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Lake Quassapaug 2019 Data Summary

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Water Quality Summary

Secchi Disk Transparency

All Secchi values from 2013 to 2019 are listed in Table 1. Values in 2019 were generally worse than average. Based on the historical data, water clarity appears to fluctuate dramatically throughout the season and does not seem to follow the same pattern from year to year. The lack of a repeated pattern suggests that the lake clarity is heavily influenced by external factors. These factors may include watershed changes, in-lake management efforts, natural pollen release periods, and weather. The blank dates in the table below indicate that water sampling was conducted by volunteers for nutrient and profile testing but no Secchi values were reported. All values are graphed in Figure 1.

Table 1: Lake Quassapaug 2013-2019 Secchi Disk Depths (meters)

Date	Secchi (m)	Date	Secchi (m)	Date	Secchi (m)
5/1/2013	5.4	4/29/2015	4.0	6/8/2017	7.4
8/2/2013	5.5	5/5/2015	3.5	8/30/2017	7.2
8/15/2013	5.0	5/21/2015	5.0	9/17/2017	
8/19/2013	5.5	5/29/2015	8.0	5/21/2018	5.0
9/8/2013	5.5	6/25/2015	6.5	7/10/2018	5.6
10/6/2013	6.3	7/31/2015	8.0	8/10/2018	
10/20/2013	5.0	9/16/2015	6.3	4/4/2019	3.5
4/21/2014	4.5	10/21/2015	6.3	5/6/2019	4.0
5/21/2014	5.0	4/20/2016	6.0	6/11/2019	4.3
6/18/2014	5.7	5/10/2016	6.0	7/15/2019	3.6
7/21/2014	4.5	8/5/2016	7.5	7/25/2019	5.1
8/29/2014	6.6	8/18/2016	7.5	8/15/2019	4.7
9/29/2014	8.0			9/15/2019	
10/29/2014	9.0			10/24/2019	5.4

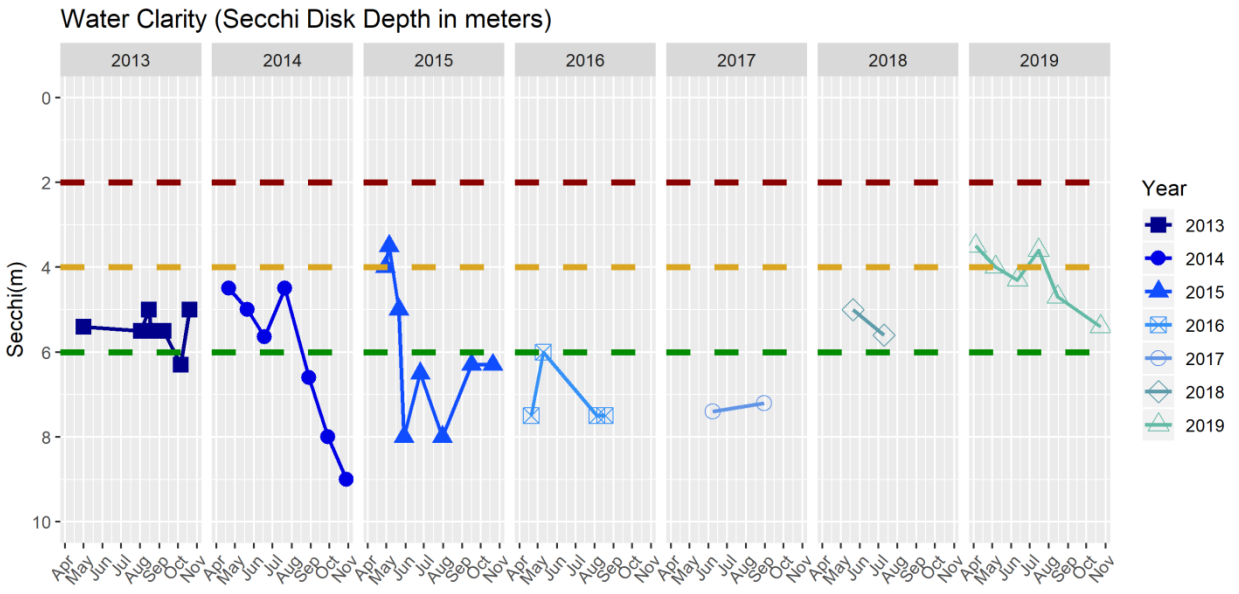

Figure 1 Water Clarity 2013-2019

The horizontal lines in the figure above represent the lake trophic classification ranges. When the water clarity is great enough for the Secchi disk to be seen deeper than 6 meters into the water column, as represented by the green dashed line, clarity is very good. Based on the excellent late-season water clarity in 2014-2017, Lake Quassapaug should be considered Oligotrophic. However, no high-quality Secchi values reported in 2018-2019. Three of the seven 2019 reported values were within the Mesotrophic range. Continued monthly monitoring of water clarity will be incredibly important in 2020 to ensure that water clarity does not continue to decline.

Temperature

Water temperature profiles were recorded much more frequently in 2019 than in 2018 because monitoring was shared by both volunteers and Northeast Aquatic Research personnel. Volunteers recorded temperature from the surface to the lake bottom at one-meter increments in May, July, and September. Northeast Aquatic Research staff performed the monitoring in April, June, late July, and October.

The water column temperature was uniform from top to bottom in April, but by May significant warming had taken place. The lake began to thermally stratify by the May 6th sampling date, and a strong thermocline had developed by June 11th. The relatively warm autumn resulted in a strong thermal gradient from top to bottom that lasted beyond the October 24th sampling date. In short, a strong thermocline for longer periods of time is expected to result in less bottom-water oxygen late in the season. As climate change leads to longer growing seasons, there is a potential for worsened internal loading of nutrients from the lake bottom. This is a compounding result of worsened oxygen conditions.

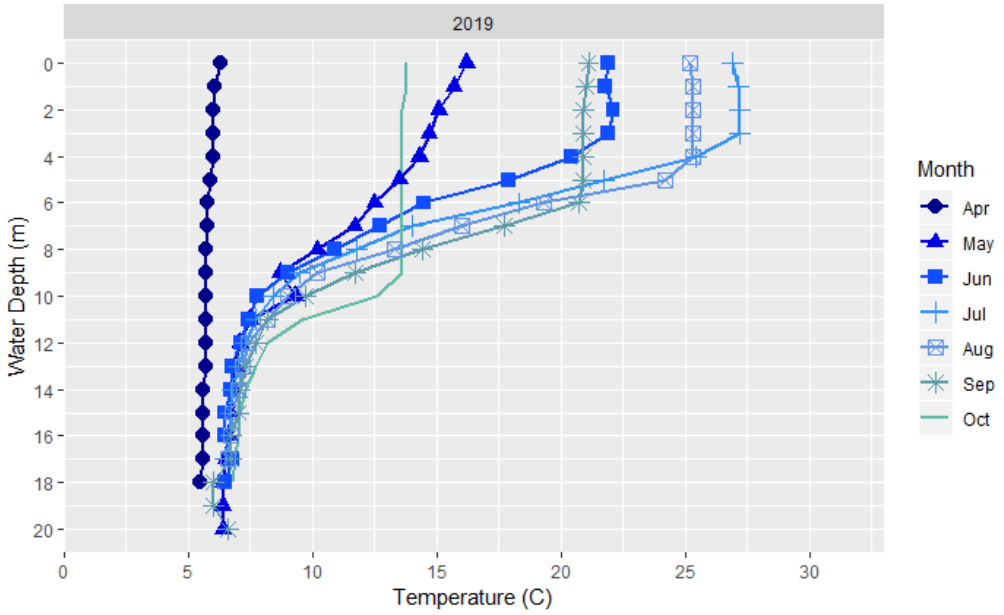

Figure 2 Water Temperature Profiles 2019

Dissolved Oxygen

Dissolved oxygen is measured in milligrams per liter (mg/L) of water. However, it is best to compare temperature profiles using percent oxygen saturation, which is normalized by the temperature of the water. Figure 2 shows how the bottom of the lake loses oxygen as the summer progresses. The loss of oxygen in the bottom waters changes water chemistry and allows nutrients stored in the sediments to be released into the overlying water column. This process is called internal loading. Oxygen loss was worst in September. There also appears to be a significant oxygen demand in the middle of the water column.

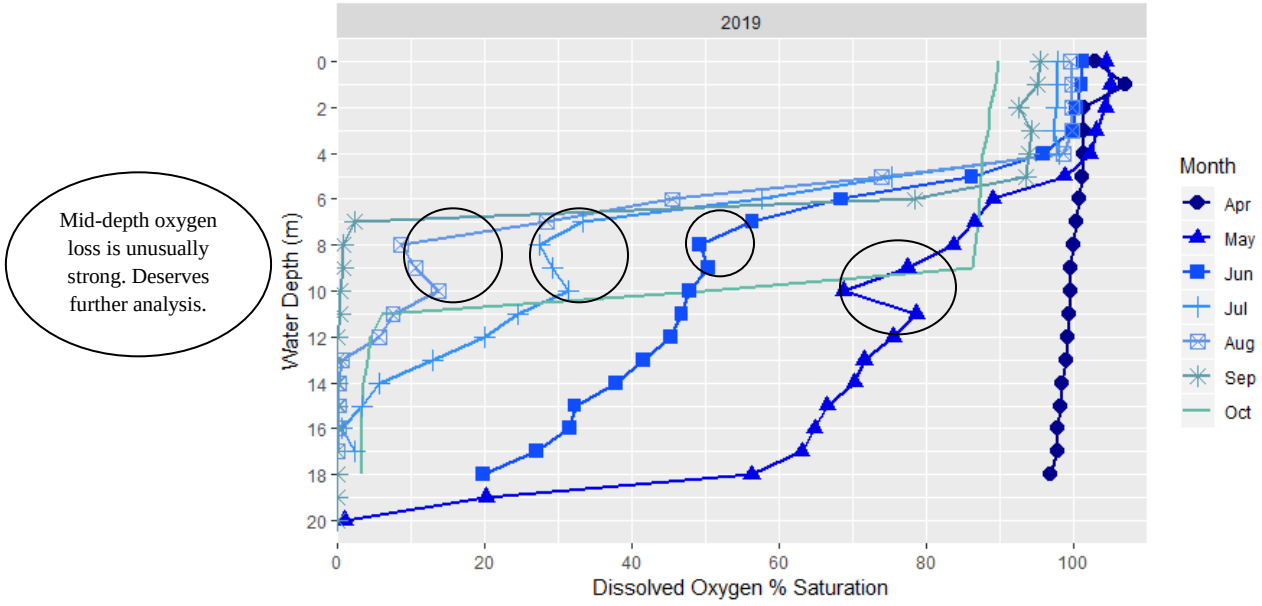

Figure 3 Percent Oxygen Saturation Profiles 2019

Nutrient Testing Results

The 2019 nutrient testing results for Total Phosphorus (TP) and Total Nitrogen (TN) are listed below. The concentrations at the lake bottom are expected to increase throughout the season and are typically much higher than the surface concentrations due to the loss of bottom-water oxygen and the process of internal loading. Bolded values are above average for Lake Quassapaug given the respective depths of the sample.

- Surface mean (2014-2019) : TP = 12ppb, TN = 224ppb
- Mean concentration below 15m (2014-2019): TP = 173ppb, TN = 631ppb

Table 2 In-Lake Nutrient Testing Results 2019

Lake	SampledBy	Station	Depth_m	Date	TP_ppb	TN_ppb	Concern?
Quassapaug	NEAR	Deep hole	1	4/4/2019	**17**	215	✓
Quassapaug	NEAR	Deep hole	6	4/4/2019	16	202	
Quassapaug	NEAR	Deep hole	10	4/4/2019	15	216	
Quassapaug	NEAR	Deep hole	18	4/4/2019	18	239	
Quassapaug	NEAR	Deep hole	1	6/11/2019	**14**	**230**	✓
Quassapaug	NEAR	Deep hole	6	6/11/2019	14	205	
Quassapaug	NEAR	Deep hole	10	6/11/2019	8	170	
Quassapaug	NEAR	Deep hole	16	6/11/2019	18	336	
Quassapaug	Volunteers	Deep hole	1	5/6/2019	**16**	213	✓
Quassapaug	Volunteers	Deep hole	6	5/6/2019	13	**389**	✓
Quassapaug	Volunteers	Deep hole	10	5/6/2019	11	194	
Quassapaug	Volunteers	Deep hole	18	5/6/2019	14	267	
Quassapaug	Volunteers	Deep hole	0	7/15/2019	**15**	**251**	✓
Quassapaug	Volunteers	Deep hole	13	7/15/2019	12	**332**	✓
Quassapaug	Volunteers	Deep hole	18	7/15/2019	22	475	
Quassapaug	Volunteers	Deep hole	19	7/15/2019	**474**	**905**	✓
Quassapaug	NEAR	Deep hole	1	7/25/2019	**18**	204	✓
Quassapaug	NEAR	Deep hole	6	7/25/2019	**21**	204	✓
Quassapaug	NEAR	Deep hole	10	7/25/2019	13	216	
Quassapaug	NEAR	Deep hole	18	7/25/2019	29	446	
Quassapaug	Volunteers	Deep hole	1	8/15/2019	9	**251**	
Quassapaug	Volunteers	Deep hole	6	8/15/2019	10	188	
Quassapaug	Volunteers	Deep hole	10	8/15/2019	16	297	
Quassapaug	Volunteers	Deep hole	18	8/15/2019	**1052**	**1711**	✓
Quassapaug	Volunteers	Deep hole	1	9/15/2019	12	192	
Quassapaug	Volunteers	Deep hole	7	9/15/2019	14	189	
Quassapaug	Volunteers	Deep hole	16	9/15/2019	52	319	
Quassapaug	Volunteers	Deep hole	19	9/15/2019	**188**	473	✓
Quassapaug	NEAR	Deep hole	1	10/24/2019	**14**	204	✓
Quassapaug	NEAR	Deep hole	6	10/24/2019	13	204	
Quassapaug	NEAR	Deep hole	10	10/24/2019	15	180	
Quassapaug	NEAR	Deep hole	18	10/24/2019	**164**	**475**	✓

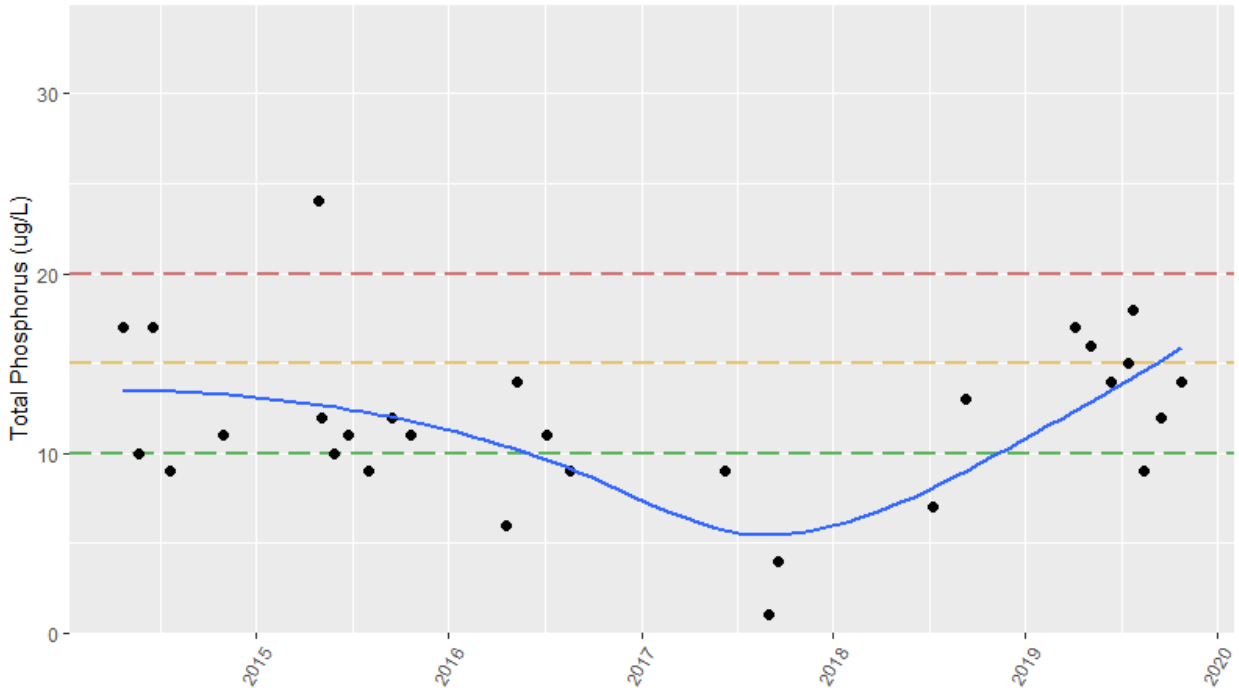

Figure 4 Trend in Surface Total Phosphorus Concentrations 2014-2019

In reference to the CT DEEP Trophic Categories, in-lake surface Total Phosphorus (TP) concentrations below 10ug/L are considered good; concentrations below 15ug/L are considered okay; and surface TP greater than 20ug/L increases the chances of a cyanobacteria bloom. These three thresholds are shown as horizontal dashed lines in Figure 4.

Aquatic Plants

Invasive Species Survey Results

The 2019 aquatic plant survey at Lake Quassapaug was conducted on 7/25/19. Invasive Variable milfoil (*Myriophyllum heterophyllum*) was located at 31 of the total survey waypoints (23% occurrence). The long term reduction of Variable milfoil was apparent in the survey data (Table 3).

Map 2. Lake Quassapaug 2019 Variable Milfoil locations.

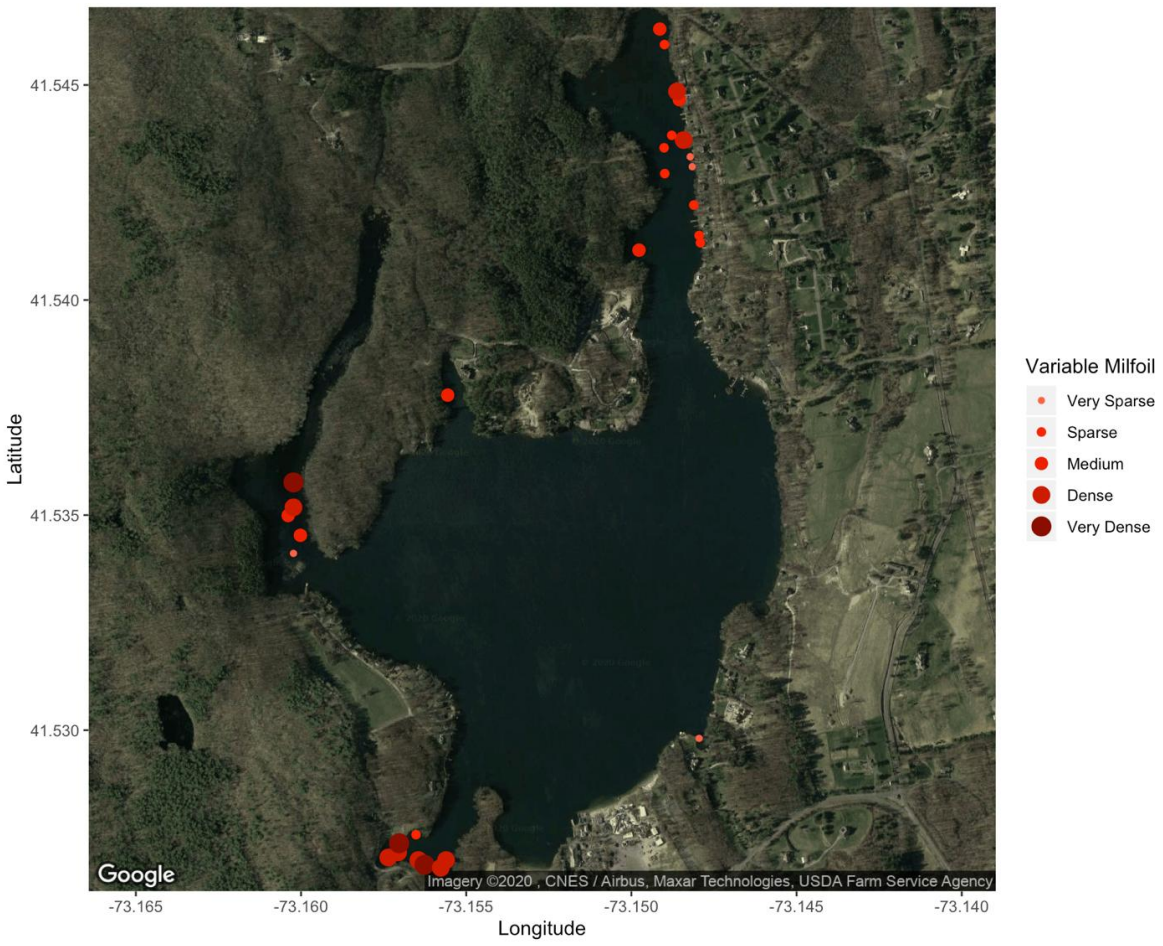

Table 3 Long Term Reductions in Variable Milfoil

Variable milfoil (*Myriophyllum heterophyllum*)						
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
%occur	%occur	%occur	%occur	%occur	%occur	%occur
38	39	34	31	29	34	23
AVG%	AVG%	AVG%	AVG%	AVG%	AVG%	AVG%
	59	68	56	66	33	35
Overall%	Overall%	Overall%	Overall%	Overall%	Overall%	Overall%
	23	23	17	19	11	8

Invasive Eurasian milfoil was found at two locations, both at low densities during the 2019 survey (Map 4). As mentioned in previous reports, suction harvesting efforts should diligently tackle any Eurasian milfoil found in the lake. Eurasian milfoil is a more aggressive invasive plant than Variable milfoil, and the low prevalence in the lake allows for potential complete eradication.

Map 4. Lake Quassapaug 2019 Eurasian Milfoil locations.