Northeast Aquatic Research

74 Higgins Highway
Mansfield Center, CT 06250

March 2, 2021

TO: Andover Lake Management Association
ATTN: Linda Derick, ALMA President
FROM: Hannah Moore & Hillary Kenyon, CLM
Re: Andover Lake 2020 Water Quality and Aquatic Plant Results

Discussion of 2020 Water Quality Results

Volunteer monitors conducted water quality monitoring at Andover Lake once per month from June through October and collected inlet water samples in April, May, and June. NEAR conducted a full-lake aquatic plant survey on July 21st.

Water Clarity

Overall, the water clarity in Andover Lake was moderate in 2020. The Secchi disk depth in June was 2.1 meters, which is similar to measurements recorded around the same date in the prior three years. Water clarity had improved to 3.3 meters by July 24th. Clarity decreased slightly to 2.9 meters in late August, before improving to 3.8 meters in mid-September. The July and September 2020 Secchi disk depths are the best measurements on record in the past five years. September clarity was significantly better than usual.

Dissolved Oxygen

By the time of the first monitoring event in June, a small portion of water at the bottom of the deep spot was anoxic (devoid of oxygen). The anoxic boundary remained around 4 meters from the surface through the summer season. In the prior four years, the anoxic boundary rose to a maximum height of ~3.75 meters. By early October, oxygen had returned to the bottom water and oxygen concentrations were fairly consistent from the top to the bottom of the water column. Raw temperature & oxygen profile data is included at the end of this data summary.

2020 Secchi Disk Depths and Anoxic Boundaries **(NA = no anoxic water)**

	Anoxic Boundary Depth (m)	Secchi (m)	Secchi Better or Worse than Historical Monthly Average
12-Jun	4.03	2.1	Worse
24-Jul	3.98	3.3	Better
31-Aug	4.04	2.9	Better
14-Sep	4.04	3.8	Better
5-Oct	4.5	2.8	Better

Nutrients

Total phosphorus (TP) in June ranged from 20ppb to 24ppb at the three sampling depths. All three July samples had TP concentrations below 20ppb. In August, TP remained below 20ppb at the top and middle sampling depths but was elevated to 38ppb in the bottom water, indicative of internal sediment nutrient release. In September, TP decreased slightly in the bottom-water and increased in the surface waters, potentially caused by a short-term partial mixing event due to increased winds and cooler surface temperatures. By early October, TP had reduced to ~10ppb in the top and bottom samples. The middle water sample had extremely elevated nutrient concentrations, suggesting contamination of the sample.

Total nitrogen (TN) remained below 300ppb in all water samples in 2020 with the exception of the June top water sample, which was 303ppb. In recent years, May and June surface samples tended to have elevated TN, which is potentially due to watershed nitrogen loading in spring.

From June through September, Ammonia (NH3) ranged from less than 3ppb to 17ppb in all samples except for the July bottom water sample, which had a concentration of 34ppb. In October, Ammonia was elevated above 20ppb in both the top and bottom water samples. Ammonia nitrogen is most frequently related to internal sediment-released nitrogen during periods of anoxia, but as ammonia migrates to the upper water levels, it is rapidly used by phytoplankton in the water column (becoming organic nitrogen).

Nitrate nitrogen (NOx) was very low in the lake in 2020. The nutrient was below the detection limit in all samples. NOx is most commonly present in the water column in April and October.

In-lake Station 1 2020 Nutrient Results. "ND" implies the result was below the 3ppb detection limit.

Total Nitrogen (TN) ppb					
	12-Jun	**24-Jul**	**31-Aug**	**14-Sep**	**5-Oct**
Top	303	208	215	275	223
Middle	281	210	233	237	
Bottom	253	243	246	274	208

The October 5th sampling date "middle" sample had extremely high nutrients, suggesting an unknown problem with the sample or lab test.

Total Phosphorus (TP) ppb					
	12-Jun	**24-Jul**	**31-Aug**	**14-Sep**	**5-Oct**
Top	23	14	18	22	10
Middle	20	14	18	17	
Bottom	24	17	38	25	11

Ammonia (NH3) ppb					
	12-Jun	**24-Jul**	**31-Aug**	**14-Sep**	**5-Oct**
Top	13	10	ND	17	22
Middle	12	12	ND	9	
Bottom	16	34	7	12	23

Nitrate Nitrogen (NOX) ppb					
	12-Jun	**24-Jul**	**31-Aug**	**14-Sep**	**5-Oct**
Top	ND	ND	ND	ND	ND
Middle	ND	ND	ND	ND	
Bottom	ND	ND	ND	ND	ND

Inlets

Water samples were collected from Cheney Brook and Skoog Brook in April, May, and June. Both total phosphorus and total nitrogen were low in April. TP remained low in May, but TN was slightly elevated in Skoog Brook. In June, both Cheney Brook and Skoog Brook had elevated TP and TN concentrations. Ammonia and Nitrate Nitrogen were also tested in June. These nutrients were only slightly higher than the long-term monthly averages. Moving forward, it will be incredibly important for volunteers to take geo-tagged photos of the Inlets from the same location during every sampling period. The concentration of nutrients in the streams will depend on the stream water level to some degree. That additional information should be tracked monthly.

2020 Inlet Nutrient Results

Total Phosphorus (TP) ppb			
	28-Apr	**26-May**	**12-Jun**
Cheney Brook	8	15	31
Skoog Brook	12	20	51

Total Nitrogen (TN) ppb			
	28-Apr	**26-May**	**12-Jun**
Cheney Brook	186	220	370
Skoog Brook	189	302	542

Ammonia (NH3) ppb	
	12-Jun
Cheney Brook	16
Skoog Brook	23

Nitrate Nitrogen (NOX) ppb	
	12-Jun
Cheney Brook	1.5
Skoog Brook	149

Aquatic Plants

16 aquatic plant species were documented in Andover Lake during the July 21st, 2020 survey.

Dominant aquatic species found at more than 20% of the total survey waypoints:

Vallisneria americana (tape grass)
Nitella (stonewort)
Elodea nuttallii (western waterweed)
Potamogeton berchtoldii (slender pondweed)
Filamentous green algae (not a plant, but still dominant)

Vallisneria, the main aquatic nuisance plant that has been historically managed by water level drawdown, covered roughly 20.6 acres of the lake's littoral zone. This is less coverage than in 2019, and similar to 2018 coverage.

No invasive species were found in the lake in 2020.

Recommendations

The water quality in Andover Lake in 2020 was generally better than average. Water clarity was notably better in 2020 compared to the prior 4 years. In-lake water samples were not collected in April or May, so it is unclear what effect watershed loading had on water quality in these months. In prior years, nutrient concentrations were elevated in the spring due to watershed loading, which includes both background natural flows, stormwater runoff, lawn fertilizers, and septic system inputs from shoreline properties. We suggest that 2021 monitoring include a series of stormwater monitoring for each major stream, as well as potential culvert monitoring to capture road runoff concentrations. This is the first step in determining how much of the total annual watershed load comes from road runoff and what sort of reductions are possible by using various types of catch basin filters and/or stormwater best management practices like vegetated swales and partial infiltration areas. This future work should be done in partnership with the Town. We also encourage residents to remain vigilant and active in ongoing discussion with their neighbors about proper septic system cleaning, inspections, and potential rebuilds, if necessary.

Monthly water quality monitoring should continue in 2021, with two monitoring trips collected each month in July and August. Additionally, volunteer monitors should attempt to take weekly dissolved oxygen profiles measurements from early July through mid-August to better understand the duration of annual internal loading. We could also set up an array of temperature data loggers and a dissolved oxygen continuous sensor near the anoxic boundary. The future of lake management and monitoring is in continuous data sensors to improve accuracy of management decisions, particularly in understanding internal sediment release of nutrients that may worsen summer clarity and drive potential cyanobacteria blooms.

The annual plant survey should be conducted in July or August 2021 to track the changes in tape grass coverage. The 2021 survey documented extensive coverage of filamentous algae and expanded density of cyanobacteria-covered Elodea, particularly at the southwestern end of the lake. Historically, plant management has been limited to winter drawdowns, but there are other steps that the Association can take to reduce and/or remove very dense plants and algae from the lake. We encourage aquatic plant management to be a group effort. This topic can be discussed at the annual board meeting.

Thank you for your ongoing commitment to monitoring and improving Andover Lake. As always, if you have any questions, please email us at hannahmoore318@gmail.com and hillary.kenyon@gmail.com. If you would like to speak directly to Dr. George Knoecklein, owner and NEAR principal, he can be reached at knoecklein@sbcglobal.net.

Reference Data to Understand Nutrient & Secchi Classification Ranges

Connecticut DEEP Trophic Categories and Ranges of Indicator Parameters

Category	T.P. (ppb)	T. Nitrogen (ppb)	Secchi Depth (m)	Chlorophyll *a* (ppb)
Oligotrophic	0 -- 10	2 -- 200	6 +	0 -- 2
Oligo-mesotrophic	10 -- 15	200 -- 300	4 -- 6	2 -- 5
Mesotrophic	15 -- 25	300 -- 500	3 -- 4	5 -- 10
Meso-eutrophic	25 -- 30	500 -- 600	2 -- 3	10 -- 15
Eutrophic	30 -- 50	600 -- 1000	1 -- 2	15 -- 30
Highly Eutrophic	50 +	1000 +	0 -- 1	30 +

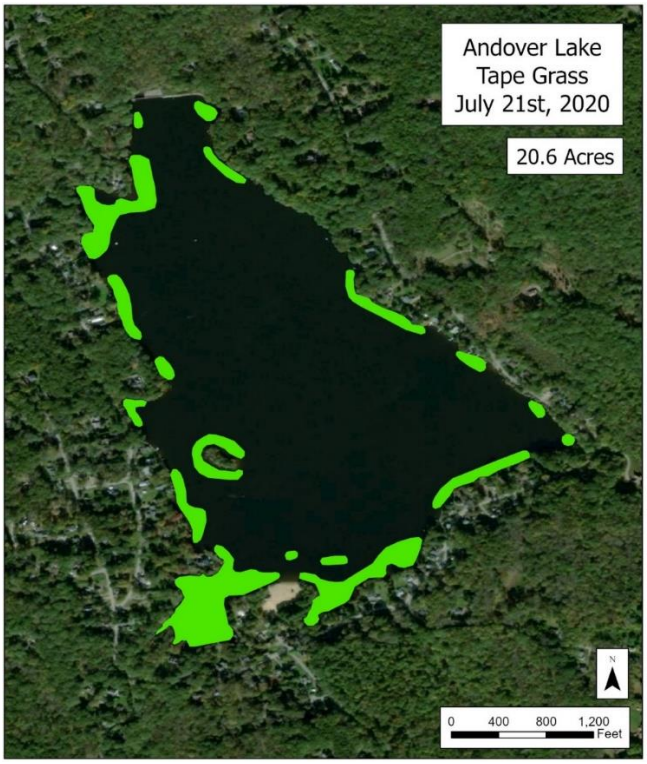
2020 Raw Water Column Profile Data

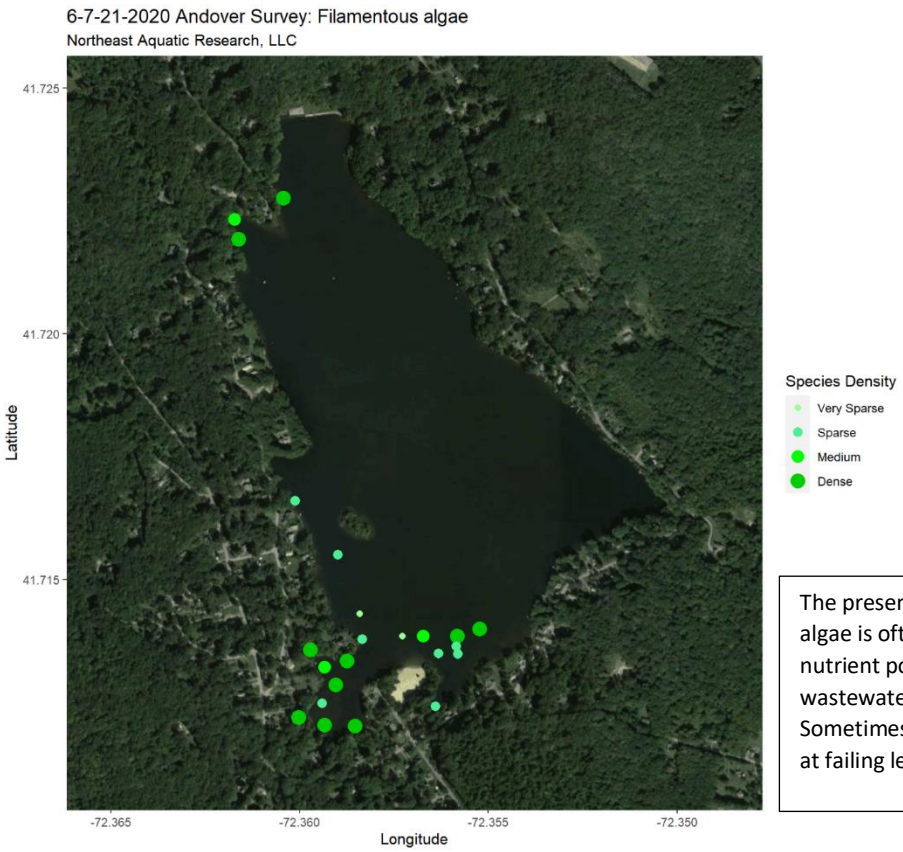
Date	Depth (ft)	Temp (C)	DO (mg/L)	% O2 Sat.
6/15/2020	0	24.2	8.9	106
6/15/2020	1	24	8.9	106
6/15/2020	2	23.4	8.8	104
6/15/2020	3	22.9	8.5	99
6/15/2020	3.5	20.4	9.3	103
6/15/2020	3.75	18.5	4.9	52
6/15/2020	4	18.1	3.2	34
6/15/2020	4.11	17.6	0.1	1
7/24/2020	0	29.3	8.5	112
7/24/2020	1	29.2	8.4	111
7/24/2020	2	28.6	8.6	112
7/24/2020	3	27.4	7.1	91
7/24/2020	3.5	26	4.0	103
7/24/2020	3.75	18.5	4.5	56
7/24/2020	4	25.2	0.7	9
7/24/2020	4.11	23.7	0.1	1
8/31/2020	0	24.5	7.9	96
8/31/2020	1	24.6	7.9	96
8/31/2020	2	24.2	7.8	94
8/31/2020	3	23.8	7.5	90
8/31/2020	3.5	23.6	7.3	89
8/31/2020	3.75	23.6	7.3	87
8/31/2020	4	23.6	7.3	37
8/31/2020	4.05	23.6	0.2	2
9/14/2020	0	23.6	8.1	97
9/14/2020	1	23.6	8.1	96
9/14/2020	2	23.6	8.1	97
9/14/2020	3	23.5	8.1	96
9/14/2020	3.5	23.5	8.1	97
9/14/2020	3.75	23.5	8.1	96
9/14/2020	4	23.6	7.9	94
9/14/2020	4.05	23.4	0.1	1
10/5/2020	0	21.3	8.3	95
10/5/2020	1	20.3	8.4	94
10/5/2020	2	19.7	8.6	95
10/5/2020	3	19.4	8.6	95
10/5/2020	3.5	19.3	8.7	95
10/5/2020	3.75	19.3	8.7	95

Aquatic plant species present in Andover Lake during the July 21, 2020 aquatic plant survey.

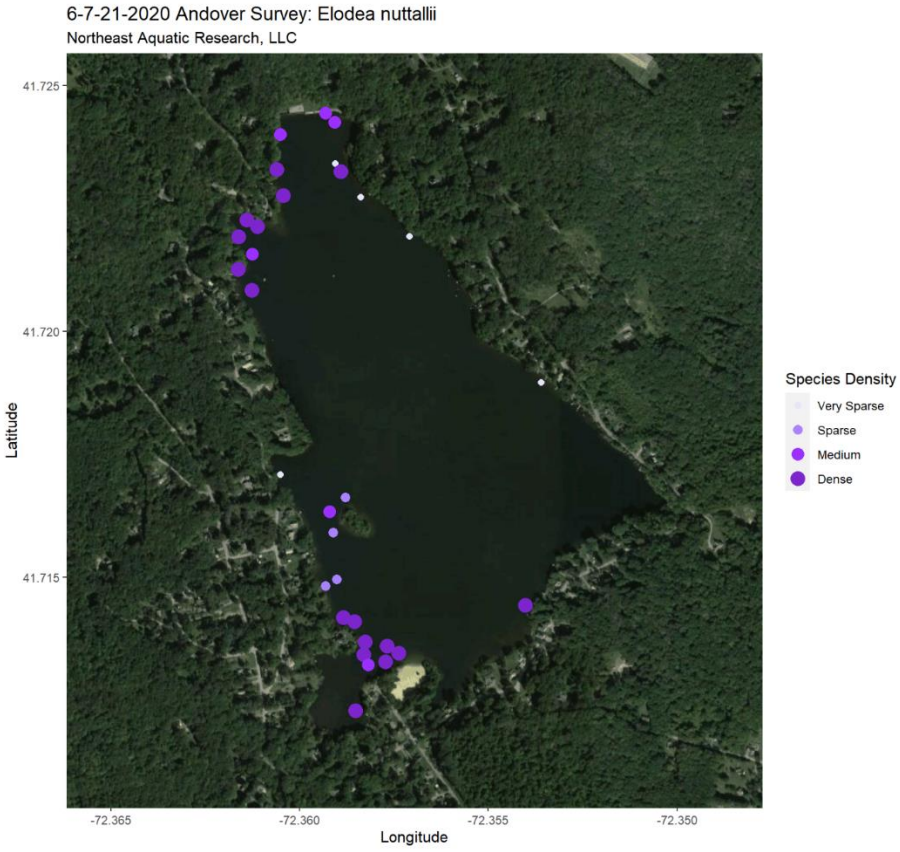
Common Name	Scientific Name	Frequency	Avg. Density %
Tape grass	*Vallisneria americana*	61	58
Stonewort	*Nitella sp*	35	53
Western waterweed	*Elodea nuttallii*	27	70
Filamentous green algae	*Filamentous green algae*	24	63
Slender pondweed	*Potamogeton berchtoldii*	21	47
Muskgrass	*Chara sp*	8	67
Needle spikerush	*Eleocharis acicularis*	6	53
Canadian waterweed	*Elodea canadensis*	4	42
Small pondweed	*Potamogeton pusillus*	3	21
Watershield	*Brasenia schreberi*	2	37
Nodding waternymph	*Najas flexilis*	2	28
Cattail	*Typha*	2	NA
Bur-reed	*Sparganium sp.*	2	50
Pickerelweed	*Pontederia cordata*	2	30
Snail-seed pondweed	*Potamogeton bicupulatus*	2	30
Ribbon-leaf pondweed	*Potamogeton epihydrus*	2	38
Yellow water lily	*Nuphar variegata*	1	15
Floating bladderwort	*Utricularia radiata*	1	5

Maps of Aquatic Species of Interest





The presence of large amounts of Filamentous algae is often indicative of localized shoreline nutrient pollution, particularly due to onsite wastewater nitrogen and phosphorus. Sometimes large mats of Filamentous algae form at failing leach field sites.



7-21-2020 Andover Survey: Nitella sp. & Chara sp.

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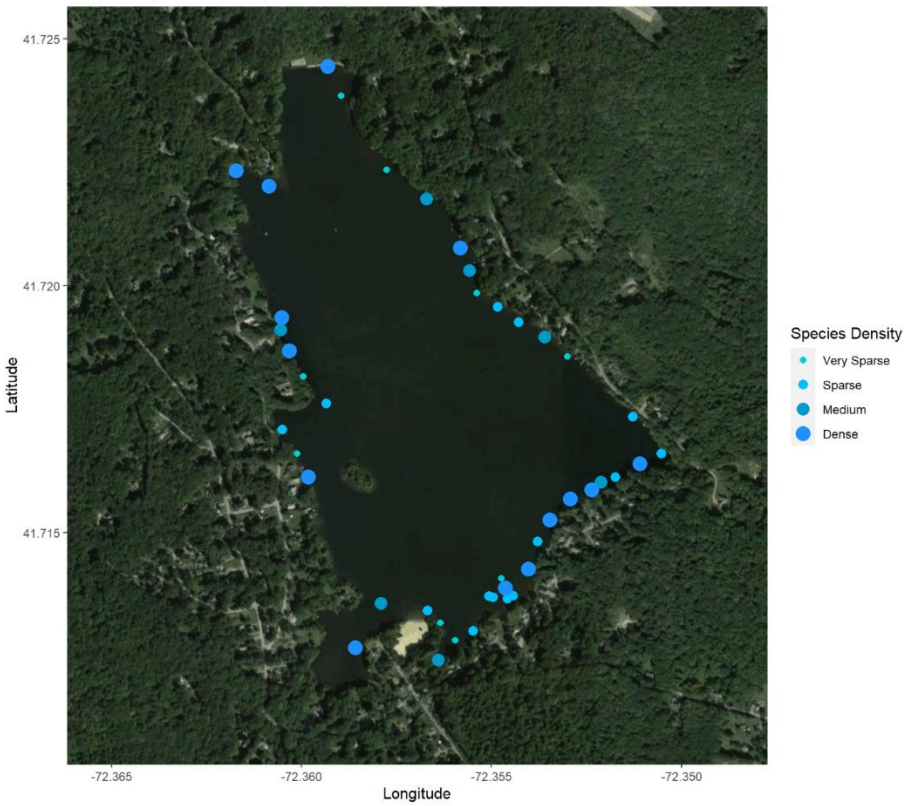

6-7-21-2020 Andover Survey: Potamogeton berchtoldii

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