



Northeast Aquatic Research



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January 14th, 2021

TO: Crystal Pond Association
ATTN: Tom Hawkins
FROM: Kendra Kilson and Hillary Kenyon
Re: Crystal Pond 2020 Water Quality and Aquatic Plant Results

Discussion of 2020 Water Quality Results

Water Clarity

Water clarity was best early in the season but worsened later in the season. The best water clarity was 7.25m, recorded on May 26th. This was slightly better than the long-term average for May. The worst water clarity reading was 4.9m, recorded on September 8th, which was significantly worse than the long-term average for September. Compared to long term averages, May and July readings were higher, whereas September clarity reading was lower.

Nutrients

Total Phosphorus (TP) remained below 20ppb in the top and middle of the lake, with concentrations ranging from 9ppb to 16ppb. The September bottom water concentration was elevated as a result of internal nutrient release during periods of anoxia at the lake bottom. Total nitrogen (TN) concentrations were highest at the bottom of the lake also during September. TN concentrations in the top and middle of the lake were ranged from 192ppb to 276ppb. Middle water ammonia nitrogen (NH₃) was elevated in July.

Inlet Nutrients

Inlet samples were collected on the May 26th visit from the four flowing inlets. Inlet 1, 8, and 9 total phosphorus (TP) levels were below 20ppb. The highest TP concentration was 26ppb at Inlet 7. Inlet 7 was also the highest concentration of nitrate nitrogen (NO_x).

Aquatic Plants

NEAR conducted a full-lake aquatic plant survey on September 8th, 2020 and documented a total of 24 species. No invasive species were found in the pond during this survey. The same five species, all of which are native, have remained dominant in the pond since 2011, when annual surveys began. *Potamogeton robbinsii* (Robbin's pondweed), *Potamogeton amplifolius* (Largeleaf pondweed), and *Potamogeton gramineus* (Grassy pondweed) are consistently present at frequencies near or above 20%. *Bidens beckii* (Water marigold), which is a Connecticut state listed protected Species, was present at 14% of survey waypoints. *Vallisneria americana* (Tapegrass) and *Fontinalis sp.* (Aquatic moss) were present at 12% and 7%, respectively.

Recommendations

We recommend in-lake and inlet monitoring from April through November in 2021. Additional watershed monitoring should take place in partnership with the Eastern Conservation District (ECCD). We recommend coordinating water quality monitoring efforts between NEAR and ECCD.

Next winter, we recommend that we conduct a long-term comparison of all of our annual surveys. Since we began conducting annual surveys in 2011, we have anecdotally noticed that largeleaf pondweed (*Potamogeton amplifolius*) and Tapegrass (*Vallisneria americana*) is becoming denser and more widespread in the lake. Both species may indicate a shift toward eutrophication, and both species can become a nuisance if left unmanaged. A long-term comparison of the same waypoints visited during each annual survey would provide a good understanding of the distribution and density of these species over the year, and would provide a strong justification for any future plant management in Crystal Pond.

We also propose that a continuous monitoring station be set up at the deep-hole sampling location. Temperature loggers are relatively inexpensive and can be deployed at various depths in the water column, to determine if the lake has multiple partial mixing events per season. This information would not replace the NEAR monitoring but would provide higher resolution information for temperature. We also recommend installing a dissolved oxygen continuous sensor at a depth of 8 meters, which is the depth where anoxia becomes particularly problematic. Dissolved oxygen loggers are significantly more expensive, with a typical cost around \$2,000, but the value of continuous oxygen monitoring at this site would provide key data between the NEAR sampling periods. The loggers will monitor for changes in mixing and stratification patterns every 30 minutes. Monitoring differences in water temperature and oxygen throughout the season will help to better illustrate the thermal stratification and its impact on internal loading of nutrients that lead to surface algae blooms.

Thank you for your tireless efforts to improve Crystal Pond. As always, if you have any questions or concerns, please email us at northeastaquaticresearch@gmail.com. We would be happy to answer additional question about continuous data loggers and anticipate forming a proposal for 2021.

Sincerely,
Hillary Kenyon, Certified Lake Manager
Kendra Kilson, Research Scientist
Northeast Aquatic Research, LLC

Average Secchi Disk Depth in Crystal Pond Per Month (1990-2002, 2004-2006, 2008-2020) compared to 2020 Secchi Disk Depths – higher values indicated better water clarity/visibility:

Month	Average Secchi Disk Depth	2020 Secchi Disk Depth (m)
May	6.9	7.25
June	6.6	--
July	4.1	5.25
August	4.2	--
September	6.2	4.9
October	6.0	--

2020 Nutrient Results

Total Phosphorus (TP) ppb

Depth	May 26	July 24	Sept 8
Top (1m)	13	10	16
Middle (4 or 5m)	9	12	16
Bottom (8 or 8.5m)	14	12	39

Total Nitrogen (TN) ppb

Depth	May 26	July 24	Sept 8
Top (1m)	204	208	256
Middle (4 or 5m)	192	219	276
Bottom (8 or 8.5m)	202	182	431

Ammonia Nitrogen (NH₃) ppb

Depth	May 26	July 24	Sept 8
Top (1m)	ND	13	9
Middle (4 or 5m)	ND	31	16
Bottom (8 or 8.5m)	5	19	27

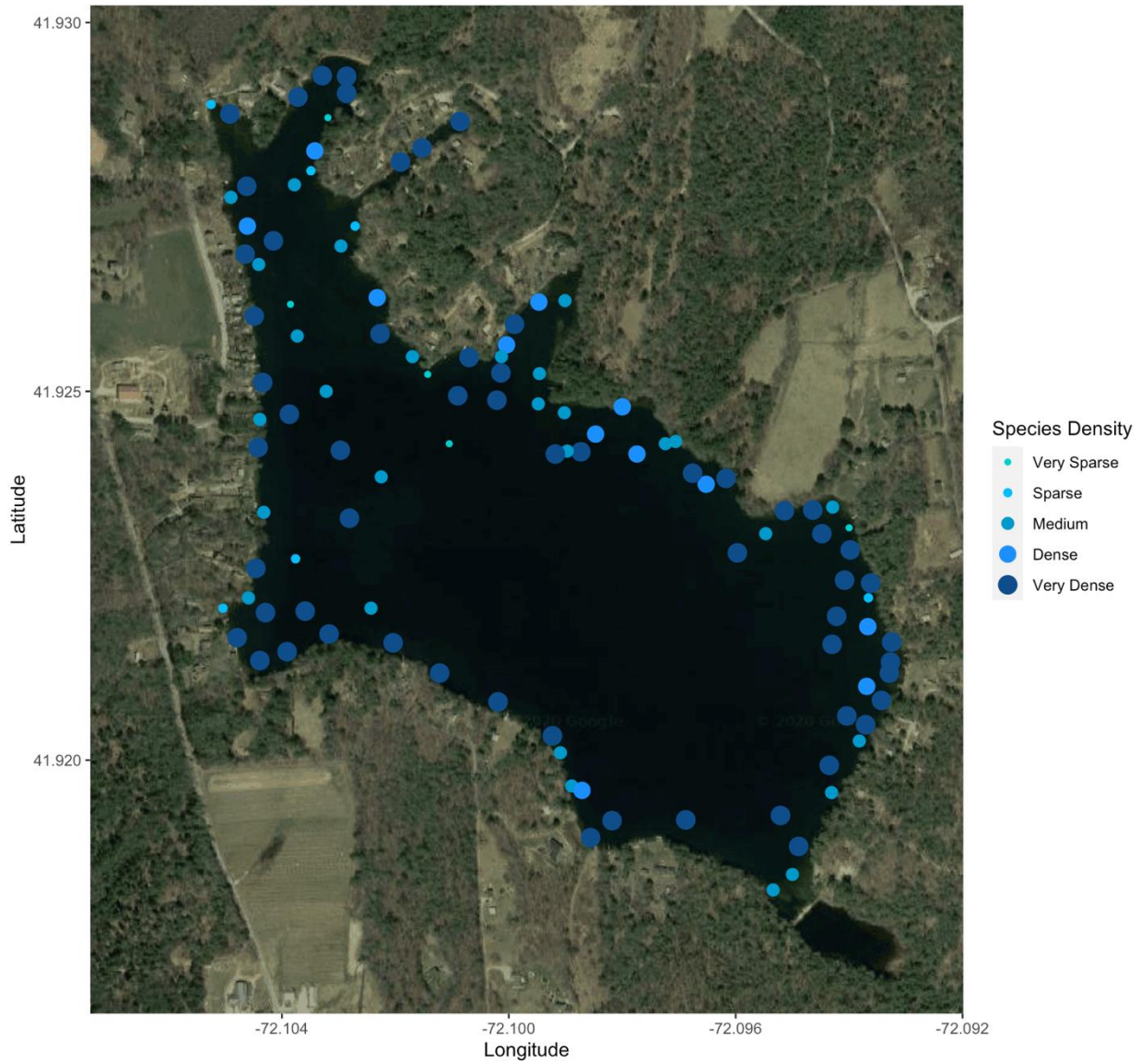
Inlet Sample Results from May 26th, 2020

Inlet #	NOX (ppb)	TP (ppb)
1	ND	7
7	374	26
8	111	11
9	25	14

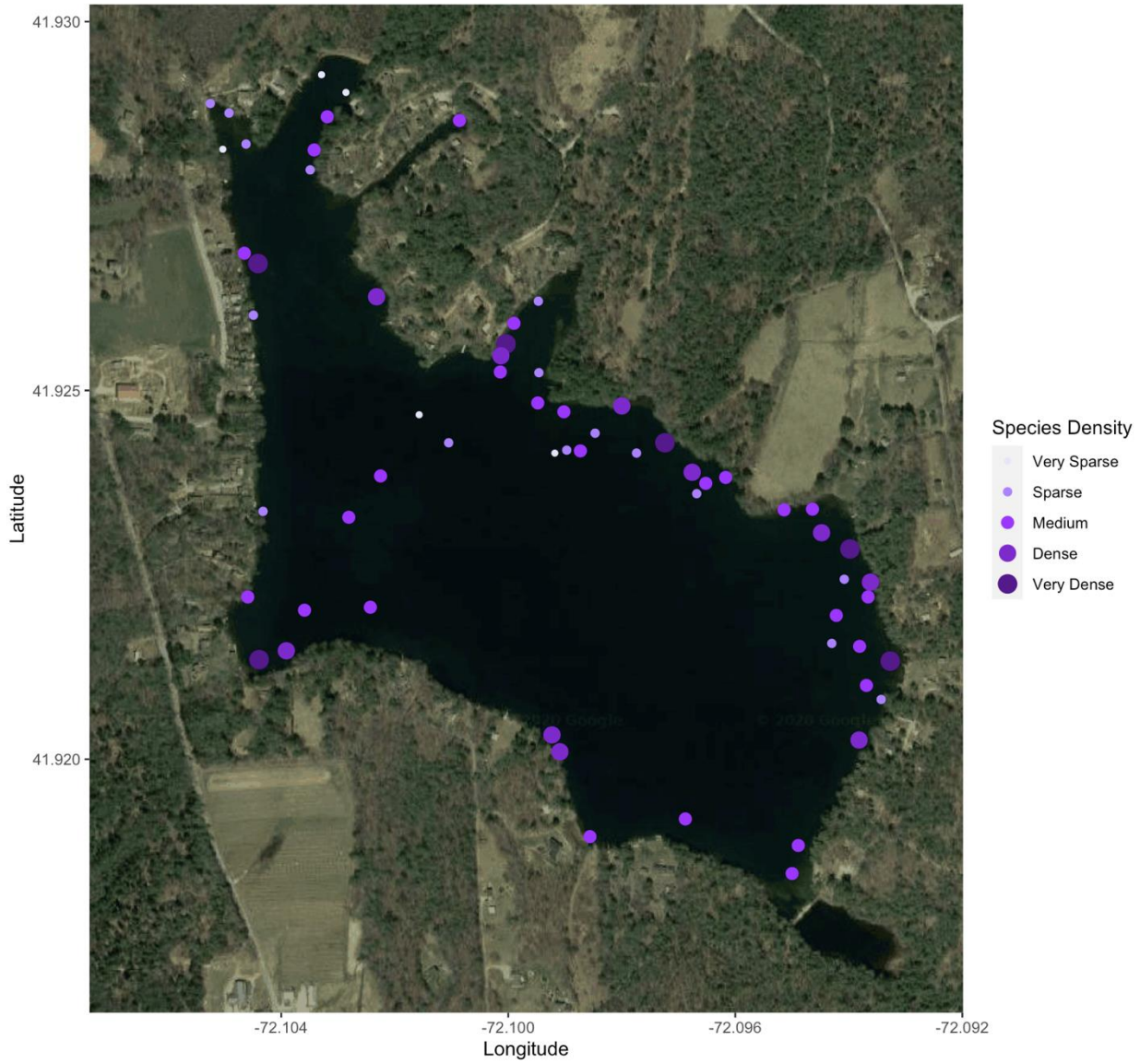
List of aquatic plant species documented during September 8th, 2020 full-lake survey of Crystal Pond.

Scientific Name	Common Name	Frequency	Average Density
<i>Potamogeton robbinsii</i>	Robbin's pondweed	82.8	65.8
<i>Potamogeton amplifolius</i>	Largeleaf pondweed	47.0	33.9
<i>Potamogeton gramineus</i>	Grassy pondweed	22.4	29.7
<i>Bidens beckii</i>	Water marigold	14.9	7.25
<i>Vallisneria americana</i>	Tapegrass	12.7	67.1
<i>Fontinalis</i>	Aquatic moss	7.5	9
<i>Eleocharis acicularis</i>	Needle spikerush	6.7	50
<i>Potamogeton epihydrus</i>	Ribbonleaf pondweed	5.9	38.75
<i>Sagittaria graminea</i>	Grassy arrowhead	5.9	16.25
<i>Utricularia macrorhiza</i>	Common bladderwort	5.2	8.6
<i>Potamogeton berchtoldii</i>	Small pondweed	4.5	16.7
<i>Utricularia purpurea</i>	Purple bladderwort	4.5	9.2
<i>Filamentous algae</i>	Filamentous algae	2.9	7.5
<i>Nitella sp.</i>	Stonewort sp.	2.9	22.5
<i>Chara sp.</i>	Muskgrass sp.	2.2	25
<i>Ceratophyllum echinatum</i>	Spiny hornwort	1.5	7.5
<i>Typha</i>	Cattail	1.5	NA
<i>Utricularia geminiscapa</i>	Hiddenfruit bladderwort	1.5	5
<i>Elatine sp.</i>	Waterwort sp.	0.7	30
<i>Elodea nuttalli</i>	Waterweed	0.7	5
<i>Eriocaulon sp.</i>	Pipewort sp.	0.7	5
<i>Najas flexilis</i>	Nodding waternymph	0.7	10
<i>Nuphar variegata</i>	Yellow Water Lily	0.7	5
<i>Phragmites</i>	Common reed	0.7	NA

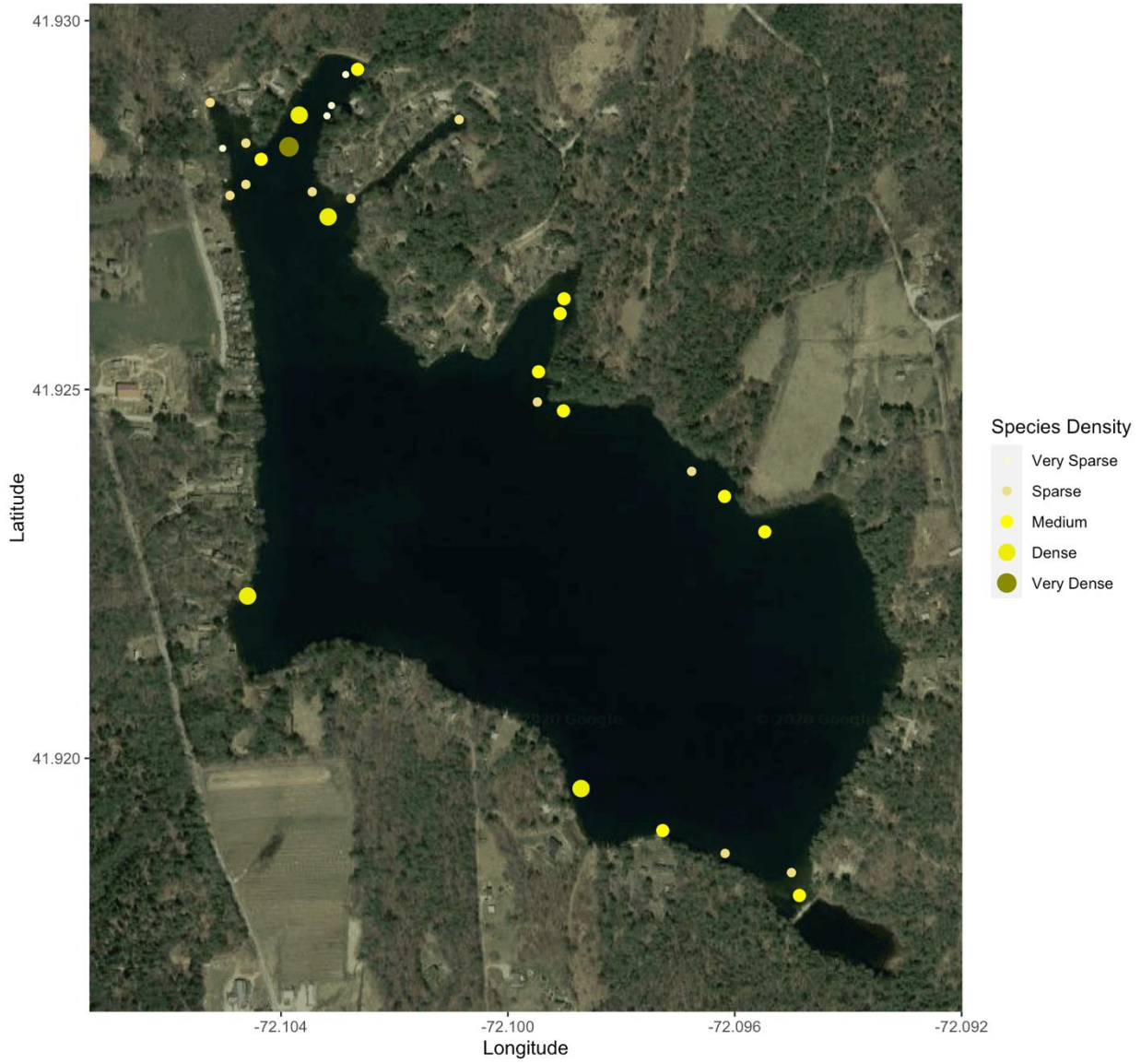
Crystal Pond September 8, 2020 Survey: *Potamogeton robbinsii*
Northeast Aquatic Research, LLC



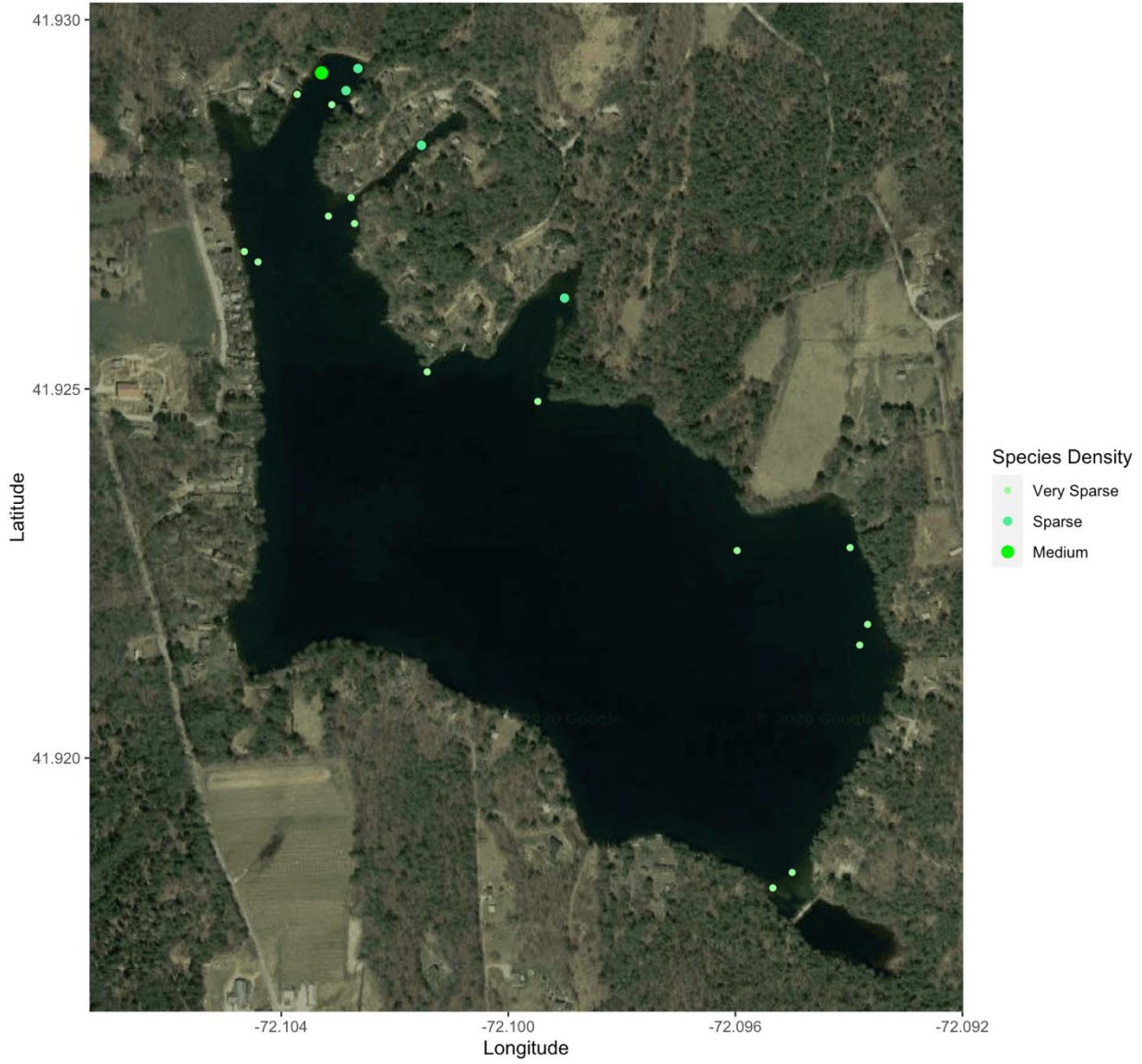
Crystal Pond September 8, 2020 Survey: *Potamogeton amplifolius*
Northeast Aquatic Research, LLC



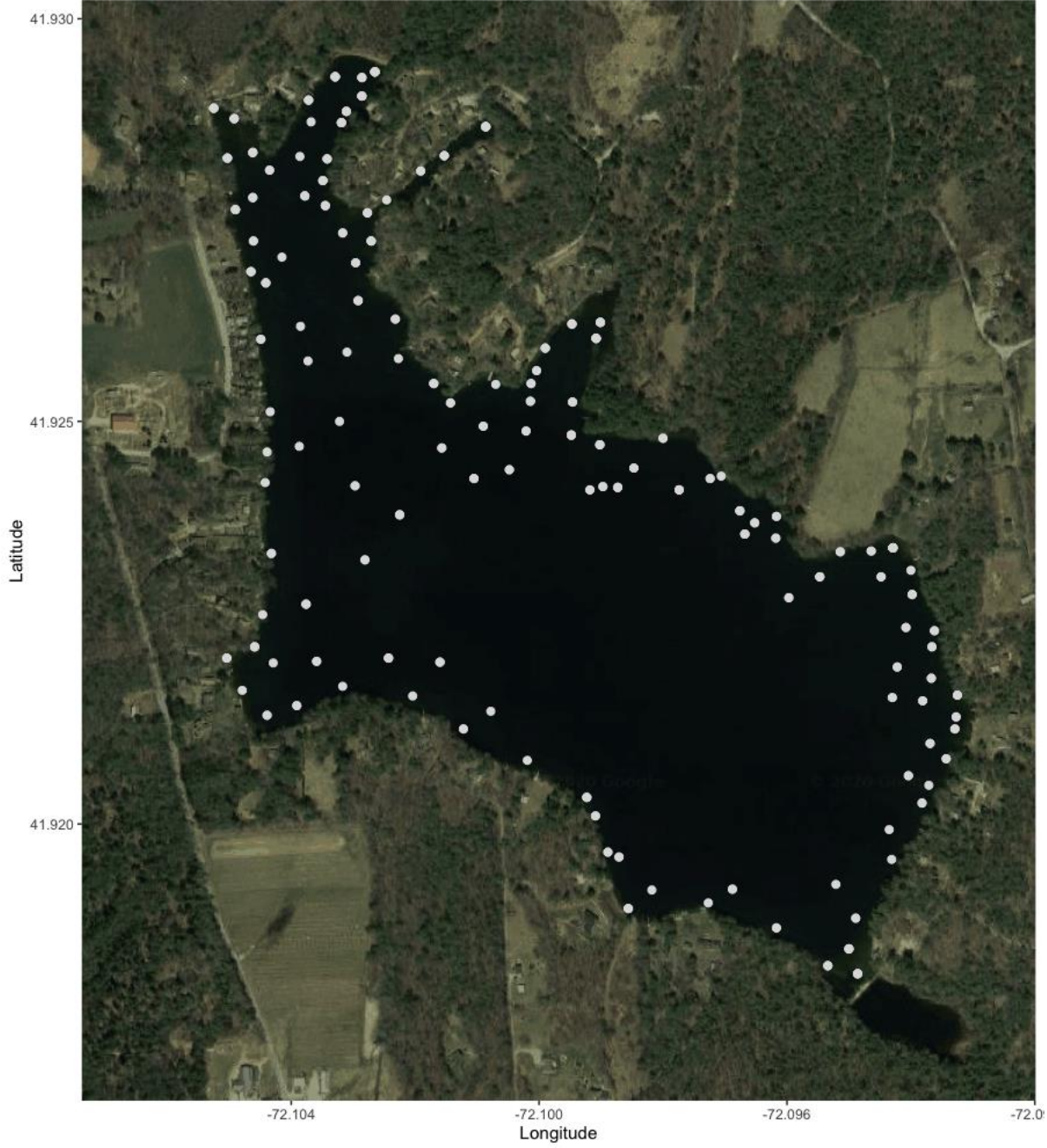
Crystal Pond September 8, 2020 Survey: *Potamogeton gramineus*
Northeast Aquatic Research, LLC



Crystal Pond September 8, 2020 Survey: *Bidens beckii*
Northeast Aquatic Research, LLC



9-8-2020 Crystal Pond Survey Waypoints
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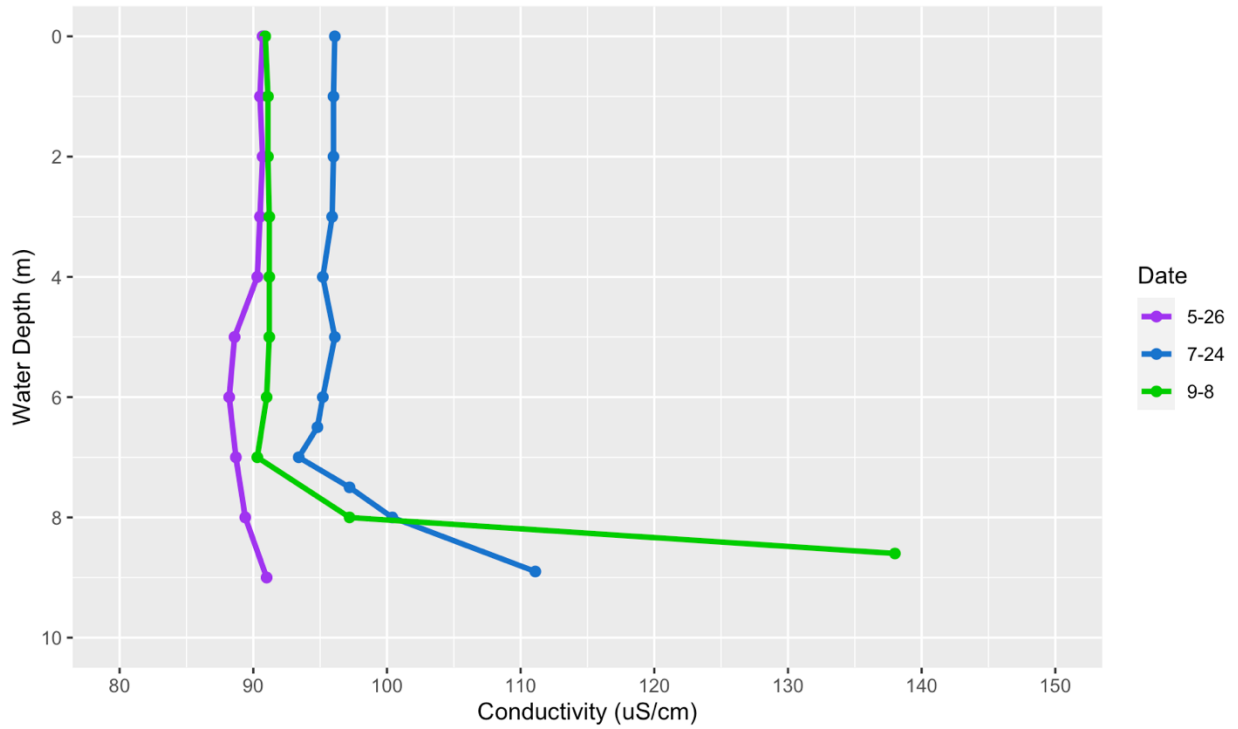


Appendix

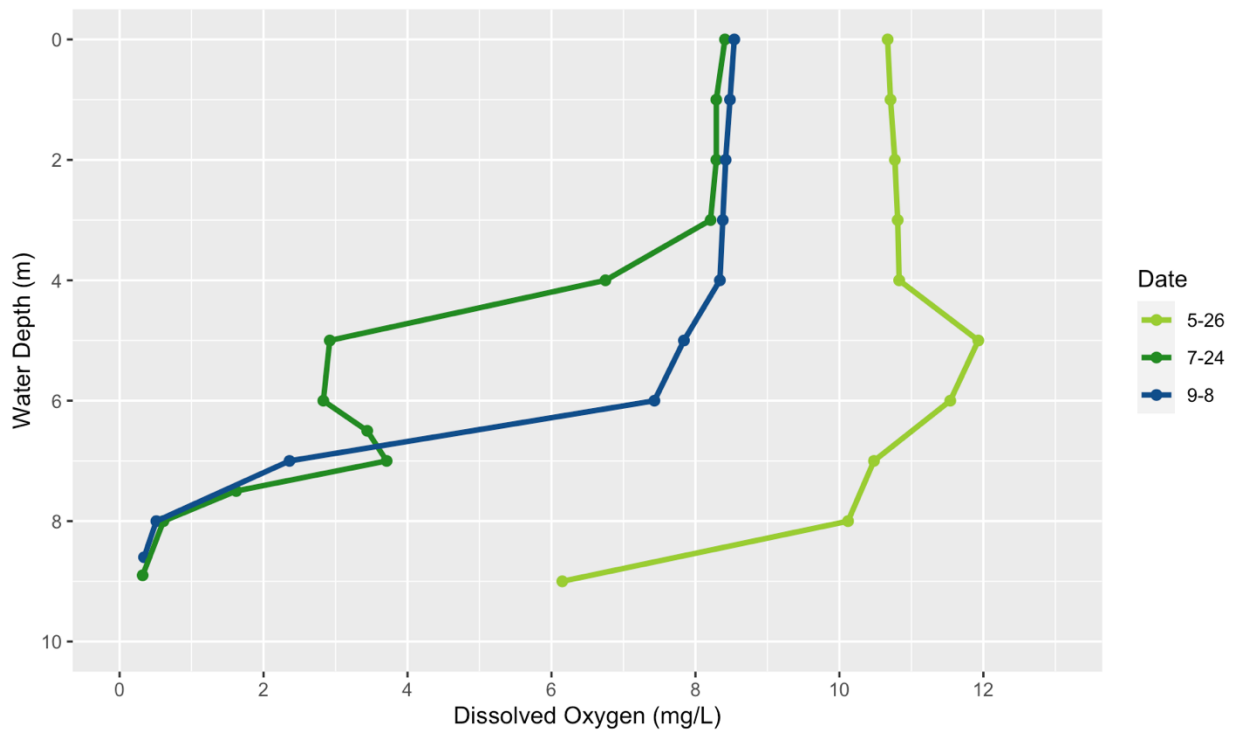
Connecticut DEEP Trophic Categories and Ranges of Indicator Parameters.

Category	T.P. (ppb)	T. Nitrogen (ppb)	Secchi Depth (m)	Chlorophyll <i>a</i> (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 +

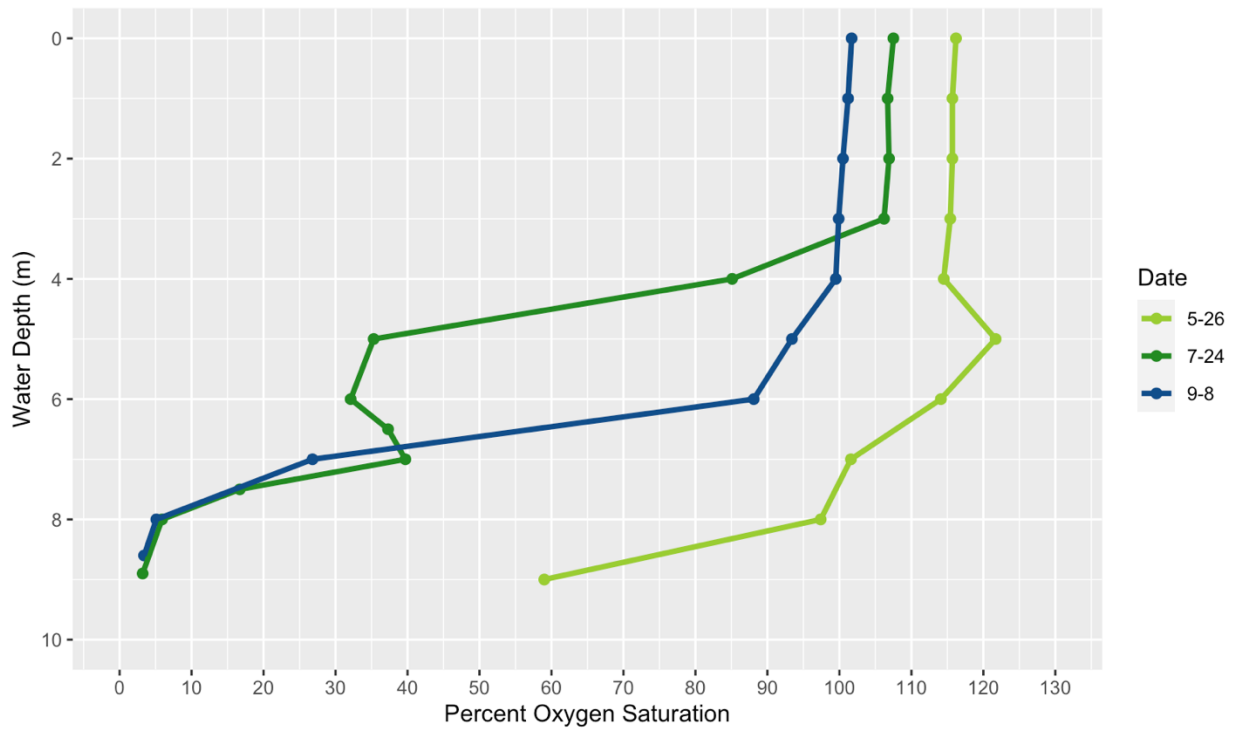
2020 Crystal Pond Conductivity Profiles



2020 Crystal Pond Dissolved Oxygen Profiles



2020 Crystal Pond Percent Oxygen Saturation Profiles



2020 Crystal Pond Temperature Profiles

