Aquatic Vegetation Survey 2023
Bass Lake

by

Tip of the Mitt Watershed Council

Survey performed and report written by Tip of the Mitt Watershed Council

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Table of Contents

List of Figures

List of Tables

Introduction

Aquatic plant communities are an important component of lake ecosystems. Submerged macrophytes, which are plants and algae large enough to be seen by the naked eye, provide food and shelter for other organisms within the ecosystem, such as fish and invertebrate communities. Like most plants, macrophytes supply oxygen to the ecosystem via photosynthesis. Macrophyte photosynthesis can also potentially reduce eutrophication in lakes through the uptake of nutrients, which decreases nutrient availability to phytoplankton (Canfield *et al*. 1984). By reducing the amount of nutrients in the water column, aquatic plants decrease the likelihood of algal blooms. Macrophytes also reduce effects of water turbulence (Canfield *et al*. 1984), helping to reduce erosion along shorelines and nearshore areas.

Lake ecosystems that do not have healthy and abundant macrophyte communities are less biologically diverse due to the lack of habitats and food resources on which aquatic organisms rely. Typically, a reduced abundance of macrophytes also corresponds with greater nuisance algae populations and increased erosion of the shoreline. Removal or loss of native plant communities could also make it more inviting for invasive species to dominate the ecosystem, which could further change the community structure.

Despite all the benefits of aquatic plant communities, an overabundance of aquatic plants, especially invasive species, can be detrimental to lake ecosystems. Excessive plant growth can disrupt recreational uses of the lake, such as boating, fishing, and swimming, as well as ecosystem functions like habitat for fish and other aquatic life. Lakes that contain excessive nuisance plant growth can sometimes benefit from integrated pest management programs to control the effects of the plant community.

Aquatic plants surveys are a way to understand the macrophyte community by recording plant species, abundance, density, and the presence of invasive species. This report details the work conducted in 2023, when Tip of the Mitt Watershed Council was contracted by the Bass Lake Association of Elk Rapids Township to carry out a full aquatic plant survey. The last plant survey done on Bass Lake by the Watershed Council occurred in 1992.

Study Area

Bass Lake is located on the northern side of the Village of Elk Rapids, between Elk Lake and Grand Traverse Bay, in the Grand Traverse Bay Watershed. It is a small inland lake, covering 144 acres with a 2-mile long shoreline. The maximum depth is 24 feet, located within the western basin of the lake. Bass Lake is a seepage lake, meaning it does not have an inlet or an outlet, and has a higher retention time than other lakes. The primary source of water is precipitation or runoff.

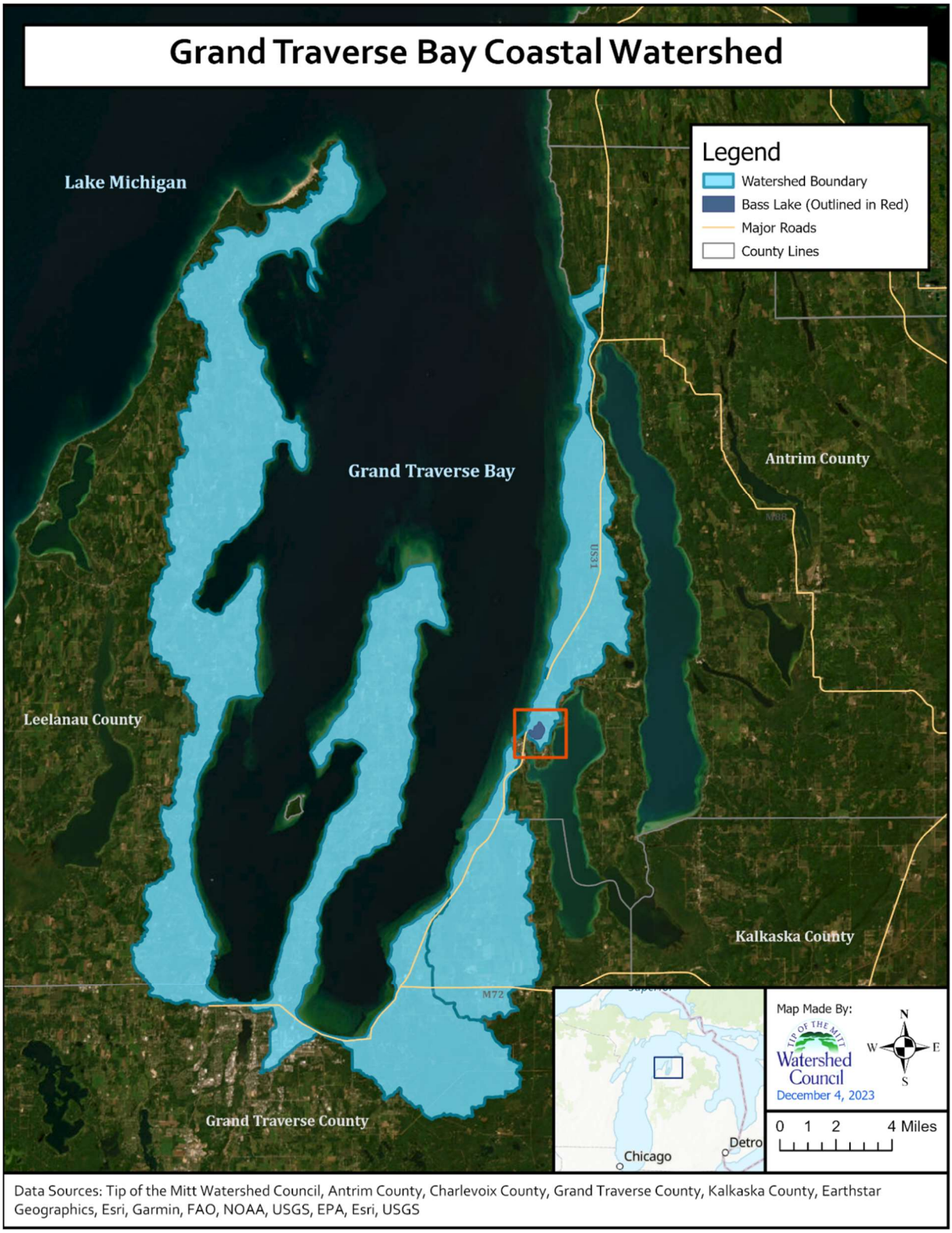

Figure 1: Map of Grand Traverse Bay Watershed with Bass Lake outlined.

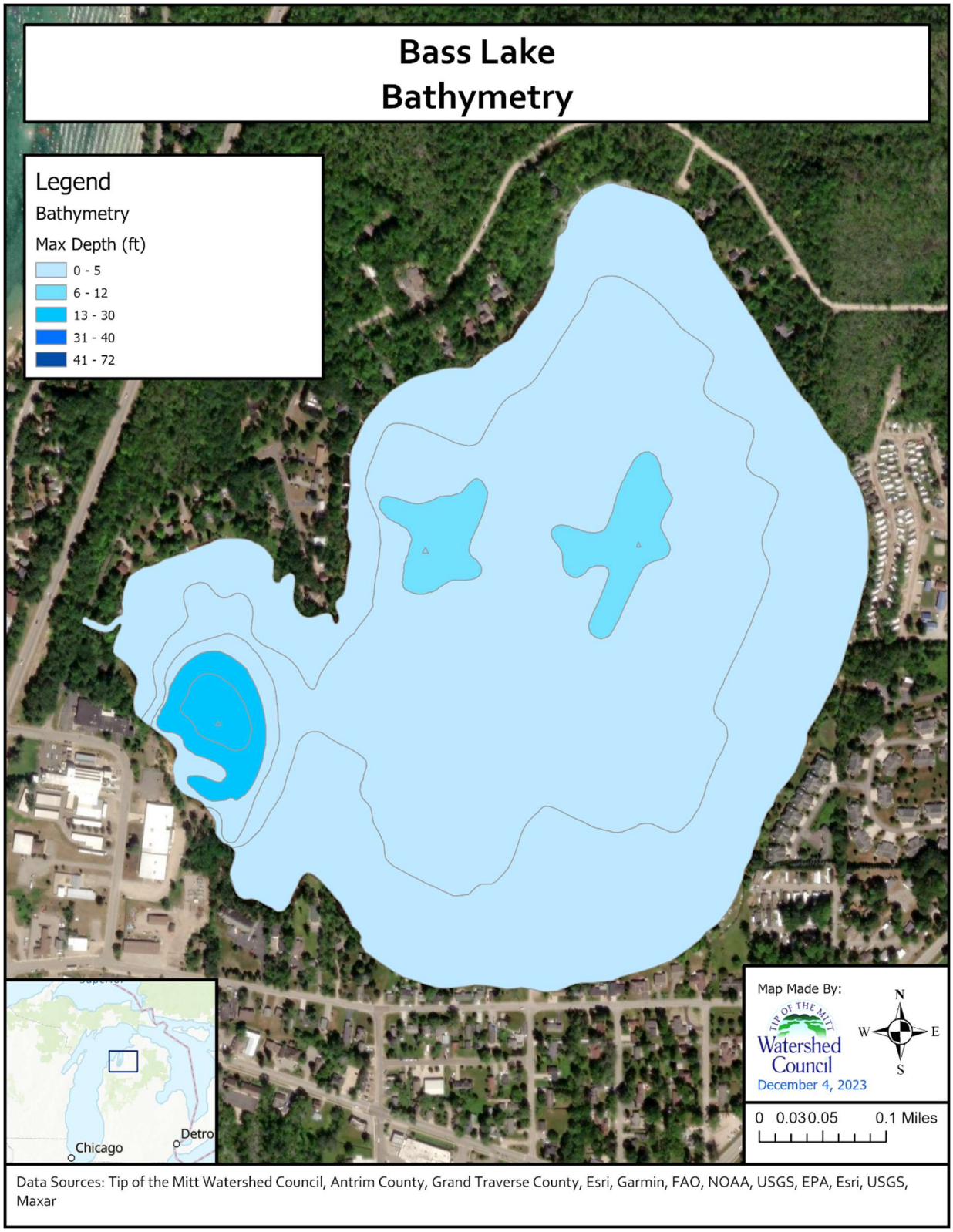

Figure 2: Map of the bathymetry of Bass Lake

Methods

The aquatic plant survey was conducted over 2 days in August of 2023. A total of 86 sites were sampled through all vegetated lake areas (Figure 3). Sample sites were determined by creating transects from the shore approximately 500 feet apart. Sample sites were chosen as close to the middle of plant communities as possible. Where communities were larger than what could be sampled at a single sample point, multiple samples were collected in the interior and edges of plant communities. At each sample site, the boat was anchored, usually with two anchors. Grappling rakes (made by attaching the head of a double-sided bow rake to a rope) were used as sampling devices and thrown in four directions from the boat to obtain a sufficient sample. Additional species sighted in the water but not represented in the grappled samples were noted in observations and included in density estimations.

All species present were recorded and assigned to one of seven possible density categories using the following subjective scale: 1- Very Light; 2- Light; 3- Light/Moderate; 4- Moderate; 5- Moderate/Heavy; 6- Heavy; 7- Very Heavy. The same scale was used to determine the overall density for a site using Very Light to indicate only a few stems and Very Heavy to indicate plants reaching the water's surface. No vegetation rake was thrown in areas where there was no visible vegetation. A majority of the specimens were identified in the field. Where specimens could not be identified in the field, a sample of the vegetation was collected in a sealable plastic bag, labelled with their corresponding site ID. Collected samples were later identified using dichotomous keys. All vascular plant specimens were identified to the species level except for irises (*Iris* species), which did not have the correct flower parts at the time of year sampled to be able to identify them accurately to species.

The location, data, and any photos associated with each sample point were recorded on iPads using Survey123 for ArcGIS. Survey123 collects quantitative, qualitative, and spatial information that makes creating, sharing, and analyzing surveys easy. Survey123 automatically created a geographic information system (GIS) shapefile with all information from the survey forms. Survey123 geopoints have a precision range of one square meter. The sample point layer was overlaid with an aerial map of Bass Lake and the surrounding area to display survey results. Density data for each sample point were displayed on the map to assess patterns and trends.

Line and point features, as well as photographs and field notes, were used to create polygons representing distinct plant communities. These polygons were created by hand in ArcGIS Pro version 3.1.3. ArcGIS Pro was also used to fix discrepancies in the field data including editing species names and checking comments for consistency. Plant community polygons were determined based on like characteristics in a lake area's plant assemblage and density. Attributes for plant community polygons included density, dominant community, other species present, and community description.

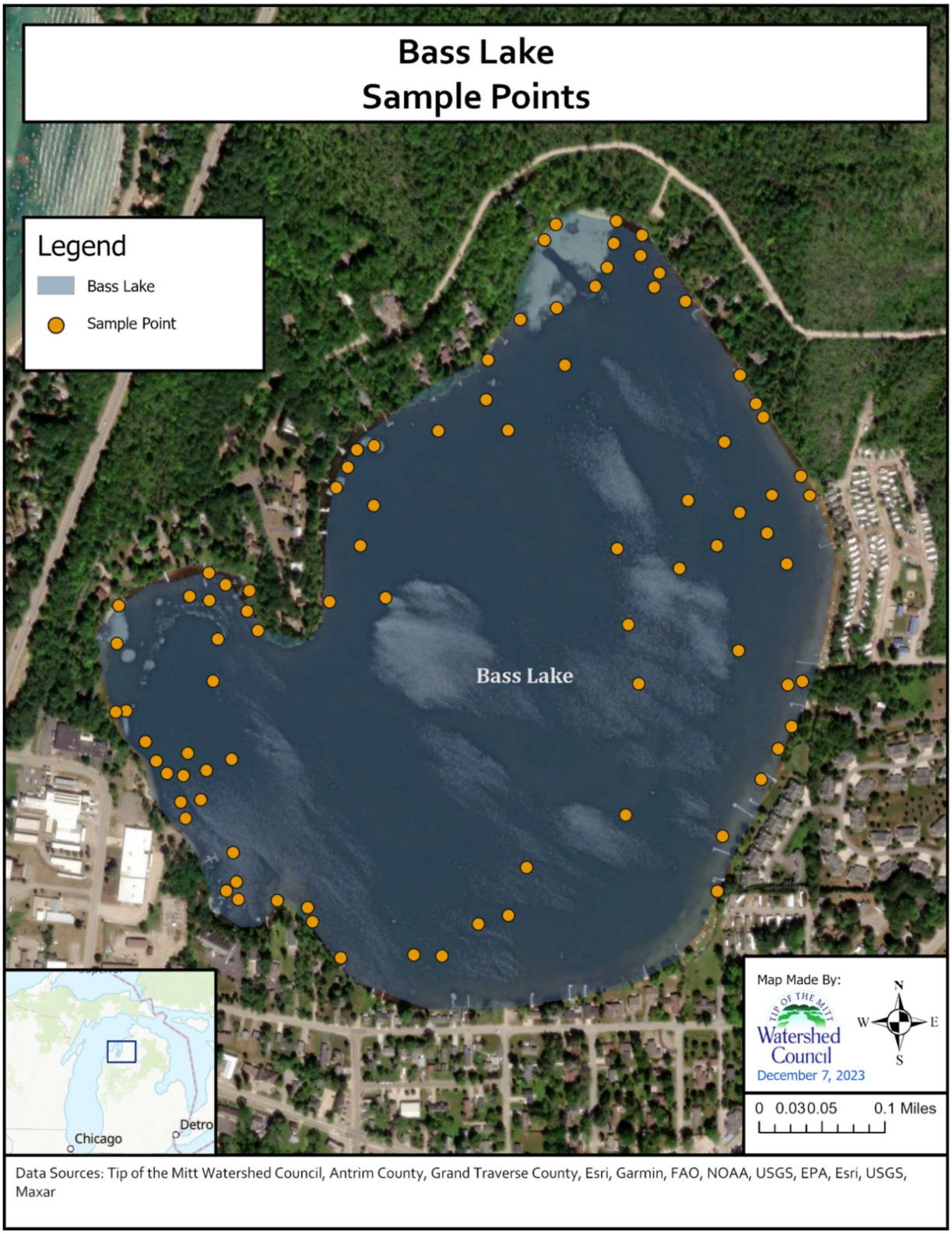

Figure 3: Map of sample sites form the Bass Lake Aquatic Vegetation Survey 2023.

Results

Sample Sites: Species and Density

In total, 20 taxa were found during the survey. Taxa refers to a taxonomic group in the classification of macrophytes, in this case, the genus or species. The most frequently found plant was muskgrass (*Chara spp.),* found at 54.7% of sites on Bass Lake (Table 1). The next three frequently-found plants on Bass Lake were slender naiad (*Najas flexilis*), Illinois pondweed (*Potamogeton illinoensis*), and white pond lily (*Nymphaea odorata*). The only invasive species found on Bass Lake itself was purple loosestrife (*Lythrum salicara)*, found at only one site.

Table 1: Plant taxa and frequency in Bass Lake 2023

Latin Name	Common Name	Sites Found	Percent of Sites Found
Chara spp.	Muskgrass	47	54.7
Najas flexilis	Slender naiad	36	41.9
Potamogeton illinoensis	Illinois pondweed	36	41.9
Nymphaea odorata	White pond lily	28	23.6
Elodea canadensis	American elodea	25	29
Myriophyllum heterophyllum	Variable-leaf water milfoil	23	26.7
Myriophyllum sibericum	Northern water milfoil	23	26.7
Schoenoplectus pungens	Three-square bulrush	23	26.7
Potamogeton praelongus	White-stem pondweed	21	24.4
Potamogeton robbinsii	Robbin's pondweed	19	22.1
Schoenoplectus acutus	Hardstem bulrush	11	12.8
Cladium mariscoides	Twig rush	7	8.1
Brasenia shreberi	Watershield	6	7
Utricularia vulgaris	Common bladderwort	6	7
Potamogeton zosteriformis	Flat-stem pondweed	5	5.8
Typha latifolia	Broad-leaved cattail	5	5.8
Bidens beckii	Water marigold	3	3.5
Nuphar variegata	Yellow pond lily	3	3.5
Iris spp.	Iris	2	2.3
Lythrum salicara	Purple loosestrife	1	1.2
	Total Sites*	86	

*Plants may be found at more than one site

Plant Communities and Density

Plants cover 72.6% of Bass Lake's total lake bottom, based on this survey (Table 2). Bulrush was the most dominant plant community, accounting for 22.16% of the total vegetated area. This category includes three-square bulrush (*Schoenoplectus pungens*) and hardstem bulrush (*Schoenoplectus acutus*). Bulrushes were the most dominant species on 23.17 acres and were mixed with pondweed in some areas, covering an additional 0.96 acres. Muskgrass and pondweed were the next most dominant communities. Plant communities were evenly distributed among the density classes for the total vegetated area (Table 3). Heavy and very heavy plant communities accounted for 30.92 acres, representing 21.47% of the total lake area. See below Figures 4 and 6 for mapping of plant communities on Bass Lake.

Table 2: Dominant plant communities and coverage in Bass Lake 2023.

Dominant community	Area (acres)	Percentage of Total Vegetated Area	Percentage of Total Lake Area
Bulrush	23.17	22.16	16.09
Muskgrass	21.63	20.68	15.02
Muskgrass and naiad	15.91	15.21	11.05
Pondweed	15.21	14.55	10.56
Pond lily	5.74	5.49	3.99
Pondweed and water milfoil	3.92	3.75	2.72
Elodea and water milfoil	3.75	3.59	2.60
Elodea and pondweed	3.01	2.88	2.09
Muskgrass and pond lily	2.97	2.84	2.06
Pond lily and water milfoil	2.67	2.55	1.85
Naiad	1.66	1.59	1.15
Bulrush and pondweed	0.96	0.92	0.67
Pondweed and pond lily	0.62	0.59	0.43
Muskgrass and pondweed	0.53	0.51	0.37
Cattail	0.5	0.48	0.35
Bladderwort, rush, and pond lily	0.44	0.42	0.31
Naiad, pondweed, and watermilfoil	0.41	0.39	0.28
Pond lily and twig rush	0.41	0.39	0.28
Naiad and water milfoil	0.31	0.30	0.22
Pond lily and watershield	0.22	0.21	0.15
Elodea and naiad	0.19	0.18	0.13
Water milfoil	0.19	0.18	0.13
Twig rush	0.15	0.14	0.10
Total	104.57	100	72.6
Total Lake Area	144		

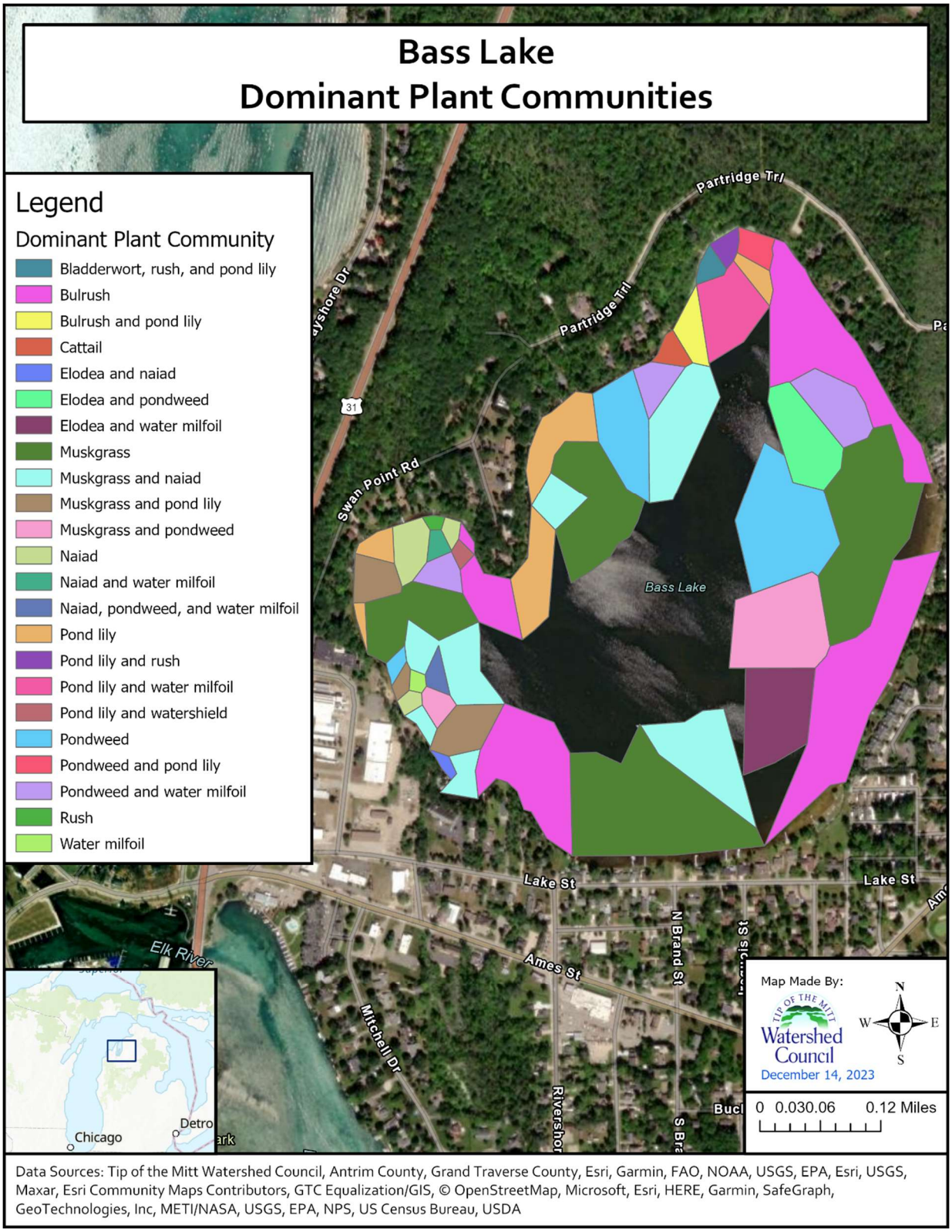

Figure 4: Map of dominant plant communities and coverage in Bass Lake 2023.

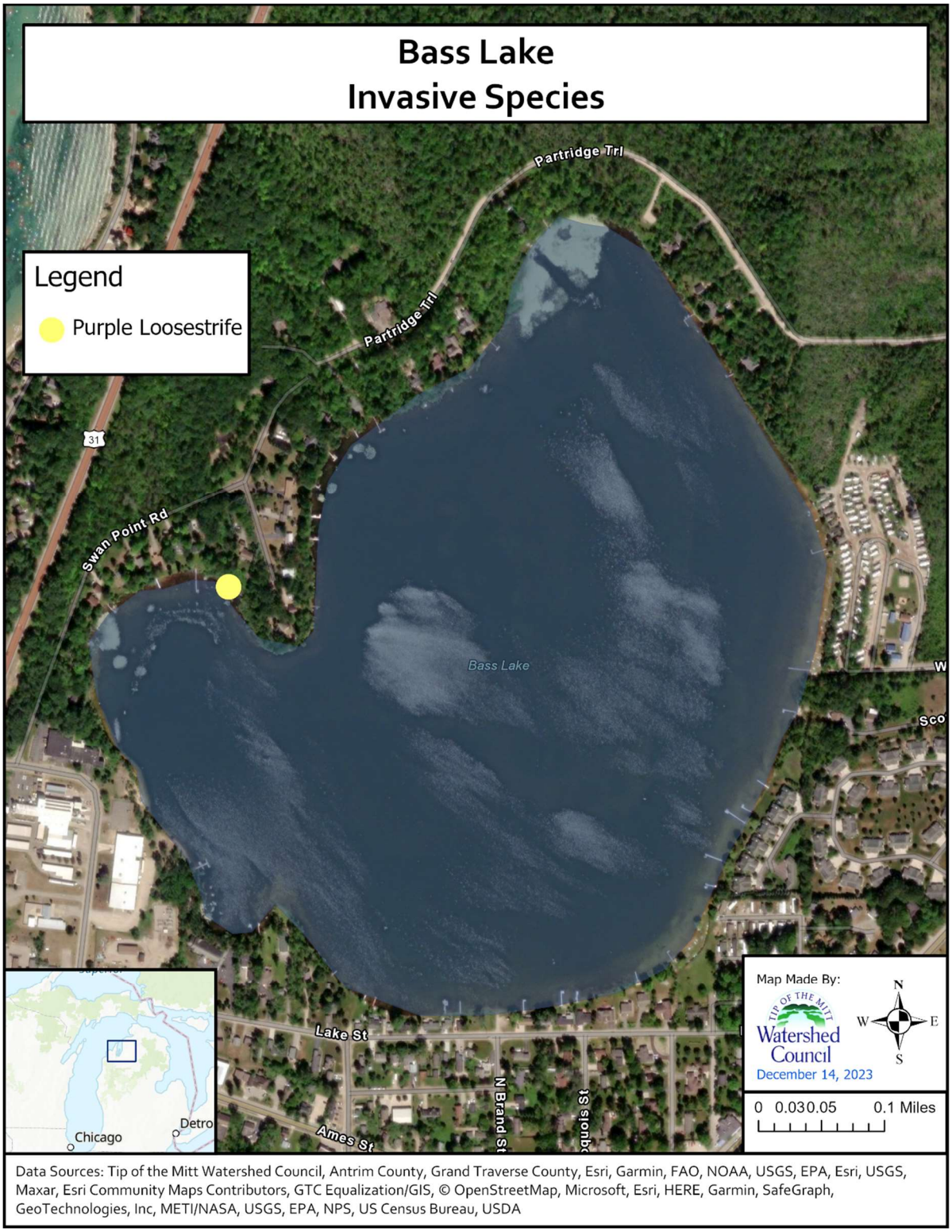

Figure 5: Map of invasive species site on Bass Lake 2023.

Table 3: Plant community density in Bass Lake 2023

Density	Number of Sites	Area (acres)	Percentage of Total Vegetated Area	Percentage of Total Lake Area
Very Light	6	13.89	13.28	9.65
Light	13	18.37	17.57	12.76
Light-Moderate	11	10.11	9.67	7.02
Moderate	13	19.78	18.92	13.74
Moderate-Heavy	20	11.50	11.00	7.99
Heavy	11	19.51	18.66	13.55
Very Heavy	12	11.41	10.91	7.92
Total	86	104.57	100.00	72.60

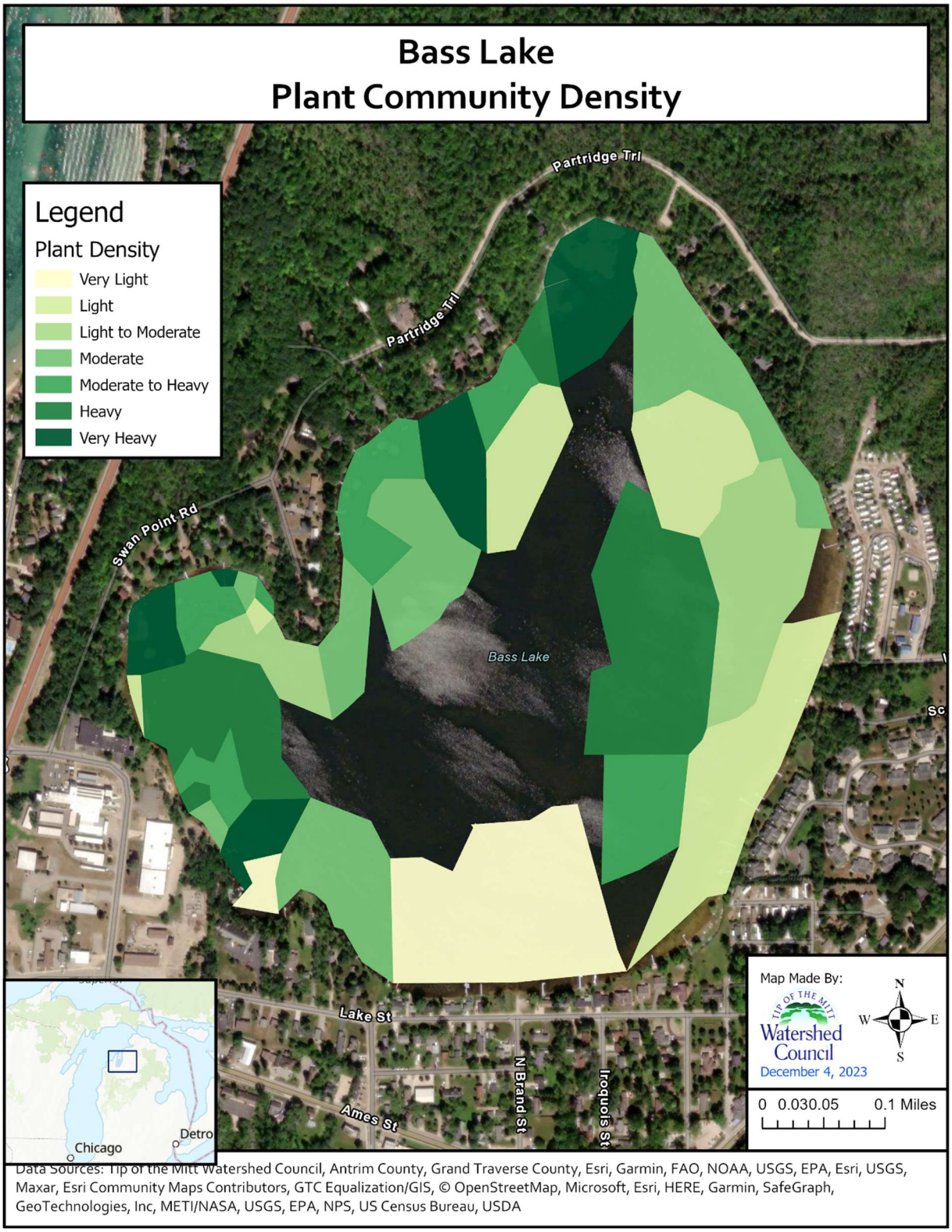

Figure 6: Map of plant community density and coverage in Bass Lake 2023.

Comparison to Previous Plant Surveys

Water quality monitoring is carried out weekly each summer by volunteers through the Watershed Council's Volunteer Lake Monitoring Program and every three years by Watershed Council staff in the Comprehensive Water Quality Monitoring Program. Secchi disk readings and bi-weekly chlorophyll-a samples May through August each year are used to calculate a Trophic State Index (TSI) value, which characterizes the lake's productivity. Data from 2001 to 2014 shows Bass Lake is a mesotrophic lake which indicates intermediate productivity levels and following years of no monitoring, data in 2022 and 2023 showed the same result (Tip of the Mitt Watershed Council, 2023).

Tip of the Mitt Watershed Council has performed plant surveys on 18 other lakes in Northern Michigan since 2005 (Table 4). Bass Lake was below average in the category of total taxa found in the lake and above average in the percent of vegetated lake area and percent of densely vegetated sites. However, many of the lakes surveyed are different from Bass Lake in terms of size and trophic status. Bass Lake is most similar to Adams Lake and Hanley Lake, both of which are also under 150 acres and have a high vegetated lake area.

Table 4: Comparison of vegetation surveys conducted in Northern Michigan.

Lake Name	Survey Year	Lake Size (acres)	Max Depth (ft)	Total Taxa In Lake	Vegetated Lake Area	Densely Vegetated Sites†
Adams	2010	43	18	27	99%	66%
Bass	2023	144	25	20	73%	21%
Bellaire	2013	1810	95	27	18%	8%
Black	2014	10,133	50	38	18%	15%
Clam	2013	446	27	28	69%	43%
Crooked	2008	2,351	50	28	56%	13%
Elk	2015	8194	195	27	4%	0.5%
Hanley	2014	89	27	29	94%	34%
Intermediate	2014	1,570	70	30	23%	1%
Larks	2020	600	9	24	36%	10%
Long	2013	398	61	30	29%	11%
Douglas	2019	3,780	80	22	22%	33%
Millecoquins	2005	1,116	12	20	95%	61%
Mullett	2007	17,205	144	42	19%	13%
Paradise	2008	1,947	17	24	58%	28%
Pickerel	2008	1,083	70	20	24%	5%
Skegemog	2014	2,766	29	30	67%	0%
Torch	2021	18,473	300	16	<1%	0%
Walloon	2013	4,620	100	32	22%	3%
Wycamp	2006	689	7	35	83%	24%
AVERAGE	NA	NA	NA	28	48%	20%

**All surveys performed at least in part by TOMWC.*
†Includes sites with plant density classified as heavy or very heavy

Comparison to Previous Plant Surveys on Bass Lake

In May of 1992, five transects across Bass Lake were monitored for aquatic plants by Tip of the Mitt Watershed Council to determine the best control methods in response to an abundance of aquatic plants that restricted recreation in the lake. Only ten species were identified in the 1992 survey (Tip of the Mitt Watershed Council, 1992). The more expansive 2023 survey identified an additional ten species for a total of twenty. The 1992 survey found no locations with submerged aquatic invasive species and did not survey near shore for emergent aquatic plants. Similarly, the 2023 survey did not find any

submerged aquatic invasive species at any sample site, but did find one sample site with purple loosestrife (*Lythrum salicaria*) while monitoring for both submergent and emergent vegetation.

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) surveyed Bass Lake in September of 1997. Their protocol employs a lake meander with rake tosses, visual observations, and targeted snorkeling/wading at sites with high likelihood of having invasive species, such as boat launches and inlets. There were several species found in this survey that were not found in the Watershed Council's 2023 survey including several pondweeds: big-leaved pondweed (*Potamogeton amplifolius*), grassy pondweed (*Potamogeton gramineus*), floating pondweed (*Potamogeton natans*), and Richardson's pondweed (*Potamogeton richardsonii*) (Michigan Department of Environment, Great Lakes, and Energy, 1997).

In May of 2002, Bass Lake was surveyed by Professional Lake Management using both visual observations and plants collected with a rake (Professional Lake Management, 2002). One species found in this survey that were not found in 2023 was long-leaf pondweed (*Potamogeton nodosus*). Additionally, Professional Lake Management surveyed in August of 2021 and found similar species that were, again, not found in 2023 by the Watershed Council including: Richardson's pondweed (*Potamogeton richardsonii*) and *Nitella* (Professional Lake Management, 2021).

Other than the discrepancies described above, results among plant surveys regarding plant communities and densities were similar. Discrepancies in plants found among surveys could be due to a few factors. For instance, Richardson's pondweed (Potamogeton ricahardsonii) was found in small densities in other surveys but not found at all in the 2023 survey. This could be that because it was in such small densities that it was not collected in sample at all in 2023. Other plant species could have been misidentified, not in abundant in the lake currently and missed due to chance, or may no longer be present in the lake due to past aquatic vegetation control measures or other unknown factors.

Conclusion

The whole-lake survey of plants found 20 different plant taxa in Bass Lake. Plants ranged in density on Bass Lake from very light to very heavy, with the majority of sites surveyed having a moderate to heavy plant density. Plants were found to cover 72.6% of Bass Lake's total bottom. Compared to eighteen

other lakes in Northern Michigan surveyed by the same methods, Bass Lake was below average in total number of taxa found, and above average in percent of vegetated area and densely vegetated sites. However, Bass Lake appears to have a normal abundance of aquatic vegetation and number of taxa for a lake of its size and trophic status.

Vegetation is typically an important factor in water quality as it can take up nutrients and reduce wave action along shorelines to keep erosion at bay. Water clarity influences the depth at which plants can grow and plants can improve water clarity by trapping sediment and nutrients. Due to having such a large area covered in plants, vegetation on Bass Lake is likely to play a significant role in the overall lake water clarity and quality. Bass Lake currently has no submersed invasive aquatic plants and only one small area with an emergent species (purple loosestrife) is excellent in this regard. However, future colonization by invasive species could change the ecosystem for the worse.

Recommendations

1. Share the results of the survey with Bass Lake Association; the Charlevoix, Antrim, Kalkaska, Emmet Cooperative Invasive Species Management Area (CAKE CISMA); Paddle Antrim; and the Elk River Chain of Lakes Watershed Protection Implementation Team.
2. Encourage the sharing of information to riparian landowners from local and state-wide invasive species and landscape practices resources, for instance, the MI Shoreland Stewards program (www.mishorelandstewards.com).
3. Encourage riparian landowners to maintain, create, or expand shoreline greenbelts. Greenbelts are areas of native shrubs, grasses, sedges, wildflowers, and sometimes trees along the shoreline. In addition to stabilizing the shoreline, they also remove fertilizer and other pollutants from runoff entering the lake, where they could fuel excess growth of aquatic plants and algae.
4. Encourage the sharing of information to riparian landowners on the important role of native aquatic plants in maintaining lake health.
5. Encourage lake association board members and riparian landowners to attend educational programs about invasive species and lake health. For example, NotMISpecies webinars (https://www.michigan.gov/egle/outreach/not-mi-species-webinar-series) or Tip of the Mitt Watershed Council programs.
6. Create and maintain invasive species signage and handouts at the public access site.

7. Use the Midwest Invasive Species Information Network (MISIN) app and website to report sightings on invasive species.
8. Encourage the creation and maintenance of a crew of volunteers that can respond to invasive species sightings around the lake.
9. Start efforts to treat existing small patches of invasive species and address new patches as they appear.
10. Continue annual surveys of known invasive species locations for 3-5 after control treatments to ensure complete eradication.
11. The Watershed Council and the lake association should continue to comment on water resource permits for projects that disrupt the lake bottom (e.g. dredging) as those areas are more prone to invasive species colonization.
12. Repeat this survey every 5-10 years to look for trends.

References

Canfield Jr., D. E., Shireman, J. V., Colle, D. E., Watkins , C. E., Watkins II, C. E., & Maceina, M. J. (1984). Prediction of chlorophyll a concentrations in Florida lakes: Importance of aquatic macrophytes. *Canadian Journal of Fisheries and Aquatic Sciences*, 497-501.

Michigan Department of Environment, Great Lakes, and Energy. (1997). *Aquatic Plant Survey (Field Report).*

Professional Lake Management. (2002). *Aquatic Plant Survey and AVAS (Aquatic Vegetation Assessment Sites) Summary Sheet.*

Professional Lake Management. (2021). *Standard Aquatic Vegetation Summary Sheet*.

Tip of the Mitt Watershed Council. (1992). *1992 Aquatic Plant Survey of Bass Lake.*

Tip of the Mitt Watershed Council. (2023). *2023 Volunteer Lake Monitoring on Bass Lake.* Petoskey: Tip of the Mitt Watershed Council.