

Lime Lake Biologist 2022 Final Report

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In collaboration with Freshwater Solutions, LLC

Following are “Projects and Services” listed in Exhibit 1 of the “2022 LLA Lake Biologist Contract” with a description of work accomplished and results if applicable.

1. Prepare LLA Newsletter reports related to water quality and watershed biologist activities when requested.

We worked with Steve Olson throughout the year in preparation of periodic LLA newsletters by editing content he provided that related to any and all lake biologist services.

2. Develop and organize an emergency response plan for new invasive species discovered within the Lime Lake watershed in 2022, especially for Eurasian watermilfoil (EWM).

An emergency response plan has been informally developed that includes early detection and rapid response to EWM. It is our intent, during the winter months, to formalize the plan in the form of a “Letter of Agreement” that clearly describes FWS’s action plan and approximate costs should EWM be discovered in Lime Lake in 2023.

3. Conduct up to three (3) Discovery Boat II excursions on Lime Lake in 2022 (with boat assistance from LLA Board members).

We conducted one Discovery Boat excursion, with the generosity of Captain Mark Fisher, the use of his pontoon boat, and nice appetizers supplied by Mary Barss (I believe, and others?) on 27 July. The cruise went well and gave us a chance to educate more members about all of the initiatives LLA is undertaking to protect and preserve our beautiful lake. A second cruise scheduled for early August was cancelled due to lack of interest. We may consider exploring alternate days and times if its value is warranted.

4. Conduct CLMP water analysis duties and report findings to the state.

Secchi disk readings were taken approximately every two weeks from May until September and reported to the state. A phosphorus sample was not taken in September due to logistical complications. We need to consider whether this test is valuable enough to continue and who may have interest in collecting the sample and delivering to Cadillac on the specified day and time. The timing and delivery logistics makes this task complicated.

5. Analyze phytoplankton and zooplankton samples (per previous year protocols) for a growing historical database documenting the base of the Lime Lake food web.

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 27 June at the same locations sampled in 2020 and 2021 using the same protocol.

As you can see from Table 1, we observed some similarities and differences from this three-year data set (numbers represent relative abundance from 1-5). 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 1: 2020-2022 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	Surface 6/27/22	Vertical 6/27/22
Merisopodia sp.	Algae - Blue Green	1		1	2			1	1
Microcystis aeruginosa	Algae - Blue Green	4	5	5	4			4	3
Campylodiscus sp.	Algae - Diatom	1							
Cyclotella sp.	Algae - Diatom	1							
Cymbella	Algae - Diatom	3						1	
Fragularia sp.	Algae - Diatom	2			1				
Gyrosigma sp.	Algae - Diatom					1			1
Navicula sp.	Algae - Diatom	1			1			1	1
Odontidium sp.	Algae - Diatom			1					
Pinnularia sp.	Algae - Diatom							1	
Synedra nana	Algae - Diatom	1						1	2
Synedra sp.	Algae - Diatom			1	1			1	
Tabellaria sp.	Algae - Diatom	1							
Ceratium hirundinella	Algae - Dinoflagellate	4	3	4	2	1	2	4	3
Peridinium sp.	Algae - Dinoflagellate	2		1	5	2	3	3	5
Chlorococcus sp.	Algae - Green		4	2		1		1	1
Chroococcus sp.	Algae - Green	4		3	2			1	1
Desmidiium sp.	Algae - Green						1		
Mougeotia sp.	Algae - Green	1							
Pediastrum simplex	Algae - Green	4	2	3		1	1	2	3
Scenedesmus sp.	Algae - Green	3		1	1	1		1	1
Spirogyra sp.	Algae - Green		1						
Xanthidium sp.	Algae - Green	1						1	
Zygnema sp.	Algae - Green			1	1			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	2	
Daphnia dubia	Arthropod - Crustacean			1					
Paramecium sp.	Protozoan - Ciliate				3	1		3	1
Ascomorpha ecaudis	Rotifer			2					
Asplanchnia sp.	Rotifer				1				
Conochilus hippocrepis	Rotifer			1	2				
Eubosmina sp.	Rotifer				1			2	1
Kellicottia longiospina	Rotifer	1						3	3
Keratella cochlearis	Rotifer	4	5	5	3		2		
Ploesoma sp.	Rotifer				2	3	2		
Polyantra sp.	Rotifer			2	2	3	2	3	2
Veligers	Larval form of zebra mussle		5		2	2	1	5	3

6. Collect monthly water samples for the 3rd and final year of an enteric bacteria study.

Surface and well water samples were collected from 8 resident locations around the lake on the mornings of 21 June, 18 July, and 1 August. All samples were kept in a cooler brought to our FWS laboratory for DNA extraction and analysis. An appended report summarizing our findings for the 3-year project will be provided later this fall, with a more formal manuscript for publication expected in 2023.

7. Conduct site visits for interested LLA members and recommend best shoreline protection practices.

Four site visits were conducted on Lime Lake for consultation about greenbelt deployment. All meetings were incredibly positive, and the names of individuals consulted with were sent to Steve Olson for record-keeping purposes.

8. Dive on all identified aquatic gardens (“weed beds”) and document (abundance and relative number) all aquatic plant and macro algae species.

We conducted a complete drone imaging video survey of the entire littoral zone on 2 August. All video footage was archived on an external hard drive which is included with this report. All aquatic gardens identified by drone (6) were surveyed using full SCUBA gear on 17 August. Each dive location was documented using an underwater GoPro video camera. Underwater video footage was archived on the same external hard drive included with this report.

This year, we are providing a more robust map of our aquatic gardens. Included on the hard drive is a .kmz file of the plant survey. When you open this file in either Google Earth Pro or mymaps.google.com (both free programs), it will show you the locations of the aquatic gardens and all plant species identified. Each placemark (labelled 1-12) can be clicked on to open and show GPS coordinates for that site along with a list of plants found. The plants listed are those commonly found in our watershed. The plant species found at each particular site are numbered 1-4, with 4 being highly abundant and 1 being sparse (no number means that plant was not found at that site). With this map, you can get a visual snapshot of each site and where the most diverse sites are on the lake. The information is also shown in Table 2.

We continue to develop our skills by consulting with experts in the field. Last year we hired Dr. Rex Lowe, Bowling Green University, to spend time with us to verify microscopic algal species. This year we hired Dr. Jo Latimore, Michigan State University, who is an expert in aquatic vascular plant identification, to come to our lab and verify our identification of common aquatic plants in Leelanau County.

An interesting phenomenon was observed in 2022 that we haven’t ever observed- there were very few aquatic gardens and those discovered were not very robust. When observed using SCUBA gear, we discovered the plants were weighted down with a heavy layer of what appeared to be golden-brown algae. Most plants that usually send their stems up to the surface were laying horizontal near the lake bottom. It will be interesting to see how this compares to 2023.

The good news for Task #8 is that no invasive plant species (especially Eurasian watermilfoil) were identified in this comprehensive survey!

Table 2: 2022 Aquatic Vascular Plant and Macro Algae Survey

2022 Lime Lake Plant Survey		Site					
Scientific Name	Common Name	1	2	3	4	5	6
<i>Chara contraria</i>	Common stonewort	4	4	4	4	4	4
<i>Cladophora</i> sp.							
<i>Myriophyllum</i> sp.	Whorled/Northern watermilfoil			2			
<i>Najas</i> sp.	Najas						
<i>Najas flexilis</i>	Slender naiad	4	4	2	2	2	3
<i>Nitella</i> sp.							
<i>Potamogeton illinoensis</i>	Illinois Pondweed						2
<i>Potamogeton gramineus</i>	Variable Pondweed	3	4	2	1	1	2
<i>Spongilla lacustris</i>	Freshwater Sponge						
<i>Utricularia macrorhiza</i>	Common bladderwort	3	3		2	2	3
Tolypela		3	2	2	1		2
Potamogeton	Flat Stem		1				

Diagram 1. Sites sampled during the plant survey along a break line



9. Present an update at the LLA Annual Meeting (30 July, 2022 unless otherwise determined).

I presented a brief overview of the many initiatives LLA is engaged in for 2022, which was followed by a full complement of questions and answers on the various topics. Members seem quite interested in the work we continue to do on Lime Lake.

10. Attend LLA Board Meetings (upon request).

I made every effort to attend board meetings if they did not interfere with my teaching responsibilities. Ron Reimink ("Dad") filled me in on anything I missed throughout the year.

11. Respond to all LLA member inquiries.

As mentioned previously, I conducted 4 on-site greenbelt consults in 2022. Beyond that, I led a small group to remove a large beaver dam in Shetland Creek on 24 July. We all contracted significant cases of swimmer's itch while wading in the creek! I also examined a large and unprecedented algal bloom near the mouth of the creek coming out of Pat's Preserve (SW corner). Samples were identified as *Spirogyra* (my favorite species!), which is a native species. We collected drone footage of this event, which is archived and can be seen on footage in the external hard drive. I also identified pictures sent of native plants that looked similar to (but were not) EWM.

12. Assist in educating LLA members on how to identify invasive species (especially EWM).

This was done individually with concerned riparian members as well as at the Annual Meeting.

13. Assist the LLA Board in organizing Yellow Flag Iris eradication efforts if desired.

We conducted a YFI survey on the entire shoreline on 19 June. I then emailed all association members (of whom I had an email address) to alert them to the invasive species on their property and ask if they need assistance removing this invasive plant. On 7 July I worked with Leelanau Conservancy personnel and three Lime Lake volunteers to remove the YFI found on the south end in Pat's Preserve. A similar work bee is scheduled for June 22nd at 9 am for 2023, to continue the efforts of removing YFI from Pat's Preserve.

14. Create and submit a final report documenting all field activities in the fall of 2022.

This report serves that purpose.

Board Discussion Items

1. Due to FWS significant involvement again this year with the Lake Leelanau Lake Association and Grand Traverse Band of Ottawa and Chippewa Indians on their EWM control efforts, we are even more keenly aware of the importance of constant and relentless surveillance of this highly invasive plant in our watershed. We recommend discussing more regular surveillance in 2023, and the establishment of a EWM eradication protocol, complete with the required expertise, equipment and personnel in place if (when?) EWM is discovered.
2. Discuss the value of another drone shoreline survey to be done in 2023 along with drone footage analysis.
3. Discuss value of continuation of basic plant and algal surveys.
4. Discuss other water quality/preservation activities deemed important for 2023 and beyond.