

Water quality conditions in Little Traverse Lake (Summer 2018) and recommendations for future water quality sampling and model development

By Ray Canale, September 2018

Description of Monitoring Program

A monitoring program was conducted on Little Traverse Lake and Shetland Creek on three occasions in 2018. The Lake chemistry samples consisted of a 0 to 20 foot depth composite and a single near-bottom sample at a depth of 50 feet. The Shetland Creek sample was collected at a site on M22 near the inlet to the Lake. The samples were measured in triplicate for total phosphorus (TP), nitrate plus nitrite (NO_x), and chlorophyll. A YSI meter was used to measure dissolved oxygen, pH, temperature, and conductivity at 13 separate water depths to generate data for vertical profiles. The data are shown in tabular and graphical formats in Appendices A through D.

Conclusions

The data show no significant water quality problems in Little Traverse Lake (except for some likely anomalous phosphorus measurements). Bottom water oxygen depletion rates are slower and water clarity has increased in 2018 compared data collected by the Leelanau Conservancy in 1991. Surface total phosphorus concentrations varied between 5 and 7.4 mg/m³. These data show that phosphorus limits the growth of algae. Bottom total phosphorus concentrations ranged between 7.3 and 10.9 mg/m³. These elevated total phosphorus concentrations in the bottom waters suggest the release of phosphorus from bottom sediments during periods when the dissolved oxygen concentrations are less than 2 mg/L as were measured during the August 26, 2018 survey (see Appendix D). The measured nitrate plus nitrite concentrations are high enough to discourage the growth of undesirable nitrogen-fixing blue green algae.

Practical Applications

It is very important to note that these measurements alone (as well available historical water quality data) cannot be used to reliably evaluate the potential harmful impacts of future watershed developments and unforeseen new nutrient loads or quantify the potential benefits and cost-effectiveness of future remedial alternatives.

In order for the data to be used to answer these types of future “what if” questions the data must be used in conjunction with and support the development of water quality models.

Historical Data and Reports

The Leelanau Conservancy has sampled Little Traverse Lake and Shetland and Shalda creeks since 1990. Unfortunately (except for 1991) samples are taken only 3 or 4 times

per year which limits their usefulness because annual variations in the biochemical data are significant. The data have been used in reports by Steinberg (1994), Keilty (1994), and Keilty and Woller (2002) to define trophic conditions and identify trends. Canale and Nielsen (1997) used the data to construct preliminary budgets for phosphorus, nitrogen, and water. These budgets are preliminary groundwork needed for development of water quality models for applications.

Recommendations

1. It is proposed that an expanded lake sampling program be conducted for the next three years for the purpose of establishing baseline conditions as well supporting the development of water quality models, detecting trends, and identifying potential problems. Lake sampling at 2 depths should occur every 2 weeks starting in May through November. Laboratory analysis should include total phosphorus and chlorophyll. YSI measurements for dissolved oxygen, temperature, pH, and conductivity should be taken to generate vertical profiles. Secchi depth should be measured. Weather conditions should be recorded.
2. Inputs and discharges of phosphorus into and from Little Traverse Lake from Shetland and Shalda Creeks are poorly known. It is proposed that the sampling program include measurement of the flow and total phosphorus concentration of both Shetland and Shalda Creeks.
3. The Lake and Creek data should be stored in a database that can be used to retrieve and display the information in a convenient manner for trend detection and model development.

References

Canale, R. P. and W. H. Nielsen. 1997. "Nutrient Data and Budgets for Leelanau County Streams and Lakes, 1990 to 1996". Leelanau Conservancy Report-97-2

Keilty, T. K. 1997. "Water Quality Monitoring Program (A Synthesis of Data from 1990 to 1995)", Leelanau Conservancy Report

Keilty, T. K. and M. Woller. 2002. "Water Quality Monitoring Report (A Synthesis of Data from 1990 through 2001)" Leelanau County Report No. 02-1

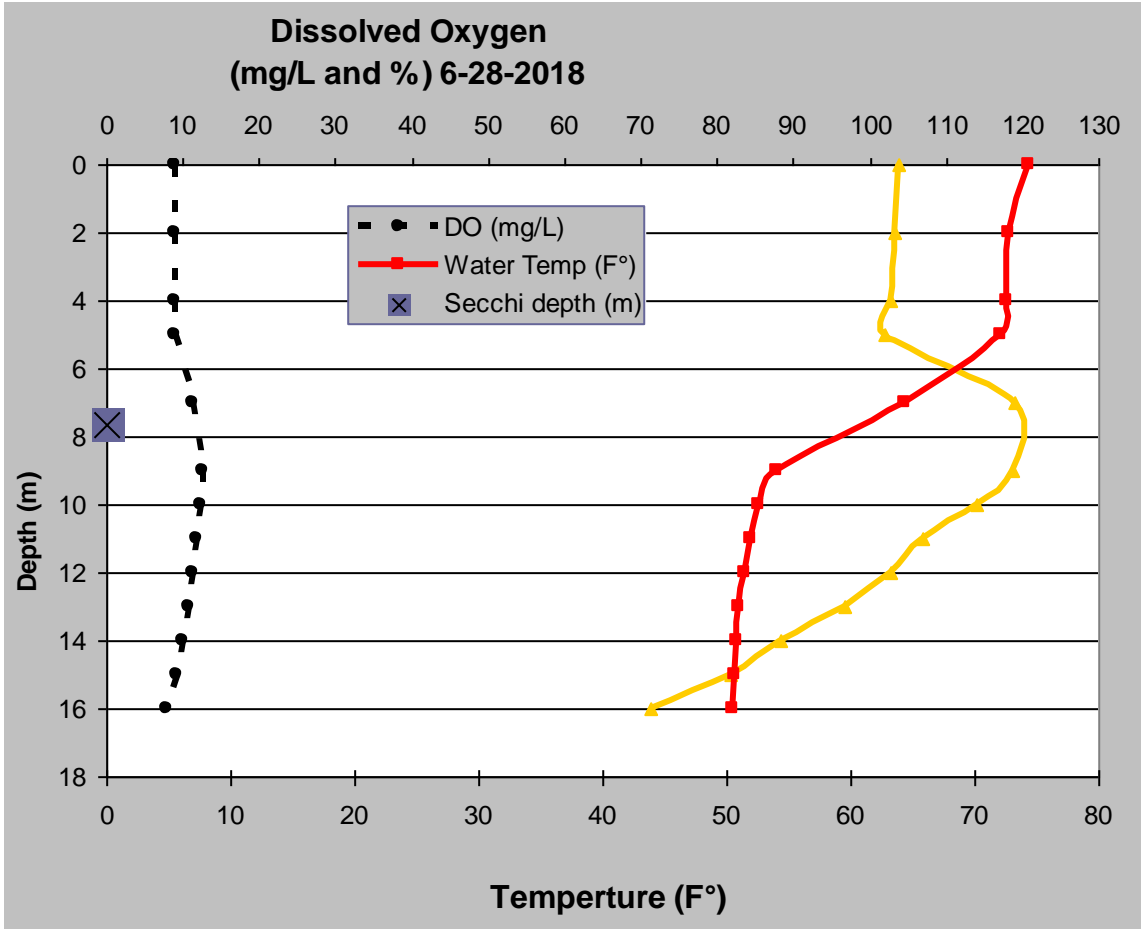
Steven J. Steinberg, Gary A. Stahl, Eric A. Olson, Patrick W. Cayen, and David T. Purdy. 1994. "Water Quality within the Little Traverse and Lime Lake Watersheds Leelanau County, Michigan". Master's Thesis for Science and Landscape Architecture, University of Michigan, School of Natural Resources and Environment.

Appendix A. Chemistry Data

Client ID	Triplicate	System Name	Date Sampled	TP (µgP/L)	Chl a (µg/L)	NOx (µgN/L)
LTL 0-20-1	A	Little Traverse Lake	6/28/18	5	0.6	121
LTL 0-20-2	B	Little Traverse Lake	6/28/18	5	0.5	123
LTL 0-20-3	C	Little Traverse Lake	6/28/18	6	1	123
LTL 50-1	A	Little Traverse Lake	6/28/18	7.6	2.2	130
LTL 50-2	B	Little Traverse Lake	6/28/18	7.3	1.6	130
LTL 50-3	C	Little Traverse Lake	6/28/18	7.3	2.1	133
Shetland Cr-1	A	Shetland Creek	6/28/18	7	0.7	152
Shetland Cr-2	B	Shetland Creek	6/28/18	7	0.5	177
Shetland Cr-3	C	Shetland Creek	6/28/18	7	0.5	149
LTL 0-20 R1	A	Little Traverse Lake	7/29/18	19.5	2.3	66
LTL 0-20 R2	B	Little Traverse Lake	7/29/18	18.2	2.3	66
LTL 0-20 R3	C	Little Traverse Lake	7/29/18	21.5	2	64
LTL 50 R1	A	Little Traverse Lake	7/29/18	17.2	1.7	97
LTL 50 R2	B	Little Traverse Lake	7/29/18	12.7	0.9	93
LTL 50 R3	C	Little Traverse Lake	7/29/18	12.4	1.5	95
Shetland Cr. 1	A	Shetland Creek	7/29/18	7.1	0.7	101
Shetland Cr. 2	B	Shetland Creek	7/29/18	5.5	0.9	101
Shetland Cr. 3	C	Shetland Creek	7/29/18	5.2	0.7	104
LHL 0-20	A	Little Traverse Lake	8/26/18	7.8	1.7	51
LTL 0-20	B	Little Traverse Lake	8/26/18	7.3	1	51
LTL 0-20	C	Little Traverse Lake	8/26/18	7.4	0.8	46
LHL 50	A	Little Traverse Lake	8/26/18	10.9	1.2	61
LTL 50	B	Little Traverse Lake	8/26/18	9.2	0.9	58
LTL 50	C	Little Traverse Lake	8/26/18	9.8		69
Shetland Cr.	A	Shetland Creek	8/26/18	9.1	0.8	101
Shetland Cr.	B	Shetland Creek	8/26/18	9.8	0.8	100
Shetland Cr.	C	Shetland Creek	8/26/18	8.8		103

Appendix B. Field Data for June 28, 2018

Little Traverse Lake - Leelanau County, MI						
Date:	Thursday, June 28, 2018		Weather:	Condition	temperature (°F)	wind
Who:	J. Ransom			Sunny	78	0-5 mph W
Sample Site:	Deep Basin 54 ft					
			Secchi depth (m)	7.6		
YSI ProDSS						
Time	Depth (m)	Water Temp (F°)	pH (units)	SpCond (µS/cm)	DO (mg/L)	DO saturation %
12:46:16 PM	0	74.4	8.23	374.1	8.8	103.8
12:47:26 PM	2	72.8	8.19	373.1	8.9	103.2
12:48:50 PM	4	72.5	8.17	373.2	8.89	102.8
12:49:50 PM	5	72.1	8.16	373.5	8.86	102.0
12:52:30 PM	7	64.4	8.11	375.9	11.24	118.9
12:53:54 PM	9	54.0	8.06	376.0	12.7	118.7
12:55:46 PM	10	52.5	7.98	376.5	12.44	113.9
12:57:27 PM	11	51.9	7.92	379.0	11.77	106.9
12:58:37 PM	12	51.5	7.88	380.6	11.37	102.8
12:59:59 PM	13	51.0	7.84	383.2	10.77	96.8
1:01:47 PM	14	50.8	7.79	387.2	9.84	88.2
1:03:09 PM	15	50.6	7.75	389.5	9.15	81.8
1:04:50 PM	16	50.5	7.68	392.1	7.98	71.2
Shetland Creek Probe Data						
Date	Water Temp (F°)	DO (mg/l)	DO (% sat)	Sp Cond	pH	
6/28/2018	73	8.07	93.8	362.7	7.98	



Appendix C. Field Data for July 29, 2018

Little Traverse Lake - Leelanau County, MI

Date:	Sunday, July 29, 2018	Weather:	Condition	temperature (°F)	wind
Who:	J. Ransom		Cloudy	78	0-5 mph W
Sample Site:	Deep Basin 54 ft				
		Secchi depth (m)	3.4		

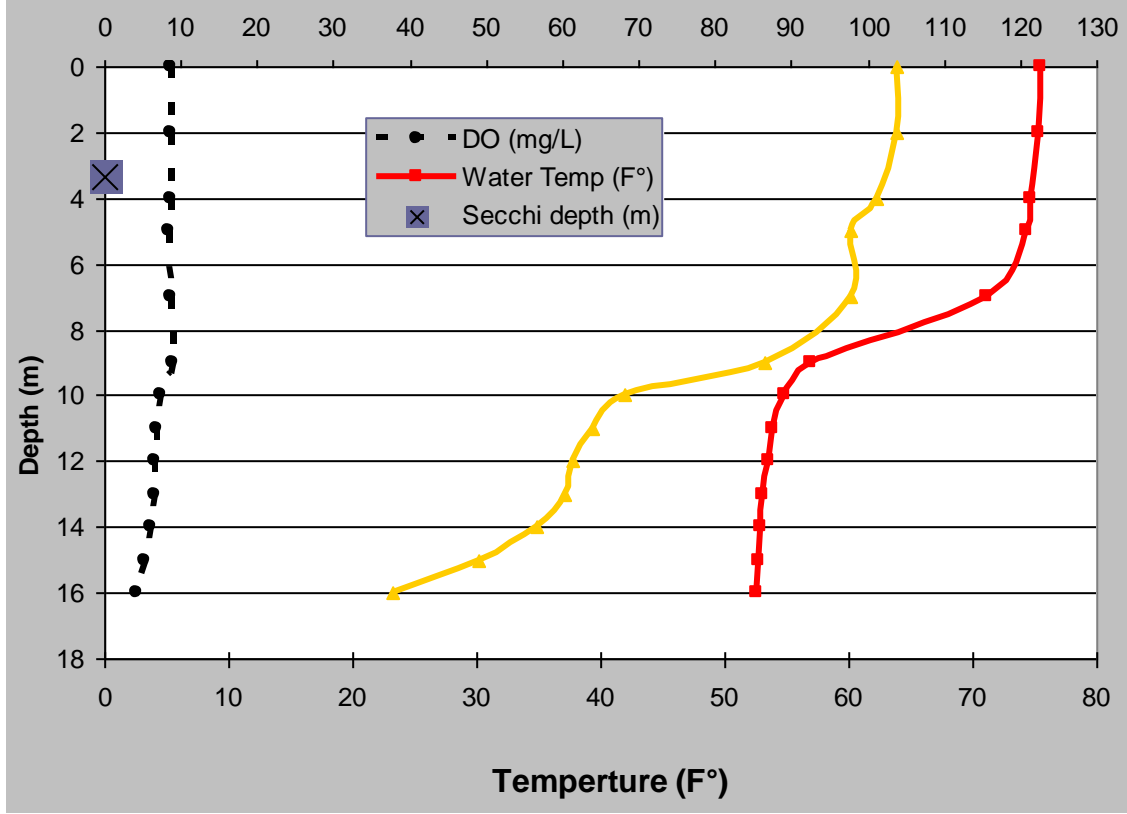
YSI ProDSS

Time	Depth (m)	Water Temp (F°)	pH (units)	SpCond (µS/cm)	DO (mg/L)	DO saturation %
6:09:20 PM	0	75.5	8.32	368.0	8.69	103.7
6:10:41 PM	2	75.4	8.32	367.9	8.7	103.7
6:11:46 PM	4	74.7	8.33	368.1	8.56	101.3
6:14:44 PM	5	74.4	8.29	368.6	8.3	97.8
6:15:52 PM	7	71.2	8.18	374.0	8.57	97.7
6:17:34 PM	9	57.0	7.78	384.0	8.93	86.5
6:19:05 PM	10	54.9	7.65	388.7	7.22	68.2
6:20:42 PM	11	53.9	7.64	389.9	6.85	63.9
6:21:30 PM	12	53.6	7.63	391.9	6.61	61.3
6:22:17 PM	13	53.0	7.62	392.7	6.54	60.3
6:22:57 PM	14	52.9	7.60	394.1	6.15	56.6
6:23:55 PM	15	52.7	7.57	397.4	5.32	48.9
6:25:52 PM	16	52.6	7.52	401.0	4.12	37.8

Shetland Creek Probe Data

Date	Water Temp (F°)	DO (mg/l)	DO (% sat)	Sp Cond	pH
7/29/2018	76.3	7.30	89.4	352.1	8.05

Dissolved Oxygen (mg/L and %) 7-29-2018



Appendix D. Field Data for August 26, 2018

Little Traverse Lake - Leelanau County, MI						
Date:	Sunday, August 26, 2018		Weather:	Condition	temperature (°F)	wind
Who:	J. Ransom			Mostly cloudy	80	0-5 mph NE
Sample Site:	Deep Basin 54 ft					
			Secchi depth (m)	3.4		
YSI ProDSS						
Time	Depth (m)	Water Temp (F°)	pH (units)	SpCond (µS/cm)	DO (mg/L)	DO saturation %
2:10:17 PM	0	74.0	8.20	370.6	7.93	93.1
2:11:41 PM	2	72.8	8.19	369.9	7.95	92.1
2:12:37 PM	4	72.6	8.20	369.8	7.92	91.6
2:13:23 PM	5	72.5	8.17	370.1	7.78	90.0
2:15:02 PM	7	72.0	8.12	371.2	7.46	85.8
2:17:21 PM	9	61.0	7.47	390.6	4.78	48.6
2:18:43 PM	10	56.3	7.38	401.7	2.65	25.5
2:19:17 PM	11	55.0	7.35	403.5	2.16	20.5
2:20:08 PM	12	54.3	7.34	405.1	1.99	18.7
2:21:21 PM	13	53.8	7.33	408.4	1.39	13.0
2:22:34 PM	14	53.6	7.32	411.5	0.81	7.5
2:23:46 PM	15	53.3	7.30	414.0	0.24	2.2
2:24:44 PM	16	53.0	7.28	441.4	-0.01	-0.1
Shetland Creek Probe Data						
time	Water Temp (F°)	DO (mg/l)	DO (% sat)	Sp Cond	pH	
3:40:05 PM	72.3	8.08	93.1	352.4	8	

Dissolved Oxygen (mg/L and %) 8-26-2018

