Aquatic Vegetation Survey 2019
Douglas Lake

by

Tip of the Mitt Watershed Council

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

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Introduction

Aquatic plant communities are an important aspect of lake ecosystems. Submerged macrophytes provide food and shelter for other organisms within the ecosystem, such as fish and invertebrate communities. Like almost all plants, macrophytes supply oxygen to the system via photosynthesis. Macrophyte photosynthesis can also potentially reduce eutrophication in lakes by utilizing large amounts 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), which means that shoreline vegetation can help prevent erosion.

Lake ecosystems that have do not have healthy and abundant macrophyte communities are less diverse due to the lack of habitats and food resources on which other organisms rely. There would also be greater abundances of nuisance algae populations and increased erosion of the shoreline. A reduced native plant community could also allow invasive species, such as Eurasian watermilfoil (*Myriophyllum spicatum),* to dominate the community, which could further change the community structure within the ecosystem.

Despite all the benefits of aquatic plant communities, an overabundance of species, 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. Lakes that contain excessive nuisance plant growth can require management programs to control the effects of the plant community on the ecosystem.

Management of aquatic plant communities is important to maintain a stable lake ecosystem. Aquatic plants surveys are a good start to understanding the macrophyte community by recording plant species, abundance, density, and the presence of invasive species. In 2019, Tip of the Mitt

Watershed Council executed a contract on behalf of the Douglas Lake Improvement Association partnering with the University of Michigan Biological Station to survey aquatic plant species on the lake. One previous survey was conducted by the Watershed Council and University of Michigan Biological Station in 2012.

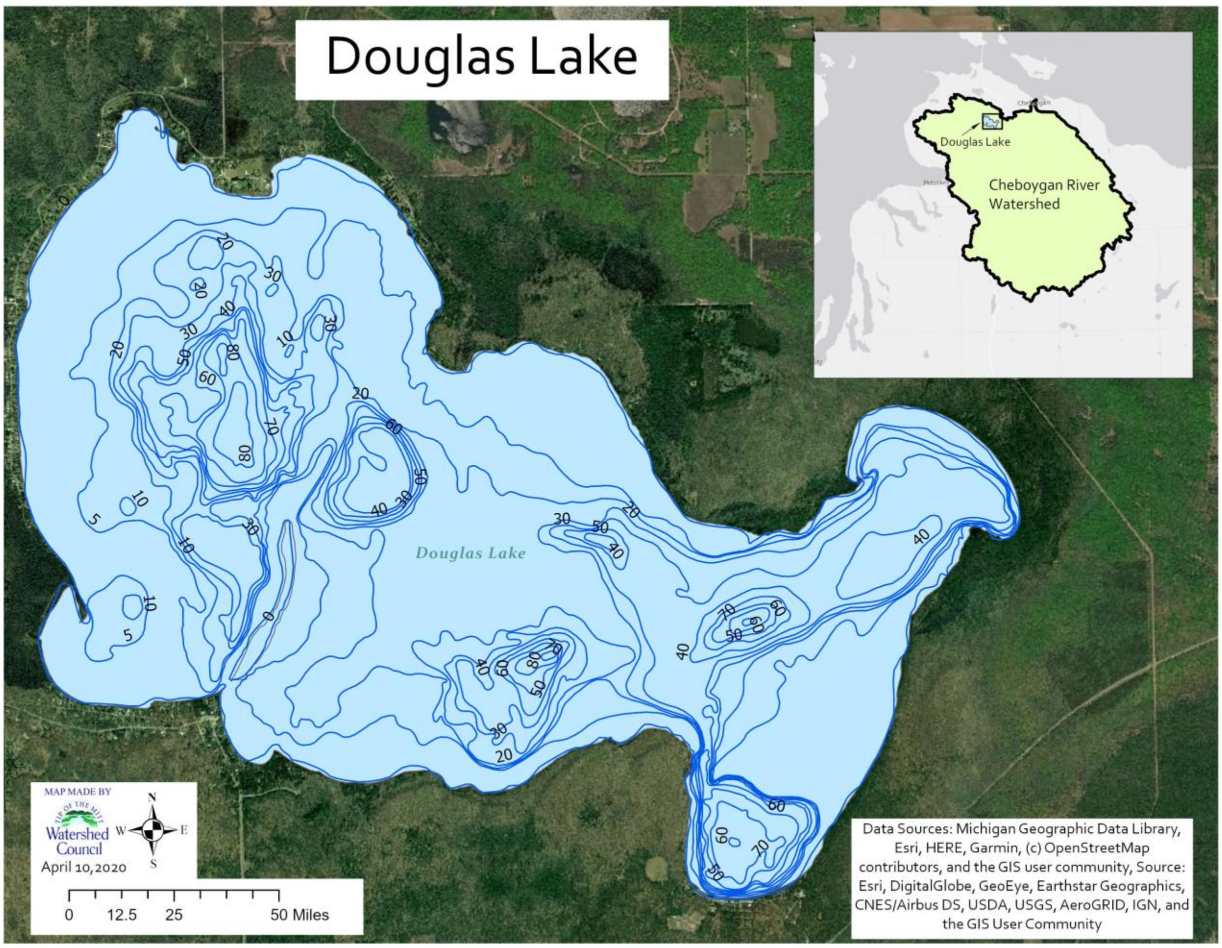
Study Area

Douglas Lake is located in northwestern Cheboygan County, Michigan, on the border of Emmet County. The lake covers an area of 15 km^2 with 22.5 km of shoreline that is divided into east and west halves by a large shoal. Major landmarks in the western half of the lake include Marl Bay, Maple Bay, and Pell's Island; North Fishtail Bay and South Fishtail Bay lie to the east. Residential urbanization is seen along the shore of the western half of the lake, while the shoreline of North and South Fishtail Bay remains mostly undeveloped.

Douglas Lake is a kettle lake with five deep kettle holes that were formed by retreating glaciers thousands of years ago (Figure 1). The maximum depth in the lake is 80 feet in kettle holes between Pells Island and Grapevine Point and northwest of Pells Island. The majority of the lake has a depth of less than 30 feet. Lancaster (or Bessey) Creek and Beavertail Creek are the major inlets of Douglas Lake at the northeastern and northwestern shores, respectively. East Branch Maple River is the major outlet of the lake in the southwestern shore of Maple Bay. The Maple River Watershed, including Douglas Lake, comprises the northwest portion of the greater Cheboygan River Watershed, water from which ultimately drains into Lake Huron at the City of Cheboygan.

According to Watershed Council Volunteer Lake Monitoring data, Douglas Lake is a mesotrophic lake. Surveys by the Michigan Department of Natural Resources show that some oligotrophic characteristics exist, allowing for suitable levels of dissolved oxygen in the depths of kettle holes (Godby & Cwalinski, 2016). Oligotrophic lakes are characterized by cold, deep, clear water that is nutrient-poor. A mesotrophic lake is a lake that is transitioning from an oligotrophic state to a eutrophic state. Eutrophic lakes are warm, turbid, and very productive due to the high nutrient content. Therefore, Douglas Lake is moderately productive and transitioning to a more productive state, especially in the shallow areas.

Figure 1. Douglas Lake features and watershed.



Methods

The study focused on more developed areas of Douglas Lake, including Stoney Point, Bentley Point, Nuttings Bay, Marl Bay, Maple Bay, and Pells Island, and Bryan Bay. The assumption was that invasive species would be more likely to be introduced in developed areas. The study also focused on areas of the lake with vegetation. Field data was collected from August through October 2019.

The survey was conducted using grappling rakes (made by attaching the head of a double-sided bow rake to a rope) as well as visual assessment of the area. Depth was used as a proxy for light penetration and abundant plant growth. Individual data points were captured on iPads using Survey123 for ArcGIS. Survey123 collects quantitative, qualitative, and spatial information that makes creating, sharing, and analyzing surveys easy. Specimens were collected, identified, photographed, and recorded into Survey123 forms. Transitions between plant communities or areas without vegetation were mapped using a Lowrance HDS10 fish finder.

A total of 253 sites were sampled throughout all vegetated lake areas. Sample sites were determined by creating transects from the shore. Spacing along the shoreline between sampling transects generally ranged from 150 to 500 meters and the distance between sampling points along each transect varied from approximately 50 to 300 meters. The range in distances between sampling transects and sample points is a result of the variability in distribution of aquatic plants in Douglas Lake and reflects the surveyors' efforts to obtain samples representative of all aquatic plant communities.

At each sample site, the boat was anchored, most of the time with two anchors. A new Survey123 form was opened after anchoring at the site on an iPad, which used cellular signal from cell phone hot spots to acquire GPS coordinates automatically. Survey123 geopoints have a precision range of one square meter. Depth and temperature were recorded from the Lowrance HDS 10 fish finder. Grappling hooks were used as sampling devices and thrown in four directions from the boat to obtain a sufficient sample. When possible, a visual assessment of the site was used to ensure that all plant species were accounted for. Specimens sighted in the water that were not represented in the grappled samples were noted in observations and included in density estimations.

Most vascular plant specimens were identified to the species level except for bladderwort, bulrush, burr-reed, and naiad. All species present were recorded and estimated 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. If multiple throws at a site with visible plants resulted in no specimens, that site was documented as having little to no vegetation and assigned a scale value of 0. No vegetation rake was thrown in areas where there was no visible vegetation. Specimens that could not be identified on the boat were put into Whirl-Pak® bags labeled by sample site to be keyed out in the laboratory. Although the methods were as thorough as possible, some species may have been missed. Some species including *Potamogeton strictifolius*, *P. zosteriformis*, and *P. haynesii* are known to be very similar in appearance. *P. haynesii* is a cross between *P. strictifolius* and *P. zosteriformis*. *P.zosteriformis* was the only one of the three noted during the survey.

Survey123 automatically created a Graphic Information System (GIS) shapefile with all information from the survey forms. The sample point layer was overlaid with a lake bathymetry layer to produce maps of Douglas Lake displaying 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. 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.

Results

Douglas Lake was comprehensively surveyed to document current aquatic plant species and communities, with a particular emphasis on documenting the presence of Eurasian watermilfoil or other invasive aquatic plant species.

Sample Sites: Species and Density

The number of macrophyte species found at each site ranged from zero to 14. The average number of macrophyte species at each site was 5.67 species. A total of 23 aquatic plant taxa were documented during this survey, consisting of 16 submergent, four floating leaf, and three emergent. The five most commonly encountered aquatic plants were *Najas spp.* (62.06% of sites), *P. zosteriformis* (56.13%), *P. gramineus* (50.99%), *M. sibricum* (50.99%), and *Chara spp.* (48.62%1) (Table 1 includes common names). The most abundant species were of the *Potamogeton* genus, accounting for eight of 30 taxa found in Douglas Lake. No Eurasian watermilfoil specimens or any other invasive species were encountered during the survey.

Of the survey sites on Douglas Lake, plant density ranged from Very Light to Very Heavy. Over one third of sites were found to have plants in the Very Light or Light density categories, similar to the 2012 survey (Table 2. Aquatic plant densities from sample sites on Douglas Lake in 2019.

Figure 2). Heavy to Very Heavy density growth represented 33% of the sample sites, up from 11% in 2012. Only two sites where the rake was thrown turned up no vegetation at all.

Table 1. Aquatic plant taxa frequencies at sample sites on Douglas Lake.

Aquatic Plant Species	Common Name	Number of Sites	Percentage
Najas spp.	Naiad	157	62.06
Potamogeton zosteriformis	Flat-stem pondweed	142	56.13
Potamogeton gramineus	Variable-leaf pondweed	131	51.78
Myriophyllum sibiricum	Watermilfoil	129	50.99
Chara	Muskgrass	126	49.80
Ceratophyllum demersum	Coontail	109	43.08
Elodea canadensis	Elodea	109	43.08
Utricularia vulgaris	Bladderwort	108	42.69
Vallisneria americana	Wild celery	100	39.53
Heteranthera dubia	Water stargrass	96	37.94
Potamogeton richardsonii	Richardson's pondweed	49	19.37
Potamogeton illinoensis	Illinois pondweed	37	14.62
Potamogeton praelongus	Whitestem pondweed	37	14.62
Schoenoplectus spp.	Bulrush	37	14.62
Stuckenia pectinata	Sago pondweed	24	9.49
Potamogeton natans	Floating-leaf pondweed	24	9.49
Potamogeton amplifolius	Large-leaf pondweed	17	6.72
Nuphar variegata	Pond lily	12	4.74
Megalodonta beckii	Water marigold	5	1.98
Sparganium spp.	Burr reed	1	0.40
Brassenia schreberi	Water shield	1	0.40
Polygonum amphibian	Smartweed	1	0.40
Potamogeton friesii	Fries' pondweed	1	0.40

Table 2. Aquatic plant densities from sample sites on Douglas Lake in 2019.

	2019			2012	
Density Category	**Number of Sites**	**Percentage of Sites**	**Percent Change Since 2012**	**Number of Sites**	**Percentage of Sites**
None	2	0.79	-11.45	58	12.24
Very light	9	3.56	-14.59	86	18.14
Light	19	7.51	-10.42	85	17.93
Medium-light	82	32.41	18.49	66	13.92
Medium	0	0.00	-17.51	83	17.51
Medium-heavy	58	22.92	13.22	46	9.70
Heavy	54	21.34	11.01	49	10.34
Very heavy	29	11.46	11.25	1	0.21
Total	253	100.00		474	100

The most dominant macrophytes at sample sites were *P. gramineus, P. zosteriformis, Chara spp.*, and *M. sibiricum.* In 2012, *Chara spp.*, *Najas spp.*, and *P. gramineus*, and *M. sibiricum* were the four most dominant species (Table 3). Dominance was determined by the number of plants found and the total biomass of the species compared to other co-occurring species at the site.

*Table 3. Dominant plant species in Douglas Lake.**

Latin Name	Common Name	# of sites dominant	Percent	Percent change since 2012
Potamogeton gramineus	Variable-leaf pondweed	59	21%	4%
Chara spp.	Muskgrass	44	15%	-16%
Potamogeton zosteriformis	Flat-stem pondweed	39	15%	7%
Myriophyllum sibiricum	Common watermilfoil	36	14%	1%
Najas spp	Naiad	33	11%	-6%
Schoenoplectus spp.	Hard/soft-stem bulrush	30	11%	10%
Heteranthera dubia	Water stargrass	27	10%	0%
Utricularia vulgaris	Common bladderwort	26	9%	7%
Elodea canadensis	Elodea	21	8%	0%
Ceratophyllum demersum	Coontail	15	6%	-2%
Potamogeton natans	Floating-leaf pondweed	14	6%	5%
Vallisneria americana	Eel-grass	9	3%	1%
Nuphar variegata	Yellow pond-lily	9	2%	-1%
Potamogeton illinoensis	Illinois pondweed	8	3%	2%
Potamogeton richardsonii	Richardson's pondweed	5	2%	0%
Potamogeton praelongus	Whitestem pondweed	4	1%	0%
Stuckenia pectinata	Sago-pondweed	2	0%	-1%

*Dominance was determined by number of plants and total biomass of the species compared to other co-occurring species at the site.

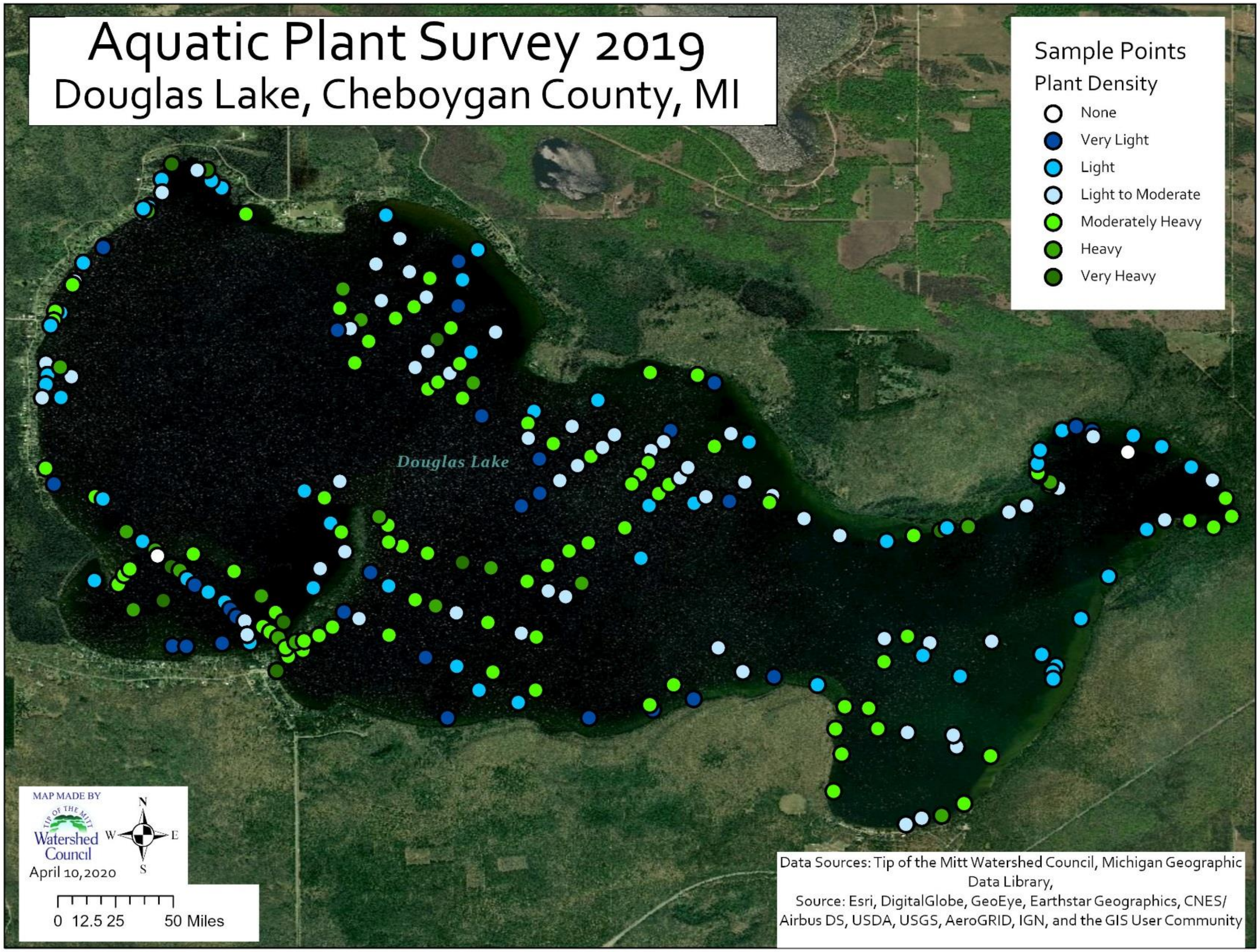


Figure 2. Average plant densities at each sample site.

Communities: Species and Density

The most prevalent dominant community type in Douglas Lake was pondweed (*Potamogeton spp*.), which accounted for nearly 4% of the lake's surface area and accounted for 18.42% of the areas of the lake with plants. When mixed with other plant communities, it accounted for over 15% of the lakes total area. Areas with greater than three dominant plant communities (represented as "Multiple >3" on figures) were the second most prevalent kind of plant community. Almost 3% of Douglas Lake is dominated by communities of four or more plants, which represents 13.5% of the areas of the lake with plants. Nearly 80% of Douglas Lake was found to have no or little vegetation. The heaviest (densest) plant growth was concentrated in the middle of the lake along depth transition areas, primarily in depths ranging from 10 to 20 feet (Figure 3, Figure 4).

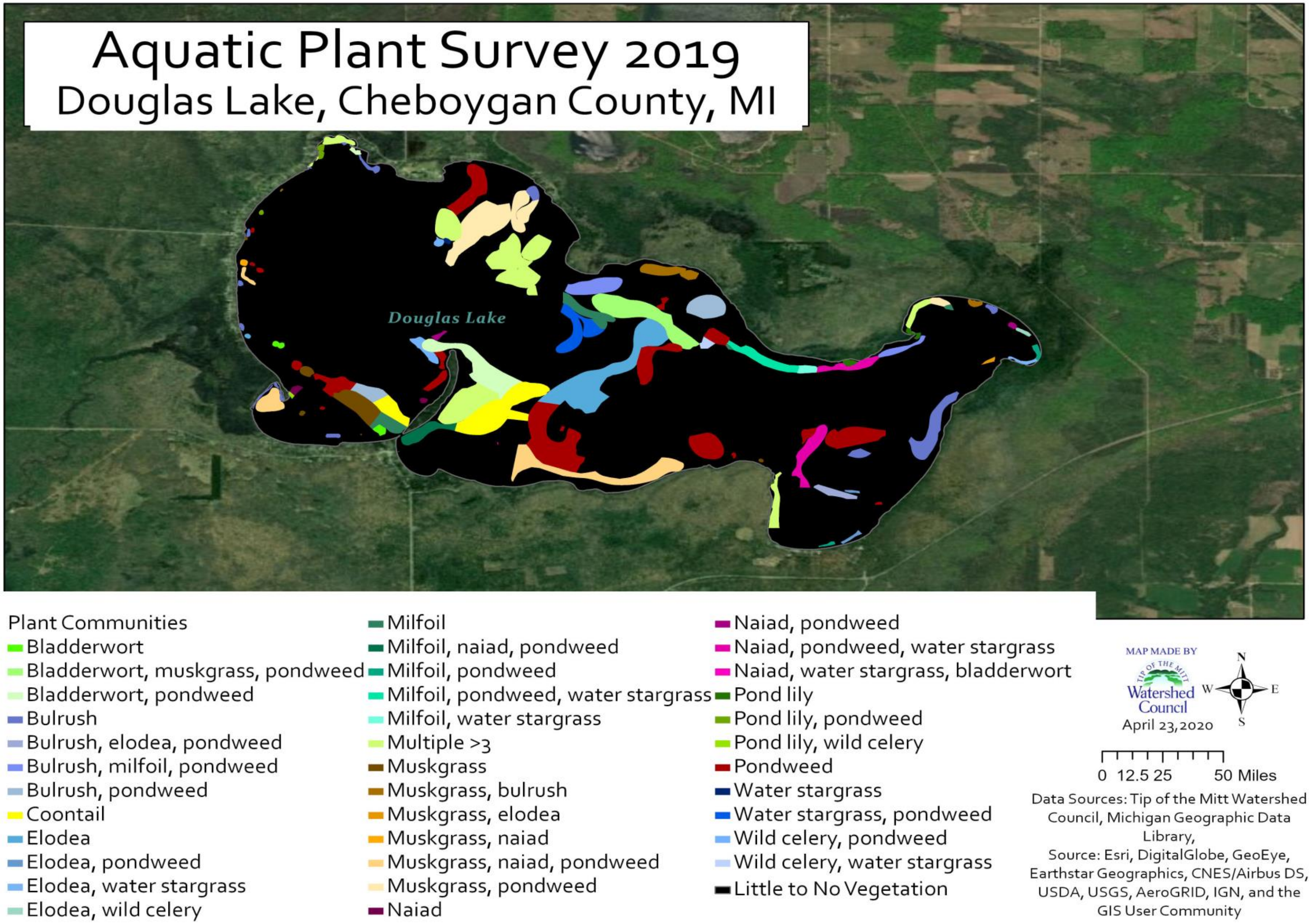


Figure 3. Dominant plant communities on Douglas Lake.

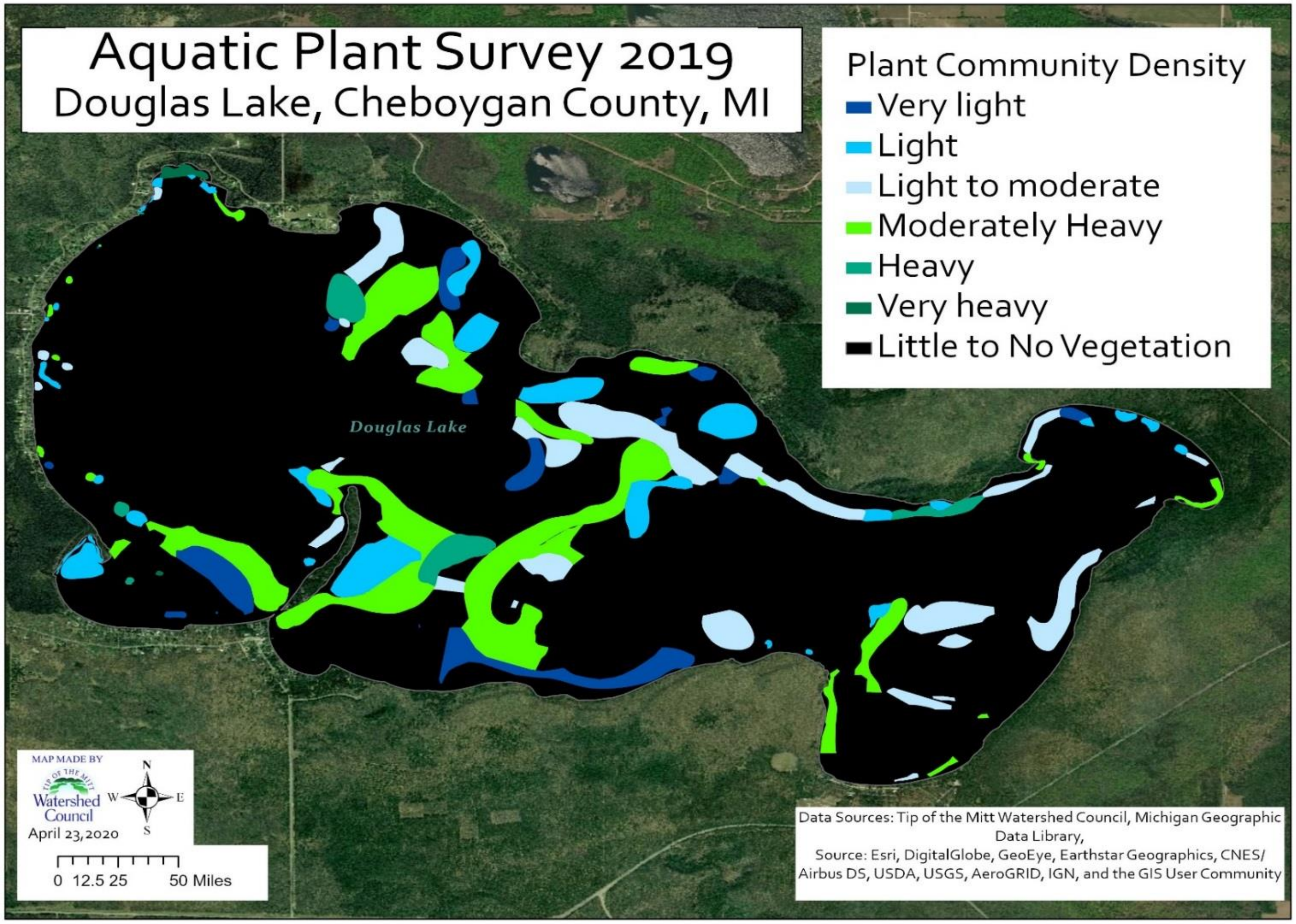


Figure 4. Plant community densities on Douglas Lake.

Discussion

Dominant Plants Found

Results show that the most frequently encountered plants during the Douglas Lake survey were muskgrass (*Chara spp.*), naiad (*Najas spp.*), common watermilfoil (*M. sibiricum*), variable-leaf pondweed (*P. gramineus*), coontail (*C. demersum*), elodea (*E. canadensis*), flatstem pondweed (*P. zosteriformis*), eel-grass (*V. americana*), water stargrass (*H. dubia*), and common bladderwort (*U. vulgaris*). All of these aquatic macrophytes occurred at over 100 sample sites, from 30% of sites (common bladderwort) to 64% of sites (muskgrass). Naiad was both the most ubiquitous plant (most frequently seen) while the most dominant macrophyte was variable-leaf pondweed (had greatest biomass).

Overall, the number of taxa found decreased from 30 in 2012 to 22 in 2019. The decrease is likely due to focusing on areas away from the shoreline, some plants were only keyed to genus, and plants resembling *P. strictifolius*, *P. zosteriformis*, and *P. haynesii* taxa were identified as *P. zosteriformis.* Plants in these taxa are morphologically similar and surveyors were unable to determine the differences. It is possible some *P. pusillus* plants were misidentified as *P. gramineus*, as that species was also missing from this study. Since the last survey in 2012, the most common plant communities changed from multiple and musk grass to pondweed and multiple. Overall coverage of plants dropped by nearly 50%. The densest areas remained the same.

These results seem characteristic of a northern Michigan lake. Compared with nearby lakes surveyed by Tip of the Mitt Watershed Council, Douglas Lake had a higher than average mean number of plants per sample site (Table 4). The total number of aquatic plant taxa found in Douglas Lake was slightly below average. The plant species found during this survey, as well as species associations in plant communities, were very similar to findings in a prior study of the lake's plant populations (Haynes and Hellquist, 1978). A number of plant species documented in the 1978 study were not encountered during the 2012 survey; however, many of these were riparian (lake margin) species, occurring in areas that were not sampled in 2012. Overall, Douglas Lake appears to have a healthy level of biodiversity, which is necessary to maintain healthy levels of productivity in the lake (Oneal & Soulliere, 2006).

Plant Densities and Depth

Plant densities transitioned from Very Light to Light-Moderate as depth increased from shore along each transect (Figure 2, Figure 4). The heaviest concentrations of plant biomass occurred in areas of intermittent depths of roughly 10 to 20 feet; i.e. in transitional zones between shallow areas with low-density growth and areas too deep to support plant growth. The percentage of sites with plant growth density in the Heavy to Very Heavy categories was above the mean for lakes in the region and triple the percentage of sites in 2012 (Table 4). However, the percentage of the lake covered in vegetation dropped from 43% to 22%, a decrease of 50%. It is likely that excessive and potentially nuisance plant growth is not an issue for Douglas Lake, similar to the 2012 survey. Although plant growth densities were more likely to be higher in 2019 compared to 2012, surveyors focused their efforts on areas with vegetation and most of the time did not collect sampling data at sites with no vegetation.

*Table 4. Aquatic plant survey statistics from area lakes.**

Lake Name	Survey Year	Lake Size (acres)	Max Depth (ft)	Total Taxa In Lake	Taxa Average Per Site	Vegetated Lake Area	Densely Vegetated Sites†
Adams	2010	43	18	27	4.9	99%	66%
Bellaire	2013	1810	95	27	2.9	18%	8%
Black	2014	10,133	50	38	3.9	18%	15%
Clam	2013	446	27	28	4.1	69%	43%
Crooked	2008	2,351	50	28	2.8	56%	13%
Hanley	2014	89	27	29	6.3	94%	34%
Intermediate	2014	1,570	70	30	2.7	23%	1%
Long	2013	398	61	30	3.9	29%	11%
Douglas	2019	3,780	80	22	5.7	22%	33%
Millecoquins	2005	1,116	12	20	6.0	95%	61%
Mullett	2007	17,205	144	42	3.1	19%	13%
Paradise	2008	1,947	17	24	5.0	58%	28%
Pickerel	2008	1,083	70	20	1.5	24%	5%
Skegemog	2014	2,766	29	30	2.2	67%	0%
Walloon	2013	4,620	100	32	1.8	22%	3%
Wycamp	2006	689	7	35	4.9	83%	24%
AVERAGE	NA	NA	NA	29	3.9	50%	22%

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

Recommendations

1. As joint funders of the survey, the DLIA and UMBS should share the results of this survey with Douglas Lake Improvement Association members, relevant parties within the University of Michigan and its community of Douglas Lake researchers, anglers, lake residents, local news sources, the Burt Lake Watershed Advisory Committee, the Michigan Department of Natural Resources, Michigan Department of Environment, Great Lakes, and Energy (EGLE), the Northeast Michigan Cooperative Weed Management Area, Huron Pines, and the Little Traverse Bay Bands of Odawa Indians.

2. Continue providing information to riparian land owners from local and state-wide invasive species and landscape practices resources, for instance, the MI Shoreland Stewards program.

3. Continue educating riparian land owners with a website and annual handouts of publications on lake health and invasive species.

4. Encourage DLIA executive board members and riparian land owners to attend educational programs about invasive species and lake health.

5. DLIA should become a partner in the Northeast Michigan Cooperative Weed Management Area.

6. Maintain invasive species signage and hand outs at boat launches.

7. Continue working with mobile boat wash station groups such as Tip of the Mitt Watershed Council and Clean Boats, Clean Waters programs to offer boat wash station and education opportunities.

8. Participate in invasive species trainings offered by MI Paddle Stewards.

9. Use the Midwest Invasive Species Network to report sightings on invasive species.

10. Maintain a crew of volunteers that can respond to invasive species concerns around the lake and particularly monitor the boat launch.

11. Zebra mussels are present in Douglas Lake. Their ability to filter out particles and increase light penetration throughout the water column can increase the chance of algal blooms. In particular, some forms of blue-green algae (cyanobacteria) can produce toxins, called cyanotoxins. An abundance of toxin-producing algae forms a harmful algal bloom (HAB). Other factors that influence HABs are warm water temperatures, calm water, and high levels of nutrients in the water. Douglas Lake riparians should be aware of HABs and be prepared to contact EGLE if they suspect an algae bloom.

12. Survey the whole lake every 5-8 years for AIS and changes in whole-lake plant communities.

Resources

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Tip of the Mitt Watershed Council, 2012. Aquatic vegetation survey 2012, Douglas Lake.