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Lime Lake Biologist 2021 Final Report

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In collaboration with Freshwater Solutions, LLC

Submergent Plant Survey

We conducted a survey of the submerged aquatic plants and macro algae the last week of June using the rake toss method (please see the 2020 Final Report for methods and protocol, if interested). The same 15 sites surveyed in 2020 were again targeted in 2021. As you know, one of the biggest concerns we have is early detection of any new invasive species, especially Eurasian Watermilfoil. We are pleased to report that no invasive species were found during our survey again this year.

As you can see from the Table 1, Illinois Pondweed, Common Bladderwort, and Common Stonewort were the most commonly found plants and macroscopic algae in the survey once again. It is interesting to note we found an absence of Native Watermilfoil, Najas, and Cladophora in 2021. That is likely due to the time of sampling, which was more than a month earlier than in 2020. Although this year's date doesn't provide for an exact comparison to 2020, we wanted to see if there were any temporal differences in the vascular plant community on LL. We did notice minor year-to-year variations at some locations. We hope to maintain the species richness and relative abundance of plants found during the 2020 survey and will try to target a later sampling date in 2022.

Table 1: 2020/2021 Relative abundance of each species of plant/algae found at each site.

		2020/2021 Aquatic Plant/Algae Survey Comparison														
Scientific Name	Common Name	Site														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Chara contraria</i>	Common stonewort	4/4	1/4	3/4	0/1	2/4	4/4	4/4	4/4	4/4	0/0	3/3	4/4	4/4	3/1	0/4
<i>Cladophora</i> sp.		0/0	1/0	2/0	0/0	1/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
<i>Myriophyllum</i> sp.	Native watermilfoil	3/0	4/0	3/0	4/0	4/0	0/0	0/0	1/0	1/0	0/0	1/0	0/0	0/0	1/0	0/0
<i>Najas</i> sp.	Naiad	0/1	1/4	2/2	0/2	1/4	0/2	0/2	0/0	1/2	0/0	0/2	4/0	0/1	3/2	0/2
<i>Nitella</i> sp.		0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	4/0
<i>Potamogeton illinoensis</i>	Illinois Pondweed	2/3	1/2	0/2	1/1	1/1	3/0	2/3	3/0	1/3	0/0	1/0	4/4	1/0	1/0	0/3
<i>Potamogeton gramineus</i>	Variable Pondweed	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/1	0/0	1/0	0/0	0/4	0/0	0/0	0/0
<i>Spongilla lacustris</i>	Freshwater Sponge	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	1/0	0/0
<i>Utricularia macrorhiza</i>	Common bladderwort	2/3	1/1	2/1	1/1	2/0	3/0	3/1	2/3	0/2	0/0	0/2	2/0	0/0	0/0	0/2

Table 2: GPS coordinates and approximate depth for each site in the plant survey.

Site	Depth	Latitude	Longitude
1	10 ft	44.8994	-85.8329
2	10-12 ft	44.8877	-85.8474
3	10-12 ft	44.8876	-85.847
4	10-12 ft	44.8873	-85.8467
5	10-12 ft	44.8865	-85.8462
6	10-12 ft	44.8949	-85.8358
7	10-12 ft	44.8916	-85.8365
8	10-12 ft	44.8936	-85.842
9	10-12 ft	44.8988	-85.8479
10	3 ft	44.8970312	-85.8488506
11	6-8 ft	44.8945768	-85.841246
12	9-10 ft	44.8944416	-85.8419222
13	8 ft	44.9003376	-85.8443858
14	7-8 ft	44.9000464	-85.8429945
15	12 ft	44.8994748	-85.8418274

Figure 1. Sites sampled during the plant survey along the break line (excl. #16)

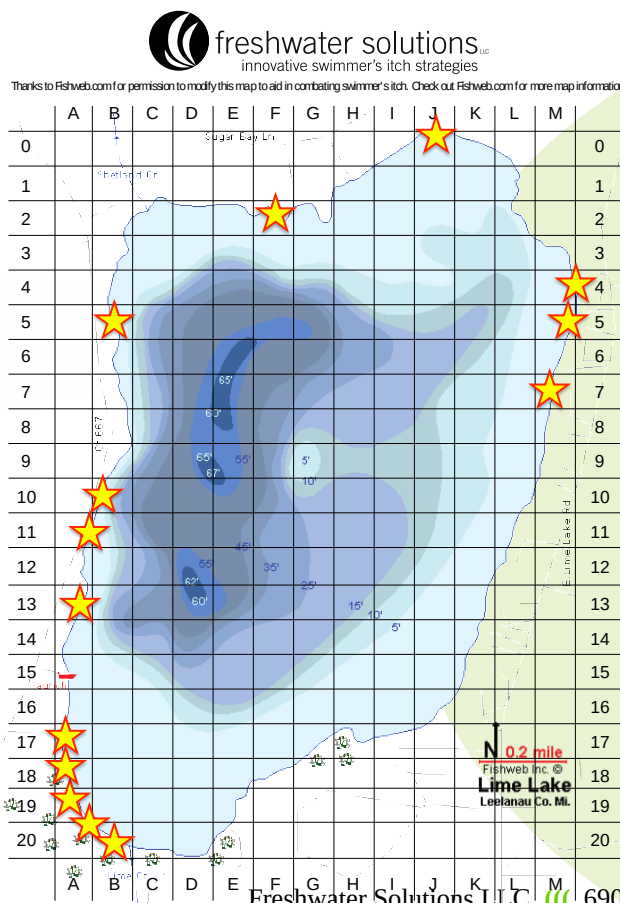


Emergent Plant Survey

We conducted two shoreline surveys, one on 8 June looking specifically for Yellow-flag Iris (YFI) and another on 8 July looking for other invasive plants including Phragmites and Purple Loosestrife (please see the 2020 Final Report for methods and protocol, if interested). We found 14 distinct colonies of YFI as seen in Figure 2 below. There were sporadic stands of Narrowleaf Cattail, which is also an invasive species but not of much concern, since it seems to be coexisting with the native Broadleaf Cattail as we observed in our 2020 survey. We did not find any other invasive plants. However, Purple Loosestrife is found along the shores of Little Traverse Lake, so we will keep close watch on that species.

We also coordinated the work of the Invasive Species Network's (ISN) invasive species survey program, in which two individuals kayaked around Lime Lake looking for emergent invasive species. From their report, they saw, "small patches of reed canary grass and autumn olive scattered around the lake. [They] also observed some bittersweet nightshade, narrowleaf cattail, bull thistle, and forget-me-not." Data will be eventually available at <https://www.misin.msu.edu/browse/>, however ISN warned that it may take a while to complete.

Figure 2: Identified Yellow-flag Iris stands



Algal Survey

As noted in 2020, microscopic organisms, including algae, rotifers and arthropods are important organisms in a lake ecosystem. Algae, along with submergent plants and photosynthetic bacteria, are the base of most aquatic food webs and their presence ultimately allows birds, fish and other animals to live in and around the lake. Zooplankton and phytoplankton were collected on 25 June at the same locations sampled in 2020 using the same protocol (please see the 2020 Final Report for methods). An additional tow was conducted in 2021 on 14 July.

We spent several hours on a day in July with Dr. Rex Lowe, noted freshwater phycology expert from Bowling Green, at the University of Michigan Biological Station examining our plankton collections from Little Traverse, Lime, and Glen Lakes. This time turned into a short “refresher course” for us and further validated our findings. In general, samples from Little Traverse Lake appeared more diverse than samples from either Lime Lake or Glen Lake. Organismal diversity is considered a good thing for most aquatic and terrestrial ecosystems.

As you can see from Table 3, we observed some similarities and differences from this two-year data set (numbers represent relative abundance from 1-5). We sampled much earlier in the season in 2021 and that is likely the cause of any major variations. For example, we found no *Microcystis* sp. in 2021, likely due to the sample date and not that it has disappeared from Lime Lake. It is much too early to draw conclusions about trends with such a short duration study, but this archived data can be used to observe trends in future years. Please refer to the 2020 Final Report for pictures of common plankton observed.

Table 3: 2020/2021 Plankton Tow Comparison



Type	Classification	Date					
		Vertical 7/10/20	Surface 7/10/20	Surface 7/15/20	Surface 8/11/20	Vertical 6/25/21	Surface 6/25/21
Merisopedia sp	Algae - Blue Green	1		1	2		
Microcystis aeruginosa	Algae - Blue Green	4	5	5	4		
Campylodiscus sp.	Algae - Diatom	1					
Cyclotella sp	Algae - Diatom	1					
Cymbella sp	Algae - Diatom	3					
Fragularia sp.	Algae- Diatom	2			1		
Gyrosigma sp.	Algae- Diatom					1	
Navicula sp	Algae - Diatom	1			1		
Odontidium sp	Algae - Diatom			1			
Synedra nana	Algae - Diatom	1					
Sydnedra sp.	Algae- Diatom			1	1		
Tabellaria sp	Algae - Diatom	1					
Ceratium hirundinella	Algae - Dinoflagulate	4	3	4	2	1	2
Peridinium sp	Algae - Dinoflagulate	2		1	5	2	3
Chlorococcus sp	Algae - Green		4	2		1	
Chroococcus sp	Algae - Green	4		3	2		
Desmidium sp	Algae - Green						1
Mougeotia sp	Algae - Green	1					
Pediastrum simplex	Algae - Green	4	2	3		1	1
Scenedesmus sp	Algae- Green	3		1	1	1	
Spirogyra sp	Algae - Green		1				
Xanthidium sp.	Algae - Green	1					
Zygnema sp	Algae - Green			1	1		
Chrysosphaerella sp	Algae- Golden Brown					1	
Dinobryon cylindricum	Algae - Yellow Green	1		2	3	3	3
Mallomonas sp.	Algae - Yellow Green	1					
Synura sp	Algae - Yellow Green				3		
Bosmina sp.	Arthropod - Cladoceran			2		1	4
Cyclops vernalis	Arthropod - Crustacean	1		2	2		2
Daphnia dubia	Arthropod - Crustacean			1			
Paramecium sp	Protozoan - Ciliate				3	1	
Ascomorpha ecaudis	Rotifer			2			
Asplanthia sp	Rotifer				1		
Conochilus hippocrepis	Rotifer			1	2		
Eubosmina sp	Rotifer				1		
Kellicottia longiospina	Rotifer	1					
Keratella cochlearis	Rotifer	4	5	5	3		2
Ploesoma sp.	Rotifer				2	3	2
Polyanthra sp.	Rotifer			2	2	3	2
Veligers	Larval form of zebra mussle		5		2	2	1

Drone Survey Analysis

Using archived video footage collected via drone by Dennis Wiand (ZeroGravity Aerial, LLC) in 2020, comprehensive shoreline analysis was completed early in 2021. The shoreline was examined for a number of different features. Each occurrence for each feature was recorded and cataloged via a screenshot. Table 1 below shows the number and percentages of properties within each category. A brief description of each category follows, along with commentary of what was found. Using Google Earth and county records, the number of

lakefront properties were identified as 144. This number was then used to find the percentage of properties (those with obvious lake usage) with certain features.

While this technology provides invaluable information for lake association boards, it does have limitations and ground truthing of any items of interest is suggested. For example, it is not always possible to distinguish *Cladophora* sp. from other filamentous algae using just drone footage. Additionally, some shoreline features may be missed due to the angle of the camera, the camouflage nature of the feature, or human error. Even with those limitations, this report will provide the LLA board with valuable information for setting goals to help preserve water quality on Lime Lake.

As more lakes utilize this evolving drone-capture and computer analysis technology for shoreline surveys, the power of comparison will become increasingly beneficial. Table 2 below shows Lime Lake in comparison with other lakes in Leelanau County. We hope to grow this comparison database in 2022 and beyond, providing even more benefit to the LLA.

Finally, it is important to understand that none of these categories or suggestions are meant to be divisive amongst Lime Lake riparians. This survey is not meant to 'point a finger' at those people who have certain characteristics in their landscape. The most useful action steps are purely from an education standpoint of letting riparians know what is best for the lake and perhaps providing incentive for making an eco-friendlier landscape.

Table 1: Lime Lake Category Percentages 2020

Category	2020	Percentage of properties
Beach Sanding	15	12.5%
Detectable Algal Growth	13	10.8%
Drain Pipes	6	5.0%
Erosions	13	10.8%
Greenbelts	35	29.2%
Inlets	14	N.A.
Lake Water Irrigation	2	1.7%
Natural Shoreline	7	5.8%
No Greenbelt	73	60.8%
Riprap	49	40.8%
Sea Walls	7	5.8%
Terrestrial Invasive Plants	4	N.A.

Table 2: Leelanau County Lakes Comparison

	Lime Lake		Lake A		Lake B		Lake C	
Category	Sites	Percentage of properties	Sites	Percentage of properties	Sites	Percentage of properties	Sites	Percentage of properties
Beach Sanding	15	12.50%	15	10.30%	116	15.80%	11	19.00%
Detectable Algal Growth (DAG)	13	10.80%	14	9.60%	35	4.80%	0	0.00%
Drain Pipes	6	5.00%	3	2.10%	34	4.60%	0	0.00%
Erosions	13	10.80%	1	0.70%	95	13.00%	0	0.00%
Greenbelts	35	29.20%	33	22.60%	428	58.50%	47	80.00%
Inlets	14	N.A.	8	N.A.	13	N.A.	2	N.A.
Lake Water Irrigation	2	1.70%	12	8.20%	69	9.40%	0	0.00%
Natural Shoreline	7	5.80%	30	20.60%	106	14.50%	0	0.00%
No Greenbelt	73	60.80%	82	56.20%	198	27.00%	12	20.00%
Riprap	49	40.80%	87	59.60%	95	13.00%	8	14.00%
Sea Walls	7	5.80%	11	7.50%	15	2.00%	1	2.00%
Terrestrial Invasive Plants	4	N.A.	8	N.A.	0	N.A.	24	N.A.

Category Explanations

Beach Sanding

These are shorelines where beach sand has been brought in to create an unnatural sandy beachfront. A permit is necessary for this activity because of the negative impact it has on the lake ecology. Much of the sand can get washed into the lake and dispersed in the winter, causing more sand to be needed each year. Furthermore, there is usually no barrier between runoff waters and the lake. Any chemicals or nutrients in runoff water will immediately drain into the lake.

Detectable Algal Growth (DAG)

Detectable algal growth may indicate an excess of nutrients (often phosphorus) in the water. It is not always clear where the nutrients are coming from, so riparians may want to gather more information to find the source. We found 14 'areas of interest' in regards to DAG. These areas will be interesting to watch if future drone surveys are completed to see if they are consistently present, growing, or if they were just a short-term occurrence.

Drain Pipes

Drain pipes are often used to direct stormwater away from houses and into the lake. Tiles are placed underground around the house to filter the water towards the drain. This can put excess runoff and nutrients into the lake, since the water is not filtered through soil and plants do not have a chance for nutrient uptake.

Erosion

Erosion is not necessarily a good or bad thing, but it is something that can be monitored for changes year to year.

Inlets

We should monitor inlets in future years to document changes. Inlets are natural and positive for the lake, but excess nutrients through an inlet can cause problems. The drone footage was key to finding all the inlets, as they were easier to see from above than during our shoreline survey.

Lack of Green Belt

We calculated the number of properties that did not have a greenbelt between their lawn and water. See Appendix 1 for more information about greenbelts and why they are important. A

major goal to improve and maintain lake health would be to increase the number of properties that have a greenbelt.

Lake Water Irrigation Systems

If riparians feel the need to have a manicured lawn, a lake water irrigation system is better than well water. This utilizes nutrient-rich water from the lake, eliminating the need for fertilizer application.

Riprap Barriers

Riprap is defined as a rock barrier at the water's edge that is not natural. This has historically been a popular way to minimize erosion, but more ecofriendly methods have been developed. We would recommend having a greenbelt instead, or core logs that help a greenbelt take hold.

Sea Walls

Sea walls are a barrier at the water's edge, generally consisting of wood, steel or concrete. We included rock seawalls in our analysis if they were of a vertical nature and wouldn't pass the "turtle test" (a barrier with a slope a turtle could climb to reach dry land). Sea walls are not necessary in a lake and cause excess damage to neighboring lake frontage due to redirection and concentration of wave energy.

Terrestrial Invasive Species

All invasive species, either aquatic or terrestrial, are problematic for a lake habitat. Invasive species have few natural predators or competition and can easily take over an area, pushing out native species and reducing diversity. We specifically looked for Phragmites, Purple Loosestrife and Yellow Iris. Coltsfoot is another common invasive species, but is very difficult to identify via drone footage at this time of year, and was not flowering during our shoreline survey.

Appendix 1: What is a Greenbelt?

This brief summary is meant to serve as a template that could be used to send out to lake association members to start educating them on the importance of greenbelts.

What is a greenbelt?

A greenbelt is a strip of land (no smaller than 20 feet deep) along the shoreline that is dominated by native vegetation. It acts as a buffer zone between a manicured lawn and the lake. One benefit of a greenbelt is to control shoreline erosion. The roots of plants hold the soil and sand in place. Another benefit is its ability to stop nutrients from leaching into the lake. Having too many nutrients can lead to nutrient loading and possible algal blooms. Other noteworthy benefits include providing a natural habitat for insects and larger animals and for deterring geese from easily accessing the mown lawn. Plus, it reduces cost and time spent manicuring a lawn.

What plants should be included in a greenbelt?

There are many beautiful perennial plants that can be included in a greenbelt. Plants should only be used if they are native to our area. These do not need to be trees that block your view of the lake, but can be low shrubs or beautiful flowering plants.

Does my entire shoreline need to be a greenbelt?

Of course, there needs to be accessibility to the lake and any amount of greenbelt is better than none! It is suggested that 75% of your shoreline is covered with a greenbelt, leaving plenty of space for water accessibility and recreation. The more greenbelt the better!

How can my frontage become a greenbelt?

Our Good Harbor Bay Watershed biologist, Kelsey Froelich, would love to come to your property and discuss ideas to incorporate a greenbelt into your property! Send an email to: kelsey.froelich@gmail.com to schedule a time to chat. For more information about greenbelts, check out the Tip of the Mitt's website [here](#).

Miscellaneous Activities

Serving as the Lime Lake Association and Good Harbor Bay Watershed Biologist invites a host of activities, of which some requiring only minutes of time and others needing a more significant time commitment. Below is a short summary of work-related activities:

- 1. Digitize Historical Water Quality Data** – All historical data stored as hard-copy in 3-ring binders was digitized where possible for easily retrievable access should it ever be needed for future reference.
- 2. Riparian Questions** – Many emails and/or phone calls were answered throughout the year ranging from swimmer's itch to invasive plants to new algal growths.
- 3. Networking** – A number of online conferences were attended as Lime Lake representatives to learn and contribute to water quality issues statewide and even throughout the Midwest.
- 4. Newsletter Assistance** – Drafts of newsletter submissions written by Steve Olson were checked and edited for clarity and scientific integrity.
- 5. Cooperative Lakes Management Program (CLMP)** – Periodic Secchi Disc readings were taken during the summer along with a fall phosphorus water sample. Results will be pass along as they become available from the state.
- 6. Discovery Boat** – We developed and conducted a first-ever Discovery Boat voyage on Lime Lake in early August.
- 7. Greenbelt Consultations** – We conducted a total of 10 site visits with riparians owners on Lime Lake to discuss ways they could begin to improve their shoreline for improve lake health.

Recommendations

1. Due to our significant involvement this year with the Lake Leelanau Lake Association and Grand Traverse Band of Ottawa and Chippewa Indians on their Eurasian Watermilfoil control efforts, we are even more keenly aware of the importance of constant and relentless surveillance of this highly invasive plant in our watershed. In near-future correspondence we will be recommending more regular surveillance in 2022, and the establishment of a EWM eradication protocol, complete with the required expertise, equipment and personnel in place if (when?) EWM is discovered.



2. It appears that Yellow-flag Iris may be on the increase on LL so we recommend a task force be formed to begin eradication of all plants (with landowner permission, of course) in the spring of 2022.
3. We recommend another drone shoreline survey be done in 2022 along with drone footage analysis.
4. We recommend expanded participation with the Cooperative Lakes Management Program in 2022 and beyond, along with continuation of basic plant and algal surveys.
5. We hope to continue to serve the Lime Lake Association and Good Harbor Bay Watershed in a host of miscellaneous roles where needed.