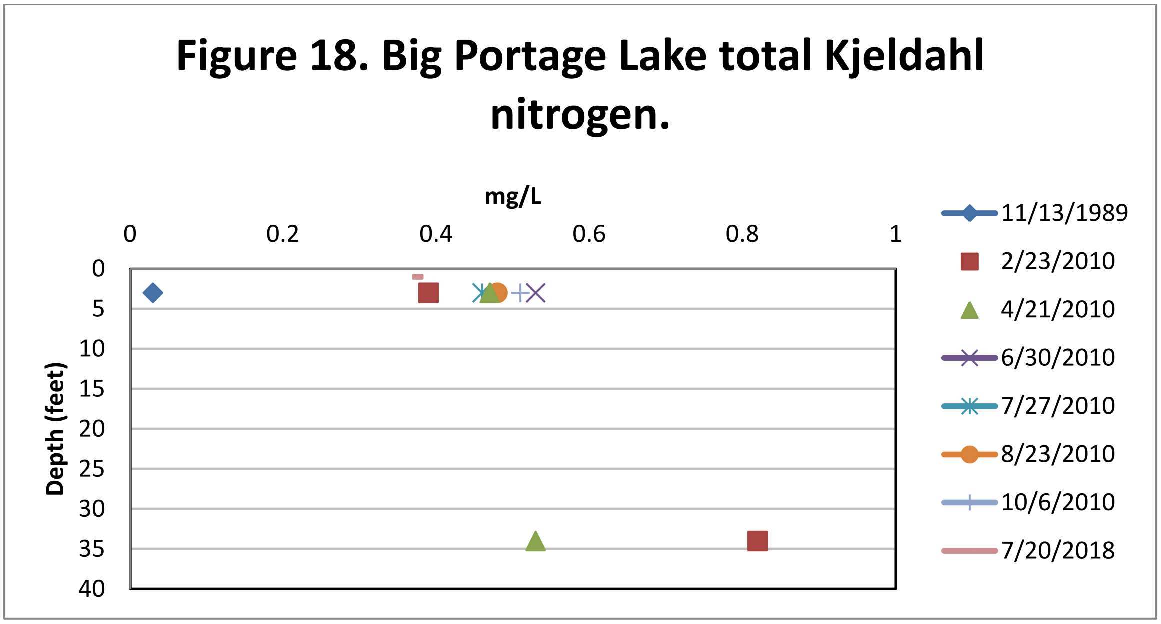
Table 3. Trophic classification of Wisconsin Lakes based on chlorophyll *a*, water clarity measurements, and total phosphorus values (Shaw et al., 2004).

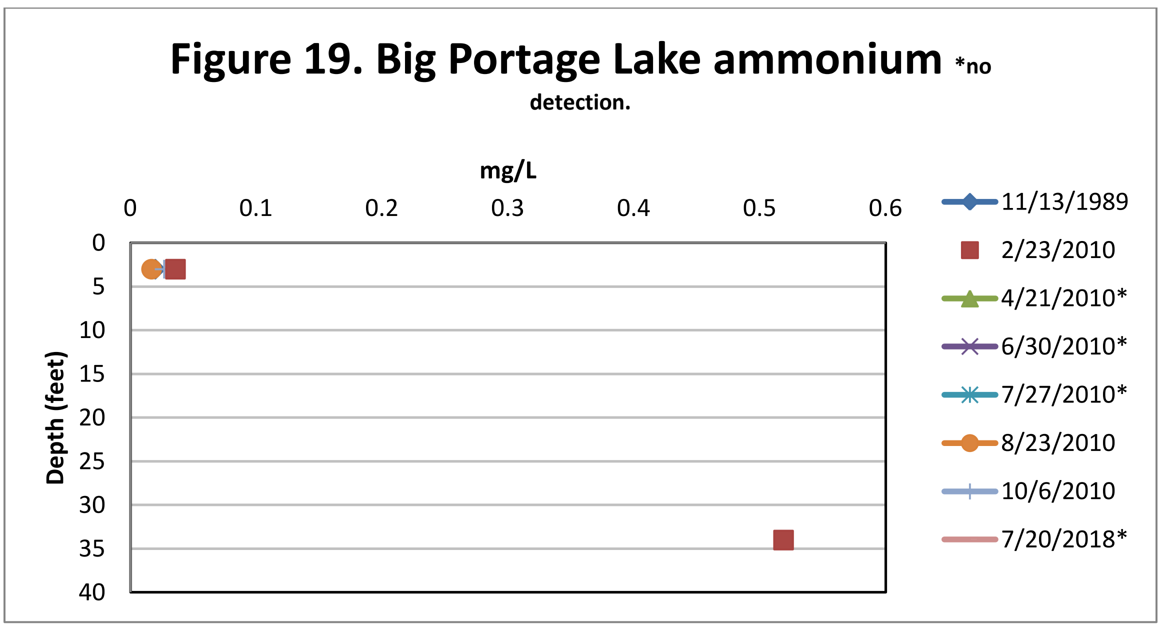
Trophic class	Total phosphorus µg/L	Chlorophyll *a* µg/L	Secchi Disk (ft.)
Oligotrophic	3	2	12
	10	5	8
Mesotrophic	18	8	6
	27	10	6
Eutrophic	30	11	5
	50	15	4

Nitrogen

Nitrogen is second only to phosphorus as an important nutrient for aquatic plant and algae growth (Shaw et al., 2004). Human activities on the landscape greatly influence the amount of nitrogen in a lake. Nitrogen may come from lawn fertilizer, septic systems near the lake, or from agricultural activities in the watershed. Nitrogen may enter a lake from surface runoff or groundwater sources.

Nitrogen exists in lakes in several forms. Nitrogen is a major component of all organic (plant and animal) matter. Decomposing organic matter releases ammonia, which is converted to nitrate if oxygen if present (Shaw et al., 2004). All inorganic forms of nitrogen can be used by aquatic plants and algae (Shaw et al., 2004). If these inorganic forms of nitrogen exceed 0.3 mg/L (as N) in spring, there is sufficient nitrogen to support summer algae blooms (Shaw et al., 2004). Elevated concentrations of ammonia, nitrate, and nitrite, derived from human activities, can stimulate or enhance the development, maintenance and proliferation of primary producers (phytoplankton, benthic algae, marcrophytes), contributing to the widespread phenomenon of the cultural (human-made) eutrophication of aquatic ecosystems (Camargo et al., 2007). The nutrient enrichment can cause important ecological effects on aquatic communities, since the overproduction of organic matter, and its subsequent decomposition, usually lead to low dissolved oxygen concentrations in bottom waters, and sediments of eutrophic and hypereutrophic aquatic ecosystems with low turnover rates (Camargo et al., 2007). Big Portage Lake nitrate/nitrite nitrogen has been tested with no detection on 11/13/1989, 2/23/2010 at 3 feet, June-October 2010, and also 7/20/2018. On 2/23/2010 a value of 0.068 mg/L at 34 feet, 4/21/2010 had a value of 0.048 mg/L at 3 feet and 0.049 mg/L at 34 feet. Figure 18 displays total Kjeldahl nitrogen and Figure 19 displays ammonium.





Chloride

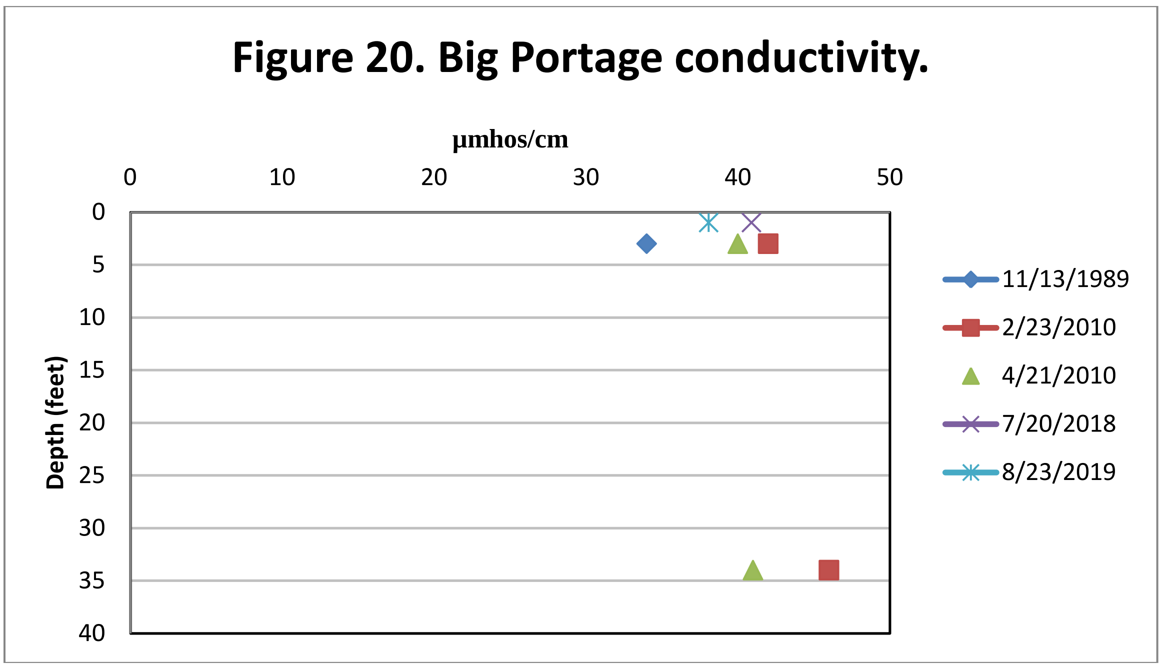
The presence of chloride (Cl^-) where it does not occur naturally indicates possible water pollution (Shaw et al., 2004). Chloride does not affect plant and algae growth and is not toxic to aquatic organisms at most of the levels found in Wisconsin (Shaw et al., 2004). Big Portage Lake chloride was analyzed on 11/13/1989 with a 0.3 mg/L. On 7/20/2018 chloride was below detection limit. For Northeast Wisconsin Lakes the mean for chloride is 2 mg/L and 4 mg/L for Wisconsin Natural Lakes.

Sulfate

Sulfate in lake water is primarily related to the types of minerals found in the watershed, and to acid rain (Shaw et al., 2004). Big Portage Lake sulfate was analyzed on 11/13/1989 with a 3 mg/L. On 7/20/2018 sulfate was below detection limit.

Conductivity

Conductivity is a measure of the ability of water to conduct an electric current. Conductivity is reported in micromhos per centimeter **(**µmhos/cm) and is directly related to the total dissolved inorganic chemicals in the water. Usually, values are approximately two times the water hardness, unless the water is receiving high concentrations of human-induced contaminants (Shaw et al., 2004). Big Portage Lake conductivity values are displayed in Figure 20.



pH

The acidity level of a lake's water regulates the solubility of many minerals. A pH level of 7 is considered neutral. The pH level in Wisconsin lakes ranges from 4.5 in acid, bog lakes to 8.4 in hard water, marl lakes (Shaw et al., 2004). Natural rainfall in Wisconsin averages a pH of 5.6. Some minerals become available under low pH (especially aluminum, zinc, and mercury) and can inhibit fish reproduction and/or survival. Mercury and aluminum are not only toxic to many kinds of wildlife, but also to humans. The pH scale is logarithmic, so every 1.0 unit change in pH increases the acidity tenfold. Water with a pH of 6 is 10 times more acidic than water with pH of 7. A lake's pH level is important for the release of potentially harmful substances and affects plant growth, fish reproduction and survival. A lake with neutral or slightly alkaline pH is a good lake for fish and plant survival. Big Portage Lake pH values are shown in Figure 21 and ranged from 6 to 7.9 SU.

Table 4 shows the effects pH levels less than 6.5 can have on fish. Big Portage Lake is close to neutral in the one sample taken of pH. While moderately low pH does not usually harm fish, the metals that become soluble under low pH can be important. In low pH waters, aluminum, zinc, and mercury concentrations increase if they are present in lake sediment or watershed solids (Shaw et al., 2004).

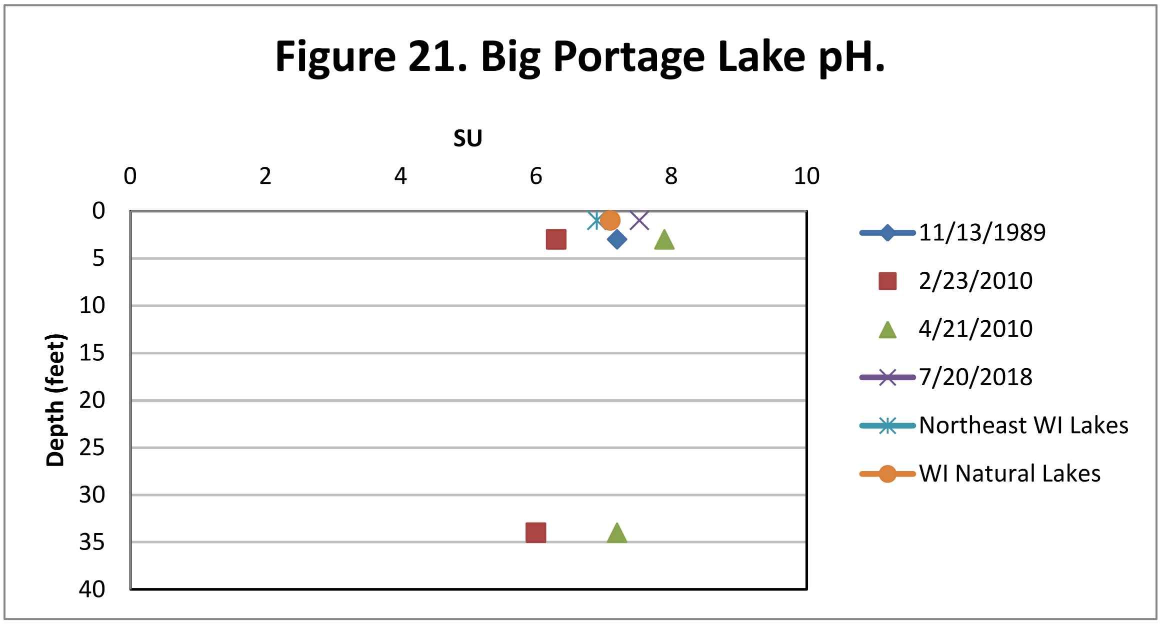


Table 4. Effects of acidity on fish species (Olszyk, 1980).

Water pH	*Effects*
6.5	Walleye spawning inhibited
5.8	Lake trout spawning inhibited
5.5	Smallmouth bass disappear
5.2	Walleye & lake trout disappear
5	Spawning inhibited in most fish
4.7	Northern pike, sucker, bullhead, pumpkinseed, sunfish & rock bass disappear
4.5	Perch spawning inhibited
3.5	Perch disappear
3	Toxic to all fish

Alkalinity

Alkalinity levels in a lake are affected by the soil minerals, bedrock type in the watershed, and frequency of contact between lake water and these materials (Shaw et al., 2004). Alkalinity is important in a lake to buffer the effects of acidification from the atmosphere. Acid rain has long been a problem with lakes that have low alkalinity levels and high potential sources of acid deposition. Big Portage Lake alkalinity is shown in Figure 22. This level categorizes Big Portage Lake as "low" sensitivity to acid rain (Table 5).

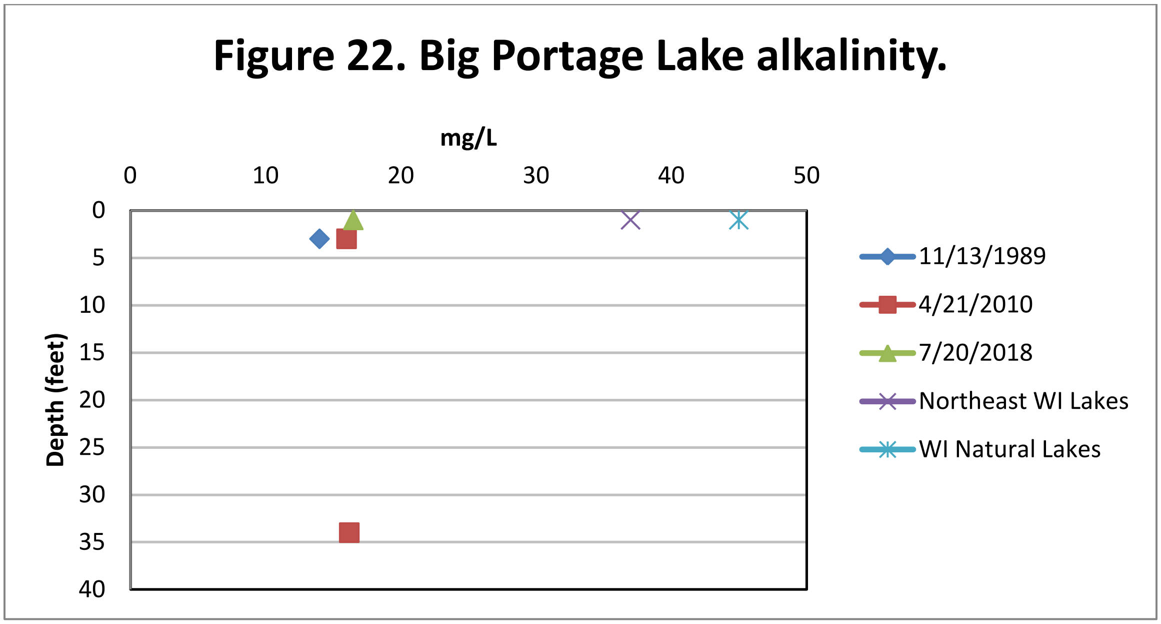


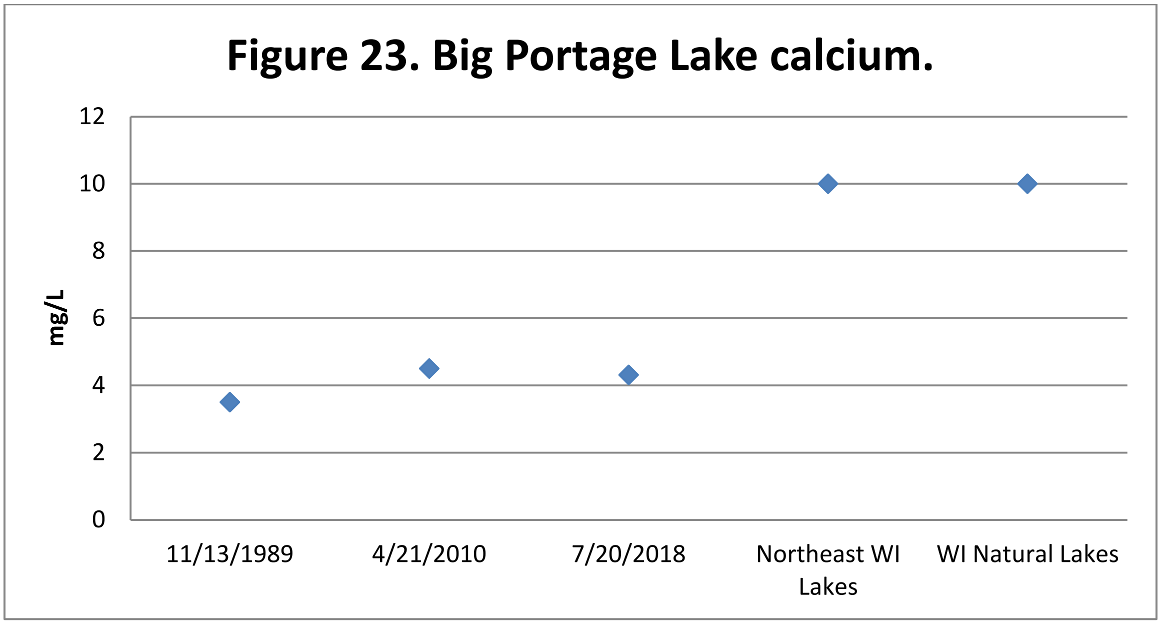
Table 5. Sensitivity of Lakes to Acid Rain (Shaw et al., 2004).	
Sensitivity to acid rain	***Alkalinity value (mg/L or ppm $CaCO_3$)***
High	0-2
Moderate	2-10
Low	10-25
Non-sensitive	>25

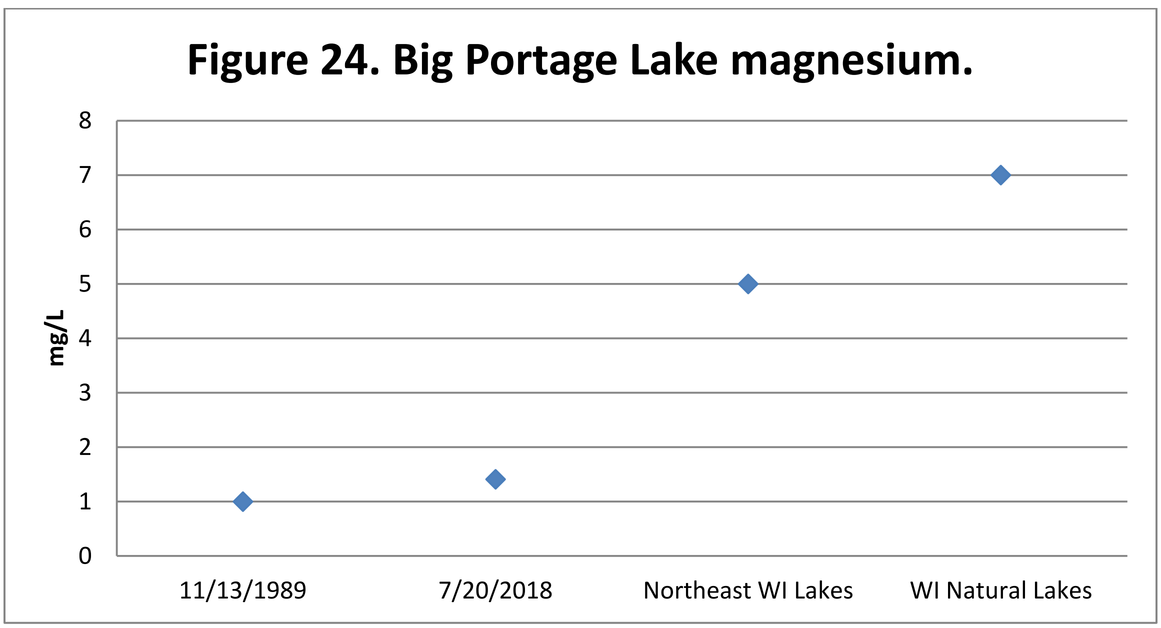
Hardness

Hardness levels in a lake are affected by the soil minerals, bedrock type, and frequency of contact between lake water and these materials (Shaw et al., 2004). One method of evaluating hardness is to test for calcium carbonate ($CaCO_3$). Big Portage Lake hardness was tested in 11/13/1989 with a value of 14 mg/L and on 7/20/2018 with a value of 16.6 mg/L.

Calcium and Magnesium Hardness

The carbonate system provides acid buffering through two alkaline compounds: bicarbonate and carbonate. These compounds are usually found with two hardness ions: calcium and magnesium (Shaw et al., 2004). Calcium is the most abundant cation found in Wisconsin lakes. Its abundance is related to the presence of calcium-bearing minerals in the lake watershed (Shaw et al., 2004). Aquatic organisms such as native mussels use calcium in their shells. The aquatic invasive zebra mussel tends to need calcium levels greater than 20 mg/L to maintain shell growth. Big Portage Lake calcium levels are shown in Figure 23. Calcium was 3.5 to 4.5 mg/L indicating that Big Portage Lake is "not suitable" for zebra mussels if they were introduced. Magnesium levels (Figure 24) are low for Big Portage Lake in comparison to Wisconsin natural lakes and Northeast Wisconsin lakes mean.





Sodium and Potassium

Sodium and potassium are possible indicators of human pollution in a lake, since naturally occurring levels of these ions in soils and water are very low. Sodium is often associated with chloride and gets into lakes from road salting, fertilizations, and human and animal waste (Shaw et al., 2004). Potassium is the key component of commonly-used potash fertilizer, and is abundant in animal waste. Both of these elements are held by soils to a greater extent than is chloride or nitrate; therefore, they are not as useful as indicators of pollution impacts (Shaw et al., 2004). Although not normally toxic themselves, they provide a strong indication of possible contamination by more damaging compounds (Shaw et al., 2004). Big Portage Lake sodium was tested on 11/13/1989 with a value of <1 mg/L and 7/20/2018 with a value of 0.985 mg/L. Potassium was also tested on the same dates with values of 0.504 mg/L and 0.39 mg/L respectively.

Dissolved Organic Carbon

Dissolved Organic Carbon (DOC) is a food supplement, supporting growth of microorganisms, and plays an important role in global carbon cycle through the microbial loop. In general, organic carbon compounds are a result of decomposition processes from dead organic matter such as plants. When water contacts high organic soils, these components can drain into rivers and lakes as DOC. DOC is also extremely important in the transport of metals in aquatic systems. Metals form extremely strong complexes with DOC, enhancing metal solubility while also reducing metal bioavailability. Baseflow concentrations of DOC in undisturbed watersheds generally range from 1 to 20 mg/L carbon. Big Portage Lake DOC has not been tested, and should be included in future water quality sampling.

Silica

The earth's crust is abundant with silicates or other compounds of silicon. The water in lakes dissolves the silica and pH can be a key factor in regulating the amount of silica that is dissolved. Silica concentrations are usually within the range of 5 to 25 mg/L. Generally lakes that are fed by groundwater have higher levels of silica. Big Portage Lake silica was analyzed 11/13/1989 with <0.2 mg/L.

Aluminum

Aluminum occurs naturally in soils and sediments. In low pH (acidic) environments aluminum solubility increases greatly. With a low pH and increased aluminum values, fish health can become impaired. This can have impacts on the entire food web. Aluminum also plays an important role in phosphorus cycling in lakes. When aluminum precipitates with phosphorus in lake sediments, the phosphorus will not dissolve back into the water column as readily. Big Portage Lake aluminum was 33 µg/L on 11/13/1989.

Iron

Iron also forms sediment particles that store phosphorus when dissolved oxygen is present. When oxygen concentration gets low (for example, in winter or in the deep water near sediments) the iron and phosphorus dissolve in water. This phosphorus is available for algal blooms. Big Portage Lake iron has not been tested, and should be included in future water quality sampling.

Manganese

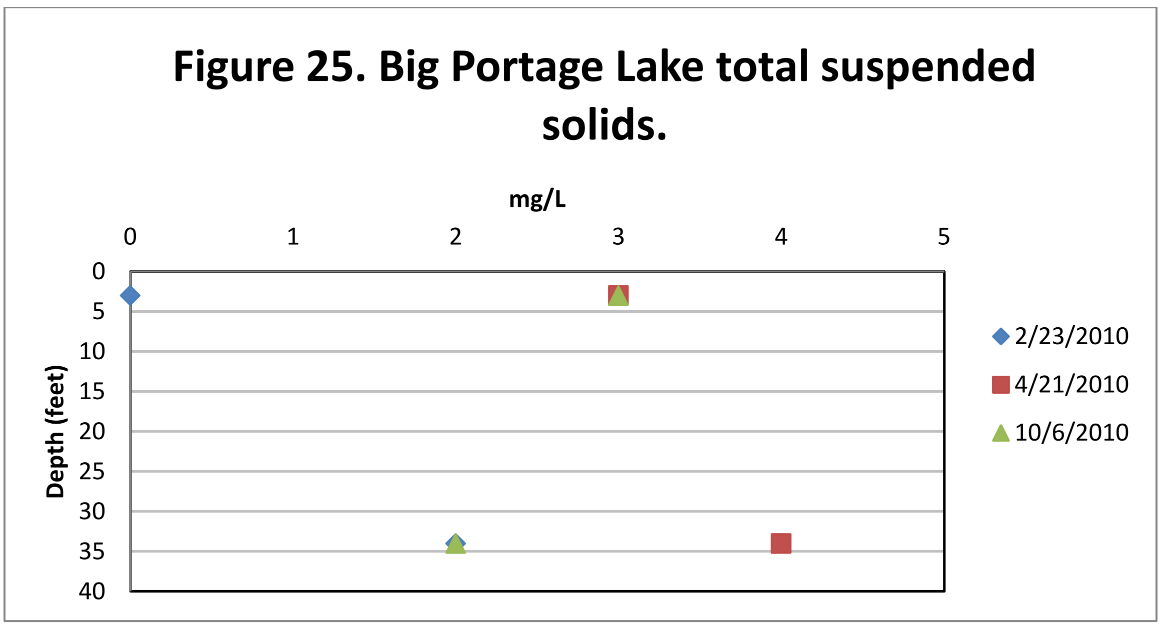
Manganese is a mineral that occurs naturally in rocks and soil. In lakes, manganese is usually in particulate form. When the dissolved oxygen levels decrease, manganese can convert from an insoluble form to soluble ions. A manganese concentration of 0.05 mg/L can cause color and staining problems. Manganese data is unknown for Big Portage Lake, so future water quality sampling should include this parameter.

Sediment

Lake bottom sediments are sometimes analyzed for chemical constituents that they contain. This is especially true for potentially toxic metals such as mercury, chromium, selenium, and others. Lake sediments also tend to record past events as particulates settle down and become part of the sediment. Biological clues for the historic conditions in the lake can be gleaned from sediment samples. Examples include analysis of pollen or diatoms that might help understand past climate or trophic states in the lake. Sediment data was not collected for Big Portage Lake, and future sampling should include this parameter.

Total Suspended Solids

Total suspended solids are all particles suspended in lake water. Silt, plankton, and wastes are examples of these solids and can come from runoff of agricultural land, erosion, and can be produced by bottom-feeding fish. As the suspended solid levels increase, they absorb heat from sunlight which can increase the water temperature. They can also block the sunlight that plants need for photosynthesis. These events can in turn affect the amount of dissolved oxygen in the lake. Lakes with total suspended solids levels less than 20 mg/L are considered "clear," while levels between 40 and 80 mg/L are "cloudy." Total suspended solids data was sampled in 2010 for Big Portage Lake (Figure 25).



Ice Out and Ice On

Ice out and ice on data was not collected for Big Portage Lake, and future sampling should include this parameter.

Aquatic Invasive Species

The only aquatic invasive species found in Big Portage Lake is the rusty crayfish. The European marsh thistle is also present (see Appendix I, Big Portage Lake AIS Report). On 9/17/2018, a White Water Associates biologist along with a volunteer from Big Portage Lake conducted an AIS Early Detection Monitoring Survey and found the banded mystery snail. Reed canary grass was found during the 2018 aquatic plant survey and was verified by Dr. Freckmann from Wisconsin Stevens Point. Also, during the conductivity survey White Water Associates, Inc biologist conducted with help from volunteer's found purple loosestrife on shore near the lake. Photos were taken and sent to the WDNR. A more detailed report can be found in Appendix E.

Clean Boats Clean Waters (CBCW) is a program that inspects boats for aquatic invasive species and in the process educates the public on how to help stop the spread of these species. Clean Boats, Clean Waters efforts have been happening since 2007. At Big Portage Lake in 2018 and 2019, 582 boats were inspected and 1,002 people were contacted (Figure 26). In 2018 and 2019, 704 hours were spent doing CBCW (Figure 27). Figure 28 shows 71 people were contacted this season by a CBCW person and the majority of people were willing to answer questions. Figure 29 indicates that 36% of boaters used their boats on another waterbody in the past 5 days and the majority of people asked understand the importance of AIS education.

Figure 26. Clean Boats, Clean Waters boats inspected and people contacted for Big Portage Lake (WDNR, 2019c).

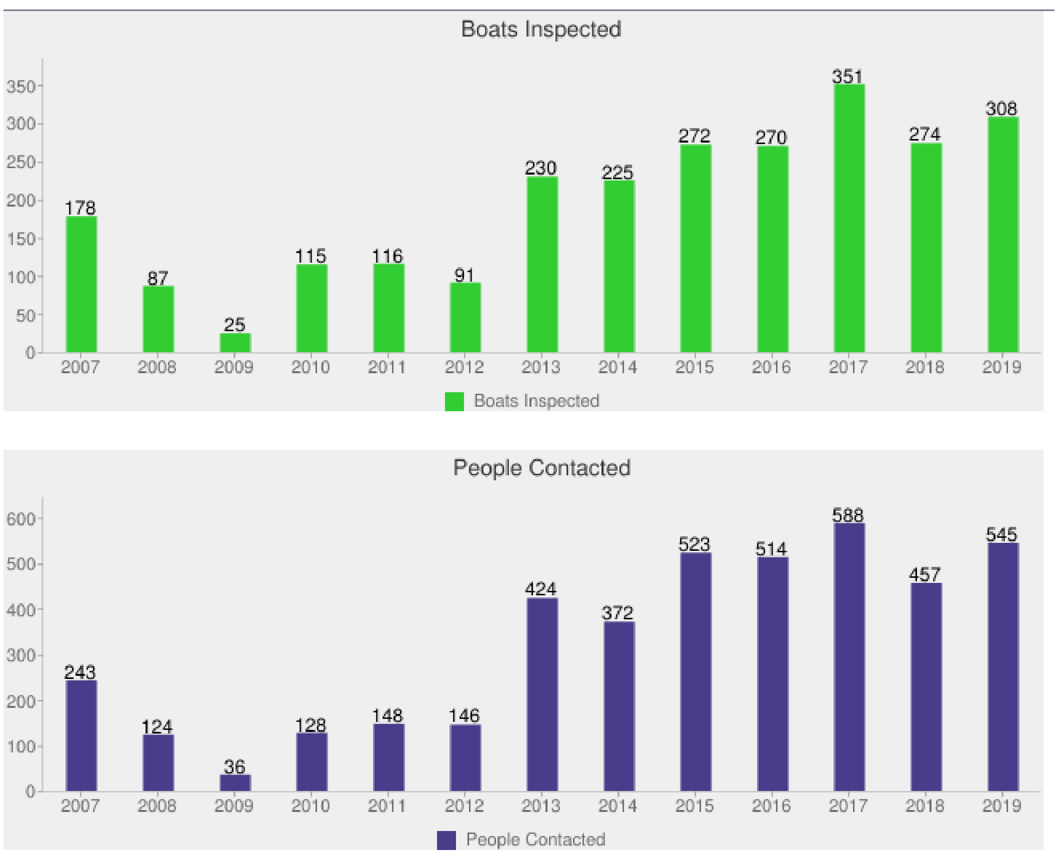


Figure 27. Clean Boats, Clean Waters hours spent for Big Portage Lake (WDNR, 2019c).

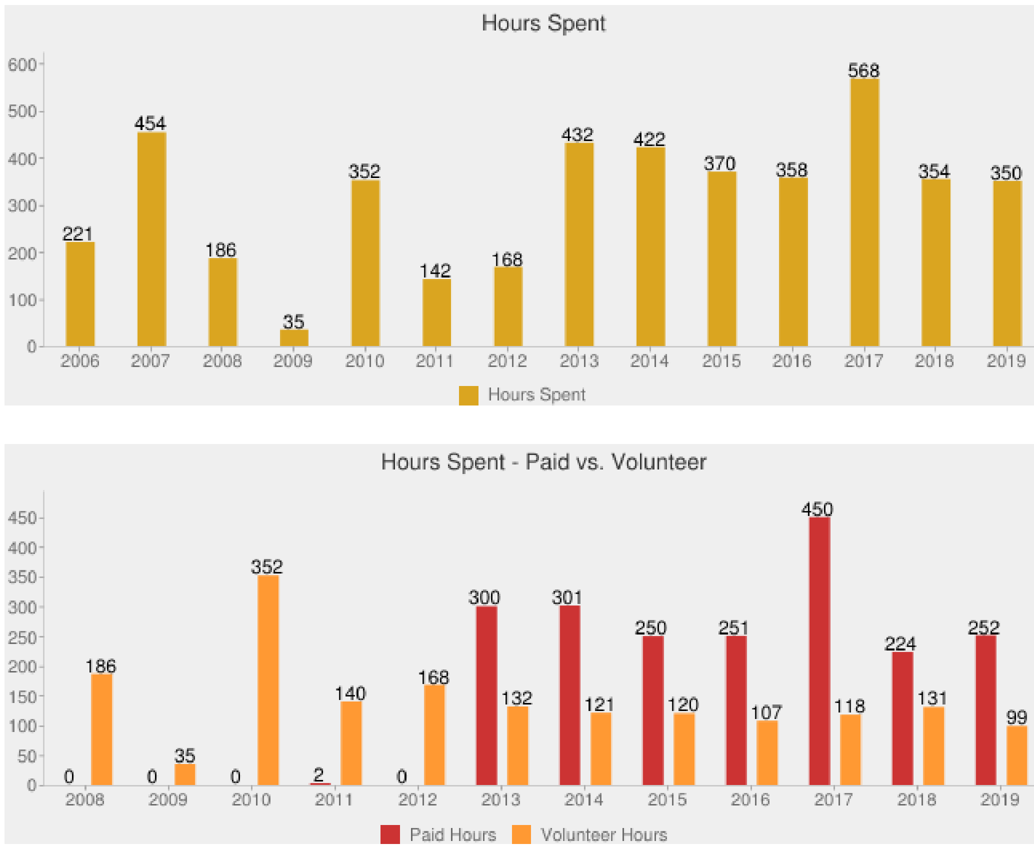
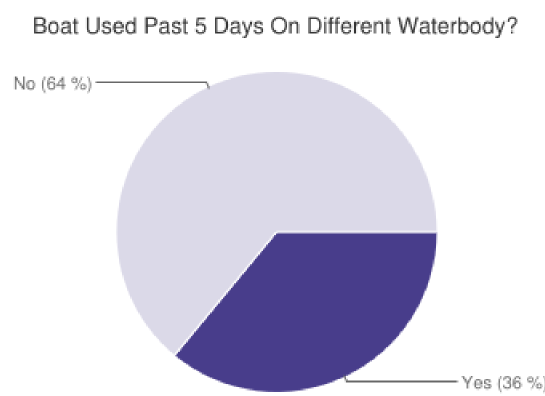
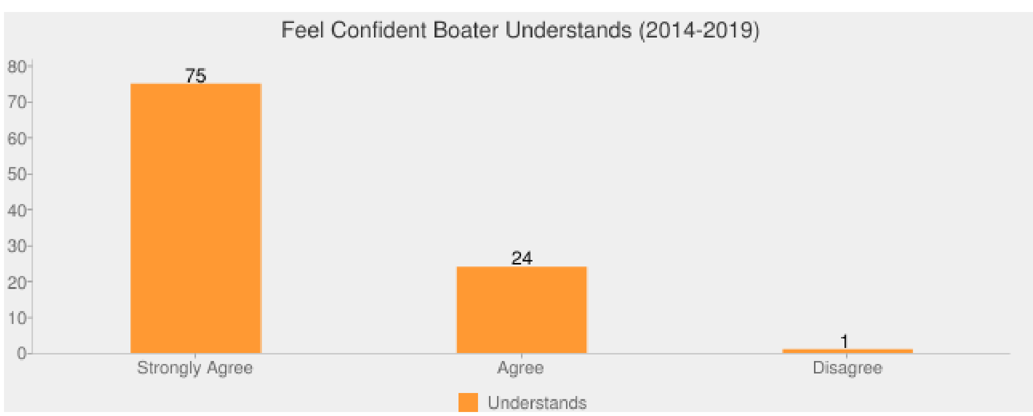


Figure 28. Clean Boats, Clean Waters people were asked if they were contacted this season and were they willing to answer questions for Big Portage Lake (WDNR, 2019c).

Figure 29. Clean Boats, Clean Waters boats used in the past 5 days and boater understands AIS questions on Big Portage Lake (WDNR, 2019c).





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Appendix D
Big Portage Lake Conductivity Survey

Big Portage Lake Conductivity Study

Angie Stine and Kent Premo, White Water Associates, Inc., March 2019

Introduction

Conductivity (also called *specific conductance*) is the measure of the water's ability to conduct an electric current (Shaw et al., 2004). It depends on ions (such as chloride, calcium, potassium or iron) in the water. The more ions present, the higher the conductivity. A lake's natural conductivity is influenced by the geology and soils in the watershed. Minerals that leach from bedrock and soils enter the lake through runoff and contribute to lake water conductivity. Human activities also affect lake water conductivity. When elevated or increasing conductivity is observed in a lake, it can be due to human activity such as road salting, faulty septic systems, urban runoff, or agricultural runoff. New construction that alters runoff patterns and exposes new soil and bedrock areas can also contribute to elevated conductivity. Conductivity is also influenced by temperature. As water temperature increases, conductivity increases (EPA, 2012).

Lake conductivity studies are carried out to determine if there are faulty septic systems or other pollution sources present that could be delivering nutrients and other dissolved substances into the lake. Low values of conductivity are characteristic of high-quality, oligotrophic (low nutrient) lake waters (GVSU, 2014). High values of conductivity are observed in eutrophic lakes where plant nutrients (fertilizers) are in great abundance (GVSU, 2014). Very high values are indicators of possible pollution sites (GVSU, 2014). A shoreline conductivity study compares conductivity values found at near-shore sites with those found near the middle of the lake.

Procedure

A White Water biologist and two Big Portage Lake volunteers conducted the conductivity study via boat on August 23, 2019. Ten points were positioned near center areas in the lake to establish a control (background) value for conductivity. Water samples for conductivity readings were collected approximately every 100 feet around the lake shore. These points would later be compared to the control data. The coordinates for each perimeter point were stored in a GPS unit prior to field sampling making navigation and sampling more efficient. Water samples were analyzed in the field using a Myron Ultrameter II 6P conductivity meter. At each sample site the conductivity value was recorded along with any observations about the site (e.g., site not accessible because of fishermen or navigation obstruction).

Results

We sampled a total of 356 points around Big Portage Lake's shoreline. Ten control sites were sampled near the center of the lake. Of the 356 shoreline sample points, 10 sites (2.8% of total) were not sampled due to difficult navigation.

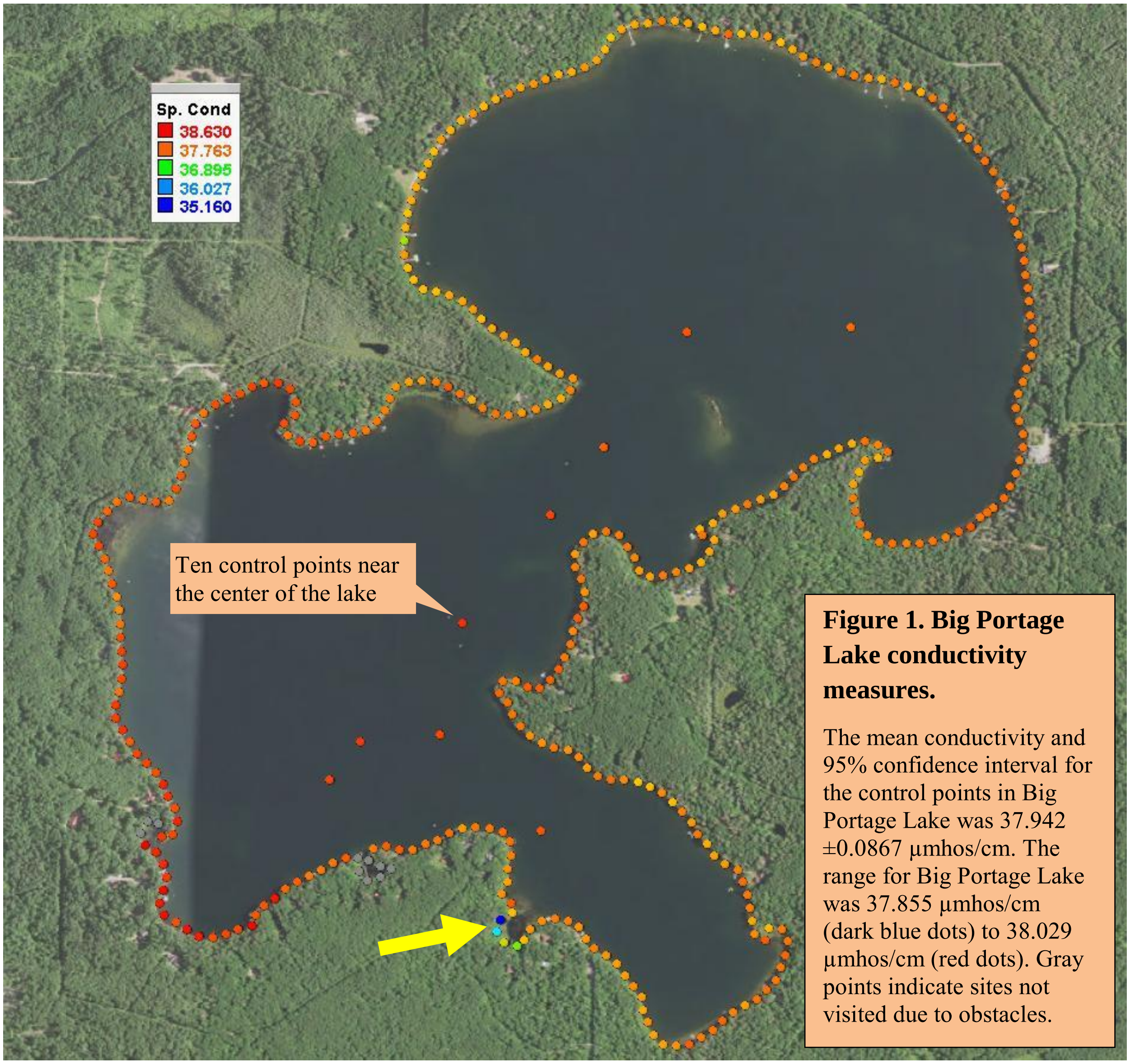


Figure 1. Big Portage Lake conductivity measures.

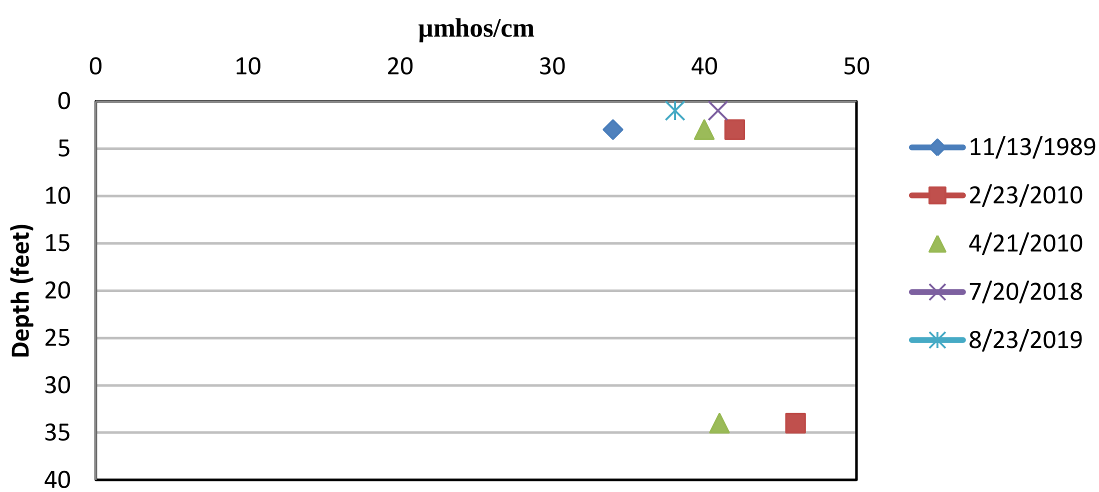
The mean conductivity and 95% confidence interval for the control points in Big Portage Lake was 37.942 ±0.0867 µmhos/cm. The range for Big Portage Lake was 37.855 µmhos/cm (dark blue dots) to 38.029 µmhos/cm (red dots). Gray points indicate sites not visited due to obstacles.

For the 346 sampled shoreline points the conductivity levels ranged from 35.16 µmhos/cm to 38.63 µmhos/cm (a narrow range of 3.470 µmhos/cm). The ten control points had a mean conductivity of 37.942 µmhos/cm (the standard deviation of these points was 0.1399 µmhos/cm). The confidence interval for the control points (at 95%) was 37.942 ±0.0867 (37.855 to 38.029 µmhos/cm). Any shoreline-sampled value that was within the range of the confidence interval was not statistically different than the control value mean. In Big Portage Lake, there were 299 sites that fell below the 95% confidence interval and 23 that were above it. Figure 1 displays the shoreline sample points of Big Portage Lake and color codes for specific conductance value. Conductivity values appear at or below the control average around most of the lake. Only a few areas of shoreline appear above the control average (the red dots on the figure indicate these points) and these sites are only slightly higher than the control average and indicate no cause for concern. These areas, however, could be observed for any other evidence of, or potential for, non-point source pollution. Such evidence includes abundant filamentous algae, usually dense riparian or aquatic vegetation, lawns mowed to the lakeshore, or impervious surfaces near the lake. One area with somewhat lower conductivity is indicated by points indicated by the yellow arrow in Figure 1 (blue, green, and yellow symbols). Again, these sites are not much lower than the mean of the control sites, but interesting nonetheless. The field biologist observed that this protected bay area had a somewhat higher density of plants and algae. Uptake of nutrients by these plants could possibly depress the conductivity. The lower conductivity readings could also result from upwelling groundwater.

Discussion

Some historic data on conductivity exists for Big Portage Lake and is displayed in Figure 2. The Big Portage Lake conductivity value was 34 µmhos/cm in November of 1989. The 2010, conductivity was analyzed in February and April with a range of 40 to 46 µmhos/cm. In 2018, the conductivity was 40.9 µmhos/cm. The 2019 White Water Associates study reported a range of conductivity values from 35.16 µmhos/cm to 38.63 µmhos/cm). All of the conductivity values from Big Portage Lake are quite low and would indicate minimal contamination is occurring.

Figure 2. Big Portage historical conductivity.



Elevated conductivity readings (higher values than those documented in the current study) can indicate human activity such as road salting, faulty septic systems, and agricultural runoff. The following are things riparian landowners can do to minimize the potential for increasing conductivity:

1. Limit soil disturbance and bedrock exposure on your property
2. Create vegetative buffers to filter and reduce the amount of storm water runoff from your property
3. Replace a conventional beach to a natural beach
4. Pump your septic system tank once every one to three years
5. Replace or upgrade a failing leach field immediately
6. Discuss alternatives to road salt use near the lake and its tributaries
7. Minimize or discontinue use of lawn fertilizers

Future conductivity studies will provide insight as to whether conductivity values in Big Portage Lake are changing over time.

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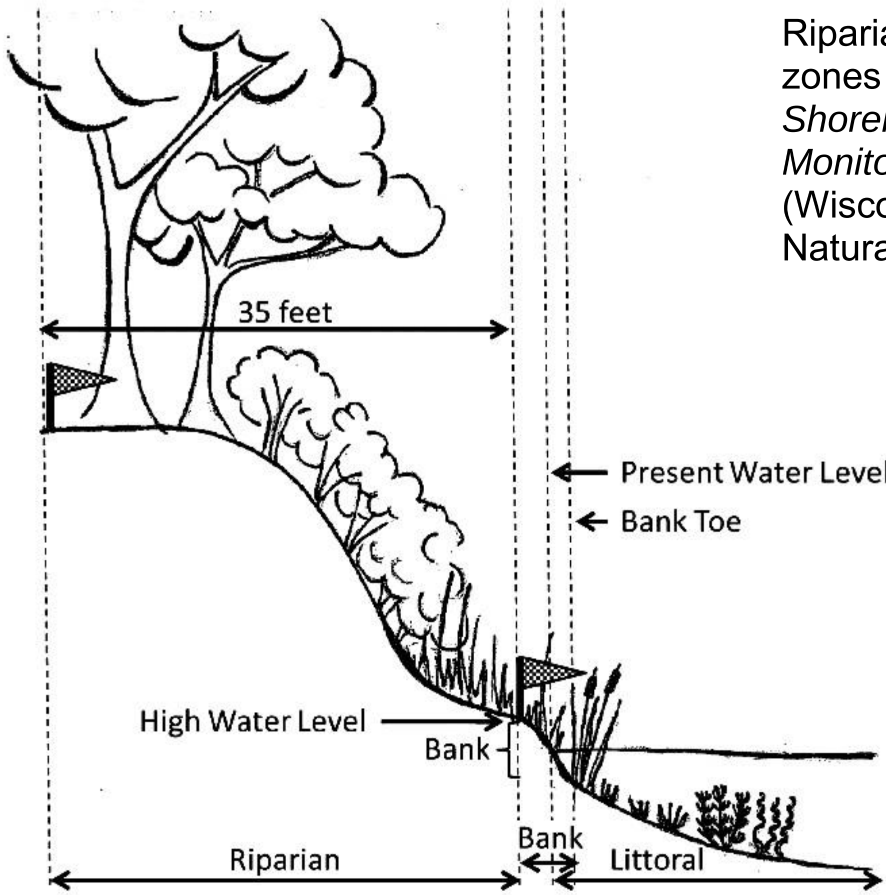
Appendix E
Big Portage Lake Shoreland and Shallows Habitat Monitoring Report

Big Portage Lake (Vilas County, Wisconsin)

Shoreland and Shallows Habitat Monitoring Report



Riparian, bank, and littoral zones covered by the *Shoreland & Shallows Habitat Monitoring Field Protocol* (Wisconsin Department of Natural Resources 2016)

White Water Associates, Inc.

Date: March 2019

INTRODUCTION

White Water Associates, Inc. is retained by the Big Portage Lake Riparian Owners Association (BPLROA). A recent Wisconsin Department of Natural Resources (WDNR) lake planning grant to the BPLROA included an assessment of the shoreland area and shallows habitat for Big Portage Lake (Vilas County, Wisconsin) by using the *Lake Shoreland and Shallows Habitat Monitoring Field Protocol* (WDNR 2016)[1]. This protocol provides a standard methodology for surveying, assessing, and mapping habitat in lakeshore areas, including the riparian buffer, bank, and littoral zone (WDNR 2016). This information will be useful to local and regional resource managers, community stakeholders, and others interested in protecting and enhancing Wisconsin's lakes and rivers (WDNR 2016).

METHODS

There are three principal components to the shoreland and shallows habitat monitoring: (1) obtain georeferenced photos of the entire lake shoreline area, (2) assess the riparian, bank, and littoral habitat by ownership parcel, and (3) count and map all pieces of large woody material in water less than 2 feet deep. In this section, we describe each of these components. The diagram on the cover page of this report identifies the riparian and littoral zones.

The photographic component of the monitoring documented shoreland habitat conditions around the lake at the time of the survey. Results may be referred to in future years (WDNR 2016). Digital photos were taken with the intent to slightly overlap, thus capturing the entire shoreline. The survey crew used the boat to circumnavigate the lake at a distance of approximately 50 feet perpendicular from shore where conditions permitted. This standardized relative position on the lake allowed the photos to include the water's edge and understory vegetation 35 feet inland. A digital camera with an internal GPS was used to capture the photos. Exhibit 1 provides an example photograph. In the laboratory, photos were processed, georeferenced, and provided as part of the data package to the WDNR.

[1] Wisconsin Department of Natural Resources. May 27, 2016. *Draft Lake Shoreland & Shallows Habitat Monitoring Field Protocol.* WDNR 2016.

Exhibit 1. Photo of the water's edge and understory vegetation on Big Portage Lake (White Water Associates, Inc., 2018)

The shoreline habitat assessment was conducted for every ownership parcel on the lake. To facilitate this effort, parcel data was obtained March 2017 via the Wisconsin Statewide Parcel Map, which can be found at https://maps.sco.wisc.edu/Parcels/. Parcel IDs and shoreline lengths were derived from these spatial data files. Parcel IDs and parcel lines, together with a "riparian buffer" line at 35 feet from the shoreline, were layered onto aerial photography maps saved as a georeferenced image file viewed on the Avenza Maps application on an Apple® iPad Pro 9.7 equipped with GPS for offline navigation. The GPS function of the iPad allowed the survey crew to know their position relative to the shoreline and specific parcels. Data sheets were prepared that included parcel ID numbers and frontage feet of each parcel (an example data sheet is shown in Exhibit 2). Exhibit 2 also shows the categories that were documented for each parcel. Back in the laboratory, data recorded on field data sheets were input to a Microsoft Office Excel spreadsheet and later conveyed to the WDNR as part of the data package to be included in a publicly available database.

The woody habitat component of the assessment was conducted on a separate circumnavigation of the lake. Before starting, a Secchi depth was measured. The protocol specifies that if the Secchi depth is less than two feet, no woody habitat survey will be conducted due to poor visibility (WDNR 2016). In addition to the Secchi depth, lake water level was documented relative to the lake's *high water level* (HWL). As the lake was circumnavigated, large wood was enumerated. The protocol defines "large wood" as wood greater than 4 inches in diameter somewhere along its length and at least 5 feet long. Eligible large wood was that which was located between the high water level and the 2 foot depth contour and the large wood section must be in the water or below the high water level. Tree "branchiness" ranking was recorded as "0" (no branches), "1" (few branches), or "2" (tree trunk with full crown). Additional details on eligible large wood are provided in the protocol document (WDNR 2016). A GPS was used to document each eligible piece of large wood. A datasheet entry corresponded to each large wood piece. An example datasheet is provided as Exhibit 3.

FINDINGS

The data and photos for the assessment of shoreland area and shallows habitat for Big Portage Lake have been delivered to the WDNR. Any user can view the results in the Wisconsin Department of Natural Resources Lakes and AIS Mapping Tool found at: https://dnr.wi.gov/lakes/viewer/. In this section we summarize a few of the data and provide some example maps that illustrate the findings from the assessment.

The assessment was conducted on June 11 and 12, 2018. At the time of the survey there were 149 ownership parcels on Big Portage Lake. The shoreline perimeter of Big Portage Lake is 6.8 miles. Exhibit 4 summarizes some of the Big Portage Lake data. Exhibits 5 through 13 provide maps of findings on Big Portage Lake. Any interested party can access the data in the database and create maps of this type or maps specific to detailed areas of shoreland and shallow water habitat.

In general, the assessment shows the shoreland and shallow water habitat of Big Portage Lake to be of high quality. There is excellent tree canopy coverage as well as shrub and herbaceous coverage. That being said, there is evidence of human influence in the riparian buffer zone and bank zone in the form of clearing, structures, and other human use. The number of large wood pieces per mile of shoreline is low.

LAKE STRATEGY

Big Portage Lake is a highly developed lake with moderate shallow water habitat and riparian area. Lake stewardship could primarily be directed toward protection of the current conditions and monitoring to detect changes over time. Although Big Portage Lake is in a mostly natural state, there are a few parcels that could undertake some restoration to ameliorate possible runoff and erosion issues. These areas can be identified by investigating the 2018 monitoring data in maps and tables in this report as well as in the WDNR database (link given previously). The Healthy Lakes program in Wisconsin provides simple, practical, and inexpensive best practices that improve habitat and water quality on lakeshore property (see https://healthylakeswi.com/ for additional information and guidance on funding projects). Big Portage Lake large woody habitat is somewhat sparse and could be augmented with the "fish sticks" best practice.

Habitat Assessment Data Sheet (one per parcel)

Date ______________ Lake name ____________________________ WBIC___________

Parcel ID__________________ Observers____

RIPARIAN BUFFER ZONE		
Percent Cover	Percent	
Canopy	☐	(0-100)
Shrub ☐ Herbaceous ☐		
Shrub/Herbaceous	☐	sum=100
Impervious surface	☐	
Manicured lawn	☐	
Agriculture	☐	
Other (e.g. duff, soil, mulch)	☐	
description:_________________________		

Human Structures	Number
Buildings	☐
Boats on shore	☐
Fire pits	☐
Other	☐
description:_________________________	

Runoff Concerns in Riparian or Entire Parcel	Present in Riparian	Present out of Riparian
Point source	☐	☐
Channelized water flow/gully	☐	☐
Stair/trail/road to lake	☐	☐
Lawn/soil sloping to lake	☐	☐
Bare soil	☐	☐
Sand/silt deposits	☐	☐
Other	☐	☐
description:_________________________		

Notes:

BANK ZONE	Length (ft)
Vertical sea wall	☐
Rip rap	☐
Other erosion control structures	☐
Artificial beach	☐
Bank erosion > 1 ft face	☐
Bank erosion < 1 ft face	☐

LITTORAL ZONE	
Human Structures	Number
Piers	☐
Boat lifts	☐
Swim rafts/water trampolines	☐
Boathouses (over water)	☐
Marinas	☐
Other	☐
description:_______________________	
Aquatic Plants	Present
Emergents	☐
Floating	☐
Plant Removal	☐

If Applicable (low water level): EXPOSED LAKE BED ZONE	
Plants	Present
Canopy	☐
Shrubs	☐
Herbaceous	☐
Disturbed	
Plants (mowed or removed)	☐
Sediment (tilled or dug)	☐

Exhibit 2. Example habitat assessment data sheet.

Exhibit 3. Coarse woody habitat inventory data sheet.

Date ______________ **Lake name** __________________________ **WBIC**___________

Observers____

Present water level is ☐ **Below** ☐ **At** ☐ **Above** **the High Water Level** **Secchi depth** ______ **ft**

ID	Branch	Touch Shore	In Water	ID	Branch	Touch Shore	In Water	ID	Branch	Touch Shore	In Water	ID	Branch	Touch Shore	In Water
1				26				51				76			
2				27				52				77			
3				28				53				78			
4				29				54				79			
5				30				55				80			
6				31				56				81			
7				32				57				82			
8				33				58				83			
9				34				59				84			
10				35				60				85			
11				36				61				86			
12				37				62				87			
13				38				63				88			
14				39				64				89			
15				40				65				90			
16				41				66				91			
17				42				67				92			
18				43				68				93			
19				44				69				94			
20				45				70				95			
21				46				71				96			
22				47				72				97			
23				48				73				98			
24				49				74				99			
25				50				75				100			

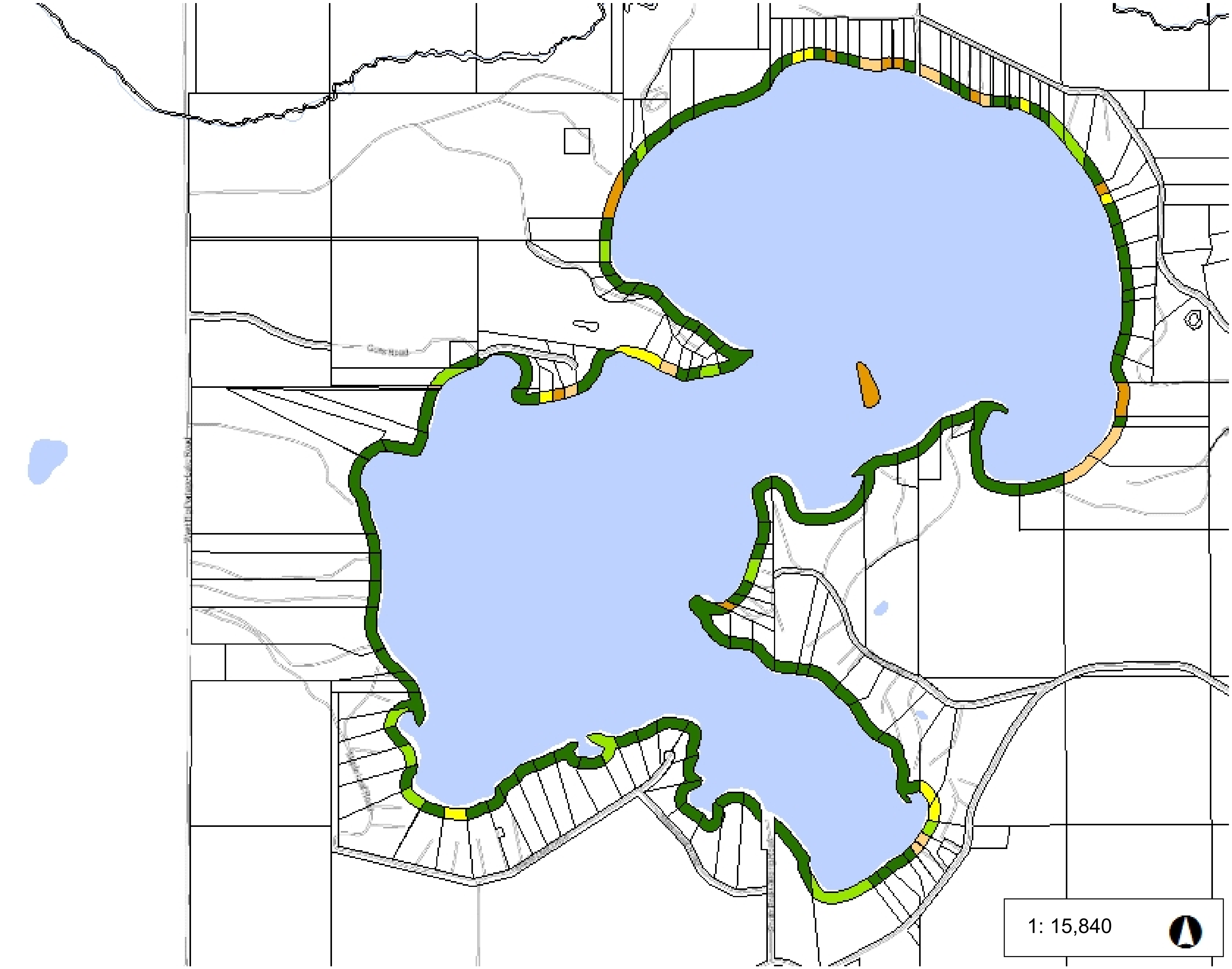
Branch: 0 = no branches, 1 = a few branches, 2 = full tree crown

Touch Shore: 0 = entirely below High Water Level (HWL), 1 = crosses HWL

In Water: 0 = less than 5 ft of log is currently underwater, 1 = at least 5 ft of log is currently underwater

Exhibit 4. Summary of shoreland and shallow water habitat for Big Portage Lake.		
Date of Survey: June 11 and 12, 2018	Miles of shoreline: 6.8	
Number of ownership parcels: 149	Mean parcel frontage feet: 241	
Riparian Buffer Zone	# of parcels	% of parcels
Impervious surfaces	70	47%
Manicured lawn	63	42%
Agriculture	1	1%
Other (duff, soil, mulch)	128	86%
Human structures (buildings, boats on shore, fire pit, other)	104	70%
Runoff concerns on the parcel (e.g., point source; channelized water flow; stair, trail, or road to lake; lawn or soil sloping to lake; bare soil; sand/silt deposits)	105	70%
Bank Zone	# of parcels	% of parcels
Concerns in the bank zone (e.g., vertical sea wall, rip rap, other erosion control structures, artificial beach, active erosion)	49	33%
Littoral Zone	# of parcels	% of parcels
Human structures in littoral zone (e.g., piers, boat lifts, swim rafts, water trampolines, boat houses over water, marinas, other)	98	66%
Emergent and/or floating aquatic plants	68	46%
Evidence of aquatic plant removal	1	1%
Large Wood Habitat		
Total Number of large wood pieces	96	
Number of large wood pieces per mile of shoreline	14.1	

Exhibit 5. Big Portage Lake Riparian Coverage - % Canopy - 2018



Legend

Percent Canopy
- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100

Shoreland Parcels
County Boundary
Municipality
State Boundaries
County Boundaries
Major Roads
- Interstate Highway
- State Highway
- US Highway

County and Local Roads
- County HWY
- Local Road

Railroads
Tribal Lands
Rivers and Streams
Intermittent Streams
Open Water
Great Lakes

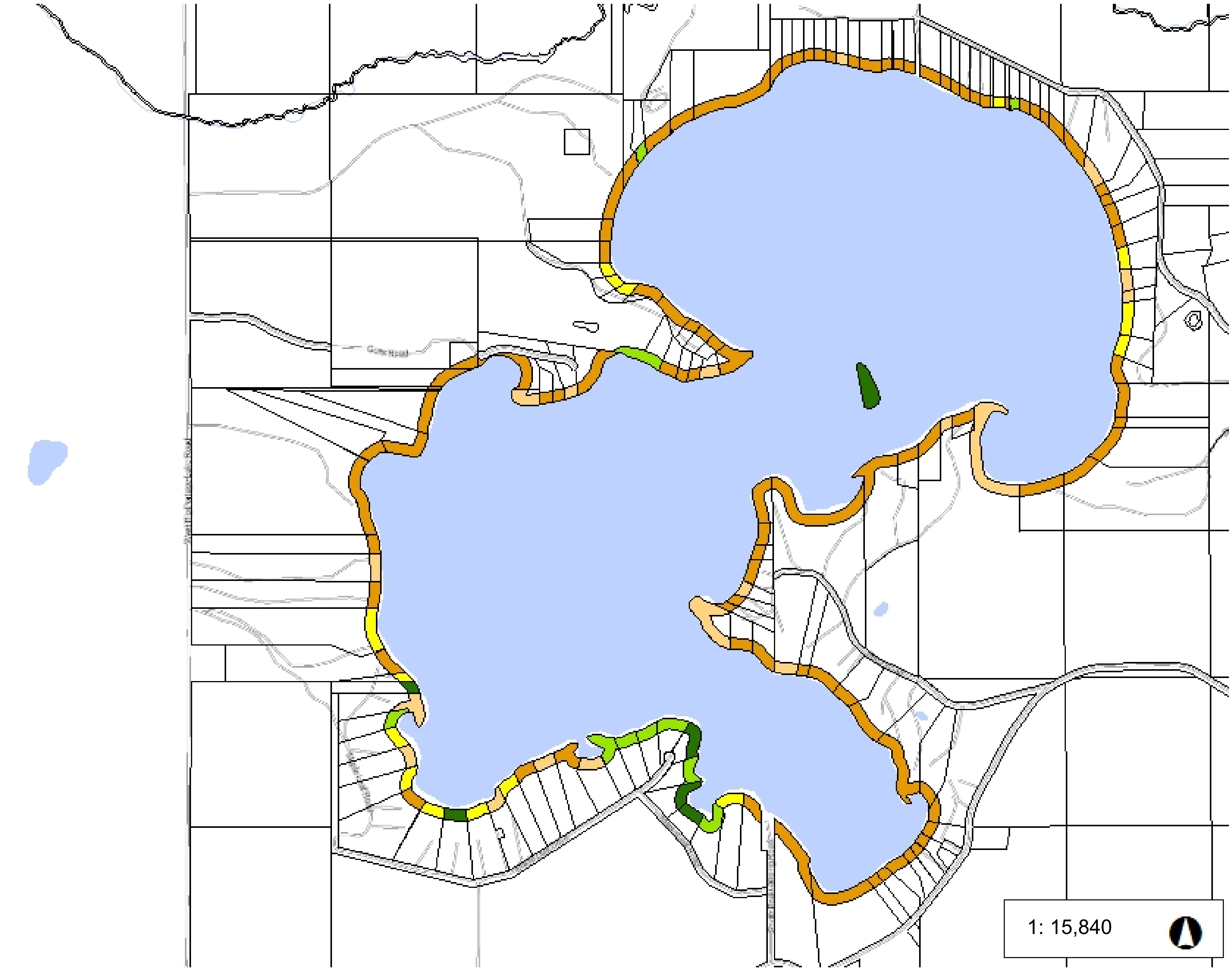
1: 15,840

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 6. Big Portage Lake Riparian Coverage - % Shrub Herbaceous - 2018



Legend

Percent Shrub Herbaceous

- 0 - 20
- 21 - 40
- 41 - 60
- 61 - 80
- 81 - 100

Shoreland Parcels

County Boundary

Municipality

State Boundaries

County Boundaries

Major Roads

- Interstate Highway
- State Highway
- US Highway

County and Local Roads

- County HWY
- Local Road

Railroads

Tribal Lands

Rivers and Streams

Intermittent Streams

Open Water

Great Lakes

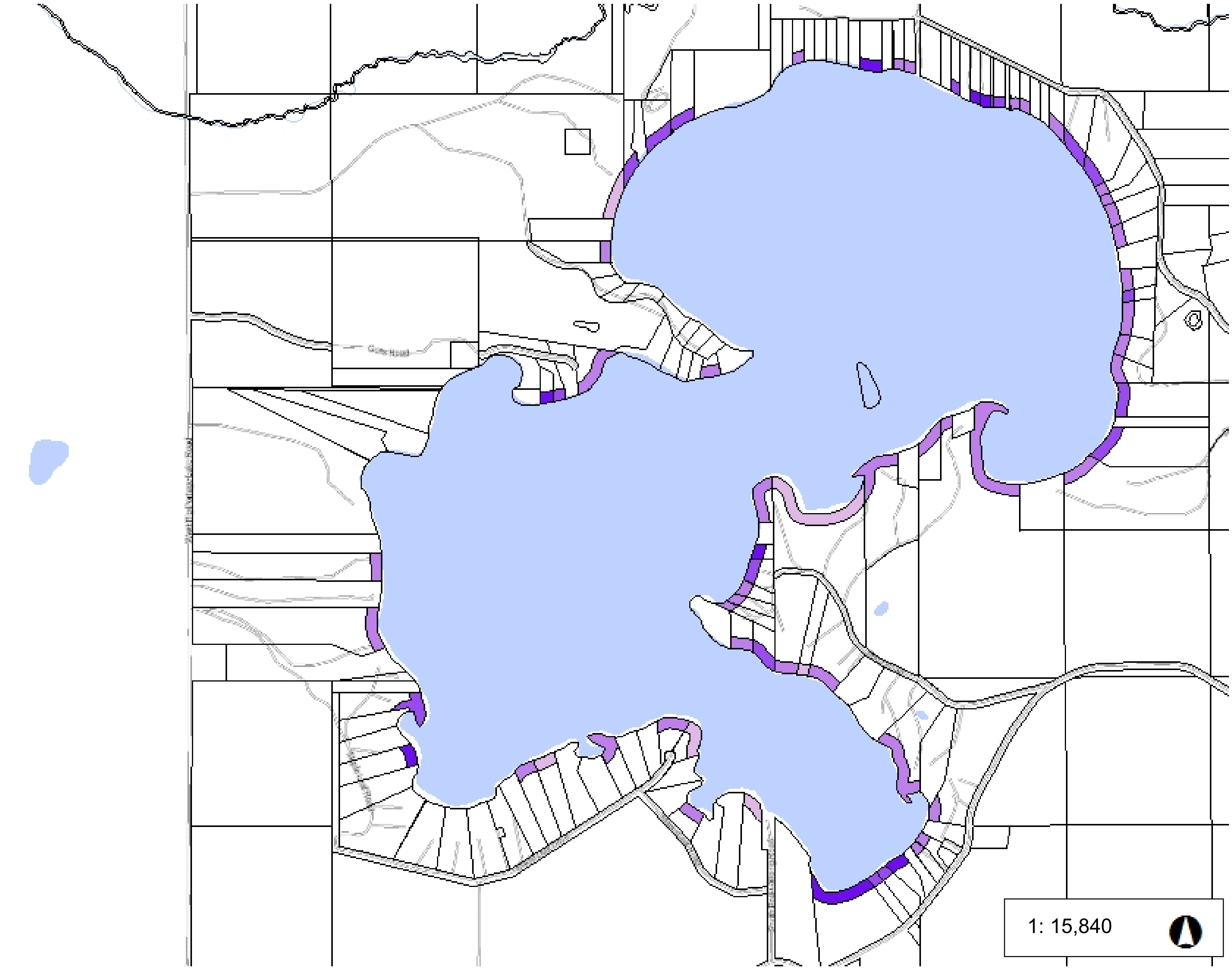
1: 15,840

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 7. Big Portage Lake Riparian Coverage - % Impervious - 2018



Legend

Percent Impervious
- 1 - 5
- 6 - 15
- 16 - 35
- 36 - 100

Shoreland Parcels
County Boundary
Municipality
State Boundaries
County Boundaries
Major Roads
- Interstate Highway
- State Highway
- US Highway

County and Local Roads
- County HWY
- Local Road

Railroads
Tribal Lands
Rivers and Streams
Intermittent Streams
Open Water
Great Lakes

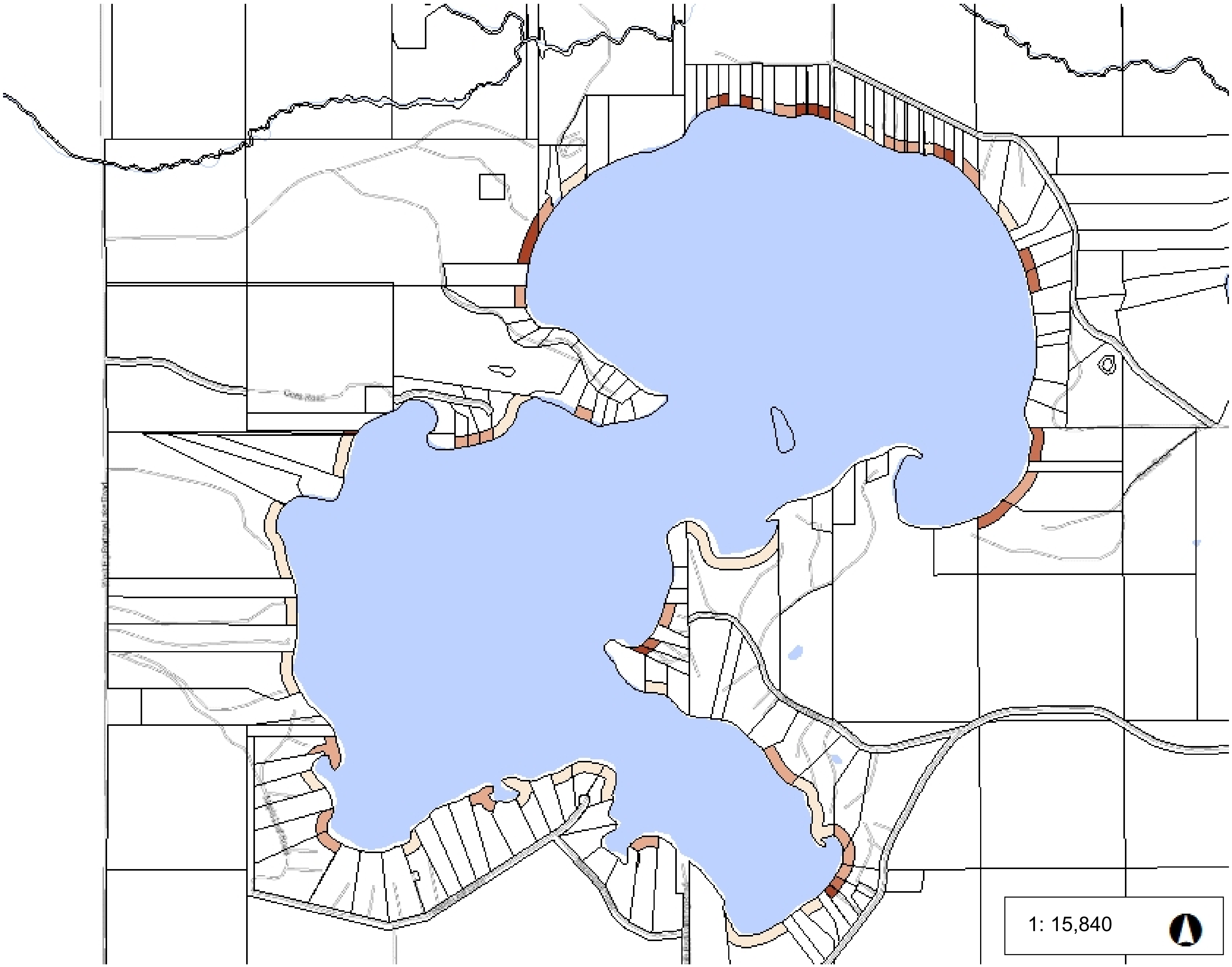
1: 15,840

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 8. Big Portage Riparian Coverage- % Manicured Lawn- 2018



Legend

Percent Manicured Lawn
- 1 - 25
- 26 - 50
- 51 - 75
- 76 - 100

- Shoreland Parcels
- Municipality
- State Boundaries
- County Boundaries

Major Roads
- Interstate Highway
- State Highway
- US Highway

County and Local Roads
- County HWY
- Local Road

- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Open Water
- Great Lakes

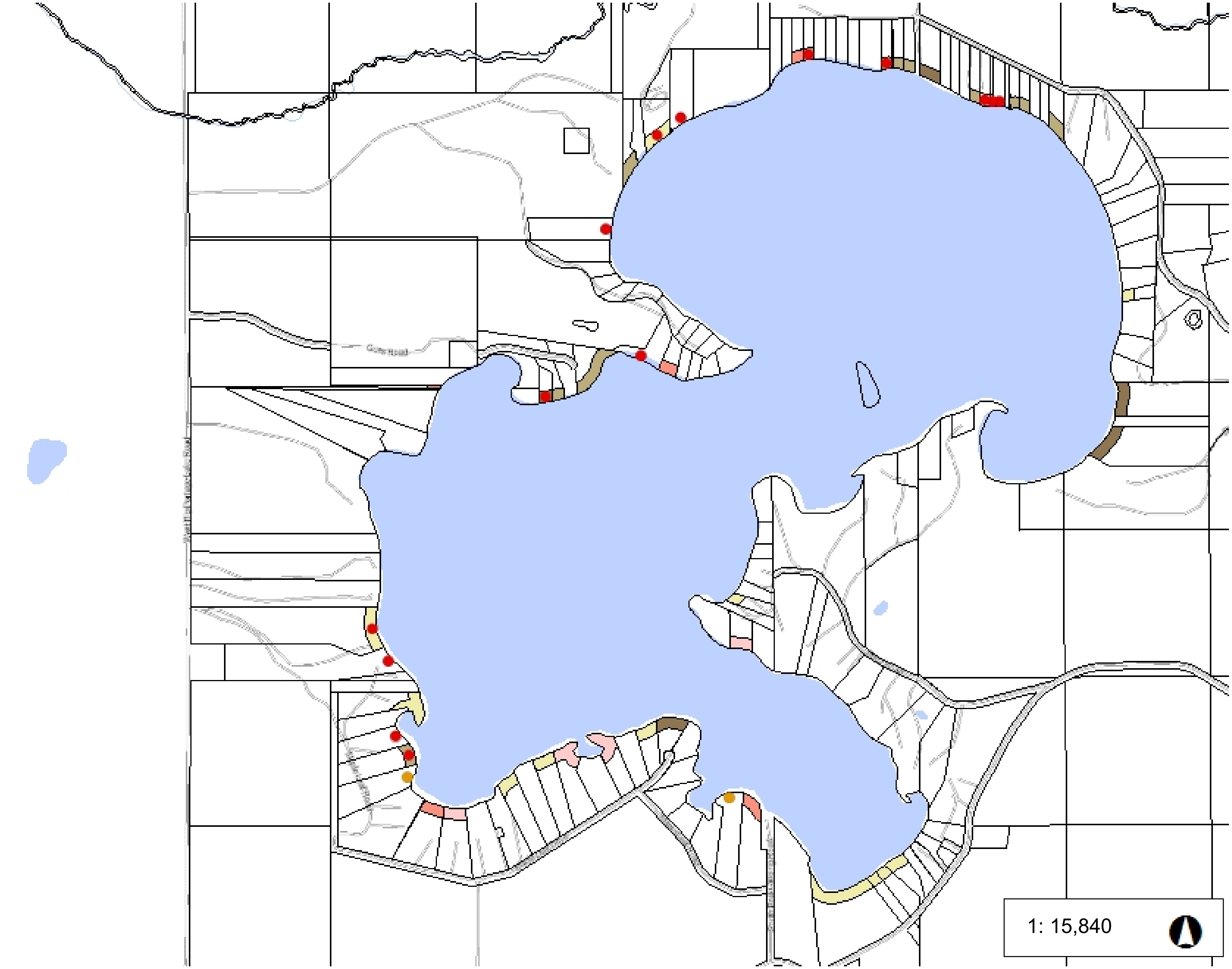
1: 15,840

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 9. Big Portage Lake Bank Erosion and Modifications - 2018



Legend

- Bank Erosion >1ft
- Bank Erosion <1ft

Vertical Sea Wall
- 1 - 50 ft
- 51 - 100 ft
- 101 - 200 ft
- 200 + ft

Rip Rap
- 1 - 50 ft
- 51 - 100 ft
- 101 - 200 ft
- 200+ ft

Other Bank Modifications
- 10 - 50 ft
- 51 - 100 ft
- 101 - 200 ft
- 200+ ft

Artificial Beach
- 0 - 50 ft
- 51 - 100 ft
- 101 - 200 ft
- 200+ ft

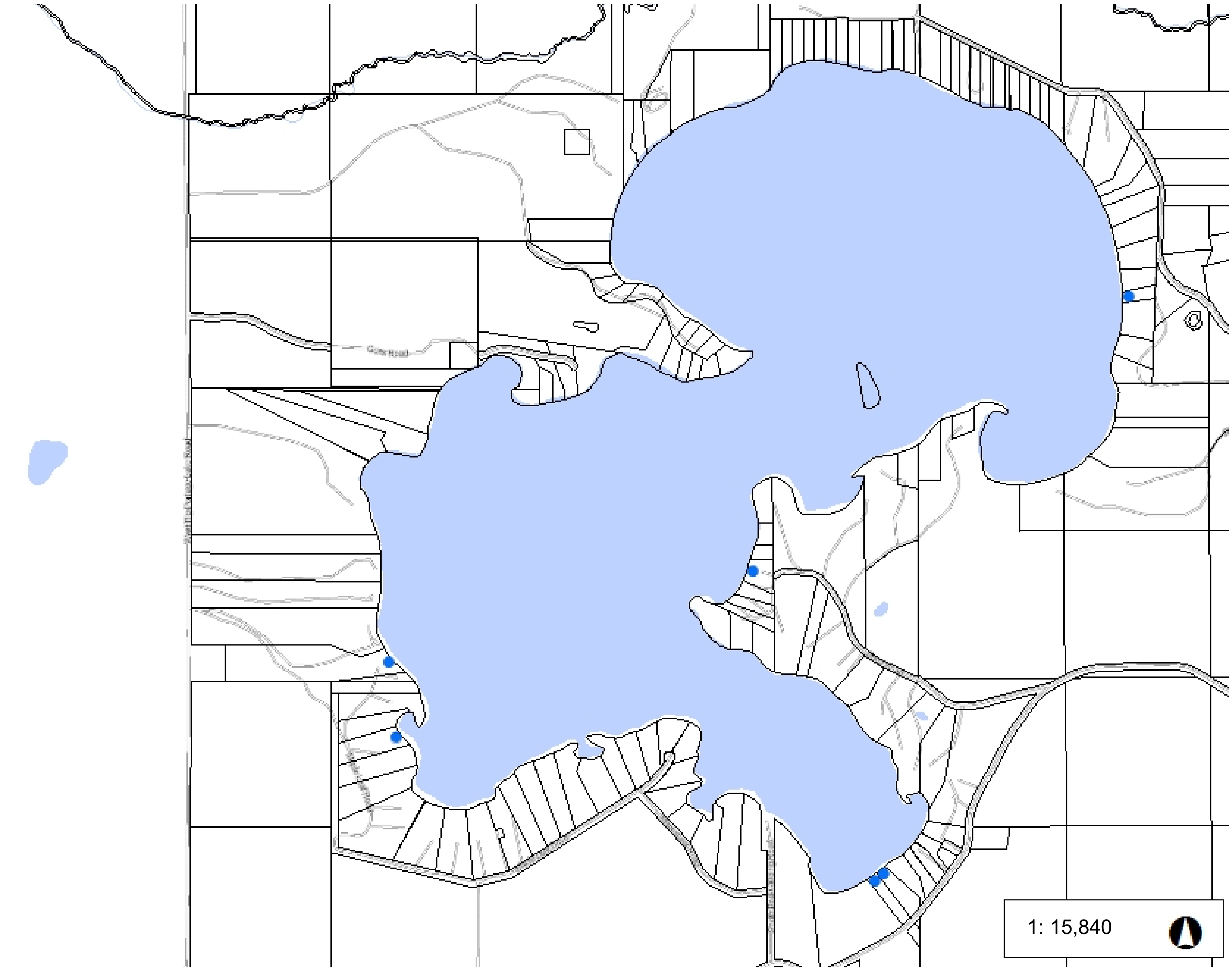
- Shoreland Parcels
- County Boundary
- Municipality
- State Boundaries

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 10. Big Portage Lake Runoff Concerns - 2018



Legend

- Channelized Flow
- Point Source
- Shoreland Parcels
- County Boundary
- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Open Water
- Great Lakes

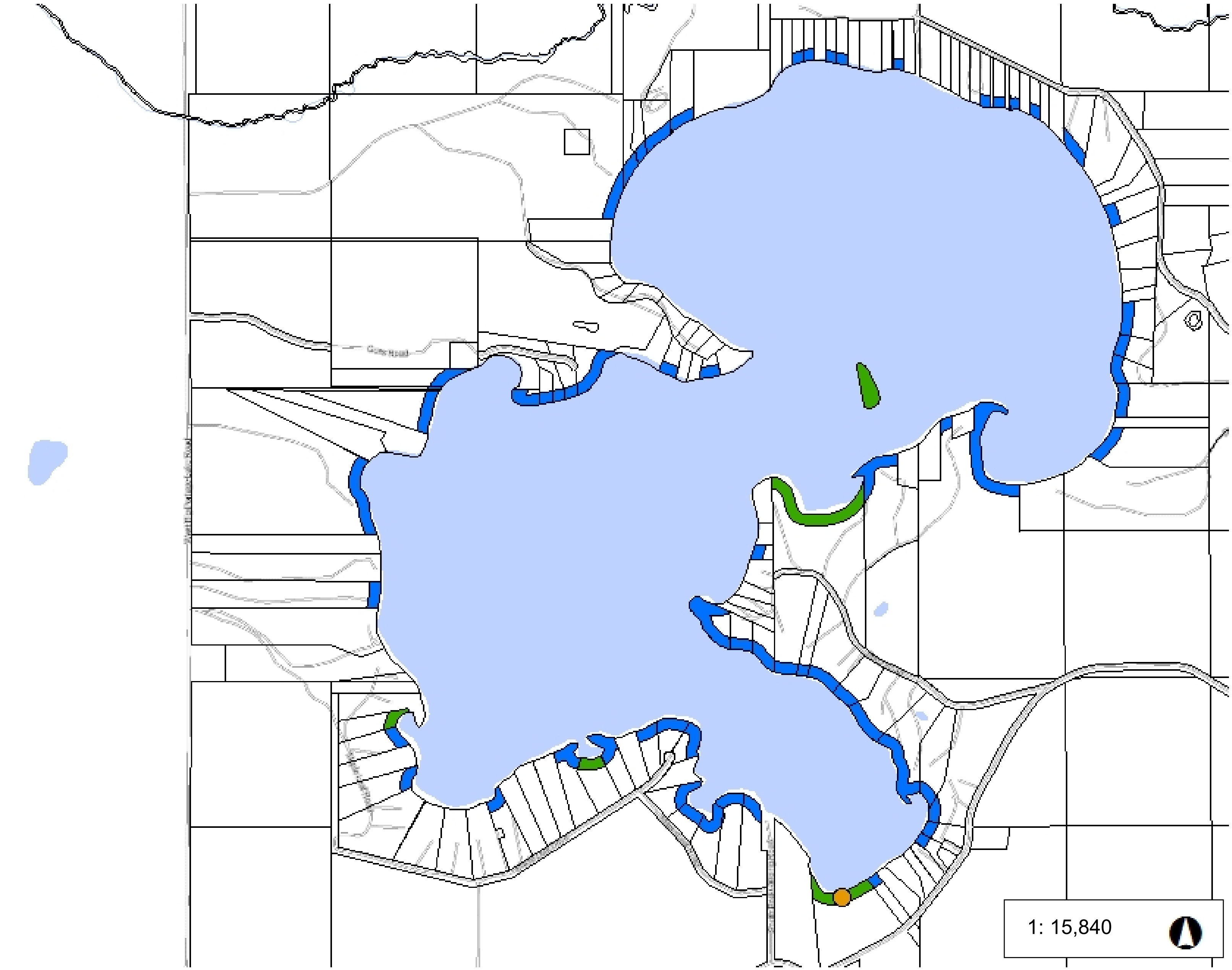
1: 15,840

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 11. Big Portage Lake Littoral Zone - Aquatic Plants - 2018



Legend

- Aquatic Plant Removal
- Floating & Emergent Plants
- Emergent Plants
- Floating Plants
- Shoreland Parcels
- County Boundary
- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Open Water
- Great Lakes

1: 15,840

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 12. Big Portage Lake Littoral Zone - Human Structures - 2018

Legend

Swim Rafts
- 1
- 2
- 3 - 5
- 6+

Boat Lifts
- 1
- 2
- 3 - 5
- 6+

Piers
- 1
- 2
- 3 - 5
- 6+

Boat Houses
- 1
- 2
- 3 - 5
- 6+

Marinas
- 1
- 2
- 3 - 5
- 6+

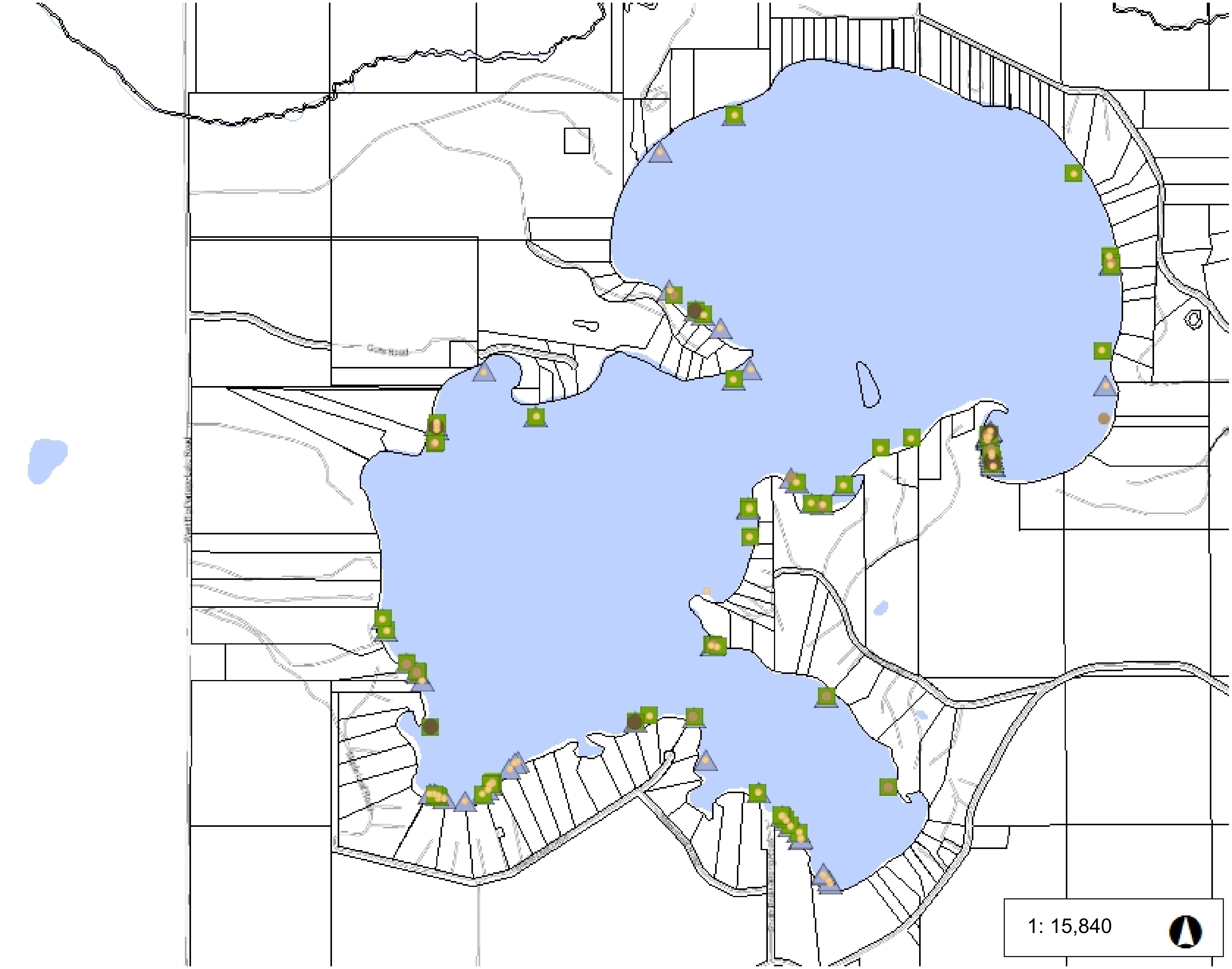
Shoreland Parcels

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Exhibit 13. Big Portage Lake Woody Habitat - 2018



Legend

WH Branchiness
No branches
Few branches
Full tree crown
WH Touching Shore
WH In Water
Shoreland Parcels
County Boundary
Municipality
State Boundaries
County Boundaries
Major Roads
Interstate Highway
State Highway
US Highway
County and Local Roads
County HWY
Local Road
Railroads
Tribal Lands
Rivers and Streams
Intermittent Streams
Open Water
Great Lakes

Notes

0.5 0 0.25 0.5 Miles

NAD_1983_HARN_Wisconsin_TM

Appendix F
Big Portage Lake Fisheries Report

Big Portage Lake, Vilas County - Fisheries Summary

Prepared by Angie Stine, White Water Associates, March 2020

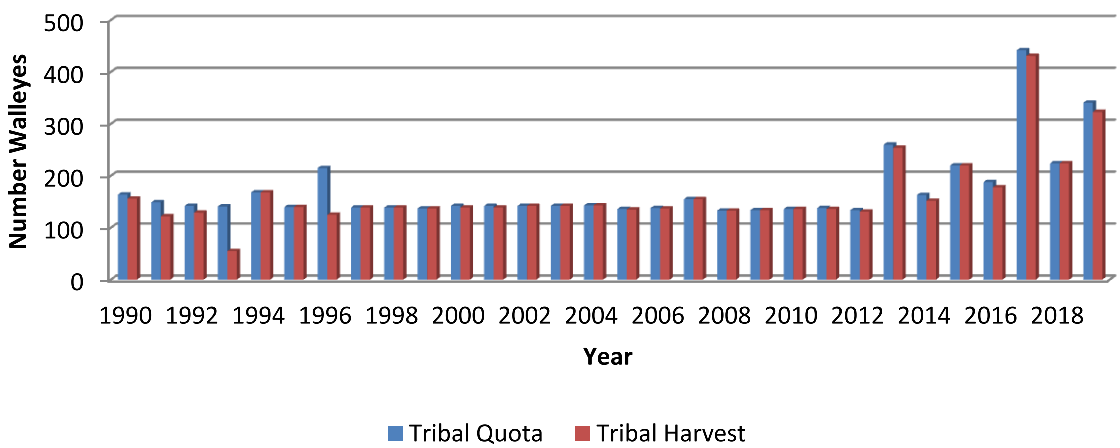
Big Portage Lake, Vilas County is a 586 acre lake with a max depth of 40 feet. There is 70% sand, 15% gravel, 15% rock, and 0% muck. It is classified as a seepage lake and is mesotrophic. Fish species present in the fishery are largemouth bass, smallmouth bass, yellow perch, rock bass, and walleye. Numerous fisheries surveys have been conducted on Big Portage Lake. The last time any species of fish were stocked was in 1975 with 24,000 walleye fingerlings. The lake has excellent natural reproduction of all species present according to the WDNR (Gilbert, 2019). Creel surveys were conducted in 1992, 2006, and 2016 and show a fairly stable fishery. Gilbert (2019) states that the WDNR management goals for Big Portage Lake are to maintain an abundant and naturally reproducing walleye fishery with moderate harvest opportunity and to protect the low density but high quality bass fishery with trophy potential. He also states there was a habitat survey and report in 2002 that indicated a paucity of woody structure in the lake. Gilbert (2019) suggests tree drops and half logs for bass would be helpful in managing this species. Gilbert has worked with the Big Portage Lake Riparian Owners Association (BPLROA) in selecting sites and permitting of this in the past.

A panfish population assessment was conducted on Big Portage Lake, Vilas County by Aqua Tech USA, LLC on June 5 through the 8th of 2014. Exhibit 1 shows the results of this assessment. There is a low-density panfish population but with high quality size structure. Big Portage Lake has little vegetative and woody cover to support a high density population. It was recommended that Big Portage Lake continue the Fish Stix Program.

Exhibit 1. Big Portage Lake (2014) Catch Per Effort (#fish/net lift*) (Aqua Tech, 2014).	
Bluegill	0.03
Pumpkinseed	0.01
Yellow Perch	1.1
Rock Bass	12.8
Total fish/net lift	14.3
	**Total number of net lifts = 24*

The Wisconsin Department of Natural Resources 2016-2017 Ceded Territory Fishery Assessment Report included Big Portage Lake. The report by Thomas A. Cichosz can be found on the BPLROA website. Wisconsin DNR gathers data from a representative sample of lakes throughout the Ceded Territory each year in order to assess abundance and stability of walleye populations (Cichosz, 2018). The DNR uses three methods: spring adult and total population estimates, fall age-0 (young-of-year) relative abundance estimates, and creel surveys of angler catch and harvest (Cichosz, 2018). When combined, these methods provide information on the current harvestable population, and indication of the future harvestable population, and the degree of exploitation in the walleye fishery (Cichosz, 2018). The DNR also conducts muskellunge population estimates. These estimates described above are important to the management of Ceded Territory fisheries. Accurate population estimates allow calculation of "safe harvest" levels (Cichosz, 2018). Results for Big Portage Lake can be found in Exhibit 2 displays the annual spearing numbers of walleye on Big Portage Lake from 1990 to 2019.

Exhibit 2. Annual spearing numbers for walleye, Big Portage Lake.



The Wisconsin DNR surveyed Big Portage Lake from April 22 through June 8, 2016 in order to assess the status of the walleye and smallmouth bass populations. Big Portage Lake's walleye and smallmouth bass populations are sustained entirely through natural production (WDNR, 2016). There were 3,244 adult walleye (5.1/acre). An estimated 44% were 15 inches long or larger. This report is also located on the BPLROA website.

There were 187 smallmouth bass eight inches or larger captured. Of those captured 87% were 14 inches long or larger, with the largest measuring 19.9 inches (Gilbert, 2016). The smallmouth bass population in Big Portage Lake (eight inches or larger) was estimated to be 307 fish (0.5/acre) (Gilbert, 2016).

There were 32 adult northern pike captured, all but one (97%) were less than 26 inches long. The largest was 35.2 inch female (Gilbert, 2016).

Length distributions for walleye, northern pike, smallmouth bass, and largemouth bass can be found in the report.

Creel surveys provide vital information about the use of fisheries by recreational anglers, including angling effort, catch and harvest (Cichosz, 2018). The most recent Creel Survey was conducted on Big Portage Lake in 2016-17. The last one was conducted in 2006-07. Anglers spent 8,143 hours, or 12.8 hours per acre, fishing Big Portage Lake during the 2016-17 seasons. They interviewed 402 people. In this document you will find estimated fishing effort, estimated specific catch and harvest rate, estimated catch and harvest, length distribution of harvested fish, and largest and average length of harvested fish. The results are organized by fish species. May was the most heavily fished month (1,618 hours). Walleyes received the most fishing effort. Anglers spent 6,010 hours targeting walleye (Blonski, et al. 2016-17).

There is a brief fishery summary on the Big Portage Lake website under fishery along with links to the most current fisheries reports (www.bigportagelake.org/pdfs/fishery.pdf). Big Portage Lake Riparian Owners Association also creates a newsletter called *Shoreline News* with up to date fisheries information that can be found on the website.

Resources

Aqua Tech USA, LLC. 2014. *Panfish Population Assessment, Big Portage Lake, Vilas County*. Aqua Tech USA, LLC. Park Falls, WI.

Blonski, Jeff and Jason Halverson. 2016-17. *Wisconsin Department of Natural Resources Creel Survey Report, Big Portage Lake, Vilas County.* Treaty Fisheries Publication. 2016-17.

Cichosz, Thomas A. March 2018. *Wisconsin Department of Natural Resources 2016-2017 Ceded Territory Fishery Assessment Report.* Treaty Fisheries Assessment Unit. Bureau of Fisheries Management. Madison, Wisconsin.

Gilbert, Steve. 2016. *Big Portage Lake Wisconsin Fisheries Information Sheet*. Wisconsin Department of Natural Resources. 2016.

Gilbert, Steve. April 2019. *Email Correspondence*. Wisconsin Department of Natural Resources. Rhinelander, Wisconsin.

Appendix G
Big Portage Lake Frog and Toad Survey

Big Portage Lake Stewardship Program
Frog & Toad Survey


Northern Spring Peeper
(*Pseudacris crucifer*)
Photo by Dean Premo

This document is a product of a WDNR Lake Planning Grant awarded to:

Big Portage Lake Riparian Owners Association (BPLROA)
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Submitted to:
Wisconsin Department of Natural Resources
Attention: Kevin Gauthier, Lake Coordinator
107 Sutliff Avenue
Rhinelander, Wisconsin 54501
Phone: 715-365-8937

Prepared by:
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Date: March 2020

Photos by Dean Premo

Introduction

A component of the Big Portage Lake Stewardship Program was to establish a volunteer frog and toad survey. Frogs and toads are sensitive to environmental changes and good indicators of ecosystem health. Monitoring frogs and toads in the Big Portage Lake landscape establishes a baseline to measure watershed health. Decline of amphibian populations in many areas in North America has prompted local monitoring programs and many states (including Wisconsin) have developed survey protocols for this purpose. This report documents the methods and findings for the frog and toad monitoring around Big Portage Lake (Vilas County).

Methods

We generally followed the Wisconsin Frog and Toad Survey Manual[1] for site selection and field methodology. Big Portage Lake stewardship volunteers Mark and Elizabeth Schermeister selected ten lakeshore sites on the Big Portage Lake as frog and toad survey stops. The sites selected for monitoring are shown in Exhibit 1 and further described in the site summary exhibits at the end of this report.

A field team of comprised of Mark and Elizabeth Schermeister volunteered for the "swing-shift" duty of surveying for frogs and toads (monitoring typically starts after dark and may go late into the night). The volunteers were provided instruction by Dean Premo along with recordings of frog calls from which to study. *First run*, *second run*, and *third run* dates are typically established in an attempt to capture the breeding phenology (seasonal timing) of all frog and toad species potentially present in the area. Because of summer scheduling, the field team was able only to survey for the later season ("Third Run") survey bouts in 2018. The monitoring was conducted under weather conditions conducive to frog/toad activity and to hearing the breeding males vocalize.

[1] Paloski, R.A. T.L.E. Bergeson, M. Mossman, and R. Hay (eds). 2006. Wisconsin Frog and Toad Survey Manual PUB-ER-649. Bureau of Endangered Resources, Wisconsin Department of Natural Resources, Madison, WI. 25 pp.

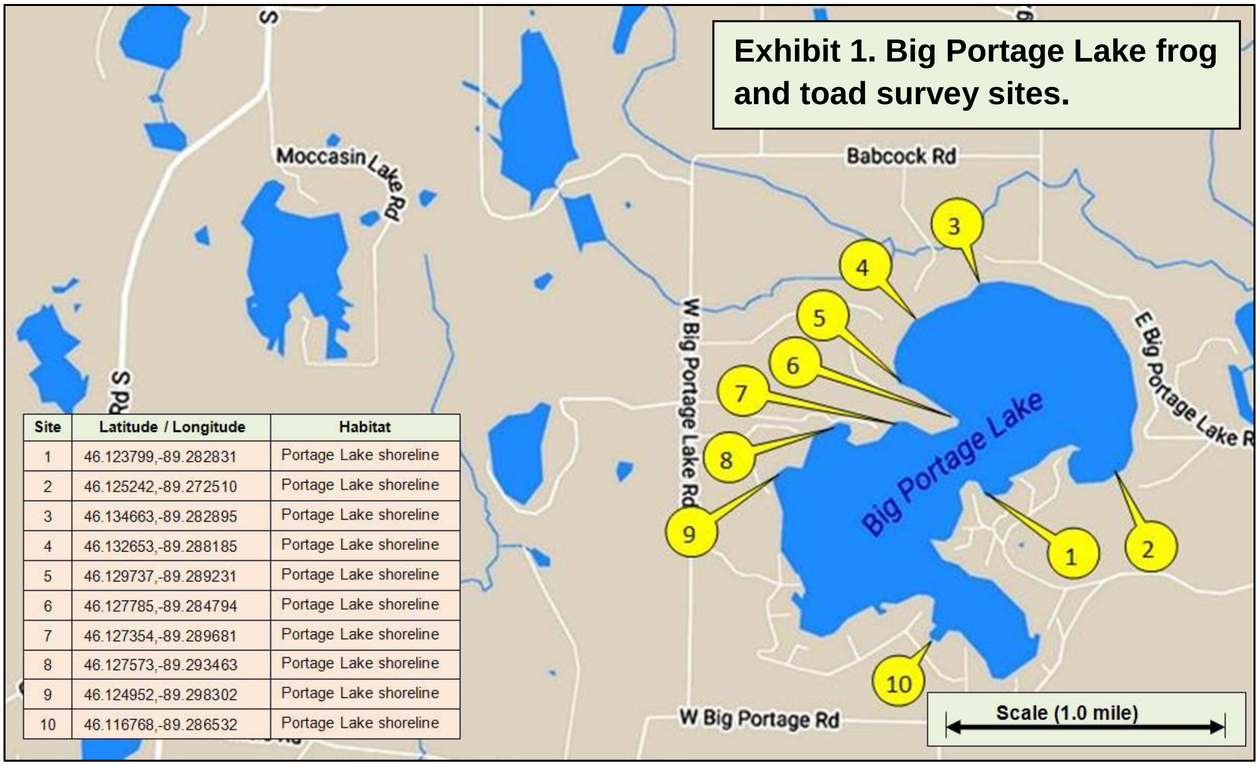


Exhibit 1. Big Portage Lake frog and toad survey sites.

Site	Latitude / Longitude	Habitat
1	46.123799,-89.282831	Portage Lake shoreline
2	46.125242,-89.272510	Portage Lake shoreline
3	46.134663,-89.282895	Portage Lake shoreline
4	46.132653,-89.288185	Portage Lake shoreline
5	46.129737,-89.289231	Portage Lake shoreline
6	46.127785,-89.284794	Portage Lake shoreline
7	46.127354,-89.289681	Portage Lake shoreline
8	46.127573,-89.293463	Portage Lake shoreline
9	46.124952,-89.298302	Portage Lake shoreline
10	46.116768,-89.286532	Portage Lake shoreline

According to range maps in the scientific literature and the Frog and Toad Survey Manual, nine anuran (frogs and toads) species have been documented in Vilas County. Exhibit 2 provides this list. These species are the most likely anurans to be heard in the Big Portage Lake landscape. The Big Portage Lake volunteers became familiar with the vocalizations of these species.

Exhibit 2. Vilas County Frogs and Toads (Anurans).

Anurans for which Vilas County Records Exist

1. Eastern American Toad (*Bufo americanus*)
2. Western Chorus Frog (*Pseudacris triseriata*)
3. Northern Spring Peeper (*Pseudacris crucifer*)
4. Gray Treefrog (*Hyla versicolor*)
5. Bullfrog (*Lithobates catesbeiana*)*
6. Green Frog (*Lithobates clamitans*)
7. Wood Frog (*Lithobates sylvatica*)
8. Northern Leopard Frog (*Lithobates pipiens*)*
9. Mink Frog (*Lithobates septentrionalis*)*

***** *Wisconsin's Natural Heritage Inventory current working list designates this species as SC/H=special concern/take regulated by establishment of open closed seasons*
Note: *Hyla chrysoscelis* has not been documented in Vilas or adjacent counties.

Results

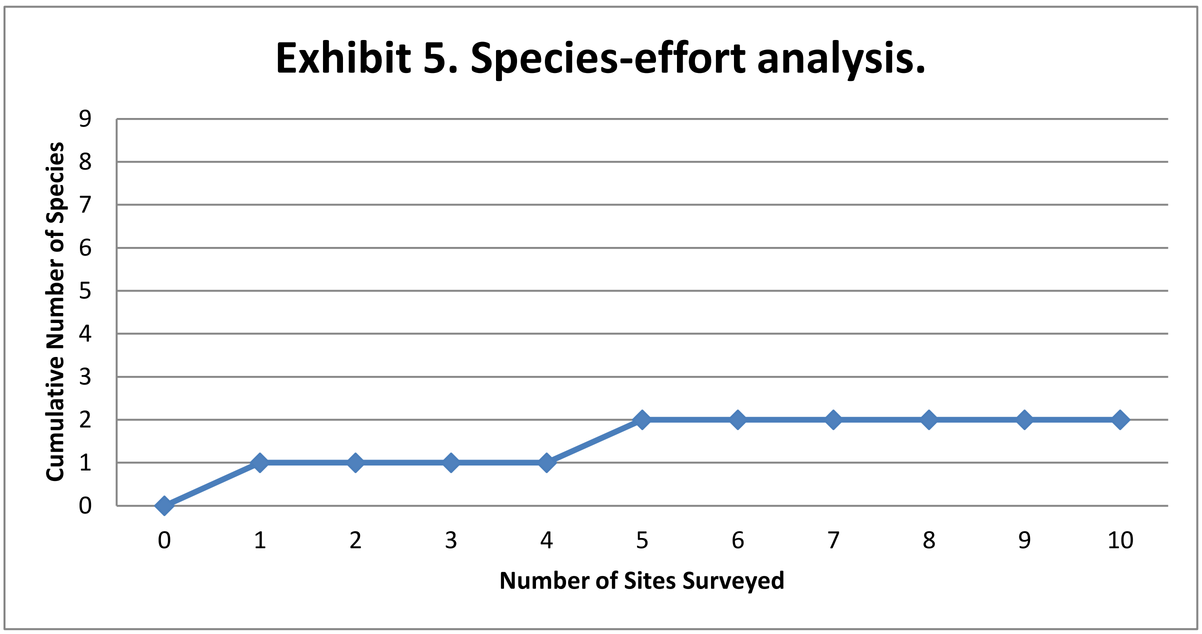
Because all of the sampling sites were shoreline sites on Big Portage Lake, the habitat diversity sampled in this survey was quite low. A total of two anuran species were detected during the auditory 2018 surveys. The species detected are listed in Exhibit 3. The Green Frog was the most widely distributed, occurring at nine of the ten monitoring sites. Spring Peepers occurred at only one survey site. It is likely that a greater diversity of species occur in the Big Portage Lake landscape than is reflected in the lakeshore survey. Surveying only in the "third run" was likely also a factor in the lower number of species represented in the sampling.

Exhibit 3. Anuran species detected in the Big Portage Lake Watershed	
Anuran Species	Number of Sites Detected in 2018
Northern Spring Peeper (*Pseudacris crucifer*)	1
Green Frog (*Lithobates clamitans*)	9

Exhibit 4 displays the species detected at each of the ten study sites in 2018. Eight sites had Green Frog only and one site had both Green Frog and Northern Spring Peeper present. No frog and toad species were documented at Site 6.

Exhibit 4. Anuran species recorded at Big Portage Lake study sites in 2018.			
Site	**Total Species**	**Spring Peeper**	**Bullfrog**
1	1		+
2	1		+
3	2	+	+
4	1		+
5	1		+
6	0		
7	1		+
8	1		+
9	1		+
10	1		+

As a measure of survey thoroughness, we present an analysis of species detected and effort expended (as measured by the number of sites surveyed). Exhibit 5 shows a graph of cumulative number of species plotted against number of sites visited. The actual site numbers were randomly arranged for this analysis. The curve levels off after five sites, indicating the number of sites was likely adequate to detect the species diversity present in the Big Portage Lake shoreline habitat. We express the caveat, however, that had earlier season runs been part of this survey it is likely that at least two additional species (American Toad and Northern Leopard Frog) would have been added to the list of species detected. Perhaps future surveys can plug in these seasonal gaps in the data.



The ten monitoring sites are described in Exhibits 6-15. These exhibits include the location of each site, an aerial photo, a description of the habitat, and a list of species detected during in 2018.

Site Number: 1 Big Portage Lake Shoreline

Coordinates: 46.123799,-89.282831

Habitat: Permanent water, lake shoreline.

Species detected: Green frog

Exhibit 6. Big Portage Lake Frog and Toad Survey Site Summary

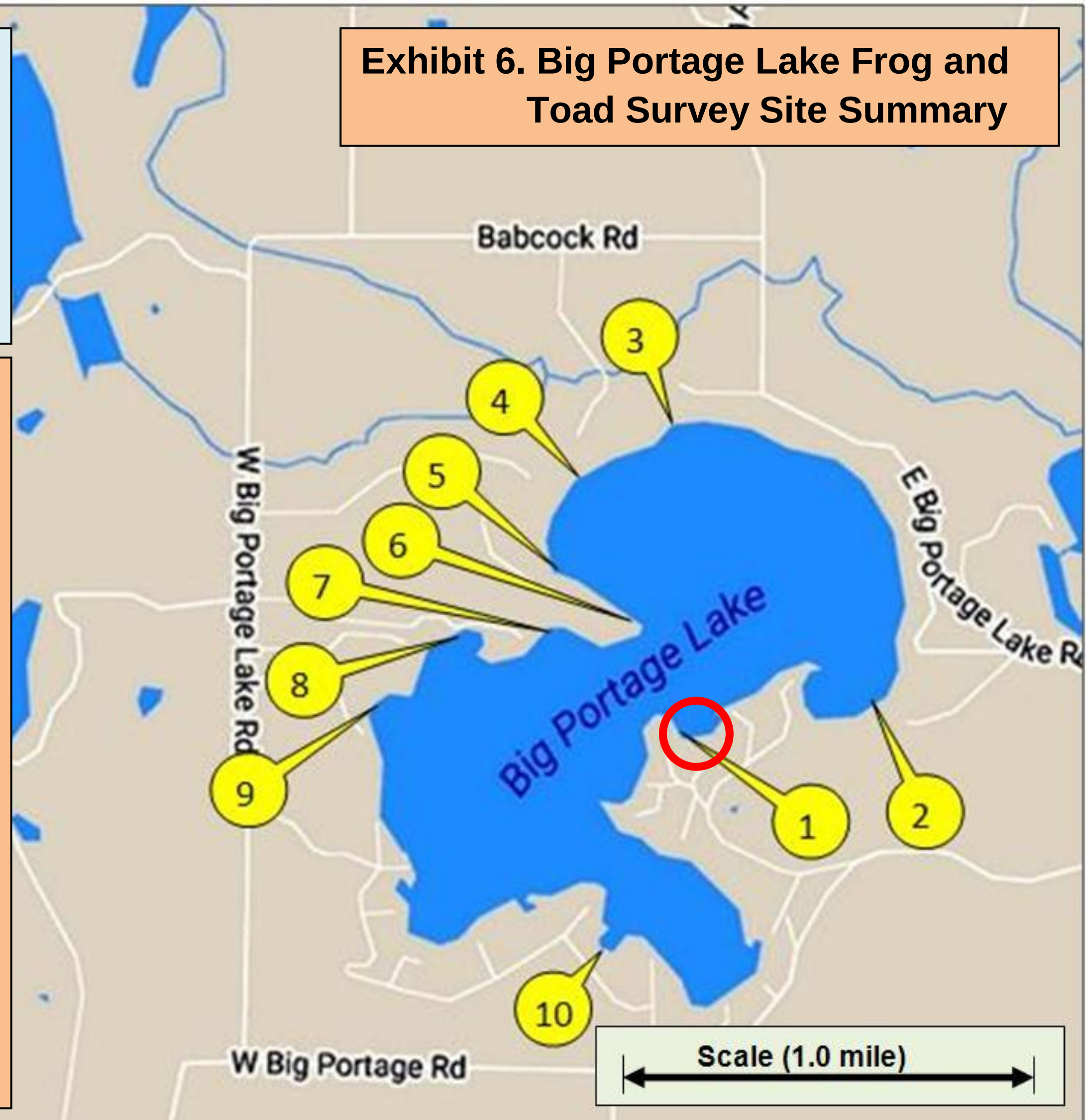


Exhibit 7. Big Portage Lake Frog and Toad Survey Site Summary

Site Number: 2 Big Portage Lake Shoreline

Coordinates: 46.125242,-89.272510

Habitat: Permanent water, lake shoreline.

Species detected: Green frog

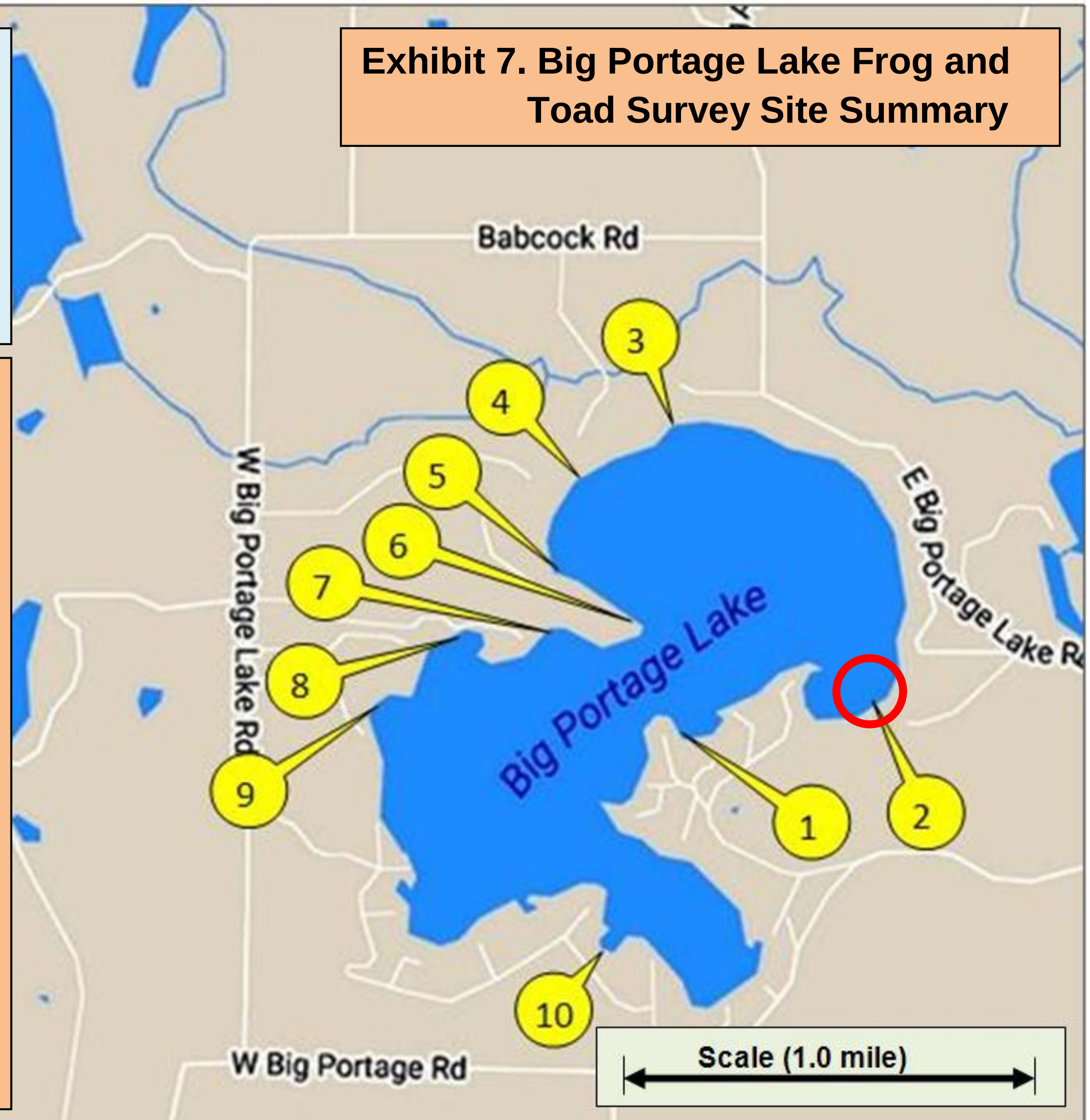


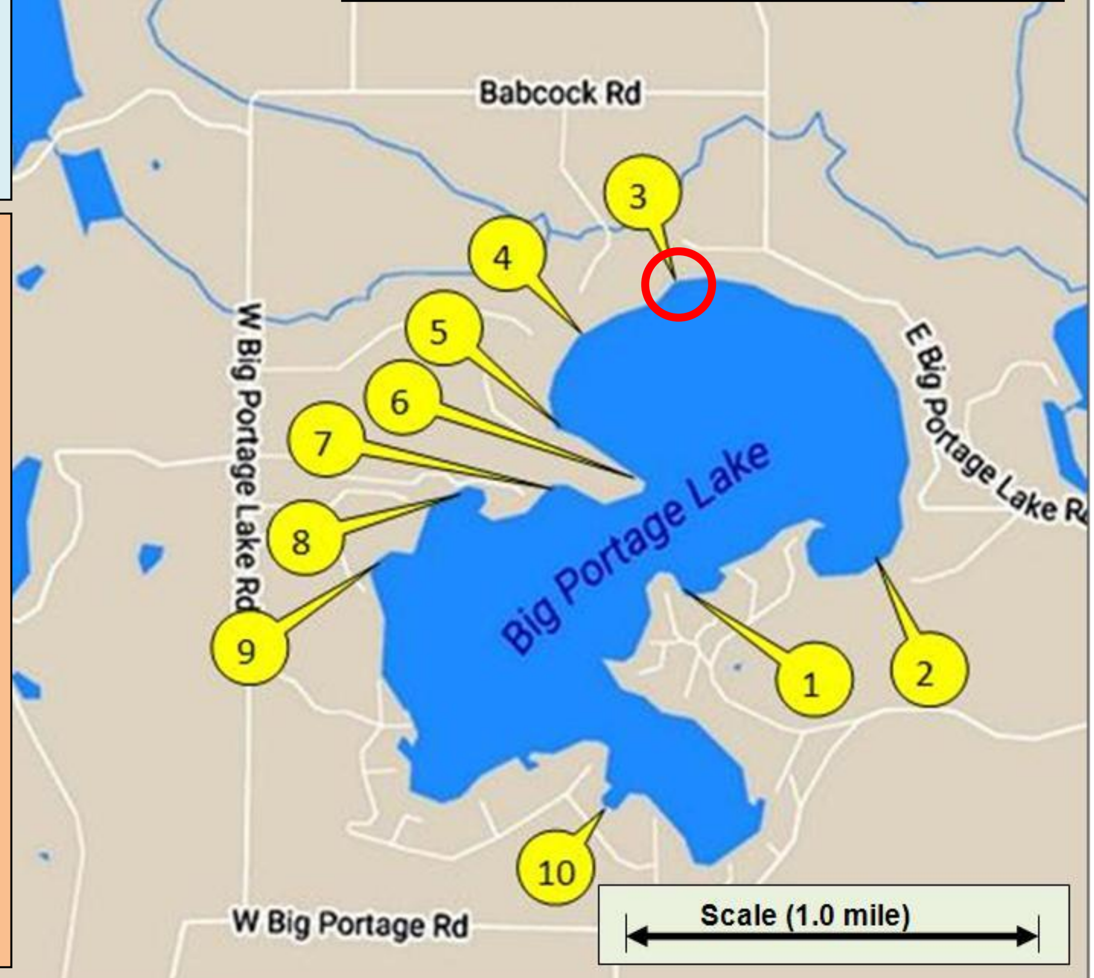
Exhibit 8. Big Portage Lake Frog and Toad Survey Site Summary

Site Number: 3 Big Portage Lake Shoreline

Coordinates: 46.134663,-89.282895

Habitat: Permanent water, lake shoreline.

Species detected: Spring peeper, Green frog



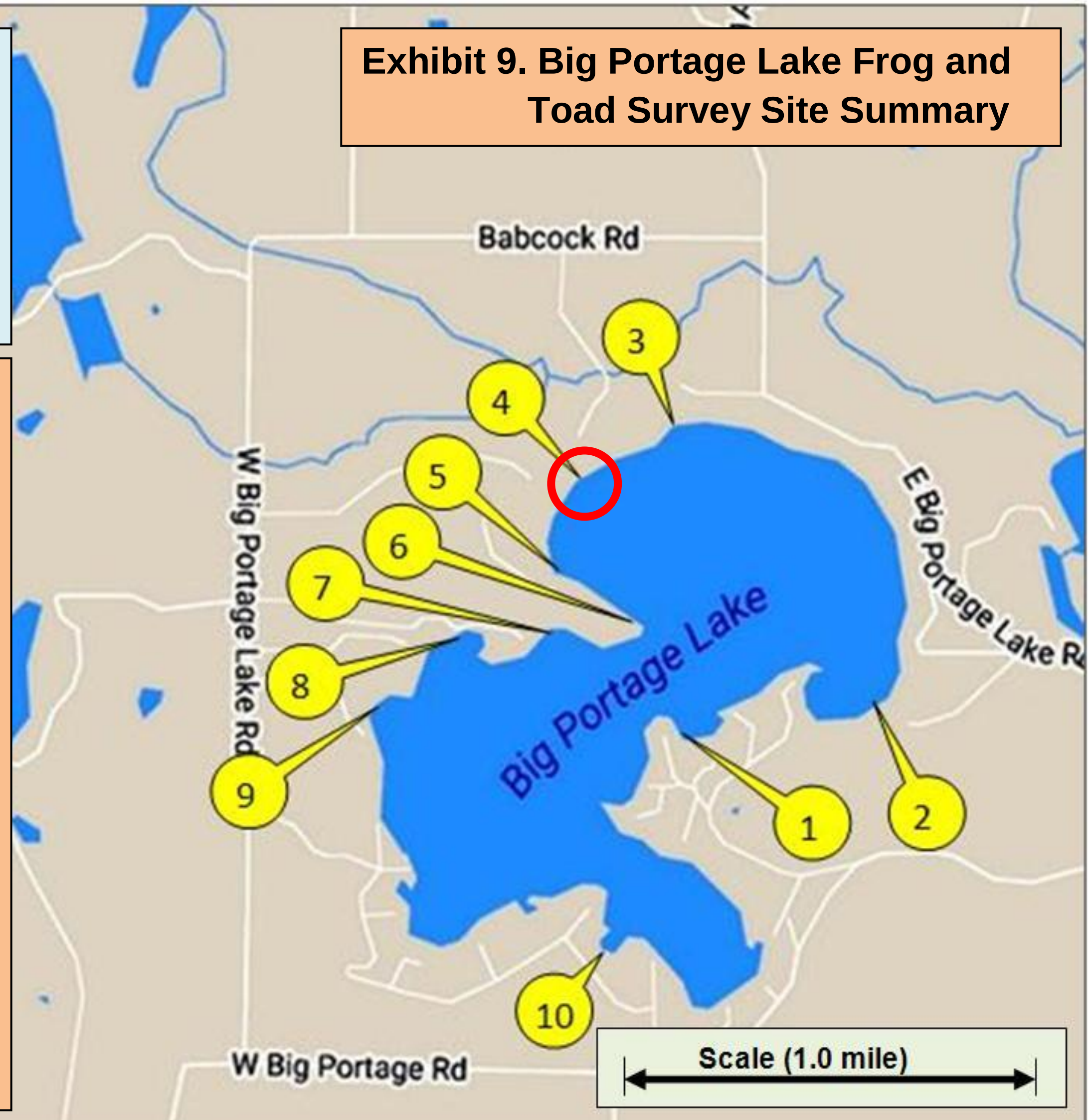
Site Number: 4 Big Portage Lake Shoreline

Coordinates: 46.132653,-89.288185

Habitat: Permanent water, lake shoreline.

Species detected: Green frog

Exhibit 9. Big Portage Lake Frog and Toad Survey Site Summary



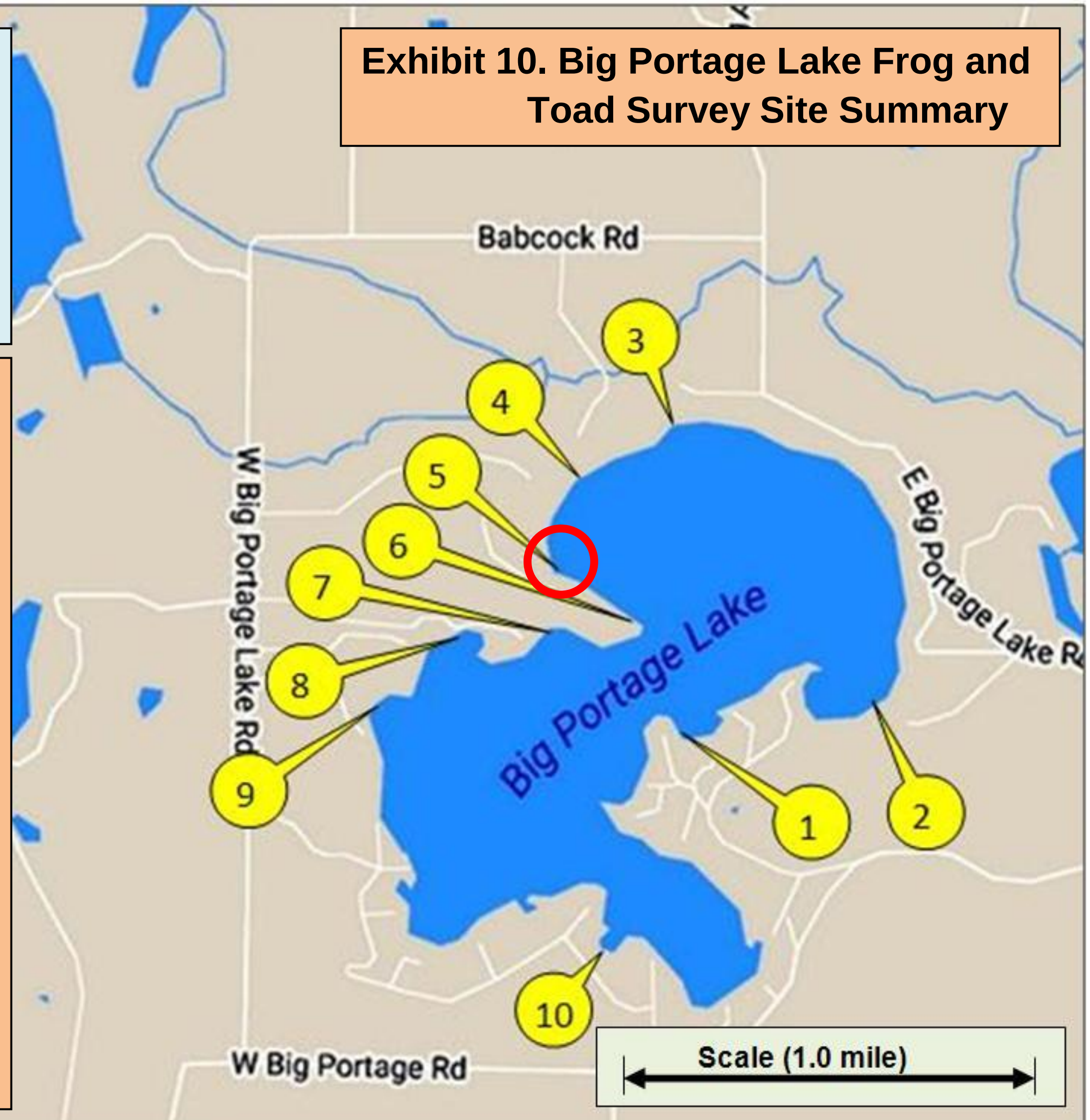
Site Number: 5 Big Portage Lake Shoreline

Coordinates: 46.129737,-89.289231

Habitat: Permanent water, lake shoreline.

Species detected: Green frog

Exhibit 10. Big Portage Lake Frog and Toad Survey Site Summary



Site Number: 6 Big Portage Lake Shoreline

Coordinates: 46.127785,-89.284794

Habitat: Permanent water, lake shoreline.

Species detected: No species detected at this site

Exhibit 11. Big Portage Lake Frog and Toad Survey Site Summary

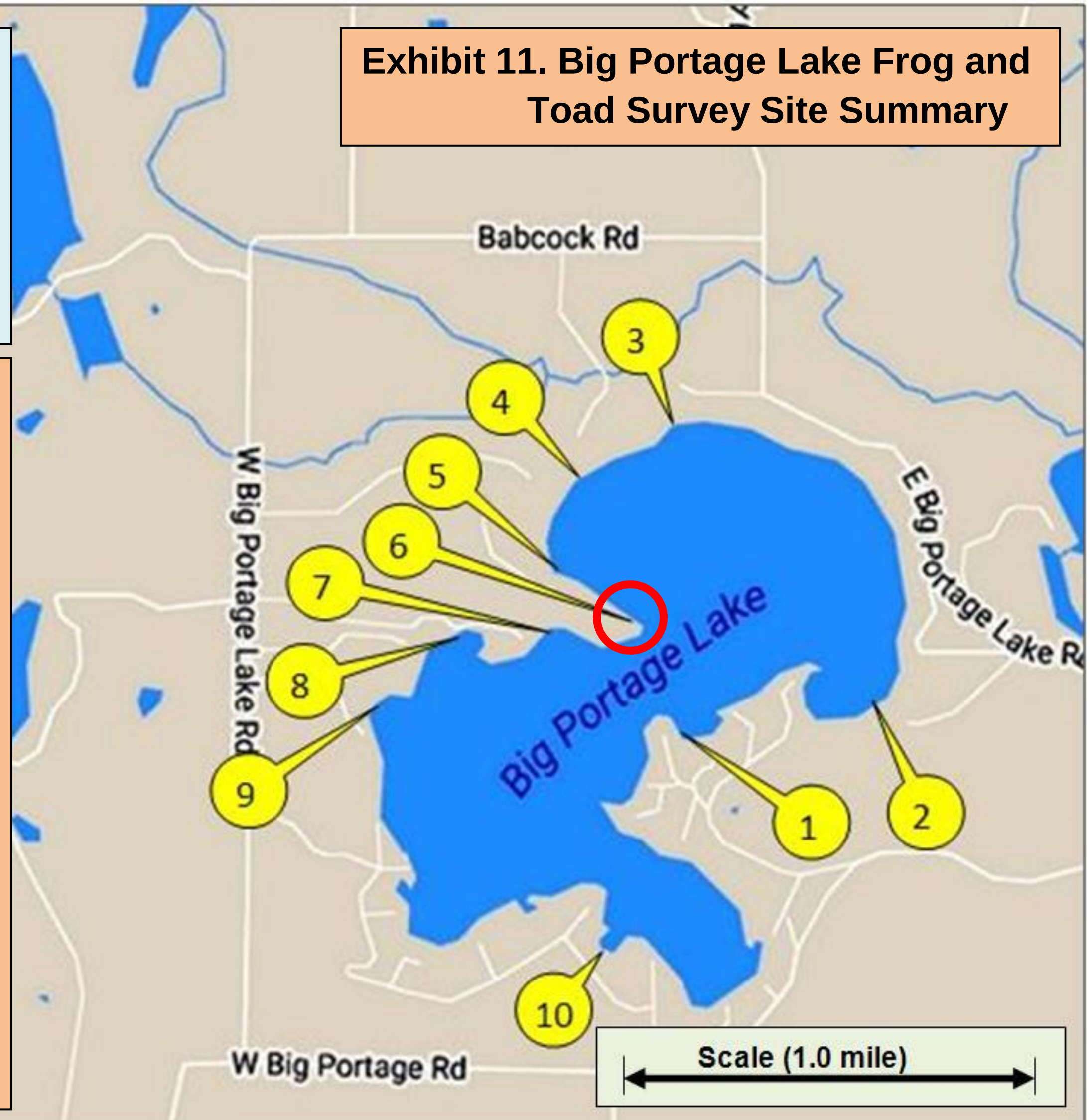


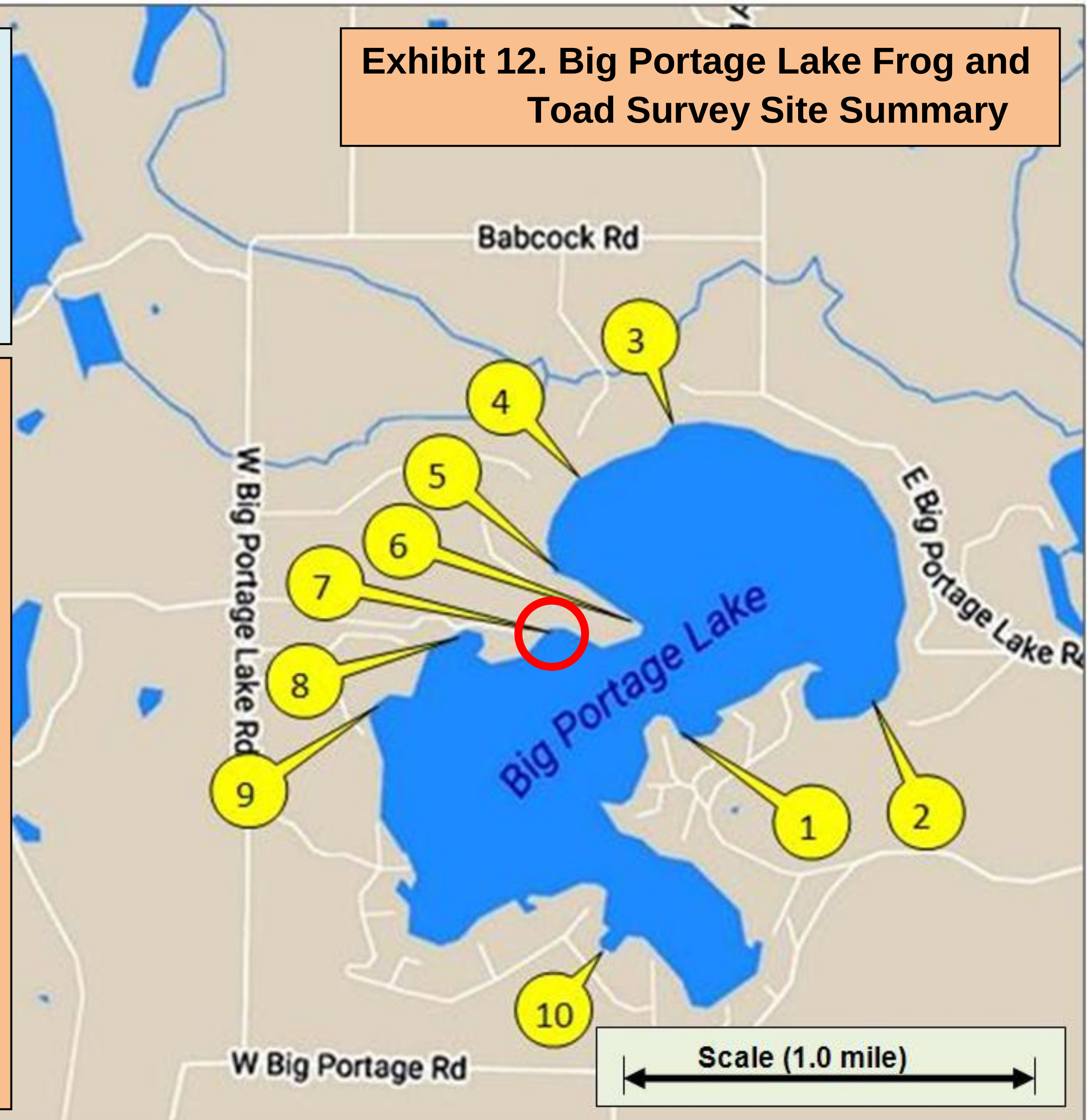
Exhibit 12. Big Portage Lake Frog and Toad Survey Site Summary

Site Number: 7 Big Portage Lake Shoreline

Coordinates: 46.127354,-89.289681

Habitat: Permanent water, lake shoreline.

Species detected: Green frog



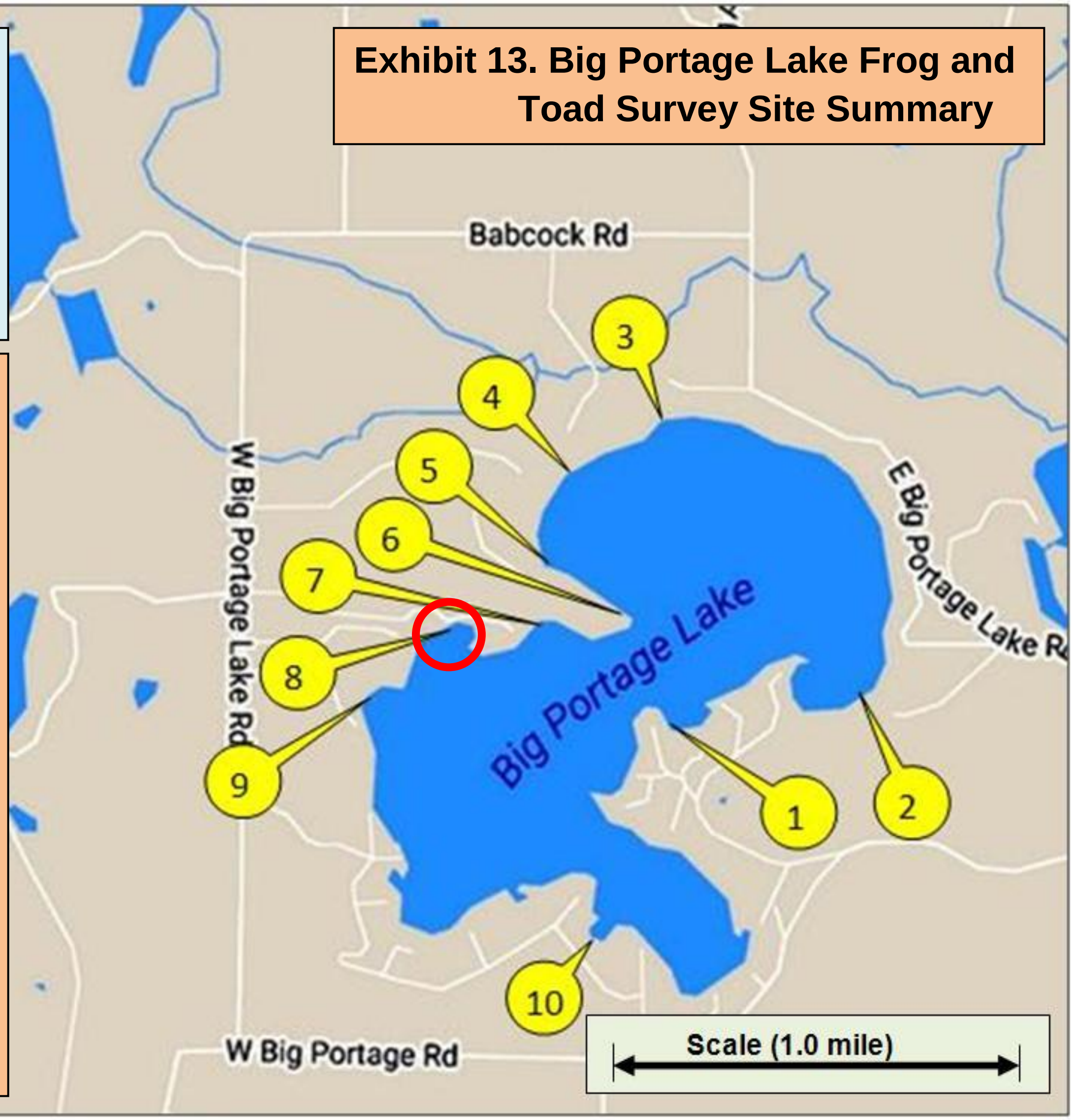
Site Number: 8 Big Portage Lake Shoreline

Coordinates: 46.127573,-89.293463

Habitat: Permanent water, lake shoreline.

Species detected: Green frog

Exhibit 13. Big Portage Lake Frog and Toad Survey Site Summary



Site Number: 9 Big Portage Lake Shoreline

Coordinates: 46.124952,-89.298302

Habitat: Permanent water, lake shoreline.

Species detected: Green frog

Exhibit 14. Big Portage Lake Frog and Toad Survey Site Summary

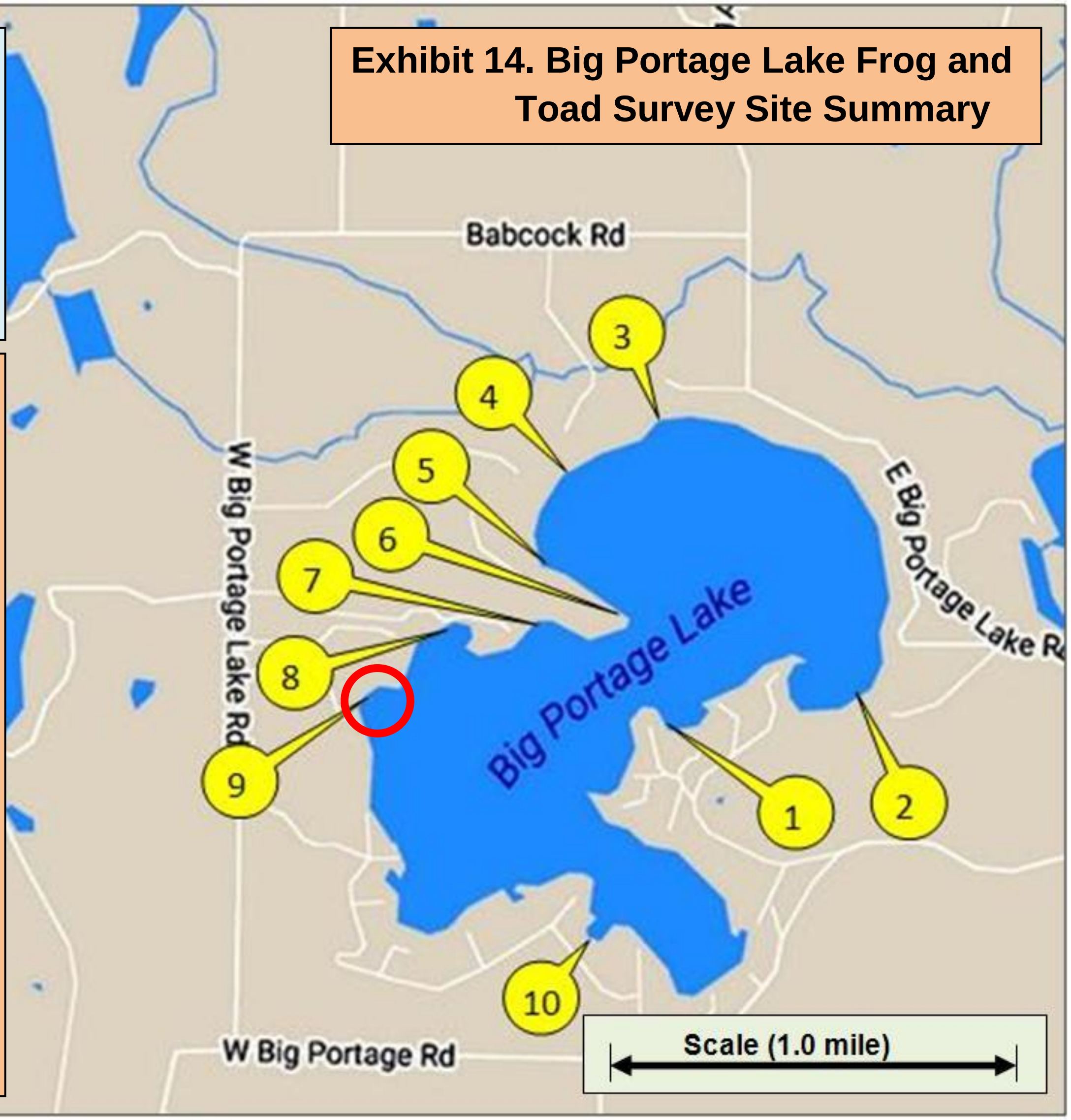


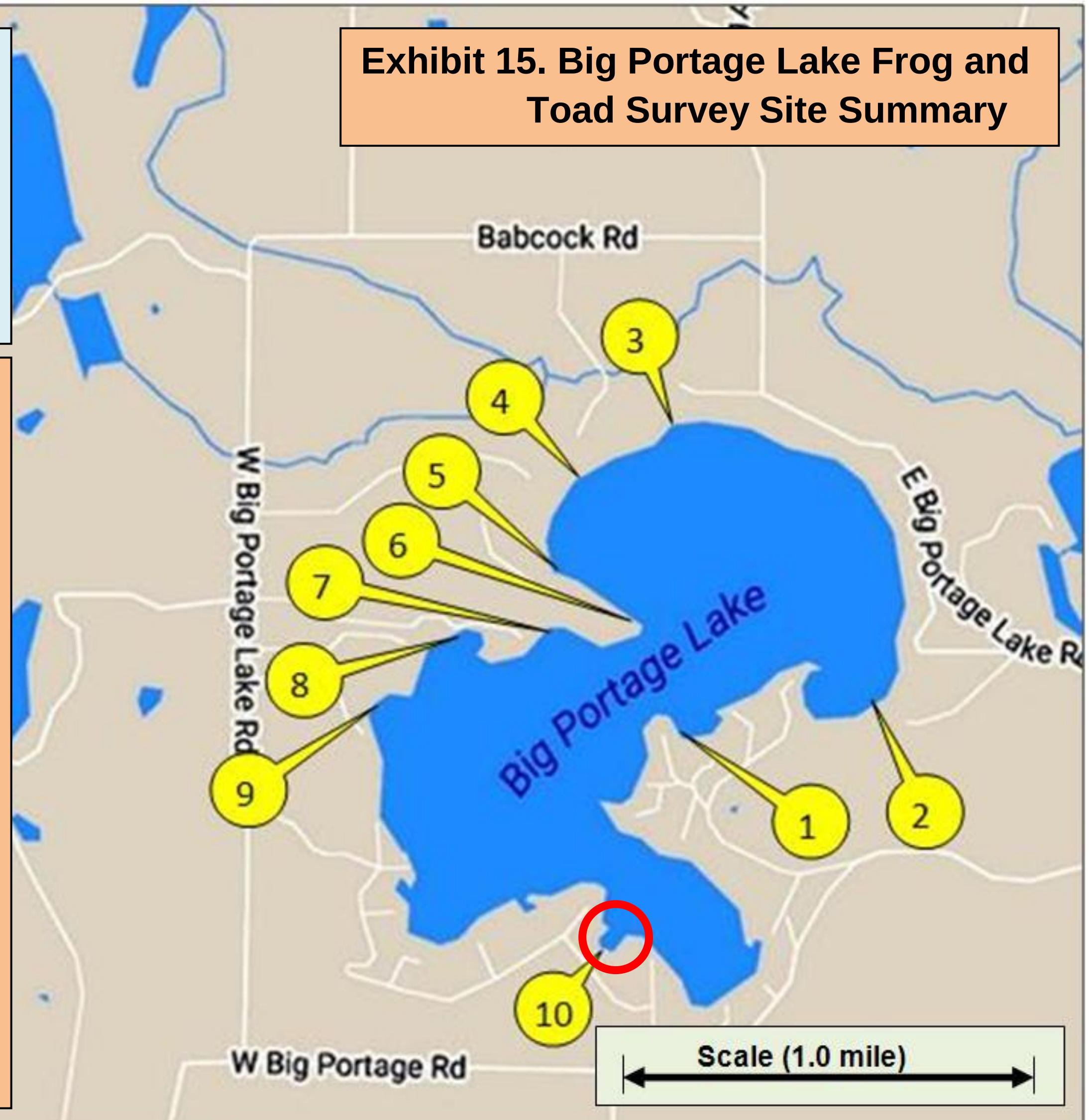
Exhibit 15. Big Portage Lake Frog and Toad Survey Site Summary

Site Number: 10 Big Portage Lake Shoreline

Coordinates: 46.116768,-89.286532

Habitat: Permanent water, lake shoreline.

Species detected: Green frog



Appendix H
Big Portage Lake Bat Survey

Big Portage Lake Acoustic Bat Survey Report 2017-2018

Provided by the Big Portage Lake Riparian Owners Association

The Wisconsin Bat Program (http://wiatri.net/Inventory/Bats/volunteer/) monitors and manages bat populations in the state. Much of the data the program collects comes from citizen-scientists. To conduct acoustic bat surveys in Wisconsin, volunteers are trained to use handheld ultrasonic detectors, or "bat detectors." The system consists of a detector that records the ultrasound, a PDA that displays the bat calls on a graph of frequency over time, and a GPS unit that tracks the route taken and pinpoints each bat call. Data is saved onto the PDA and analyzed in the office. Just like birds, bat species have different calls from each other. By looking at the frequency, shape and other characteristics of calls, the Wisconsin Bat Program staff can identify the species of bat that were recorded. For more on bats in Wisconsin, see https://dnr.wi.gov/volunteer/animals/Bats.html.

On Big Portage Lake, bat surveys were conducted in 2017 (on July 9 and September 9) and 2018 (July 5, July 21, and August 7). A total of five species were documented detected over all surveys (Little Brown Bat, Big Brown Bat, Silver-haired Bat, Long-eared bat, and Hoary Bat). The Eastern Red Bat was possibly present. Table 1 presents the species detected for each of the five surveys dates. Exhibits 1 through 5 show the locations of the documented bats.

Survey Date	**Bat species recorded**	**Exhibit**
July 9, 2017	Little Brown Bat, Big Brown Bat, and Silver-haired Bat	1
September 9, 2017	Eastern Red Bat, Little Brown Bat, Big Brown Bat, and possible Silver-haired Bat	2
July 5, 2018	Little Brown, Big Brown, and Big Brown	3
July 21, 2018	Little Brown, Big Brown, and Big Brown, and possible Silver-haired Bat	4
August 7, 2018	Little Brown, Little Brown/Northern Long-eared, Hoary, and Silver-haired	5

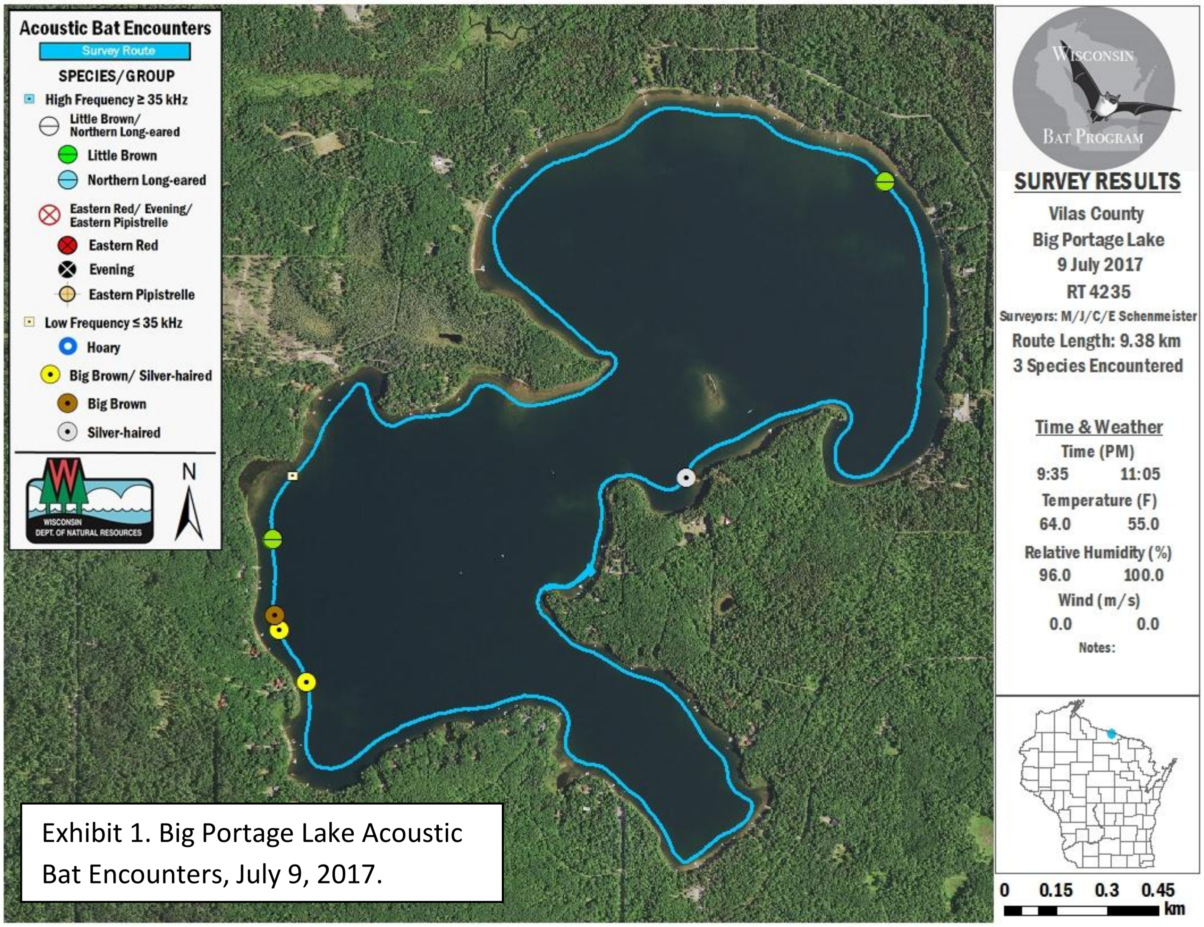


Exhibit 1. Big Portage Lake Acoustic Bat Encounters, July 9, 2017.

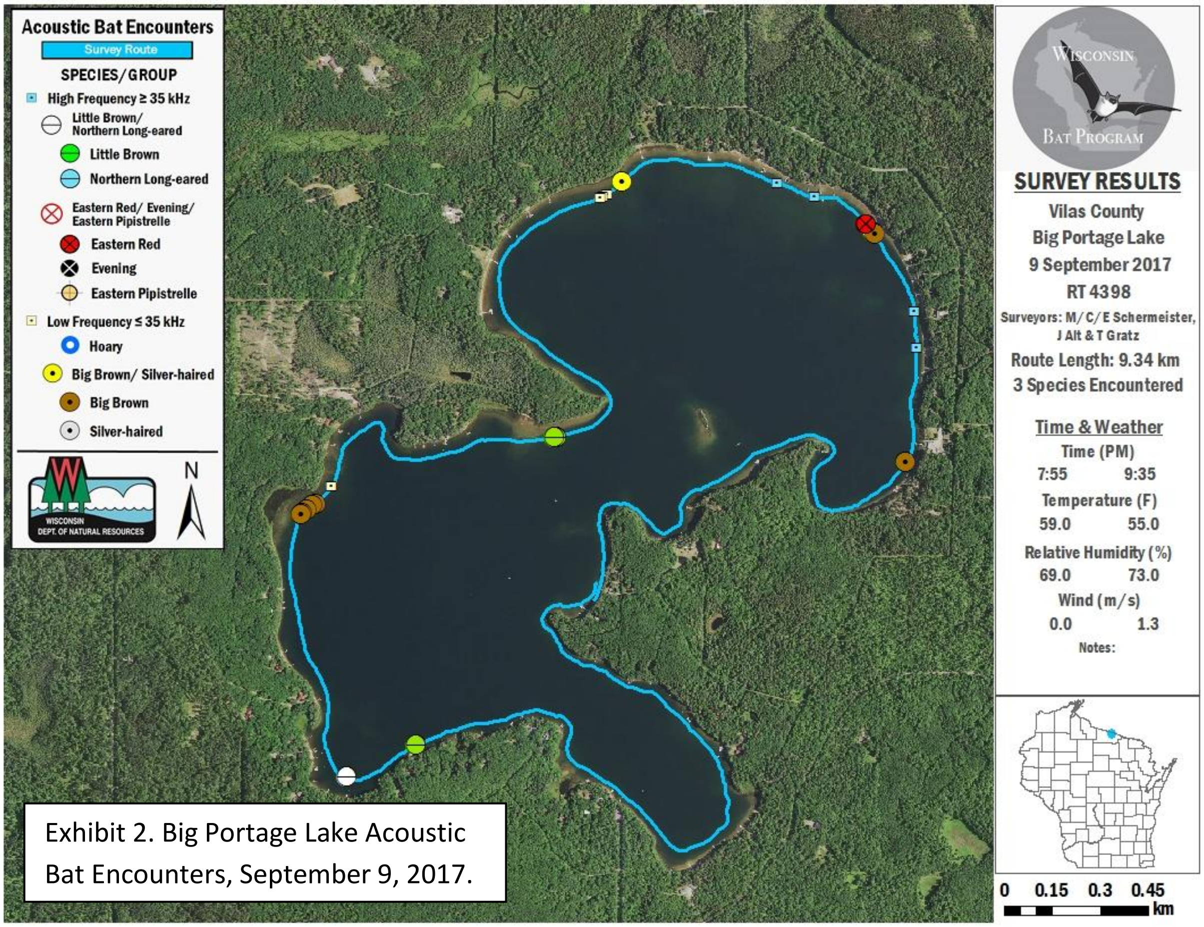


Exhibit 2. Big Portage Lake Acoustic Bat Encounters, September 9, 2017.

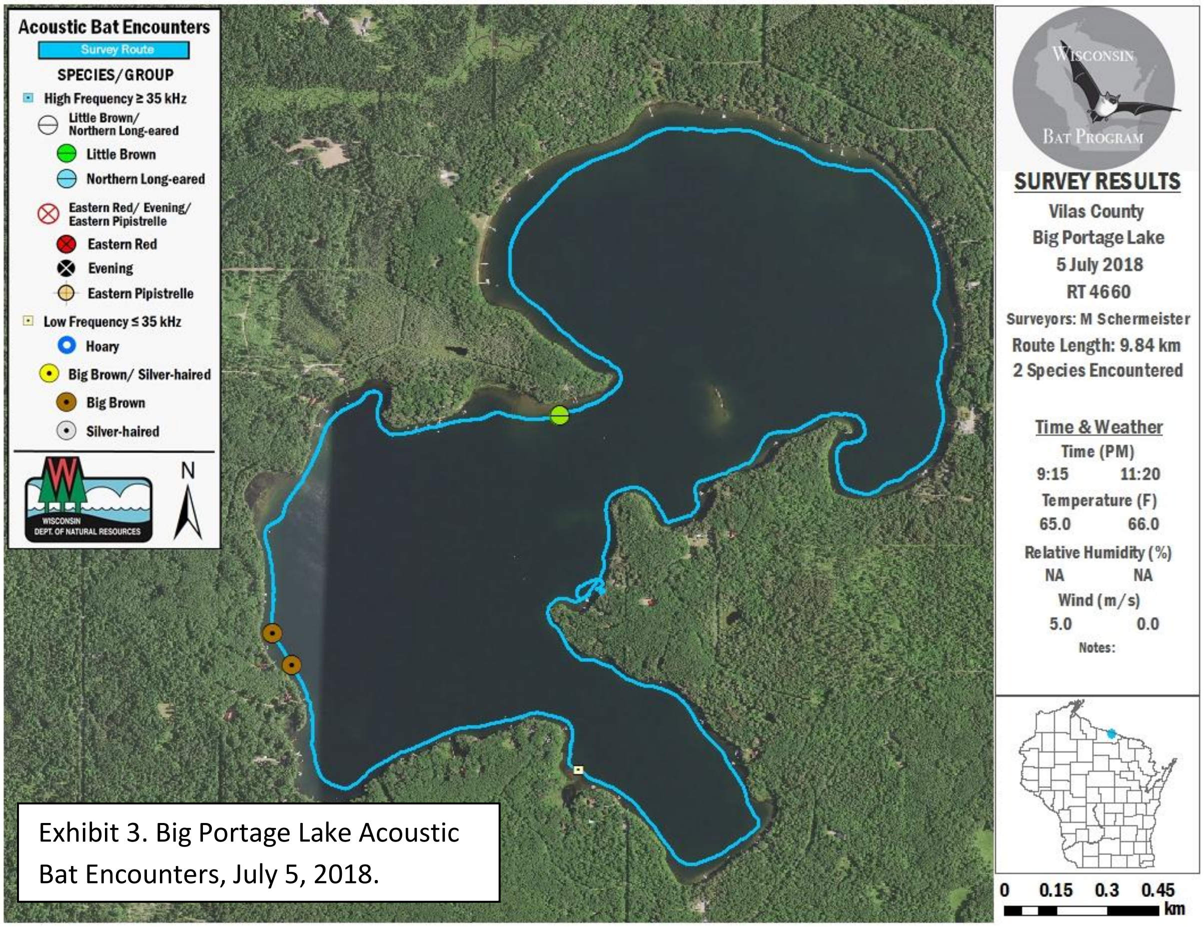


Exhibit 3. Big Portage Lake Acoustic Bat Encounters, July 5, 2018.

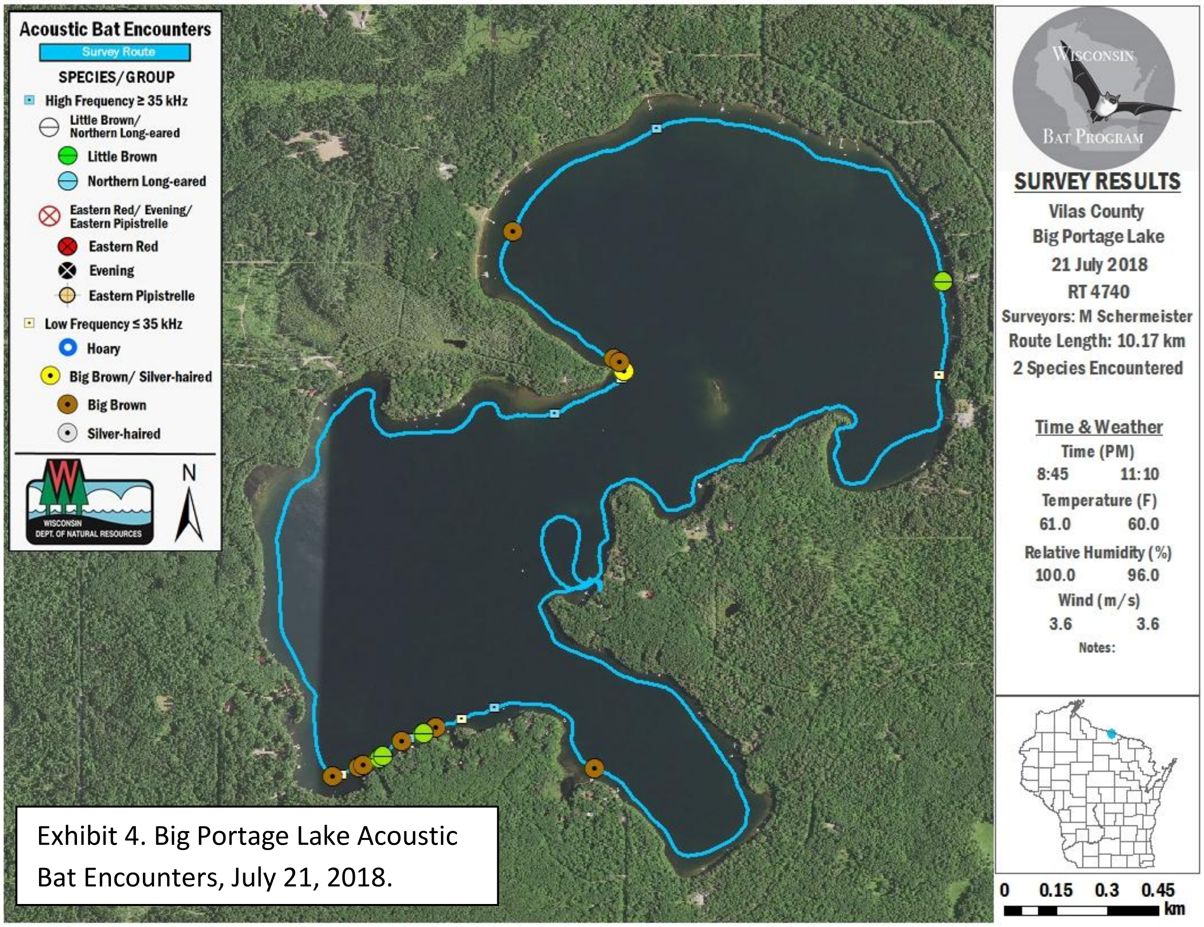


Exhibit 4. Big Portage Lake Acoustic Bat Encounters, July 21, 2018.

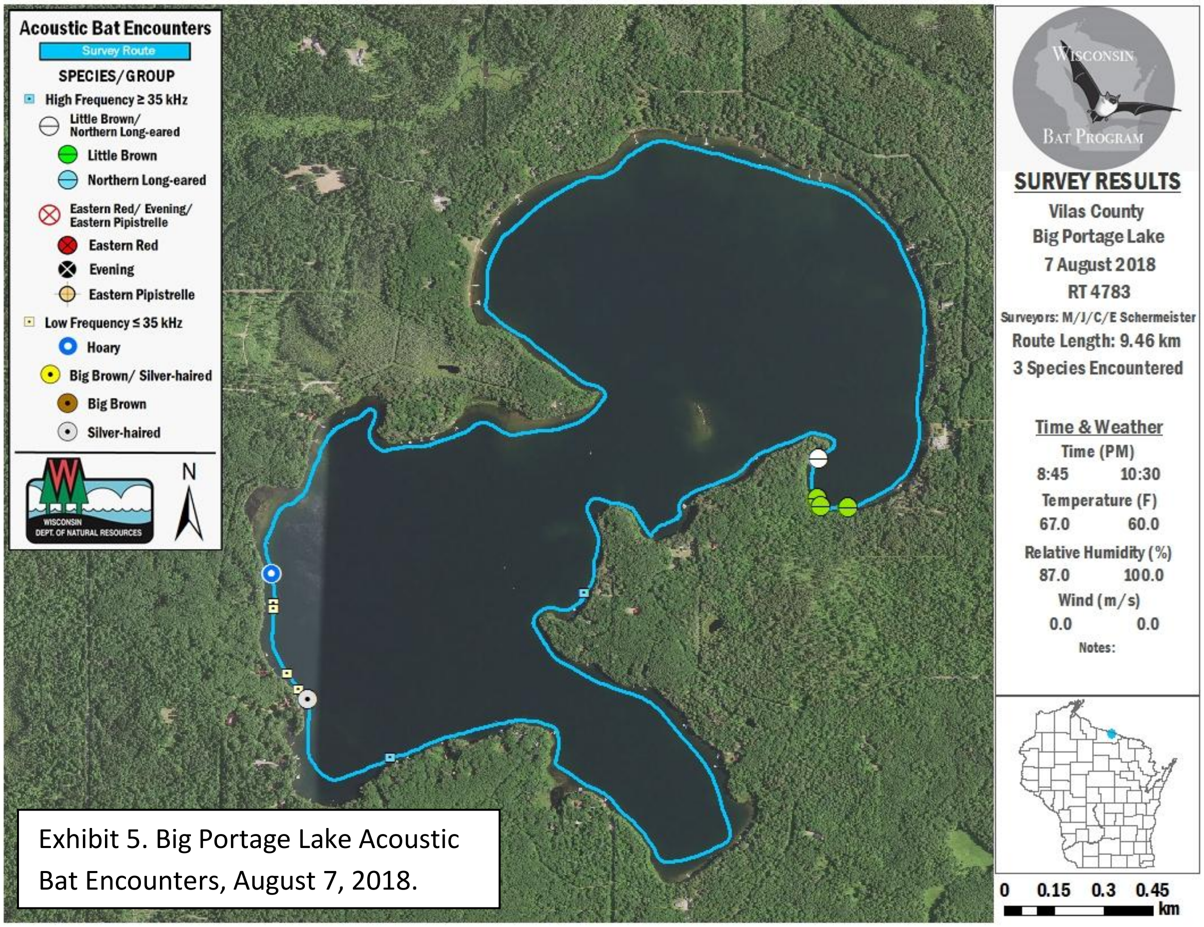


Exhibit 5. Big Portage Lake Acoustic Bat Encounters, August 7, 2018.

Big Brown Bat is a threatened species in Wisconsin.
https://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=detail&SpecCode=AMACC04010

Silver-haired Bat is a special concern species in Wisconsin.
https://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=detail&SpecCode=AMACC02010

Little Brown Bat is a threatened species in Wisconsin.
https://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=detail&SpecCode=AMACC01010

The Northern Long-eared Bat is a threatened species in Wisconsin and a federally threatened species.
https://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=detail&SpecCode=AMACC01150

The Eastern Red and the Hoary Bats have no status at this time.

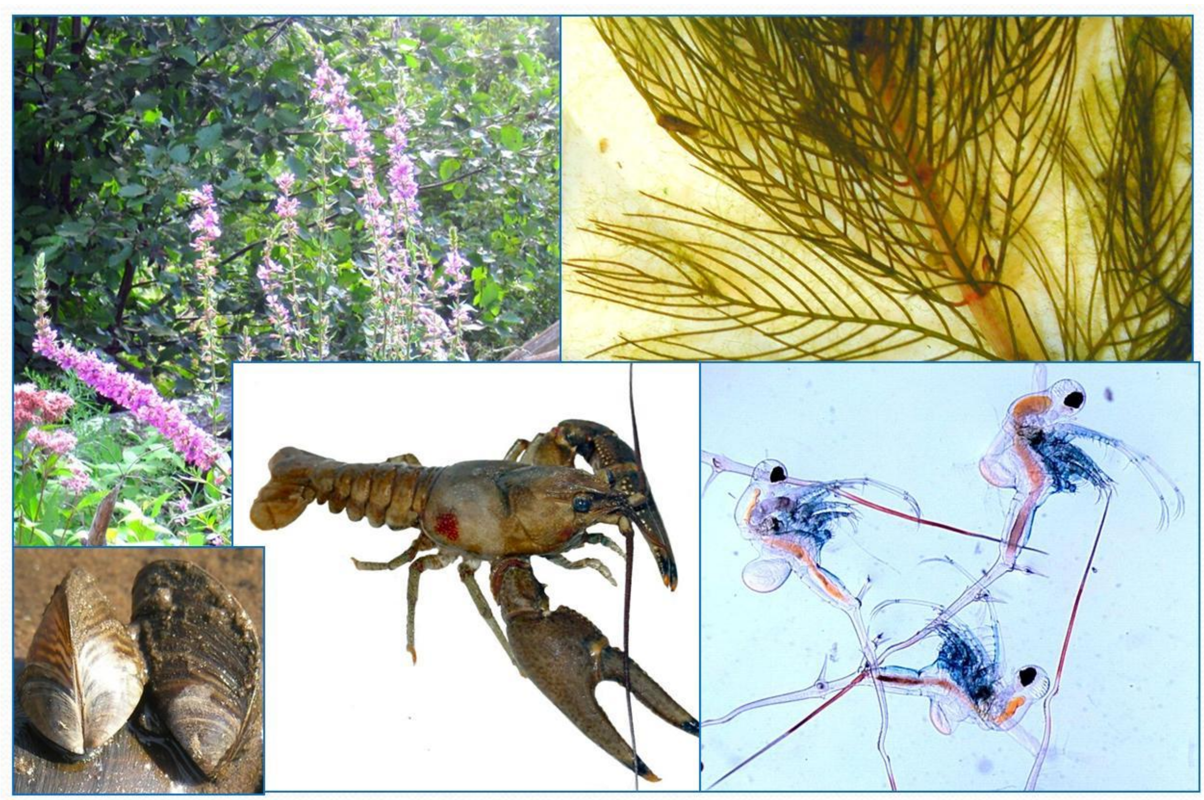
Appendix I

Big Portage Lake Aquatic Invasive Species Report

Big Portage Lake (Vilas County, Wisconsin)

Aquatic Invasive Species Report

Prepared by Angie Stine, White Water Associates, Inc.



WHITE WATER ASSOCIATES, INC.

Fall 2019

INTRODUCTION

White Water Associates, Inc. has been retained by the Big Portage Lake Riparian Owners Association (BPLROA) through a Wisconsin Department of Natural Resources (WDNR) Large Scale Planning Grant for lake consulting services on Big Portage Lake (Vilas County, Wisconsin). Some tasks for this grant focused on aquatic invasive species (AIS). Efforts are intended to increase the understanding of AIS as well as native species in Big Portage Lake. This work prepares Big Portage Lake stakeholders to conduct actions that serve lake health. As part of this effort White Water monitored Big Portage Lake for AIS using WDNR protocol. This approach assesses the lake as to its vulnerability to AIS and documents aquatic invasive plant species as detected. Findings from the survey were entered into the SWIMS database. A *floating workshop* on lake health, riparian ecology, and AIS was conducted for Big Portage Lake stewards.

AQUATIC INVASIVE SPECIES EARLY DETECTION MONITORING

In order to determine if other aquatic invasive species (AIS) were present in study areas, biologists followed the *Aquatic Invasive Species Early Detection Monitoring Standard Operating Procedure* (WDNR, 2014). This procedure outlines several types of monitoring techniques, including: boat landing searches, sample site searches, targeted searches, waterflea tows and/or a Ponar dredge, and a meander search. The Big Portage Lake survey took place September 17, 2018.

Five sites around the lake shoreline were thoroughly searched and a meander search was conducted while traveling from one site to another. The public boat landing was surveyed for 15 minutes by checking the dock and walking 200 feet of shoreline and a volunteer snorkeled. The other four shoreline sites were randomly selected and are identified in Exhibit 1 and Exhibit 2. Snorkeling was not used to search for AIS due to the high water clarity (it is very easy to see into the water from the boat). A long rake was used to collect any suspicious aquatic plants for closer inspection and identification. A D-net was used to collect invertebrate animals to look for AIS. Any invasive species observed were recorded. In the event of a new AIS record, specimens are collected for verification.

Spiny water fleas are an aquatic invasive zooplankton that is found in a few lakes in Wisconsin. They can be monitored by way of plankton tow nets or by an examination of sediment for dead waterflea exoskeleton fragments. In Big Portage Lake, plankton net was used at three locations (Exhibit 1 and Exhibit 3). The sample was brought back to the lab and filtered to look for spiny water fleas under magnification. No AIS were found.

Between sites a meander search is used to look for any AIS that may appear. The only riparian land plant that was noted was the European marsh thistle (this had been previously documented according to WDNR on-line information). Reed canary grass was also noted on the 2018 aquatic plant survey and it was verified by Dr. Freckmann at U.W. Steven's Point Herbarium on January 24, 2019.

Exhibit 1. Big Portage Lake AIS survey sites 1-5 and location of zooplankton sites, Aquatic forget-me-not, and Purple loosestrife.

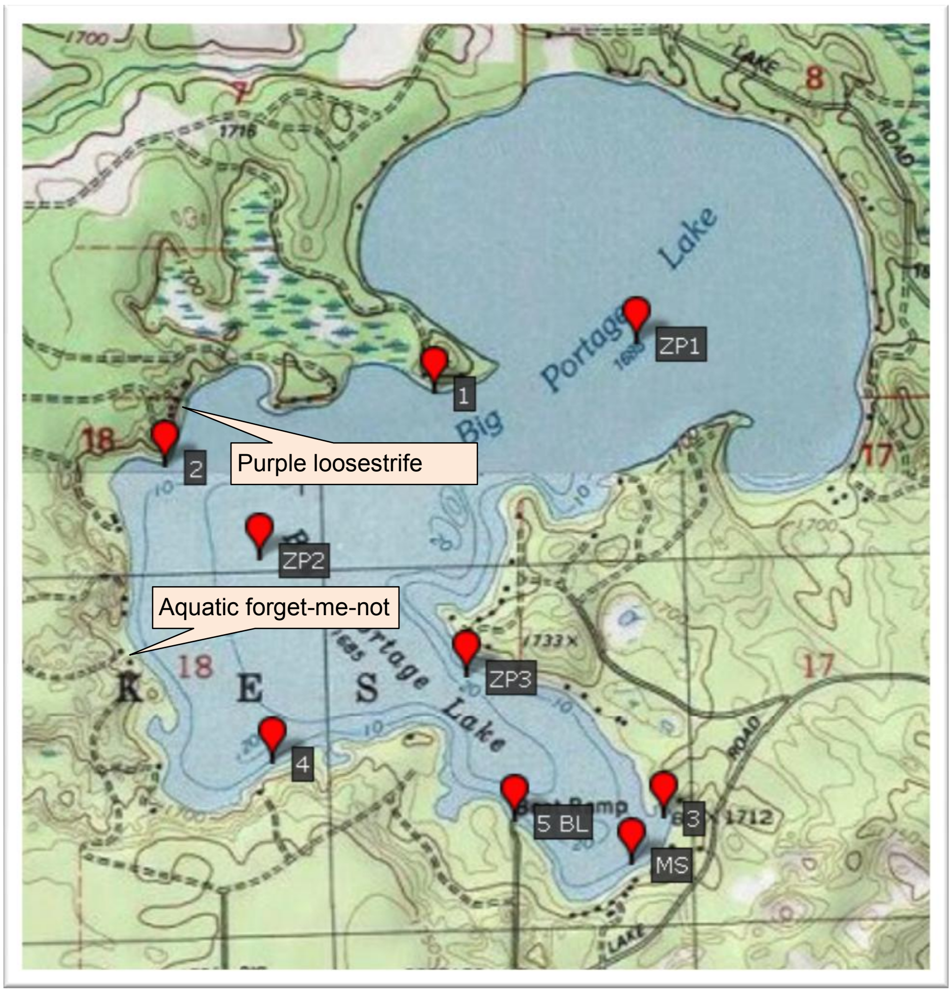


Exhibit 2. AIS Survey on Big Portage Lake 9/17/2018.			
Site	**Latitude**	**Longitude**	**Species found**
1	46.12691	-89.28702	Rusty crayfish
2	46.12508	-89.29662	none
3	46.11691	-89.27888	Rusty crayfish
4	46.11777	-89.29282	none
BL5	46.11631	-89.28418	Banded mystery snail, rusty crayfish
Meander	46.11526	-89.27997	European marsh thistle

Exhibit 3. Spiny Water Flea Zooplankton Sample from Big Portage Lake			
Date: 9/17/2018	**GPS Coordinates**		**Depth of sample (feet)**
ZP1	46.12814	-89.27983	30
ZP2	46.12279	-89.29328	26
ZP3	46.11989	-89.28587	25

One known aquatic invasive species (rusty crayfish) is established in Big Portage Lake. One terrestrial invasive species (European marsh thistle) had also been previously documented and is in the WDNR database. During White Water Associates' efforts under this grant, four new invasive species were documented:

1. ***Banded mystery snail*** was first found at the boat landing during this AIS survey (Exhibits 1, 2, and 4). A sample was collected, photos were taken, and the AIS Coordinator was notified via email.
2. ***Reed canary grass*** was collected during the 2018 aquatic plant survey. A voucher specimen was sent and confirmed by Dr. Freckmann, U.W. Steven's Point.
3. ***Purple loosestrife*** was observed on the shore (46.12632573, -89.29593266) during the conductivity survey on August 23, 2019 (Exhibit 5). Photos were taken and the WDNR was informed. Susan and Dan Johns volunteered to notify the landowner.
4. ***Aquatic forget-me-not*** was documented on the shoreline (46.12046549, -89.29761859) during the conductivity survey. It was also found near the purple loosestrife location mentioned above (Exhibit 5). A photo was taken and sent to the WDNR.

Rusty crayfish are native to parts of Ohio, Tennessee, Kentucky and Indiana, and were likely introduced to Wisconsin waters by fishermen using the crayfish as bait (Gunderson, 2014). Rusty crayfish negatively affect other native crayfish species, cause destruction to aquatic plant beds, reduce fish populations by eating eggs, and cause shoreland owners recreational problems (Gunderson, 2014). It is illegal to possess both live crayfish and angling equipment simultaneously on any inland Wisconsin water (except Mississippi River) (WDNR, 2015). It is also illegal to release crayfish into a water body without a permit (WDNR, 2015).

European marsh thistle (*Cirsium palustre*) is an herbaceous biennial. First year plants overwinter in rosette stage; flowering stems are 4-5' tall, erect, thick, sometimes reddish in color, branched at the top and bristling with spiny wings aligned with the stem. Much of the plant covered in long, sticky hairs (WDNR, 2019).

Banded mystery snails (*Viviparus georgianus*) intentionally introduced into the Hudson River basin by an amateur conchologist in 1867; spread to the Great Lakes via the Erie Canal and Mohawk River (Morningstar et al. 2019). They are also likely released to the Great Lakes from an aquarium. Large snail (up to 1 ¾ inches); olive-green shell has 4-5 whorls with distinct sutures; 4 reddish bands circle the shell. The snail does not seem to have a significant impact on native species, but its ecological and anthropological threat comes from its potential to transmit parasites and diseases (Morningstar et al. 2019). It is illegal to introduce the banded mystery snail into Wisconsin waters. Exhibit 4 is a photo of the banded mystery snail.

Exhibit 4. Photo of the banded mystery snail found at the Big Portage Lake boat landing, 2018.

Reed canary grass (*Phalaris arundinacea*), generally considered a terrestrial invasive species, and was observed in the 2018 aquatic plant survey. Reed canary grass has been found in nearly every county in Wisconsin and Michigan. It forms dense stands in wetland and riparian areas (Czarapata, 2005). It reproduces by spreading rhizomes, and seeds (Czarapata, 2005).

Purple loosestrife was introduced in North America in the early 1800s. Now, it is spread primarily via highways and waterways. Purple loosestrife is a perennial plant (2+ growing seasons) that prefers wetland areas (Czarapata 2005). It has opposite/whorled leaves with attractive purple flowers. Purple loosestrife was introduced as an ornamental plant, and has since infested every county in Minnesota, Wisconsin, and Michigan (Czarapata 2005). It impacts native plants by competing for food sources and by replacing native plants. Its survival rate is excellent because it can produce up to 2 million seeds annually, which can lie dormant in the substrate for years. Dispersal can occur by floating on open water, however, long distance dispersal may occur from seeds being imbedded in animal fur, truck or ATV tires, and outboard engines or live wells (Gilbert et al., 1998). Germination sites are most often associated with recent disturbances that expose the soil such as road construction, reduction of water levels, and roadside moving (Gilbert et al., 1998). Purple loosestrife can also regenerate from plant fragments, necessitating careful selection of control methods. Exhibit 5 is a photo of the purple loosestrife found along the shoreline of Big Portage Lake.

Exhibit 5. Photo of purple loosestrife (in yellow oval) and aquatic forget-me-not (in red oval) found at Big Portage Lake near shore, 2019.

Aquatic Forget-me-not (*Myosotis scorpioides*) a quickly crowd out native plant species and is able to form large monocultures, especially in situations where it is in or near a stream (WDNR, 2019a). This plant is restricted in Wisconsin.

Big Portage Lake stakeholders are the first line of defense when it comes to protecting the lake from introduction and establishment of AIS. Early detection and action is critical. The Wisconsin DNR has a very informative website on aquatic invasive species: https://dnr.wi.gov/topic/Invasives/.

FLOATING WORKSHOP

A floating workshop for Big Portage Lake stewards was conducted by Dean Premo (White Water Associates). This field trip discussed lake and riparian ecology including ways invasive species might impact these important ecosystems. The workshop took place July 19, 2019 using several pontoon boats. Participants learned about the point-intercept plant survey and shoreland survey conducted on Big Portage Lake and how the information gathered from these surveys could influence lake stewardship. The Big Portage Lake aquatic plant community was discussed at length. Other aspects of the Big Portage Lake Stewardship Program were also discussed (wildlife observations, water quality, and more).

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Appendix J
Big Portage Lake SWOT Analysis

Big Portage Lake Riparian Owners Association
Strategic Planning Session

August 31, 2019 , Land O'Lakes, Library
Prepared by Susan Johns, BPLROA

Strategic Planning Committee

On August 31, 2019, the Big Portage Lake Grant Planning Committee met for a strategic planning session. Attending were: Susan Johns (facilitator), Dan Johns, Dave Leifheit, David Slezewski, John Alt, Adam Fahl, Robert Wannemaker, Alice Muehlethaler, Mark Schermeister and Jill Edwards. Prior to conducting the SWOT analysis, the Planning Committee was presented with preliminary results of the lake user survey. Water quality, lake shore improvement impacts and other results presented by the contractor, (White Water) in the lake training session, were also reviewed. In the discussion that followed, it was noted that some issues of concern were not highlighted in the user survey. Of particular note was the impact of new State legislation which allows for short term rentals which are affecting multiple properties on the lake in spite of the residential zoning. It was also noted that, although not reported in the survey, there are several properties classified as "resorts" which were granted exceptions when the lake was rezoned. Major construction and remodeling is being conducted on some of these properties, which have been recently purchased by new owners. Noise levels, boater safety, lakeshore clearing by owners and related issues were reported by members of the Planning Committee. These discussion points, as well as the survey and contractor results, were all reflected in the SWOT analysis.

Mission Statement

The committee agreed the current mission statement is relevant and was adopted.

> ***To preserve and protect the natural environment and quality of Big Portage Lake for current and future generations, through continued education and involvement of stakeholders, monitoring of the lake environment, and being prepared to respond to change.***

SWOT Analysis

A SWOT analysis (*SWOT* stands for Strengths, Weaknesses, Opportunities, and Threats) was conducted to examine the strengths and weaknesses of Big Portage Lake and its stakeholders, as well as the opportunities and threats they face. The issues raised were discussed in terms of 1) feasibility of addressing, and 2) level of importance. The issues listed in the chart below are in approximate order of priority

Strengths
• Active shareholders/association
• Low boat traffic
• Stable lake with slow changes
• Good communication methods
  o Newsletter
  o Face Book
  o Website
  o Email list
	Opportunities
	• Communication/Education/Networking
	  o DNR/township
	  o Membership
	• Boat Landing
	  o Electronic monitoring/fake cameras
	  o Possible boat landing fees
	  o Volunteers/monitoring
	• Involvement of younger members/new owners
	• Tree drops

Weaknesses
• Small political influence (because most lake land owners are not voting residents)
• Small owner base (limiting funding for association)
• Lack/lower volunteer/member support
• Lack of younger member involvement
	Threats
	• Watershed changes
	  o Loss of natural shoreline
	  o New development
	• Visitors/renters/new home owners
	• Overharvest of fish
	• AIS

Goals and Actions

The following goals and actions were identified. Goal should focus on Preservation, Maintenance, Monitoring and Preventing.

- Maintain and Improve Communication
  - Explore networking and interaction with other relevant organizations (e.g., DNR, township, other lake associations)
  - Continue to maintain and develop communication vehicles (i.e., Newsletter, website, Facebook, Email)
  - Provide/encourage educational opportunities as appropriate
  - Distribute information on responsible lakefront ownership to new owners
  - Contact known property rental operations about responsible lakefront management
- Monitor/Preserve/Maintain Water Quality
  - Monitor water quality through WDNR Citizens Lake Monitoring Network
  - Authorize water testing where needed/indicated
- Monitor/Prevent AIS
  - Participate in Clean Boat/Clean Waters
  - Continue shoreline monitoring
  - Continue boat landing monitoring
    - Explore grant funding
    - Include BLPROA funding of monitors where able
    - Explore electronic monitoring for the boat landing
  - Explore methods to fund monitoring programs (e.g., through grants, donations, fees, etc)
  - Explore establishing an AIS coordinator position to coordinate AIS activities on the lake
- Monitor/Maintain/Preserve Fishery
  - Maintain a Fishery Committee to monitor lake fishing
  - Monitor spearing
  - Continue tree drop program
- Monitor/Maintain/Preserve Watershed
  - Monitor changes in shoreline development
  - Provide information to homeowners on shoreline preservation where applicable

Appendix K
Big Portage Lake User Survey

Big Portage Lake Stakeholder Survey Response, Charts and Comments

Prepared by Susan Johns, Big Portage Lake Riparian Owners Association

August 2019

Survey Design

The Big Portage Lake stakeholder survey was divided into five sections:

- Big Portage Lake Property,
- Recreational Activity on Big Portage Lake,
- Big Portage Lake Current and Historic Condition, Health, and Management
- Big Portage Lake Riparian Owners Association (BPLROA)
- Comments

In the first section (Property), questions were asked pertaining to properties on Big Portage Lake. One survey per household was completed. If more that one property was own, the respondent was asked to select the property owned the longest or the property considered as a residence. The questions were designed to provide information about how long the property had been owned, how the property was used, how often it was used and the type of septic system used.

The second section (Recreational Activity) included questions relating to the recreational activities the respondent participated in on or around Big Portage Lake. Questions were included about fishing, watercraft, and important activities on or around the lake.

The third section (Condition, Health, and Management) included questions designed to gauge the respondent's perspective on the current and past condition of Big Portage Lake. Questions were asked about water quality, invasive species, plants, and concerns for the lake.

The fourth section (BPLROA) was designed to solicit information about the respondent's knowledge of BPLROA and the effectiveness of education and communication efforts by the homeowner's association.

The final section invited the respondents to provide comments concerning Big Portage Lake and the topics covered in the survey.

It should be noted that percentages were calculated based on the total number of respondents (N) for single option questions. For questions where multiple answeres were allowed, a normalized percentage was calculated based on the total number of responses.

Survey Responses

In August 2018, surveys were sent to individuals who were primarily lake property owners or BPLROA members. A prior survey was conducted in 2010. Where possible, the answers to that survey are included with the current survey results labeled as 2018 Survey and the prior survey results labeled as 2010 Survey.

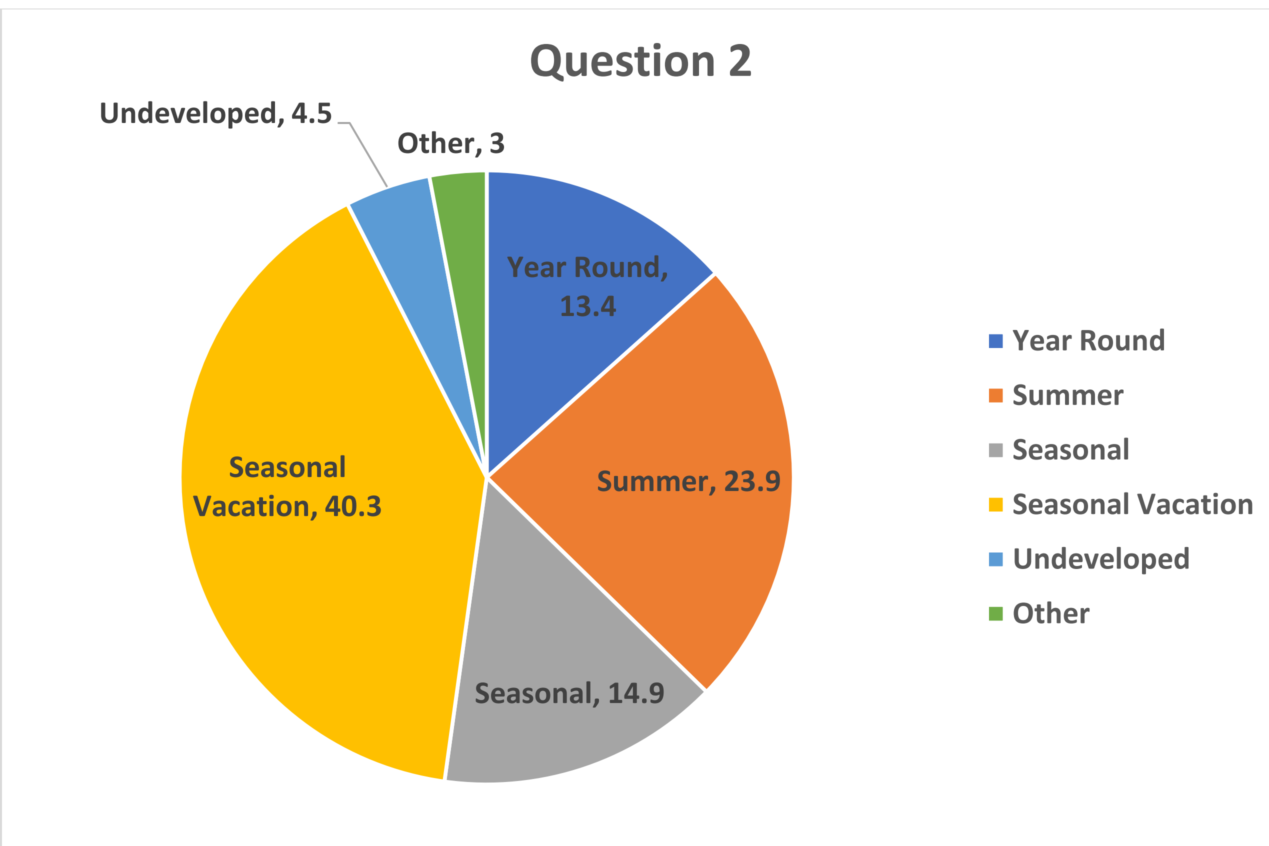
	2018 Survey	**2010 Survey**
Returned Surveys	69	74
Sent Surveys	118	106
Response Rate	**58.5%**	**69.8%**

1. **Is your property on the lake or off the lake?** Please select one.

	Total	**% N=66**
On the lake	65	98.5%
Off the lake	1	1.5%

2. **How is your property on or near Big Portage Lake utilized?** Please select the option that best describes your property's use. Consider a residence to be your primary home during that time and a vacation home to be used on weekends or occasional weeks. Summer is defined as June through August.

	Total	% N=67
A year-round residence	9	13.4
Summer residence	16	23.9
Seasonal residence	10	14.9
Seasonal vacation home	27	40.3
Resort property	0	0
Rental property	0	0
Undeveloped	3	4.5
Other (please specify):	2	3.0



3. **How many days each year is your property used by you or others?** Please answer in approximate number of days.________Days

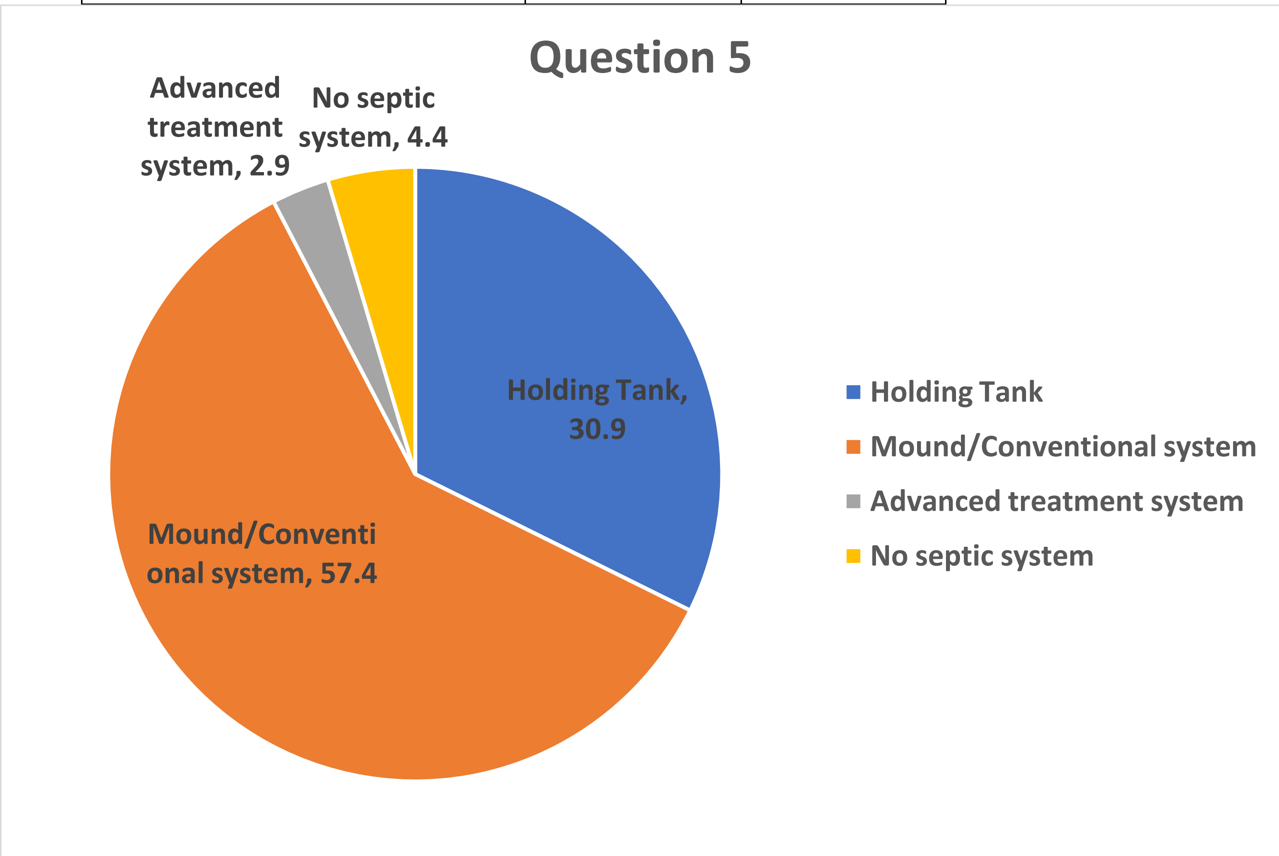
	2018 Survey	**2010 Survey**
Average (Days)	102.3	79.9
Questions Answered (N)	68	56
Standard Deviation	81.7	55.6

4. **How long have you owned your property on or near Big Portage Lake?** If less than 1 year please write 1. _____________years

Average (Years)	36.8
Questions Answered (N)	68
Standard Deviation	26.4

5. **What type of septic system does your property utilize?** Please select one.

	Total	**% N=68**
Holding tank	21	31
Municipal sewer	0	0
Mound/Conventional system	39	57
Advanced treatment system	2	3
No septic system	3	4
Do not know	3	4



Recreational Activity on Big Portage Lake

The following questions pertain to the recreational activities you participate in on Big Portage Lake. Please answer the following questions about the property that you circled in question 2 above.

6. **How many years ago did you first visit Big Portage Lake?** If less than 1 year please write 1.
___________ years

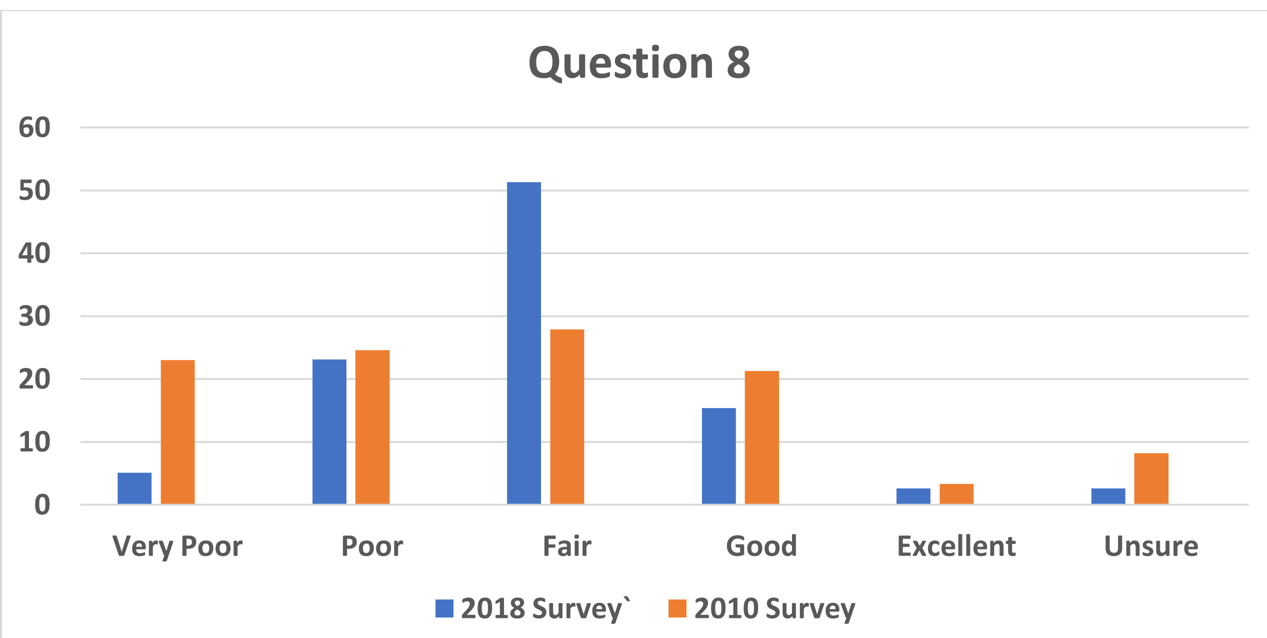
Average (Years)	48.5
Questions Answered (N)	68
Standard Deviation	17.9

7. **Have you personally fished on Big Portage Lake in the past 3 years?** Please circle one answer.

	2018 Survey		**2010 Survey**	
	Total	**% N=68**	**Total**	**% N=67**
Yes	38	56	52	77.6
No	30	44	15	22.4

8. **How would you describe the current quality of fishing on Big Portage Lake?** Please select one response on the scale below.

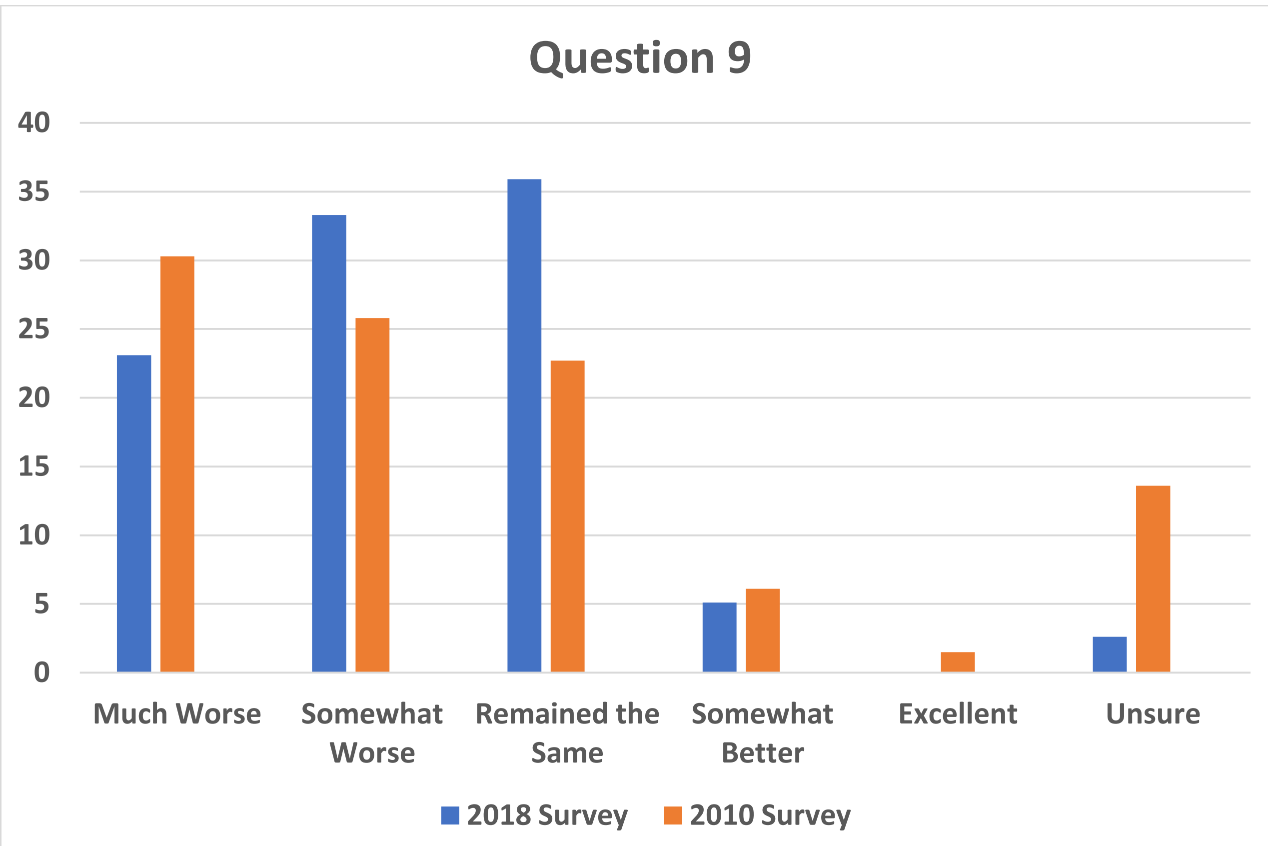
	2018 Survey		**2010 Survey**	
	Total	**% N=30**	**Total**	**% N=61**
Very Poor	2	5	14	23.0
Poor	9	23	15	24.6
Fair	20	51	17	27.9
Good	6	15	13	21.3
Excellent	1	3	2	3.3
Unsure	1	3	5	8.2



9. How has the quality of fishing changed on Big Portage Lake since you have started fishing the lake?

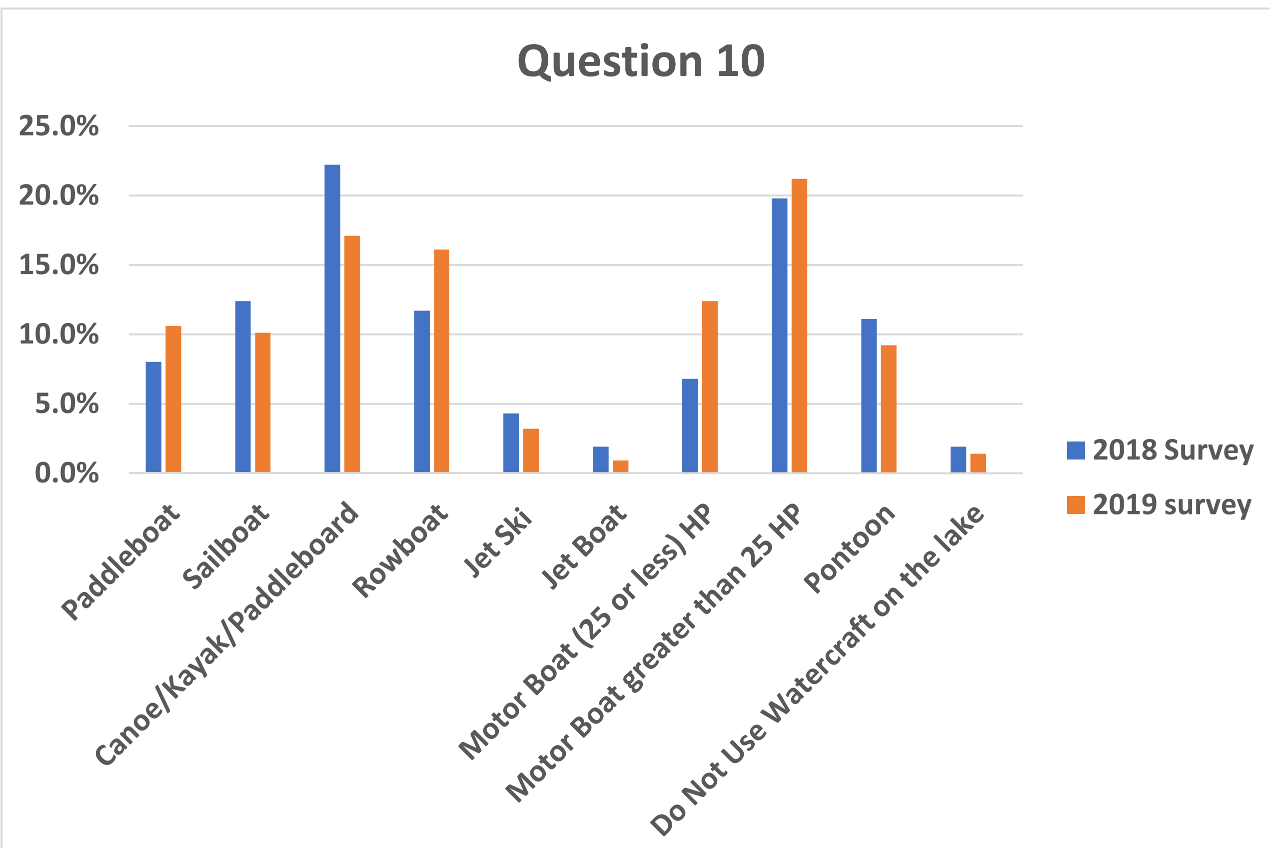
Please select one response on the scale below.

	2018 Survey		2010 Survey	
	Total	**% N=30**	**Total**	**% N=66**
Much worse	9	23	20	30.3
Somewhat worse	13	33	17	25.8
Remained the same	14	36	15	22.7
Somewhat better	2	5	4	6.1
Much better	0	0	1	1.5
Unsure	1	3	9	13.6



10. What types of watercraft do you currently use on Big Portage Lake? Please select all that apply.

	2018 Survey		2010 Survey	
	Total	**Normalized %**	**Total**	**Normalized %**
Paddleboat	13	8.0%	23	10.6%
Sailboat	20	12.4%	22	10.1%
Canoe/Kayak/Stand-up Paddleboard	36	22.2%	37	17.1%
Rowboat	19	11.7%	35	16.1%
Jet Ski (Personal Watercraft)	7	4.3%	7	3.2%
Jet Boat	3	1.9%	2	0.9%
Motor Boat with 25 HP or less motor	11	6.8%	27	12.4%
Motor Boat with greater than 25 HP motor	32	19.8%	46	21.2%
Pontoon	18	11.1%	20	9.2%
Do Not Use Watercraft on Big Portage Lake	3	1.9%	3	1.4%
Number of Respondents	48			
Total Number of Responses		162		217



11. Do you use your watercraft on waters other than Big Portage Lake?

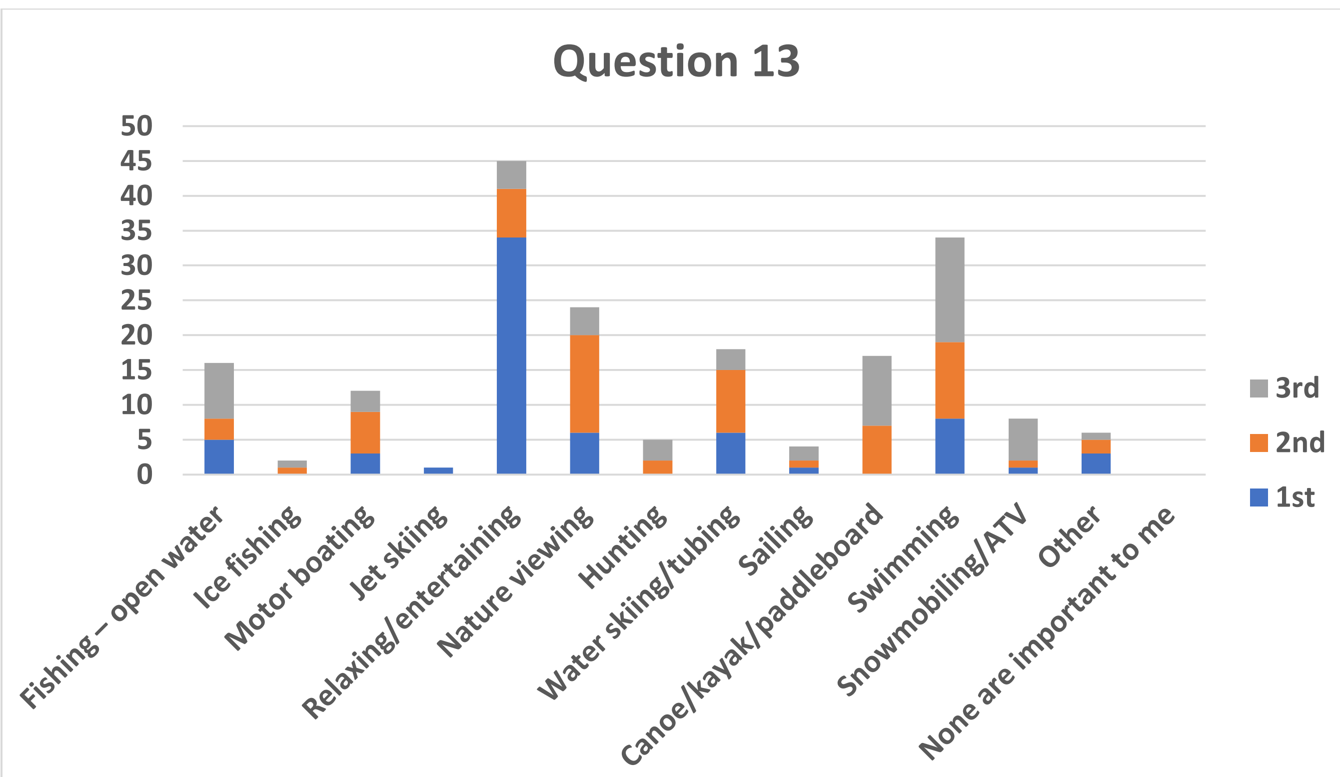
	Total	% N=66
Yes	13	19.7
No	53	80.3

12. What is your typical cleaning routine after using your watercraft on waters other than Big Portage Lake? Please select all that apply.

	Total	% N=14
Remove aquatic hitch-hikers	7	50.0
Drain bilge	6	42.9
Rinse boat	4	28.6
Power wash boat	5	35.7
Apply bleach	0	0
Air dry boat for 5 or more days	4	28.6
Do not clean boat	0	0
Other	0	0

13. **Please rank up to three activities that are important reasons for owning your property on or near Big Portage Lake.** Please enter the letters below in order of importance with 1 being most important.

	1st N=68	2nd N=64	3rd N=60	Total N=192	% Ranked
Fishing – open water	5	3	8	16	8.3
Ice fishing	0	1	1	2	1.0
Motor boating	3	6	3	12	6.3
Jet skiing	1	0	0	1	0.5
Relaxing/entertaining	34	7	4	45	23.4
Nature viewing	6	14	4	24	12.5
Hunting	0	2	3	5	2.6
Water skiing/tubing	6	9	3	18	9.4
Sailing	1	1	2	4	2.1
Canoeing/kayaking/stand-up paddleboard	0	7	10	17	8.9
Swimming	8	11	15	34	17.7
Snowmobiling/ATV	1	1	6	8	4.2
Other	3	2	1	6	3.1
None are important to me	0	0	0	0	0



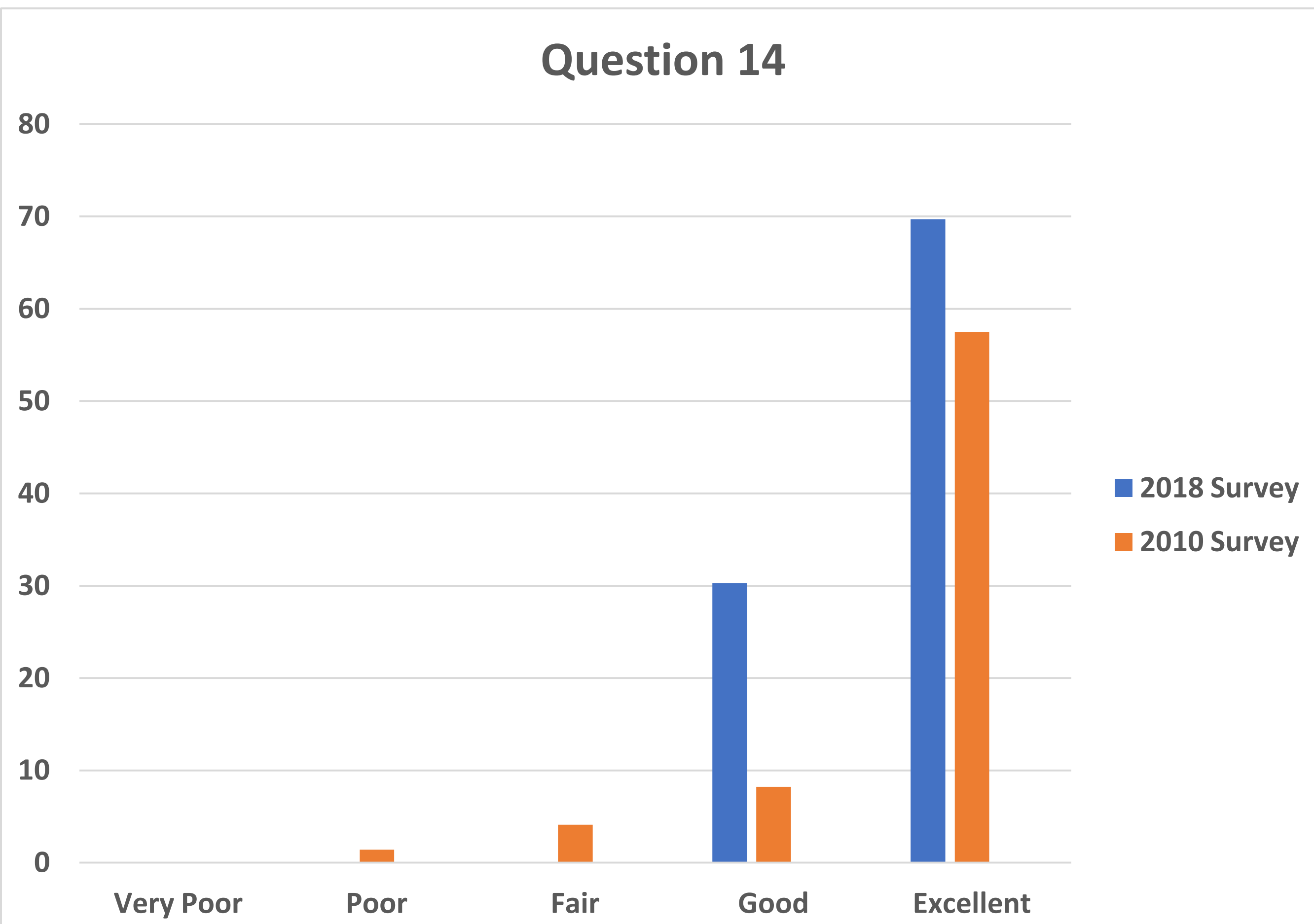
Big Portage Lake Current and Historic Condition, Health, and Management

The questions in this section are intended to gauge your perspective on the current and past condition of Big Portage Lake and what factors you believe are impacting Big Portage Lake's health. Please answer all questions to the best of your knowledge.

14. How would you describe the overall current water quality of Big Portage Lake? Please select one response on the scale below.

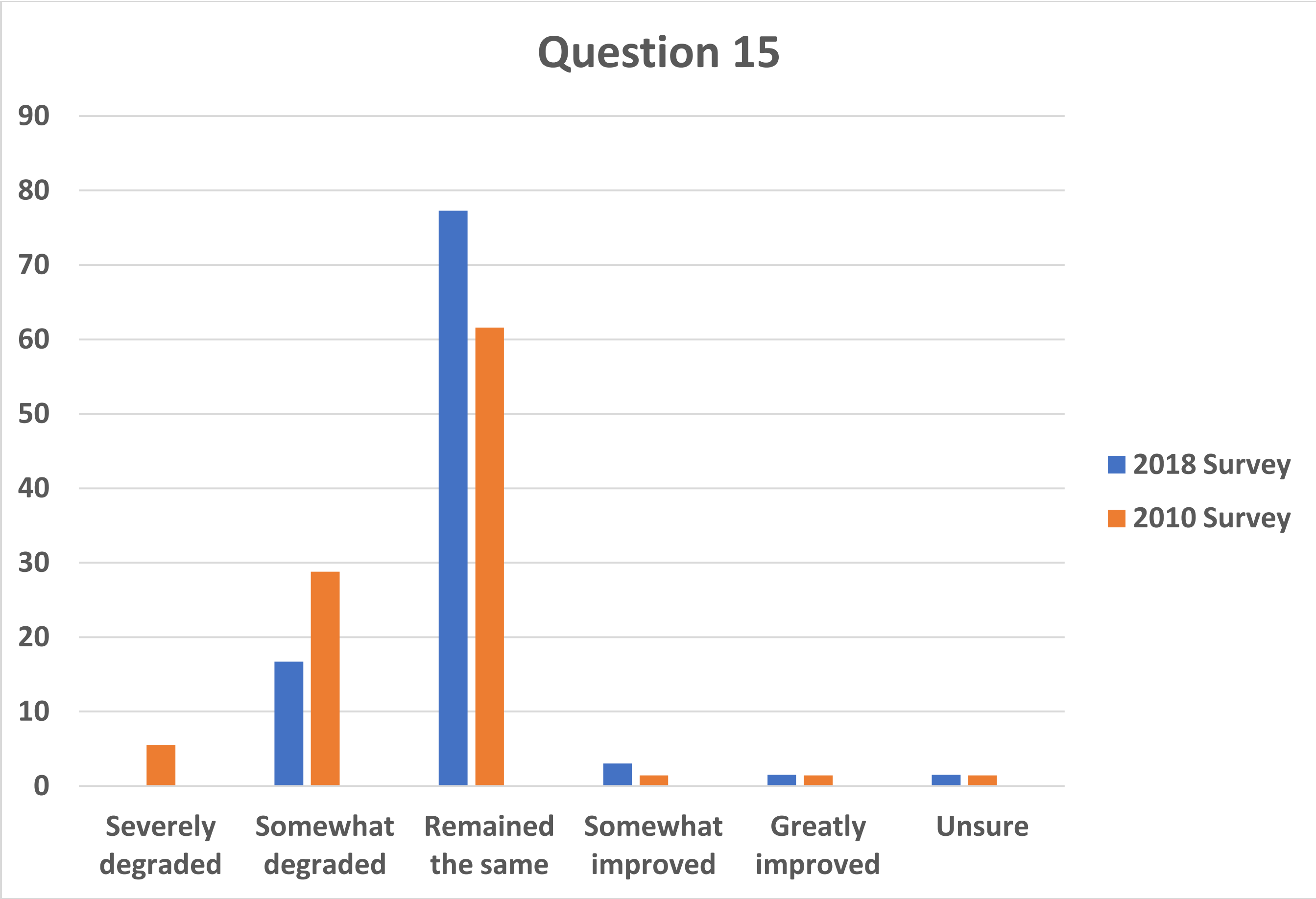
	2018 Survey		2010 Survey	
	Total	% N=66	Total	% N=73
Very Poor	0	0	*	*
Poor	0	0	1	1.4
Fair	0	0	3	4.1
Good	20	30.3	6	8.2
Excellent	46	69.7	42	57.5
Unsure	0	0	21	28.8

*Category not an option in 2010



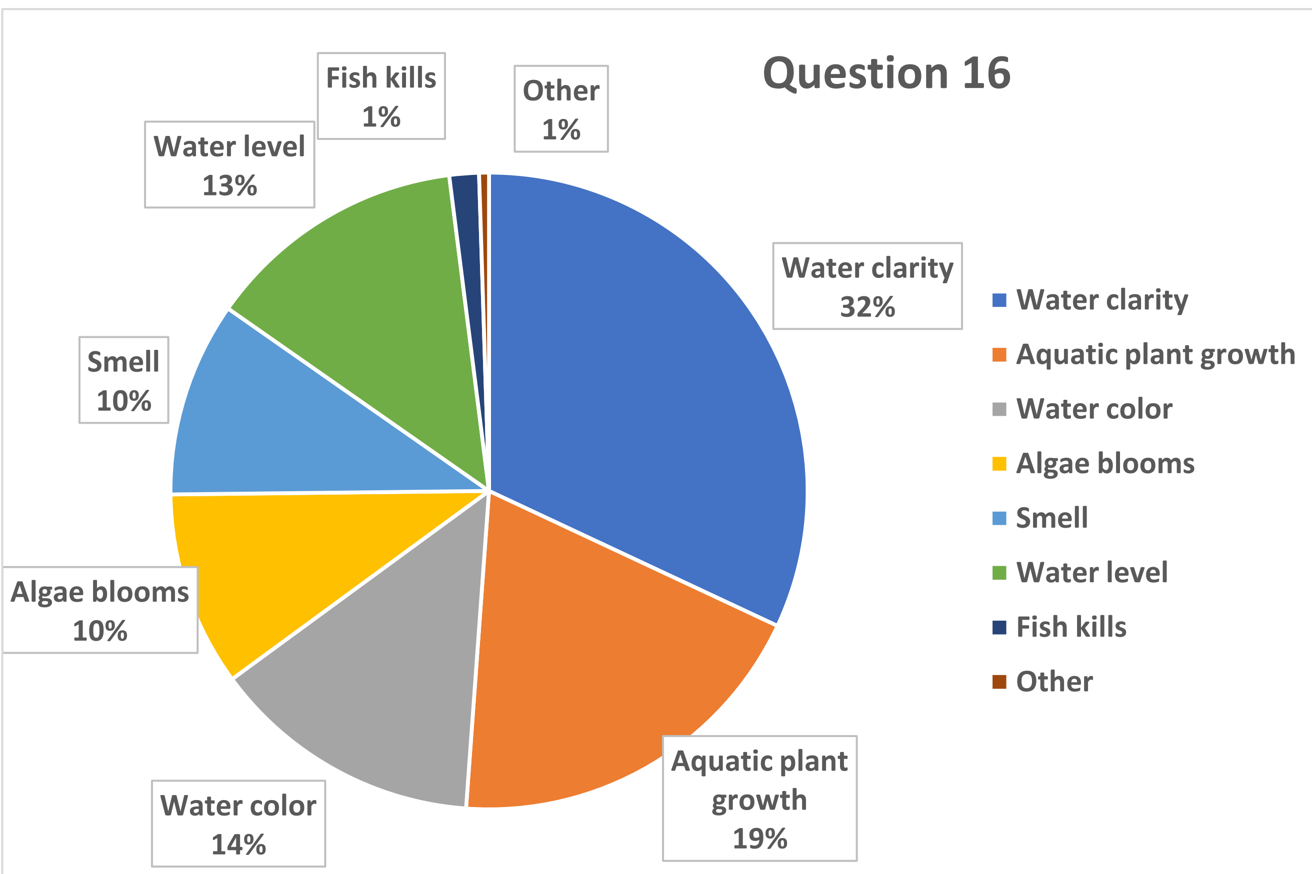
15. How has the overall water quality changed in Big Portage Lake since you first visited the lake? Please select one response on the scale below.

	2018 Survey		2010 Survey	
	Total	% N=65	Total	% N=73
Severely degraded	0	0	4	5.5
Somewhat degraded	11	16.7	21	28.8
Remained the same	51	77.3	45	61.6
Somewhat improved	2	3.0	1	1.4
Greatly improved	1	1.5	1	1.4
Unsure	1	1.5	1	1.4



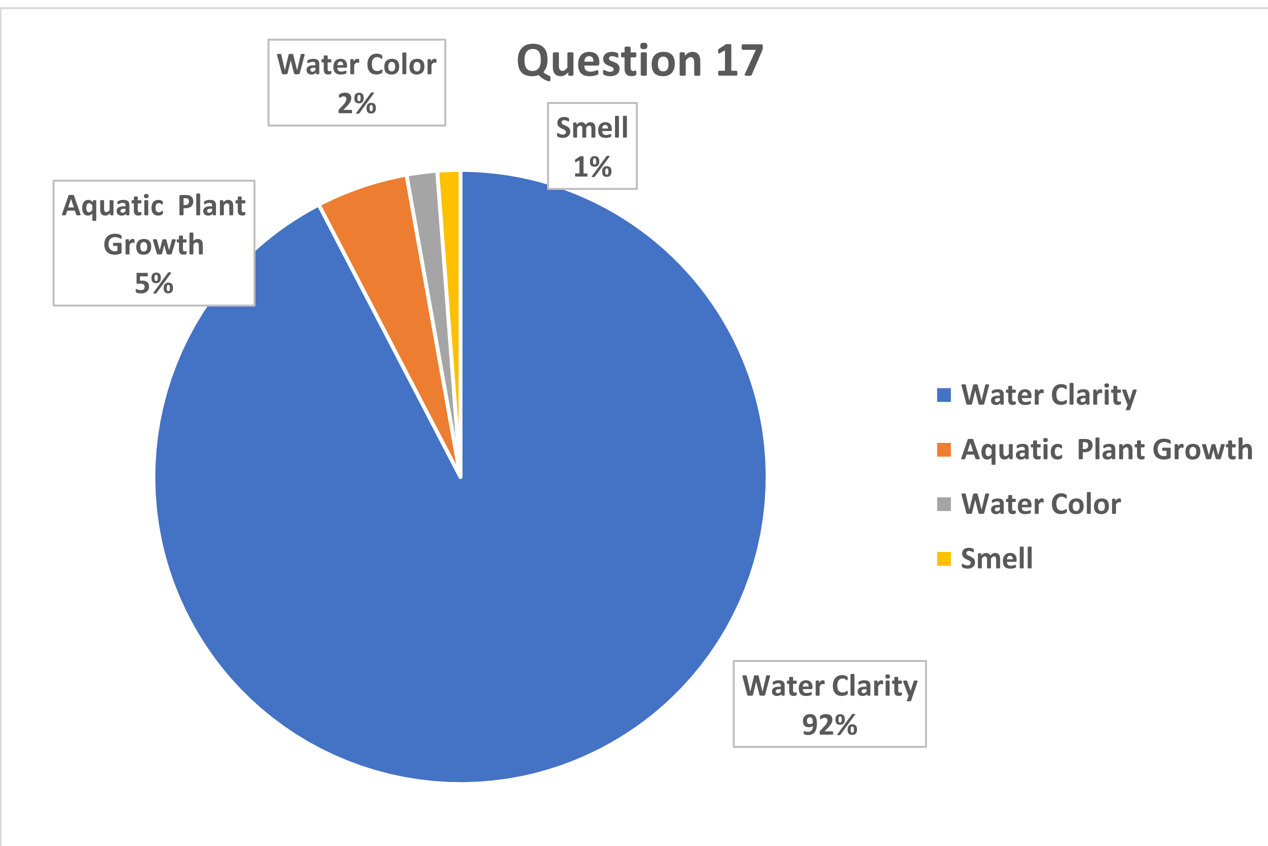
16. Considering how you answered the previous questions, what do you think of when assessing water quality?
Please select all that apply.

	Total	Normalized %
Water clarity (clearness of water)	65	32.0
Aquatic plant growth (not including algae blooms)	39	19.2
Water color	28	13.8
Algae blooms	20	9.9
Smell	20	9.9
Water level	27	13.3
Fish kills	3	1.5
Other	1	0.5
Respondents	68	
Responses	203	



17. Based on your answer above, which of the following answers is the single most important aspect when considering water quality? Please select one.

	Total	% N=68
Water clarity (clearness of water)	57	91.9
Aquatic plant growth (not including algae blooms)	3	4.8
Water color	1	1.6
Algae blooms	1	1.6
Smell	0	0
Water level	0	0
Fish kills	0	0
Other	0	0



Aquatic invasive species (AIS) are non-native plants and animals that are introduced into our lakes and streams and can potentially upset the natural balance of a lake ecosystem while decreasing recreational opportunities. Examples of AIS include animals such as carp, zebra mussels, rusty crayfish, round goby, and spiny water flea; and plants such as Eurasian watermilfoil, purple loosestrife, and curly-leaf pondweed.

18. Prior to receiving this survey, had you ever heard of aquatic invasive species? Please circle one answer.

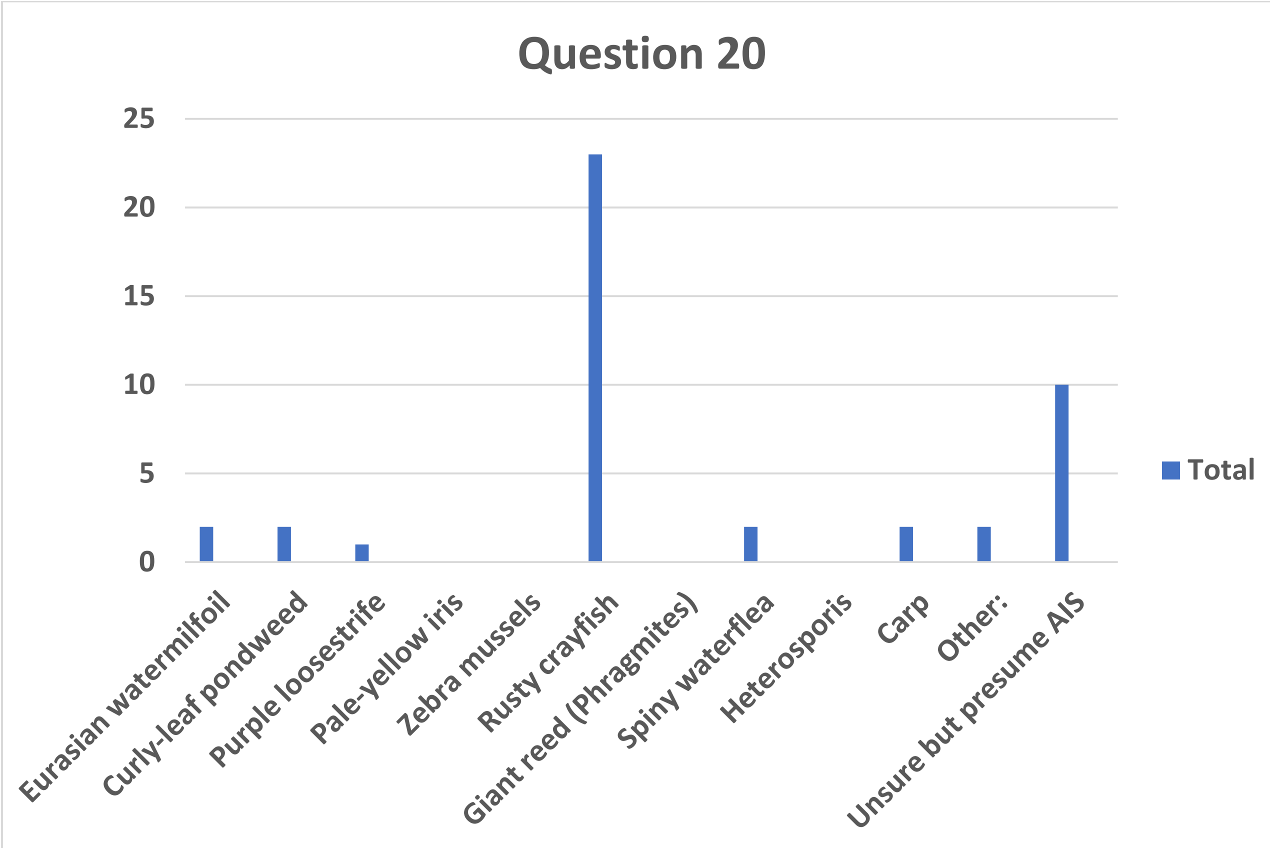
	2018 Survey		**2010 Survey**	
	Total	**% N=68**	**Total**	**% N=73**
Yes	67	98.5%	72	98.6
No	1	1.5%	1	1.4

19. Do you believe aquatic invasive species are present within Big Portage Lake? Please circle one answer.

	Total	**% N=64**
Yes	17	26.6
No	32	50.0
I think so but am not certain	15	23.4

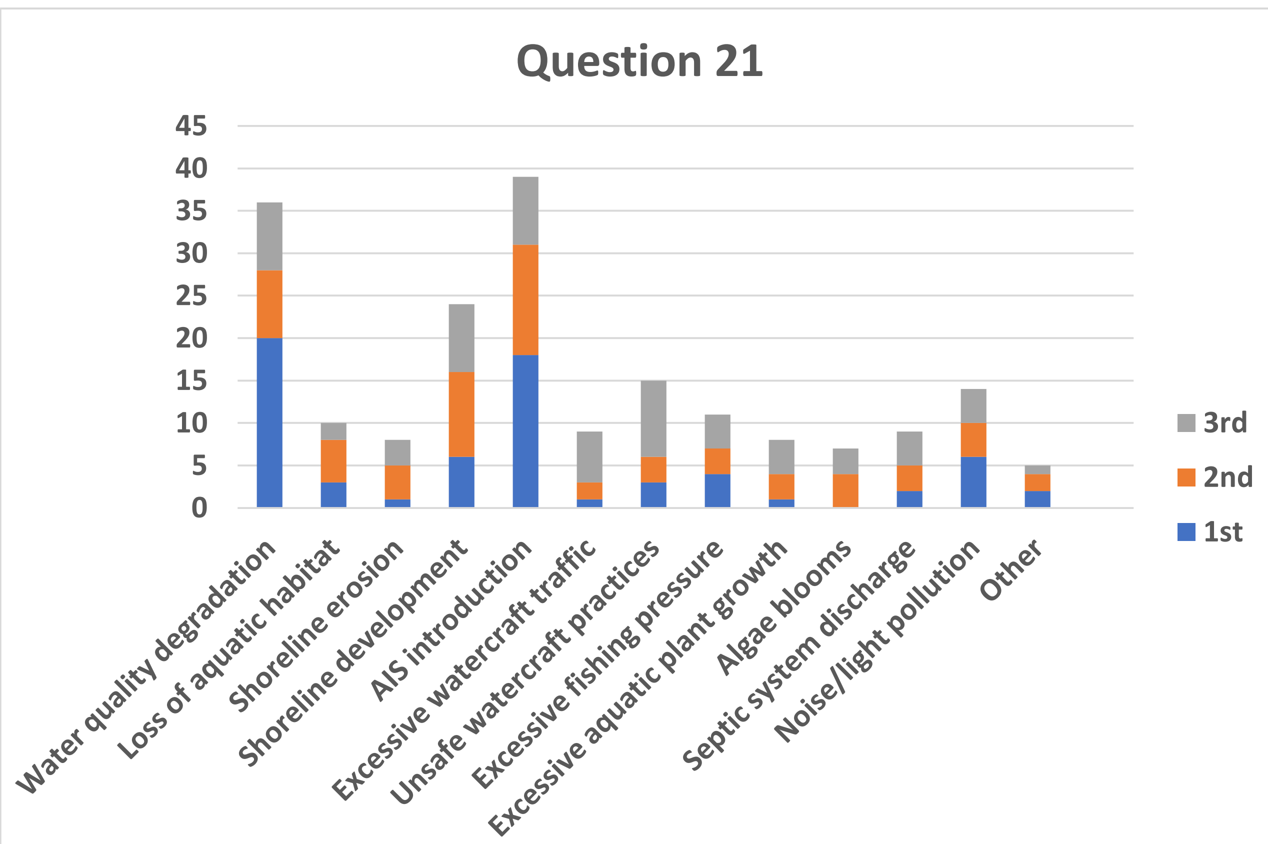
20. Which aquatic invasive species do you believe are in Big Portage Lake? Please select all that apply.

	Total	**Normalized %**
Eurasian watermilfoil	2	4.6
Curly-leaf pondweed	2	4.6
Purple loosestrife	1	2.3
Pale-yellow iris	0	0.0
Zebra mussels	0	0.0
Rusty crayfish	23	52.3
Giant reed (*Phragmites*)	0	0.0
Spiny water flea	2	4.6
Heterosporis (Yellow perch parasite)	0	0.0
Carp	2	4.6
Other:	2	4.6
Unsure but presume AIS to be present	10	22.7
Respondents	33	
Responses	44	


Question 20
25
20
15
10
5
0
Total
Eurasian watermilfoil
Curly-leaf pondweed
Purple loosestrife
Pale-yellow iris
Zebra mussels
Rusty crayfish
Giant reed (Phragmites)
Spiny waterflea
Heterosporis
Carp
Other:
Unsure but presume AIS

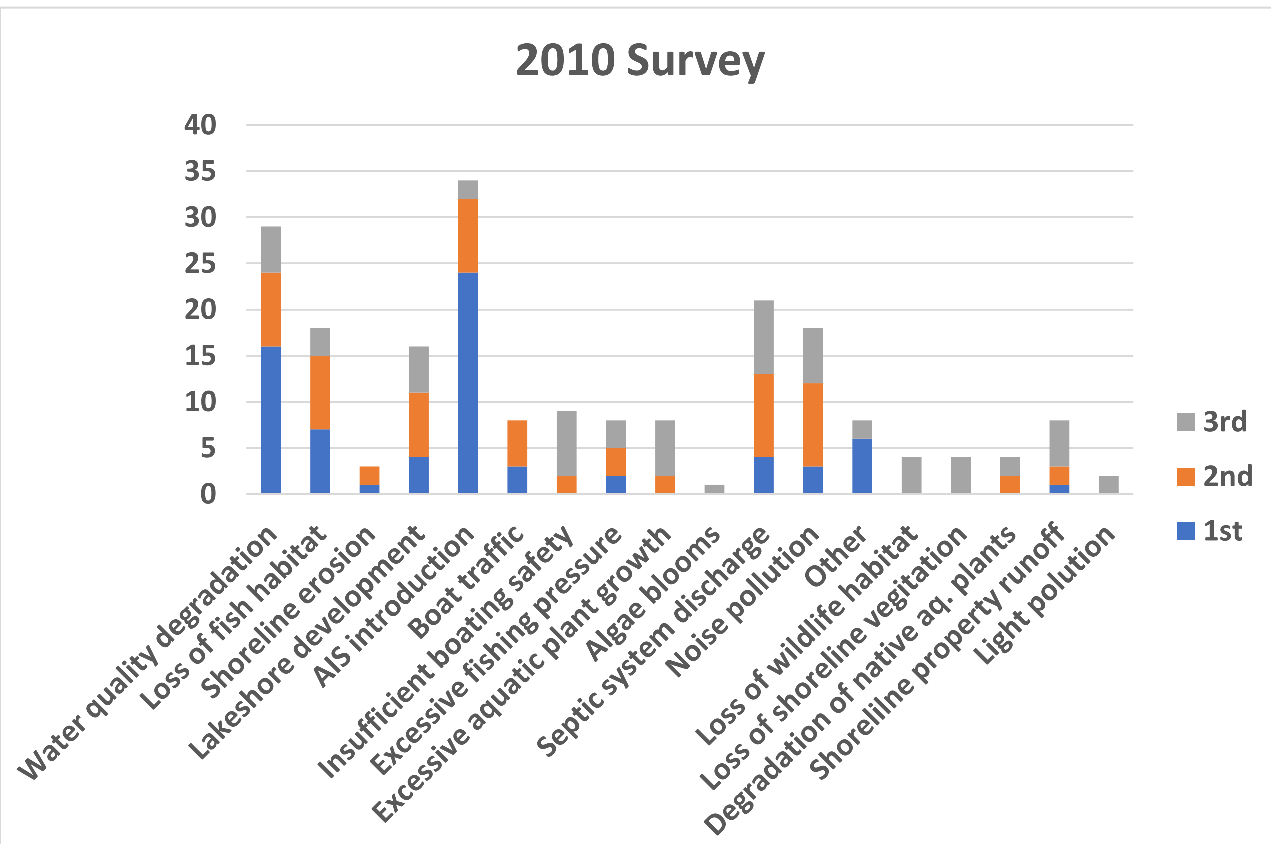
21. From the list below, please rank your top three concerns regarding Big Portage Lake. Please enter the letters below in order of concern with 1 being your top concern.

	1st N=67	2nd N=64	3rd N=64	Total N=195	%Ranked
Water quality degradation	20	8	8	36	18.5
Loss of aquatic habitat	3	5	2	10	5.1
Shoreline erosion	1	4	3	8	4.1
Shoreline development	6	10	8	24	12.3
Aquatic invasive species introduction	18	13	8	39	20.0
Excessive watercraft traffic	1	2	6	9	4.6
Unsafe watercraft practices	3	3	9	15	7.7
Excessive fishing pressure	4	3	4	11	5.6
Excessive aquatic plant growth (ex. algae)	1	3	4	8	4.1
Algae blooms	0	4	3	7	3.6
Septic system discharge	2	3	4	9	4.6
Noise/light pollution	6	4	4	14	7.2
Other	2	2	1	5	2.6



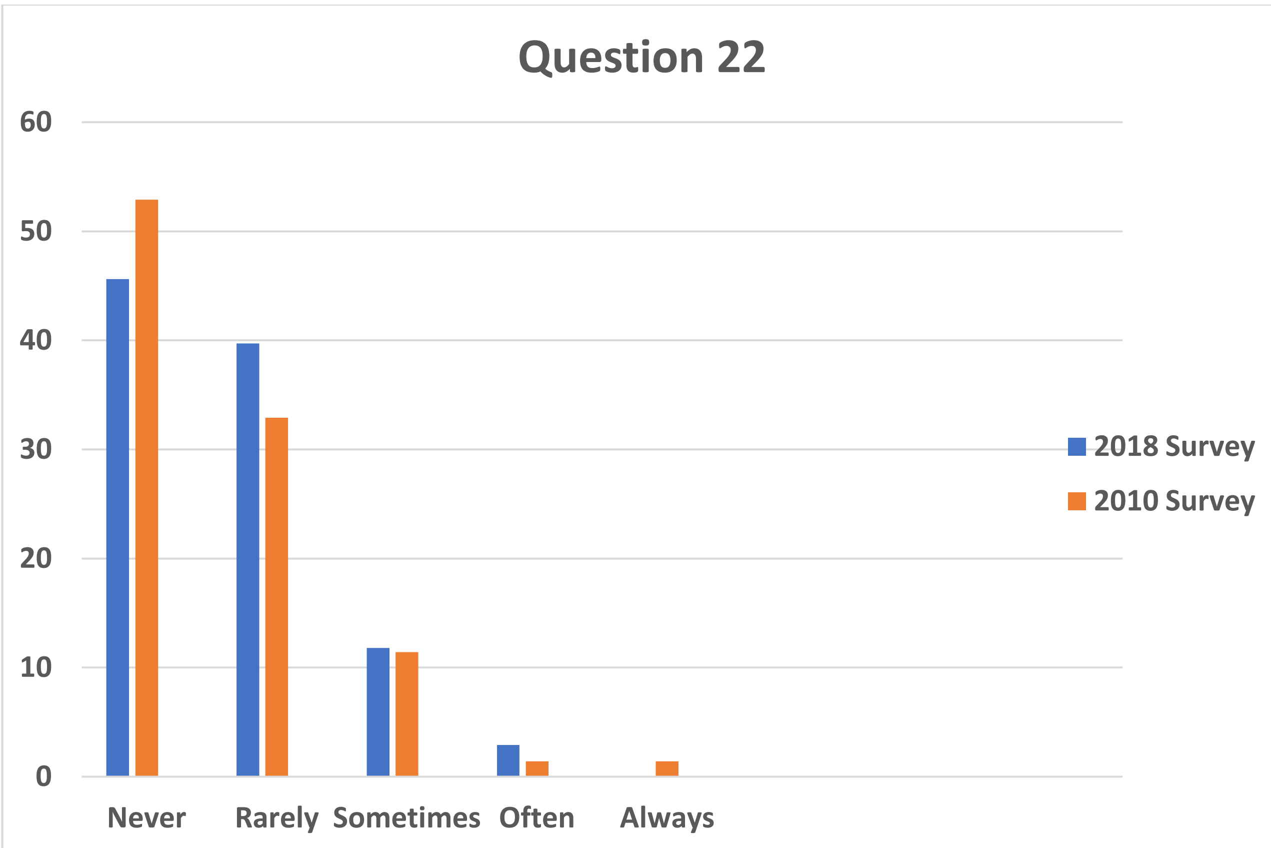
Question 21 in the 2018 survey was similar to Question 18 in the 2010 survey. The 2010 survey results for that similar question are shown below.

	2010 Survey				
	1st N=67	**1st N=71**	**2nd N=68**	**3rd N=65**	**%Ranked**
Water quality degradation	20	16	8	5	14.2
Loss of aquatic habitat	3	7	8	3	8.8
Shoreline erosion	1	1	2	5	3.9
Shoreline development	6	4	7	5	7.8
Aquatic invasive species introduction	18	24	8	2	16.7
Excessive watercraft traffic	1	3	5	0	3.9
Unsafe watercraft practices	3	0	2	7	4.4
Excessive fishing pressure	4	2	3	3	3.9
Excessive aquatic plant growth	1	0	2	6	3.9
Algae blooms	0				
Septic system discharge	2	4	9	8	10.3
Noise/light pollution	6	3	9	6	8.8
Other	2				



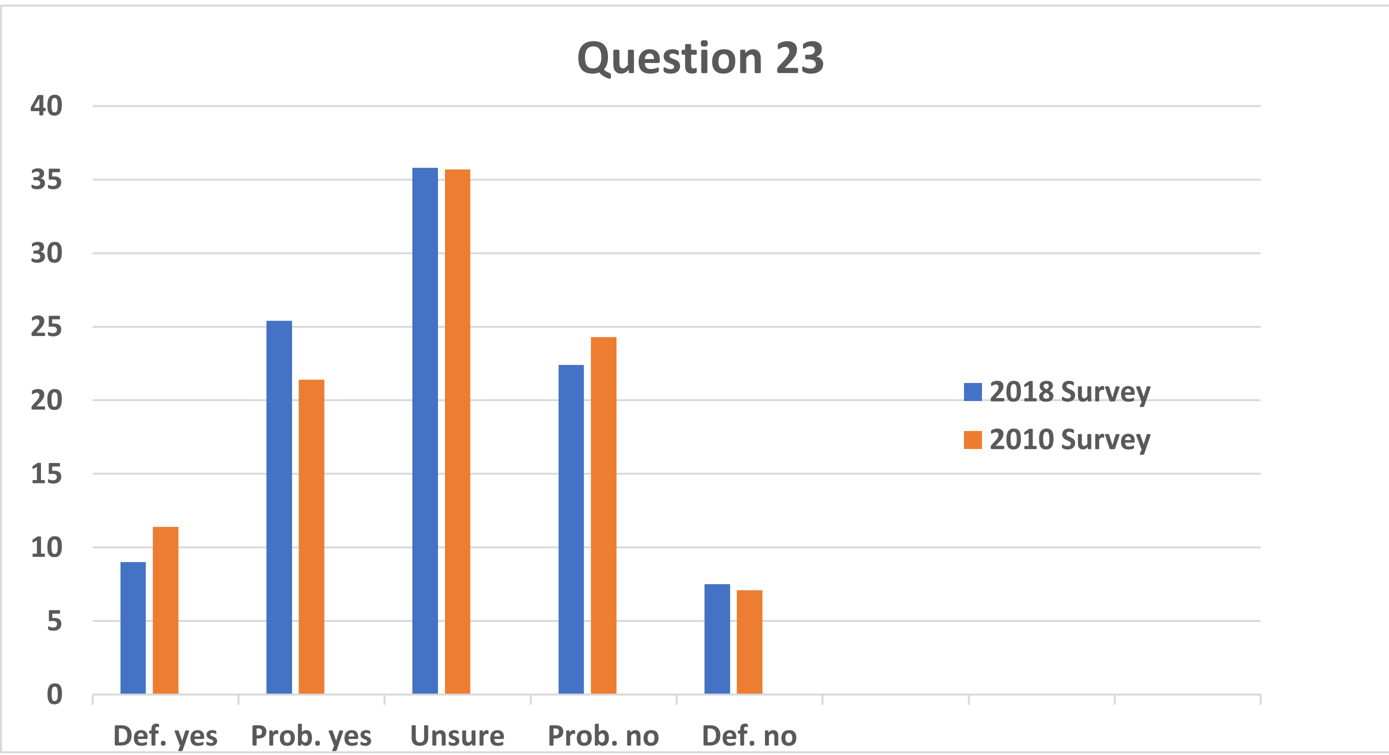
22. **During open water season how often does aquatic plant growth, including algae, *negatively* impact your enjoyment of Big Portage Lake?** Please circle one number on the scale below.

	2018 Survey		2010 Survey	
	Total	% N=68	Total	% N=70
Never	31	45.6	37	52.9
Rarely	27	39.7	23	32.9
Sometimes	8	11.8	8	11.4
Often	2	2.9	1	1.4
Always	0	0.0	1	1.4



23. Considering your answer to the question above, do you believe aquatic plant control is needed on Big Portage Lake? Please circle one number on the scale below.

	2018 Survey		2010 Survey	
	Total	**% N=67**	**Total**	**% N=70**
Definitely yes	6	9.0	8	11.4
Probably yes	17	25.4	15	21.4
Unsure	24	35.8	25	35.7
Probably no	15	22.4	17	24.3
Definitely no	5	7.5	5	7.1



Big Portage Lake Riparian Owners Association (BPROA)

The Big Portage Lake Riparian Owners Association (BPLROA) was established in the 1990s to preserve and protect Big Portage Lake and its surroundings for today and future generations. The BPLROA strives to educate property owners about issues that may affect the quality of life on Big Portage Lake and, as an Association, work to change or eliminate those factors that threaten this quality.

24. Before receiving this mailing, had you ever heard of the BPLROA? Please circle one answer.

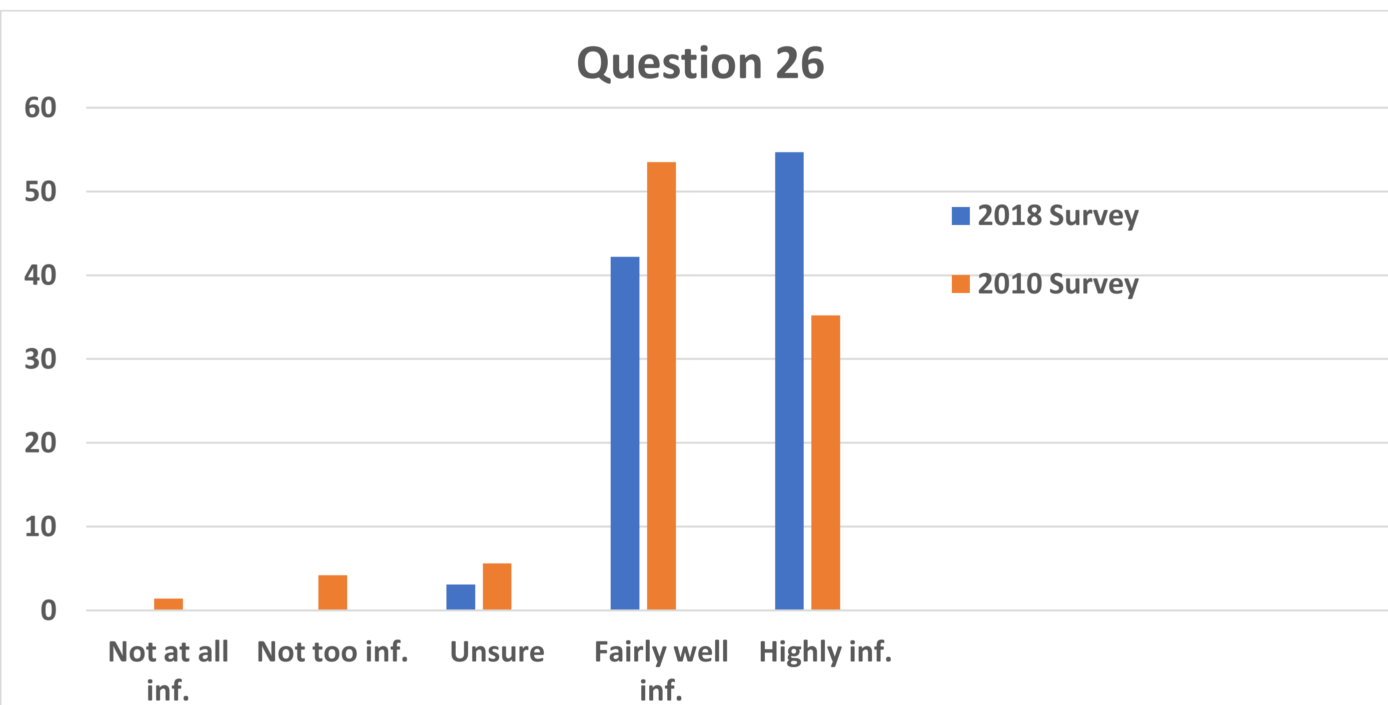
	2018 Survey		**2010 Survey**	
	Total	**% N=67**	**Total**	**% N=73**
Yes	65	97.0%	73	100.0
No	1	3.0%	0	0.0

25. What is your membership status with the BPLROA? Please circle one choice.

	2018 Survey		**2010 Survey**	
	Total	**% N=65**	**Total**	**% N=72**
Current member	62	97.0%	66	91.7
Former member	2	3.0%	4	5.6
Never been a member	1	1.5	2	2.8

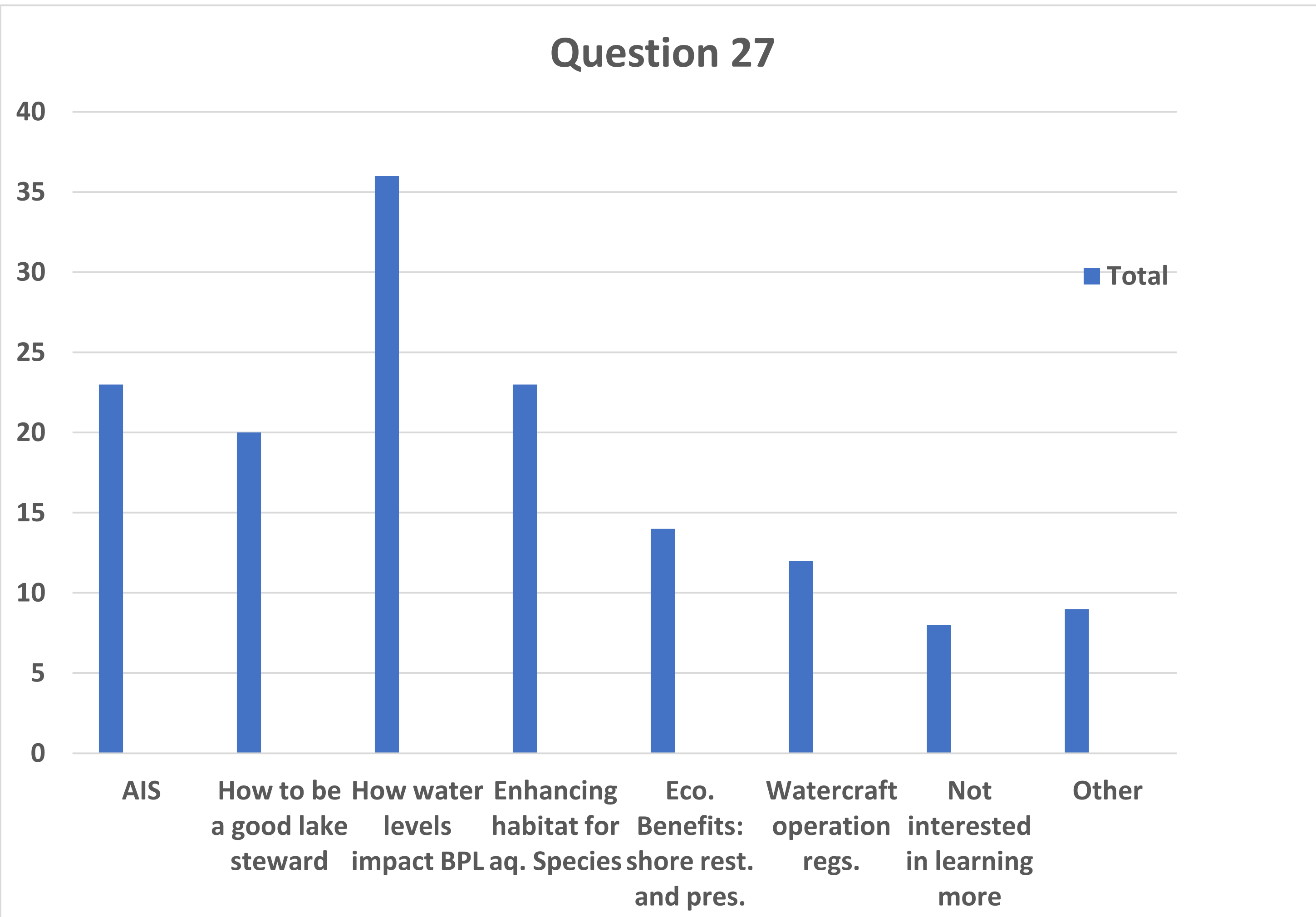
26. How informed has (or had) the BPLROA kept you regarding issues with Big Portage Lake and its management? Please select one number on the scale below.

	2018 Survey		**2010 Survey**	
	Total	**% N=64**	**Total**	**% N=71**
Not at all informed	0	0.0	1	1.4
Not too informed	0	0.0	3	4.2
Unsure	2	3.1	4	5.6
Fairly well informed	27	42.2	38	53.5
Highly informed	35	54.7	25	35.2



27. Education is an important component of every lake management planning effort. Which of these subjects would you like to learn more about? Please select all that apply.

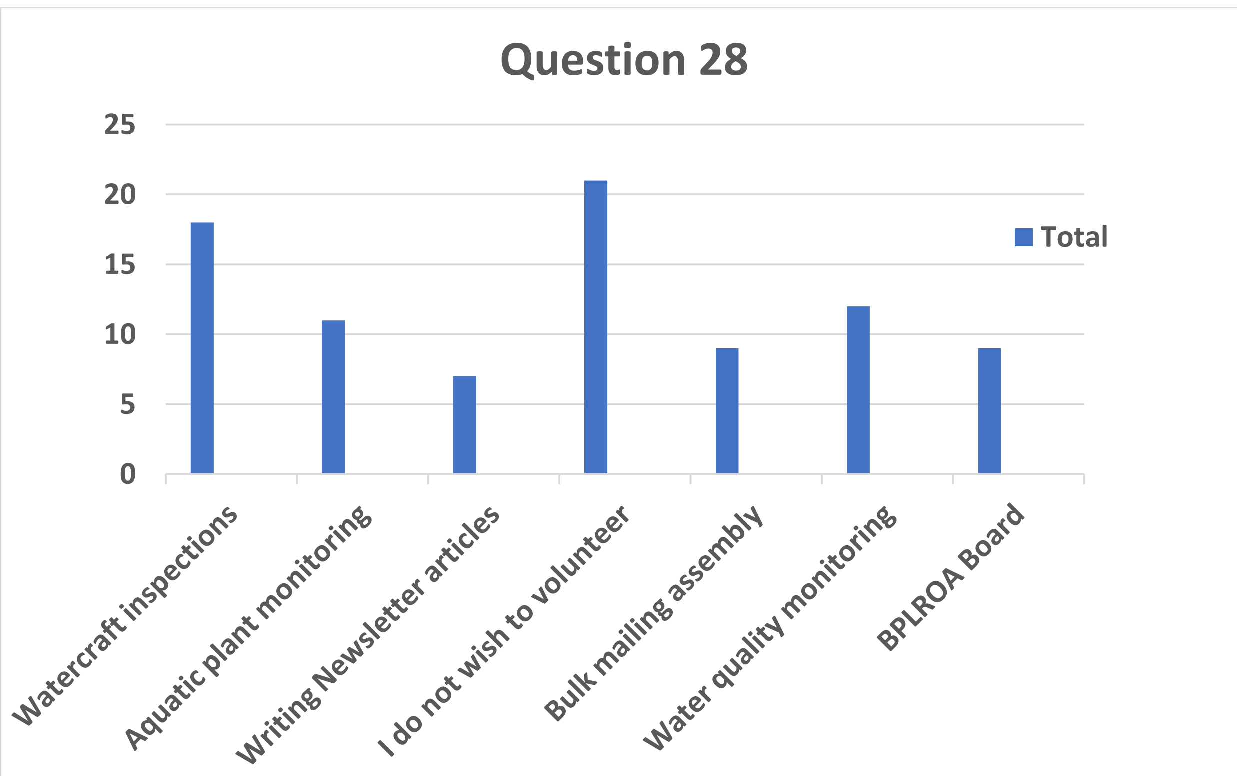
	Total	Normalized %
AIS impact, means of transport, identification, control options, etc.	23	15.9
How to be a good lake steward	20	13.7
How changing water levels impact Big Portage Lake	36	24.8
Enhancing in-lake habitat (not shoreland or adjacent wetlands) for aquatic species	23	15.9
Ecological benefits of shoreland restoration and preservation	14	9.7
Watercraft operation regulations – lake specific, local and statewide	12	8.3
Not interested in learning more on any of these subjects	8	5.5
Some other topic (please specify)	9	6.2
Respondents	66	
Responses	145	



28. Please note that because this survey is anonymous, your answer to this question will not be regarded as a commitment to participate, but instead will be used to gauge ***potential*** participation in the BPLROA.

The effective management of Big Portage Lake will require the cooperative efforts of numerous volunteers. Please circle the activities you would be willing to participate in if the BPLROA requires additional assistance.
Please select all that apply.

	Total	Normalized %
Watercraft inspections at the boat landing	18	20.7
Aquatic plant monitoring	11	12.6
Writing Newsletter articles	7	8.0
I do not wish to volunteer	21	24.1
Bulk mailing assembly	9	10.3
Water quality monitoring	12	13.8
BPLROA Board	9	10.3
Respondents	55	
Responses	87	



29. **Please feel free to provide written comments concerning Big Portage Lake, its current and/or historic condition, and its management.** Please use an additional sheet if necessary.

Question	Comment
2	Year-round vacation home
2	Get there when I can
2	Year-round vacation home
2	Year-round vacation home
3	Family-generational owners. 113 years 1st home. 28 years 2nd home
3	Total family
5	Emptied every 3 years, mandated
6	Basically, since I was born
8	Does not visit lake but has these questions: Is area open to native American spear fishing? Other? Is aquatic like all about what is was 200 years ago? Has air pollution affected lake Is land around lake subject legally to mining?
8	It used to be a walleye lake. Now mostly small mouth.
12	Do not leave BPL
12	Do not go to other lakes
12	Do not go to other lakes
12	Never leaves BPL
12	Boat unused many years, stored
13	Dedicated family time. Time currently very limited at BPL. Hopeful that retirement time will allow for time to dedicate to BPLROA activities.
13	Been in family a long time
13	Dedicated family time
13	XC skiing
13	history, always been on this lake
13	Have been absent many years. If active would have swum, canoe, sail
13	Wood cutting
13	Quiet!
14	Have been absent many years. Do not visit.
20	Northern pike
20	Rely on BPLROA for information
21	when will lake be stocked with fish?
21	fish spearing
21	Spearing
21	Northern pike
21	Future
21	Jet skis and fireworks discharge
21	If living/using/visiting BP

21	Fish spearing
22	Do not visit
22	Vigilance
26	Newsletter
27	when will lake be stocked with fish?
27	Jet skis and fireworks discharge. Sale/acquisition of BPL properties and shoreline developments, including home renovations (lake noise)
27	How to inform outsider that use the boat landing on a daily basis of the importance of maintaining BP as a clean lake since it is their lake also
27	Is area open to native -American spear fishing? Other? Ceded territory. Is aquatic life about wat it was 200 years ago? Has air pollution affected lake? Is land around lake subject (legally) to mining?
28	Already participating
28	Past BPLROA board member. Done my time
28	Have not visited for many years. Undeveloped property

Don't let John Alt get away. I will always give him my proxy if necessary.
Thank you for all you do for Big Portage Lake
Excellent management. Lucky to be here. Prettiest lake I've seen. Only one I'll swim in.
What is the plan of action if we should find invasive species in BPL?
Awesome lake. Want to keep it that way.
Concern about spreading invasives in the spring and fall when marinas deliver and pick up ponton boats and use the same trailers from one lake to the next. How likely can invasives be spread by ice fisherman? Concerned about the number of fish in the lake, between spearing and limits (high), we need to plan and preserve for the future.
Although fishing is not great, I would prefer not to stock the lake. Keep the strain of walleye as pure as possible. Possibly change slot sizes or limits?
Requested address update
One of my concerns on spreading invasives on our lake is in the spring and fall when marinas deliver and pick up pontoon boats and use the same trailers from one lake to the next. Also, hour likely can invasives be spread by ice fisherman? I am concerned about the number of fish on the lake, between spearing and limits (high), we need to plan and preserve for the future.
Thank you for all that you do for Big Portage Lake
BPLROA Board does a great job, especially communicating and staying on top of things. Concerned about deteriorating walleye fishing despite DNR surveys indicating stable population and good natural reproduction. DNR creel survey showed three times more hours of fishing effort needed to harvest a walleye than 10 years ago.
Thanks to all of you who put so much effort into monitoring aquatic invasive species and working with the DNR lake management plans. We all benefit so much from your dedication
The past 35 years, the quality of life on Big Portage Lake has significantly decreased due to

these factors: Fireworks being used all summer, not just on July4. They are often ignited late at night after 10 pm. The local sheriff's number should be included in future newsletter so that lake residents can report these violations. Jet skis. They aren't driven like motorboats. They come close to shore, ridden in circle and appear any time of day including calm of morning and evening. Other lakes have implemented jet ski hours. Why can't BPLROA Construction and renovation. New home construction or existing home renovation besieges the lake. Notices of who is undergoing lake house renovation can help resident prepare for it and plan around it. Former peace and quiet is now the exception Thankfully lake water quality seems good. Thank you for sending this survey.
Please stick to talking about actual lake topics not things like ATVs or government.
1. large suckers in water like near before - from fishing? Swim on top or are dead bottom 2. more algae by end summer - can see much more distinctly then in past years 3. don't personally fish now but our past years folks tell me less fish. Minimal bass ever caught. when I was 10, I caught 3 bass (in 1970s) 4. concern renters don't care about invasive plants, or wildlife etc. Renters lack of connection to lake affects quality - no interest in protecting from e.g. Eurasian milfoil
Fishing fish are larger but numbers are down. Best spring was 2006 over 100 walleye one Memorial Day weekend since only about 12
I am not sure how many homes are legally (by permit) available to rent but the BPLROA needs to encourage landlords to inform would be renters of invasive species, the courtesy code and simple respect the lake and its residents. He has a special gem and visitors need to respect that. Landlords should want that too because the lake beauty and serenity is what brings the renters. While conflict is never desired, I think BPLROA should encourage residents to be vigilant and proactive. It's the best way to protect what we have. Visitors should understand that if you bring a party boat to the landing, we will call the DNR. If you take smallmouth out of season, we will call the DNR. If you are going to light fireworks out of season, we will call the sheriff. I think residents are getting passive and the overall lake experience is slowly deteriorating because of it.
Keep up the good work
My main concern is the road conditions. Little Portage lake Ro9ad is awful. Berry Road has not been repaved since the original pavement which was done in the late 60s. Snow plowing is another concern. The town continues to plow us in. The also refuse to widen the road so that only one car can drive down certain areas. We would appreciate any help the board can give us.
when it was a closed lake (no public access) water quality was the best. Management good, grateful for our board and volunteers. Need some regulations about throwing things into water 0 plastic baggies and trash. Hitting golf balls into the lake and they sit there on the bottom falling open. but how would you even prevent this put it in bulletin?
from newsletter, BPLROA is serving an important oversight activity for a healthy lake system

that benefits all who use the lake
BPLROA was established in 1976 as organizing committee and its fully functional board was in 1976. The BPLROA was formed far earlier than the 1990s stated in this survey. As previous survey was made to establish the previous lake management of which this survey is to part of the new continuous lake management survey. Would have nice to have some questions from that survey to establish a continuous basepoint which I feel this survey does not provide. The lake is very serious in making sure no invasive species enter BP as we participate in a watercraft monitoring in cooperation with the WI DNR. There are several volunteers from the lake that participate in this program. There are older people who do not have computers or use electronic stuff so a definite mailing address is needed plus a time period we can get the results the survey. I got this survey about August 15th. I think itis kinds of short time to get the survey back by August 31st. How many surveys sent out? How many surveys are expected to be returned? How many are needed to viable conclusions? There is strong management on BP thru a volunteer board who believes in the lake and many residents of the lake who are not on the lake and are willing to volunteer when called upon.
Time very limited at BPL. Hopeful that retirement time will allow for time to dedicate to BPLROA activities.
Please make sure my address is corrected on your files. We do not get mail at our LOL address. As an association you need to be more on top of this.