A SHORELINE ALGAL SURVEY OF TORCH LAKE, CLAM LAKE AND LAKE BELLAIRE

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INTRODUCTION

In the summer of 2010 the Three Lakes Association with the support of the Grand Traverse Regional Community Foundation conducted the latest in a series of Cladophora surveys on Torch Lake, Clam Lake, and Lake Bellaire. A team of TLA volunteers and high school interns using kayaks examined the entire shoreline of these lakes. Wherever Cladophora or Cladophora-like algae was found near the shore, the locations were logged with a Global Positioning System (GPS), the size of the bloom noted, and samples taken. This survey was carried out weekly over the course of five weeks. Our goal has been to locate places where phosphorus nutrients are coming into our lakes and use them as a roadmap for future examinations of the sources. Sources include lawn fertilizers and soaps, leaking septic systems, agricultural fertilizers, creeks and rivers (which drain regions well away from the shoreline), and natural wells and seeps. However, as noted in this report there are relatively few obvious sources of nutrient near Cladophora blooms.

Shoreline algal loading is a measure of the overall water quality in lakes along with other indices like the Carlson Index which uses water clarity, phosphorus and nitrogen concentrations, and chlorophyll.[1,2] These indices of water quality are also related to property values.[3] When phosphorus and nitrogen levels are too high the overall effects on the lake system can be disastrous.[4,5]

Three Lakes Association last conducted an algal survey of Torch Lake in 2004. The survey located 114 sites with suspected nutrient loading. Observations made during the current shoreline survey have identified 47 sites: 7 on Torch Lake, 38 on Clam Lake, and 2 on Lake Bellaire. A total of 26 of these sites are considered significant based on their area. Table 1 shows the number and distribution of algae types among the three lakes in 2004 and Table 2 shows the same thing in 2010. Tables 3 and 4 show CSI>50 and Table shows 1<CSI<50 and GPS positions. Maps 1-5 show the location of these sites.

Similar Cladophora surveys were done on these same three lakes in 1983[6] and 2004[7] and similar surveys have been done on other nearby lakes.[8,9] Comparisons with both surveys will be noted.

METHODS

The survey occurred between June 25th and August 6, 2010. Field workers in teams of two, kayaked around the shorelines of Torch Lake, Clam Lake, and Lake Bellaire looking for the presence of filamentous green algae on hard surfaces such as rocks and logs. The CSI value of each area equaled the length of the patch in feet (L), times the width in feet (W), times the average algal filament length in inches (F). The units are arbitrary CSI units with no actual cubic values.

$$CSI = (L)(W)(F)$$

Algal patches with a CSI of <50 were noted but not sampled. When the CSI was >50 samples were collected in bottles and stored on ice in a cooler for microscopic examination. Biovolume can be estimated by using the Cladophora Status Index. Many of these samples were examined with a microscope to verify that the samples were cladophora.[10,11,12,13]

The location of all sites was recorded with GPS coordinates and the coordinates were matched with riparian addresses for later reference. TLA will use this information to contact residents and determine, if possible, the source of the nutrient, phosphorus.

OBSERVATIONS

Table 1 shows that the current survey found that Torch Lake had 4 sites with CSI>50, Clam Lake had 22, and Lake Bellaire had none. For the smaller sites (1<CSI<50) Torch Lake had 5, Clam Lake had 7, Lake Bellaire had 2. By comparison the survey in 2004 showed Torch Lake had 45 sites with CSI>50, Clam Lake had 11, and Lake Bellaire had 13. Similarly in 1983 Torch Lake had 12 sites with CSI>50 and 50 sites with 1<CSI<50. There are approximately 2,017 properties on all three lakes; so, most landowners do not have a problem with Cladophora. Tables 2 and 3 give the GPS locations of all these sites.

Figure 1 shows a microscope photo of a typical sample taken from Clam Lake. Figure 2 shows a typical Cladophora patch on Clam Lake and Figures 3 and 4 show typical shoreline growth on small patch on the east side of Torch Lake.

Maps 1-5 show the location of CSI>50 and 1<CSI<50 on Torch Lake, Clam Lake, and Lake Bellaire. The Appendix gives a more detailed location.

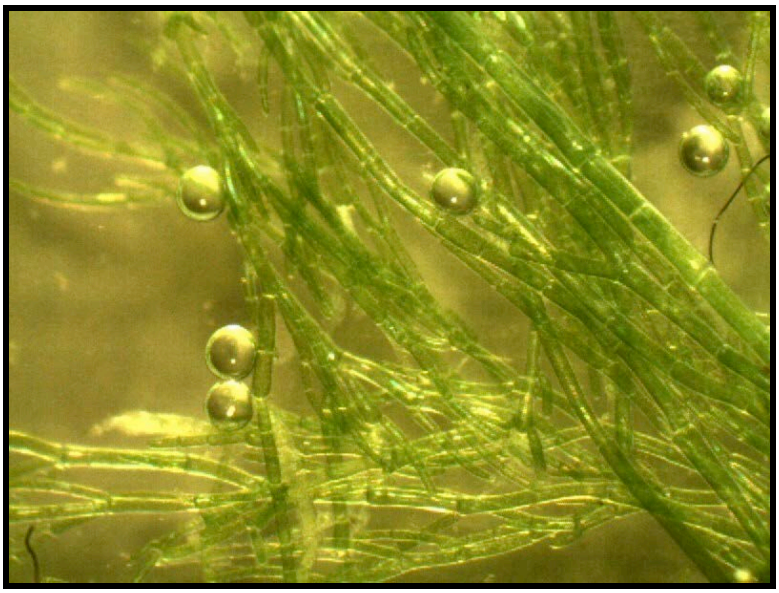


Fig. 1 Closeup of Cladophora sample taken from Clam Lake

Fig. 2 Typical Cladophora outcrop on Clam Lake

Fig. 3 CSI=10 Cladophora bloom on east side of Torch Lake

Fig. 3 CSI=32 Cladophora bloom on east side of Torch Lake

Table 1: 2010 Data Summary

	Torch Lake		Clam Lake		Lake Bellaire	
	CSI > 50	1<CSI < 50	CSI > 50	1<CSI< 50	CSI > 50	1<CSI < 50
2010	4	5	22	7	0	2
2004	45	n/a	11	n/a	13	n/a
1983	12	50	n/a	n/a	n/a	n/a

Table 2: 2010 Data: CSI>50, all lakes

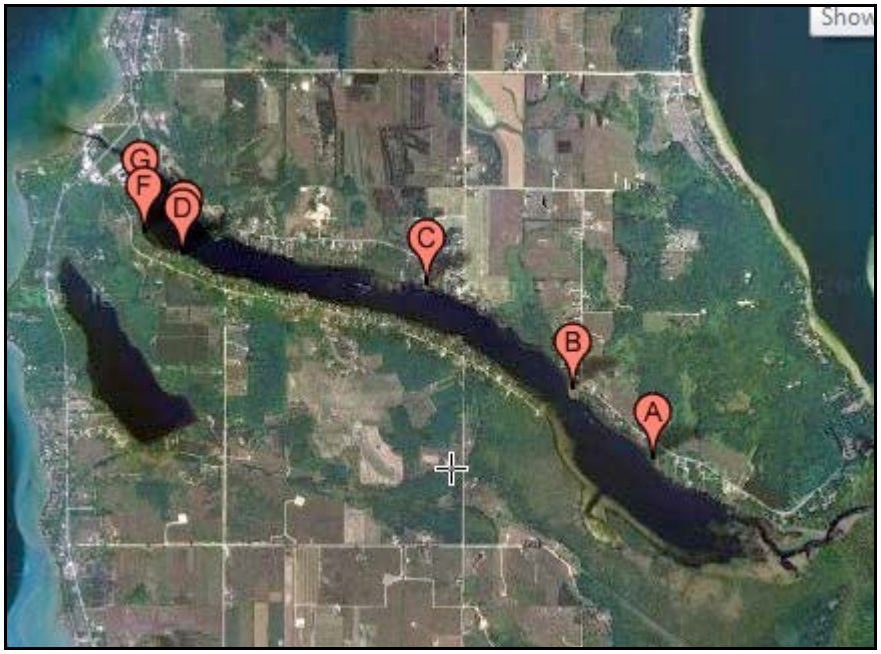
#	CSI	Lake	GPS	Date
1	1000	Clam	N 44° 55.228' W 85° 13.798'	7/9/10
2	4800	Clam	N 44° 55.244' W 85° 13.839'	7/9/10
3	144	Clam	N 44° 55.271' W 85° 13.972'	7/9/10
4	450	Clam	N 44° 55.284' W 85° 14.003'	7/9/10
5	120	Clam	N 44° 55.372' W 85° 14.142'	7/9/10
6	250	Clam	N 44° 55.242' W 85° 14.198'	7/9/10
7	750	Clam	N 44° 55.502' W 85° 14.329'	7/9/10
8	450	Clam	N 44° 55.655' W 85° 14.549'	7/9/10
9	240	Clam	N 44° 55.760' W 85° 14.682'	7/9/10
10	140	Clam	N 44° 55.823' W 85° 14.921'	7/9/10
11	60	Clam	N 44° 55.892' W 85° 14.947'	7/9/10
12	80	Clam	N 44° 55.943' W 85° 15.124'	7/9/10
13	375	Clam	N 44° 56.013' W 85° 15.324'	7/9/10
14	75	Clam	N 44° 56.019' W 85° 15.402'	7/9/10
15	500	Clam	N 44° 56.040' W 85° 15.522'	7/9/10
16	400	Clam	N 44° 56.060' W 85° 15.590'	7/9/10
17	187.5	Clam	N 44° 56.082' W 85° 15.760'	7/9/10
18	800	Clam	N 44° 56.491' W 85° 16.859'	7/9/10

19	60	Clam	N 44° 51.260' W 85° 18.599'	7/9/10
20	600	Clam	N 44° 52.612' W 85° 16.269'	7/9/10
21	240	Clam	N 44° 56.213' W 85° 16.747'	7/16/10
22	432	Clam	N 44° 56.323' W 85° 16.779'	7/16/10
23	90	Torch	N 44° 53.241' W 85° 16.873'	7/23/10
24	120	Torch	N 44° 51.150' W 85° 19.533'	7/30/10
25	900	Torch	N 44° 58.980' W 85° 17.200'	8/6/10
26	100	Torch	N 44° 52.617' W 85° 16.750'	8/24/10

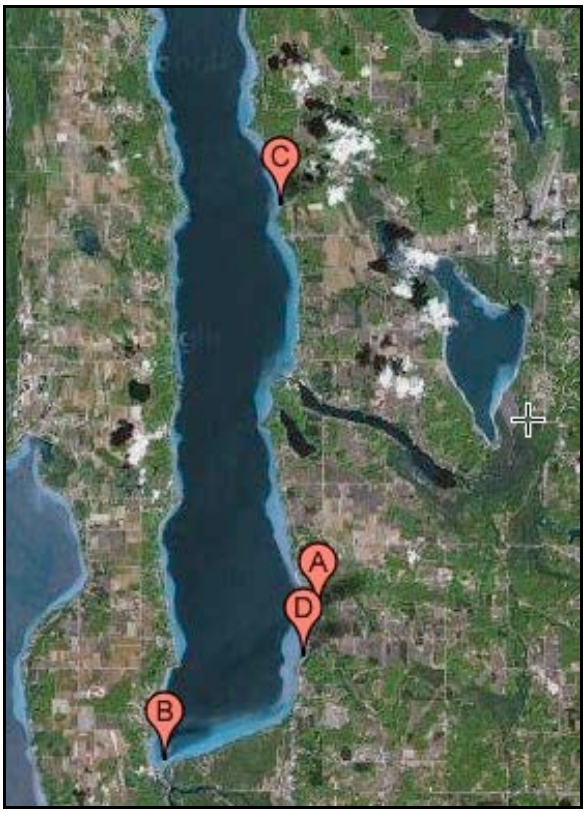
Table 3: 2010 Data: 1<CSI<50, all lakes

#	CSI	Lake	GPS	Date
27	3	Bellaire	N 44° 56.392' W 85° 12.680'	6/25/10
28	6	Bellaire	N 44° 56.716' W 85° 12.411'	6/25/10
29	40	Clam	N 44° 55.372' W 85° 14.143'	7/09/10
30	20	Clam	N 44° 55.626' W 85° 14.549'	7/9/10
31	20	Clam	N 44° 56.011' W 85° 15.303'	7/9/10
32	1.5	Clam	N 44° 56.115' W 85° 16.558'	7/16/10
33	36	Clam	N 44° 56.145' W 85° 16.555'	7/16/10
34	12	Clam	N 44° 56.195' W 85° 16.755'	7/16/10
35	12	Clam	N 44° 56.292' W 85° 16.773'	7/16/10
36	5	Torch	N 45° 04.123' W 85° 19.376'	7/30/10
37	5	Torch	N 45° 02.285' W 85° 19.096'	7/30/10
38	5	Torch	N 45° 05.270' W 85° 18.465'	8/19/10
39	32	Torch	N 45° 05.925' W 85° 20.096'	8/19/10
40	18	Torch	N 44° 52.633' W 85° 16.733'	8/24/10

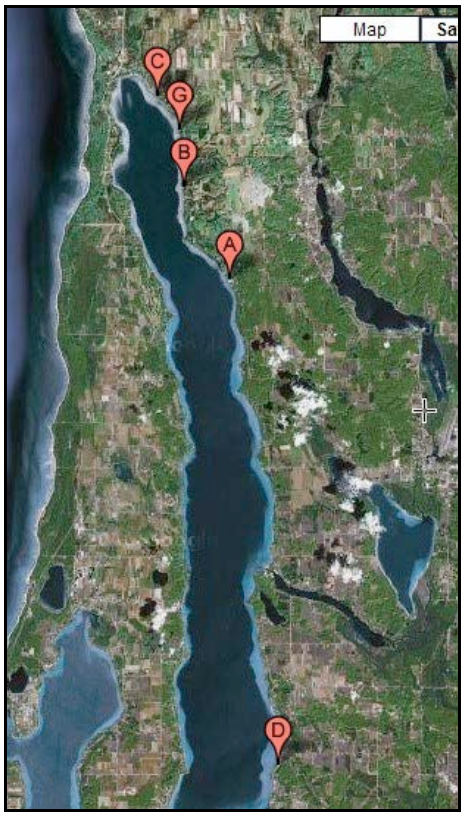
Map 1: Clam Lake sites with CSI >50[14]



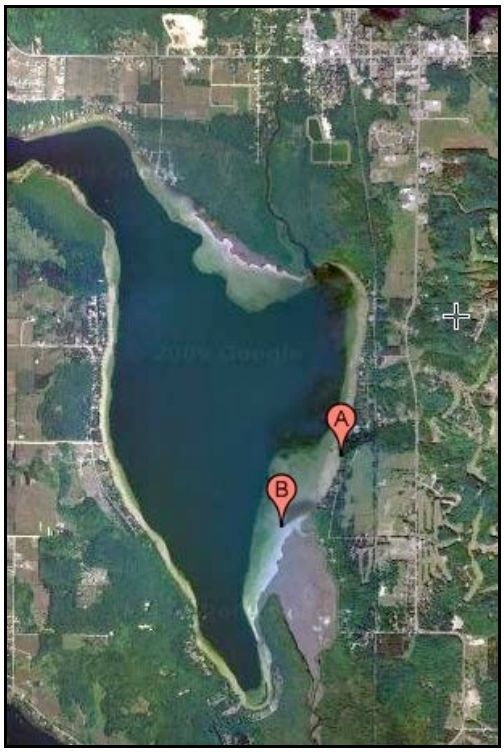
Map 2: Clam Lake sites with 1<CSI <50



Map 3: Torch Lake sites with CSI>50



Map 4: Torch Lake with 1<CSI<50



Map 5: Lake Bellaire sites CSI<50

DISCUSSION

Preliminary water quality modeling studies of Torch Lake and its tributaries indicate that 2/3 of the lake's phosphorus loading comes from a combination of non-point sources such as atmospheric deposition, and watershed runoff (unpublished sampling data). Wetland soils and organic debris found in tributaries are rich in phosphorus so water flowing through and over them would add considerable phosphorus to the lakes.[15,16,17]

Phosphorus samples were not taken during this survey. The reason is that on the average phosphorus levels in these lakes does not change much between the shorelines and lake average. Furthermore, phosphorus levels in deep and shallow, central regions in these three lakes are quite low, the lowest in Torch Lake of 2.6 ppb, and have not changed for decades.[18] However, high phosphorus levels and Cladophora sites have not been correlated. Correlation between E.coli and Cladophora levels has been seen on some lakes.[19] No E.coli data was taken in this survey.

The lakes surveyed in this report are located in Antrim County, Michigan in a 500 sq. mile watershed called Elk River Chain-of-Lakes. This watershed is shown in Figure 5.

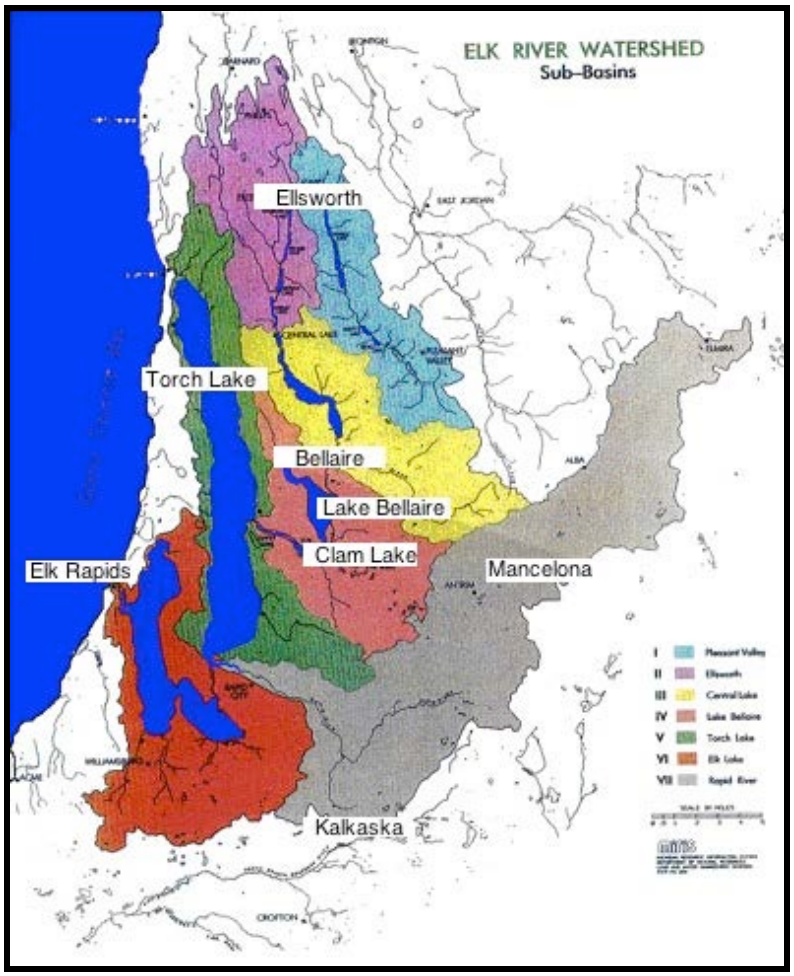


Fig. 5 Elk River Chain-of-Lakes watershed

The Cladophora we found was typically in localized patches with no obvious phosphorous source. When we compared the maps from 1983 and 2004 with the maps from our 2010 study we saw little correlation between patches. Specifically, there were numerous Cladophora sites with CSI>50 on Torch Lake (45 sites) and Lake Bellaire (13 sites) in 2004 and few in 2010. Similarly, there were few Cladophora sites on Clam Lake (11 sites) in 2004 and many in 2010 (25 sites). We did see a significantly larger amount of Cladophora on Clam Lake compared to Torch and Bellaire and there were significantly more sites on the northeast side than the southwest. This may be due to the fact that much of the northwest shore of Clam Lake is undeveloped and left in its natural state providing more nutrient rich shoreline for the Cladophora to grow along.[20] More natural southeast shoreline may provide phosphorus absorption for this region. There is also more agricultural development on the north side of Clam Lake. In general there are also more zebra mussels in Clam Lake than in Torch Lake or Lake Bellaire. On Torch Lake in 2010 the Cladophora sites appear to be located preferentially on the south and east sides. However, in 2004 this was not the case. The effect of water temperature and rainfall on Cladophora growth is strong and there is some evidence that wave action also effects Cladopora growth.[21] It is difficult to determine what the sources of phosphorous are along our shorelines, but septic systems, lawn and garden fertilizers, and erosion contribute. Seasonal growth patterns for Cladophora in our area are also unknown. In recent years lawn care companies have been using phosphorus-free fertilizers in our area, so this source of phosphorus is becoming less frequent. As an incidental observation, a number of the larger and newer lawns on the west side of Torch Lake were Cladophora free.

Because of time constraints each shoreline was surveyed only once. Cladophora can have a very short life and is easily washed away by currents and affected by temperature, so the location and frequency of the patches could be changing week to week. An event that increased phosphorous levels at the beginning of the summer may have gone unnoticed because it had no affect towards the end of the summer.

RECOMMENDATIONS AND CONCLUSION

(1) The sites marked on the maps indicating the largest Cladophora sites should be followed up with a letter or a call to the landowner offering our assistance to determine if human influenced nutrient loading is occurring.

(2) Because of the large variability noted in the last two surveys done in 2004 and 2010 that these surveys should be done more frequently and with more information collected on water and air temperature.

(3) Because of the correlation noted between Cladophora and E.coli on Grand Traverse Bay, E.coli samples should be taken on the largest sites in the survey to see if there is any correlation.

(4) The 2010 TLA Cladophora Survey should be put on the TLA website immediately following its acceptance by the author and volunteer group.

(5) No phosphorus samples have been taken during any TLA Cladophora surveys. In the future phosphorus concentration should be sampled in the water and sediment near Cladophora sites.[22]

ENDNOTES

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