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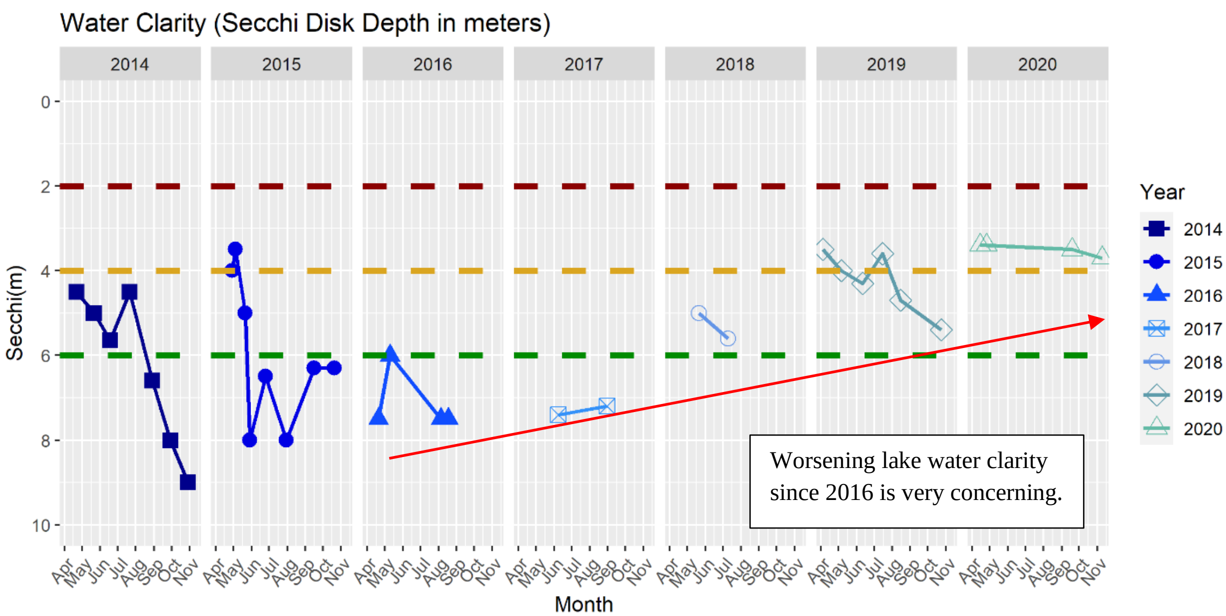
Lake Quassapaug 2020 Data Summary (DRAFT)

February 10, 2021

Secchi Disk Transparency

All Secchi values from 2014 to 2020 are listed in the table below. Values in 2020 were worse than average (you cannot see as far into the water column because there is more phytoplankton and sediment in the water column). Unfortunately, 2020 marked the third year in a row where water clarity was generally poor, and it is now evident that water clarity is slipping in a concerning trend.



The horizontal lines in the water clarity figure represent the Secchi measurement categories that are associated with overall lake 'health,' also known as 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 (Oligotrophic). Based on the excellent late-season water clarity in 2014-2017, Lake Quassapaug should be considered naturally Oligotrophic. However, recent years of clarity data suggest that the lake has slipped into a potential new Mesotrophic range, which is a result of worsening overall water quality and clarity.

It is possible that the recent years of hydro-raking in Tyler's Cove has added nutrients and sediment into the water column that impact overall water clarity. We recommend limited hydro-raking in 2021 to see if the lake clarity can recover. It is also important to understand that worsened clarity may not be solely related to hydro-raking. There are many other factors that contribute to water clarity declines, such as increased development in the watershed, watershed erosion, septic system nutrient inputs, fertilizer use on shoreline properties, unnaturally high populations of alewife fish, etc. Continued monthly monitoring of water clarity will be incredibly important in 2021 to ensure that water clarity does not continue to decline. If clarity continues to be poor in 2021, the LQA must start to think more critically about investigating the primary drivers of nutrient and sediment pollution – both internal and external. As water clarity reaches the 2-meter (red line) mark, the lake is increasingly vulnerable to a toxic cyanobacteria bloom (a.k.a. blue-green algae blooms).

Nutrient Testing Results

The 2020 nutrient testing results for Total Phosphorus (TP) and Total Nitrogen (TN) are listed below in parts per billion (ppb). The concentrations at the lake bottom are expected to increase throughout the season and are typically 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.

Nutrient Testing Results 2020

Depth_m	Level	Date	TP_ppb	TN_ppb	Concerning?
1	Top	4/14/2020	10	204	
6	UpperMid	4/14/2020	10	220	
10	LowerMid	4/14/2020	9	207	
18	Bottom	4/14/2020	13	212	
1	Top	4/25/2020	10	165	
6	UpperMid	4/25/2020	11	195	
15	LowerMid	4/25/2020	12	186	
20	Bottom	4/25/2020	13	173	
1	Top	7/16/2020	**17**	210	Yes
6	UpperMid	7/16/2020	**23**	225	Yes
10	LowerMid	7/16/2020	14	172	
18	Bottom	7/16/2020	**49**	348	Yes
1	Top	9/25/2020	9	190	
6	UpperMid	9/25/2020	8	203	
12	LowerMid	9/25/2020	11	171	
18	Bottom	9/25/2020	**126**	365	Yes
1	Top	10/15/2020	6	194	
6	UpperMid	10/15/2020	9	126	
12	LowerMid	10/15/2020	**95**	**453**	Yes
18	Bottom	10/15/2020	**385**	**882**	Yes
1	Top	11/9/2020	**13**	**214**	Yes
6	UpperMid	11/9/2020	12	202	
10	LowerMid	11/9/2020	15	206	Yes
14		11/9/2020	70	337	
18	Bottom	11/9/2020	**174**	**427**	Yes

Only one watershed sample was collected in 2020, from the Vineyard Inlet stream. Baseflow TP was 65 ppb and TN was 916 ppb; both are high values.

Sediment Testing Results

Two sediment samples were collected from the two deep holes at Lake Quassapaug on 11/9/2020. These samples had to be taken in either early spring or late fall, when the bottom of the lake is most oxygenated. Anaerobic conditions affect the results of sediment nutrients because the sediments release nutrients to the overlying water column during periods of summer anoxia. Deep-water sediment test results are displayed below. The overall loosely-sorbed Phosphorus (P) is very low, suggesting that there is a high amount of iron in the sediments that is capable to binding P in aerobic conditions. The fraction of reductant soluble (Fe-bound P) is also moderately, compared to the overall total P in the sediments. These results suggest that internal loading of phosphorus from lake sediments does occur annually at a Release Rate (RR) of roughly 8.2 to 9.1 mg/m²/day from deep sediments (preliminary modeled estimate). This value must be combined with a full lake volume, anoxia persistence, and watershed flushing/empirical nutrient loading model in order to estimate the external vs. internal annual nutrient load fractions. This work can be completed in 2021.

SampleDepth_m	Total-P (mg/kg)	Loosely-sorbed-P (mg/kg)	Reductant soluble (Fe-bound P, mg/kg)	Al-bound P (mg/kg)	Biogenic P (mg/kg)	Ca-bound P (mg/kg)	Organic P (mg/kg)
18.6	2699	< 2.00	467	1243	659	135	854
19.4	3516	< 2.00	658	1594	874	162	1103

Oxygen Testing Results

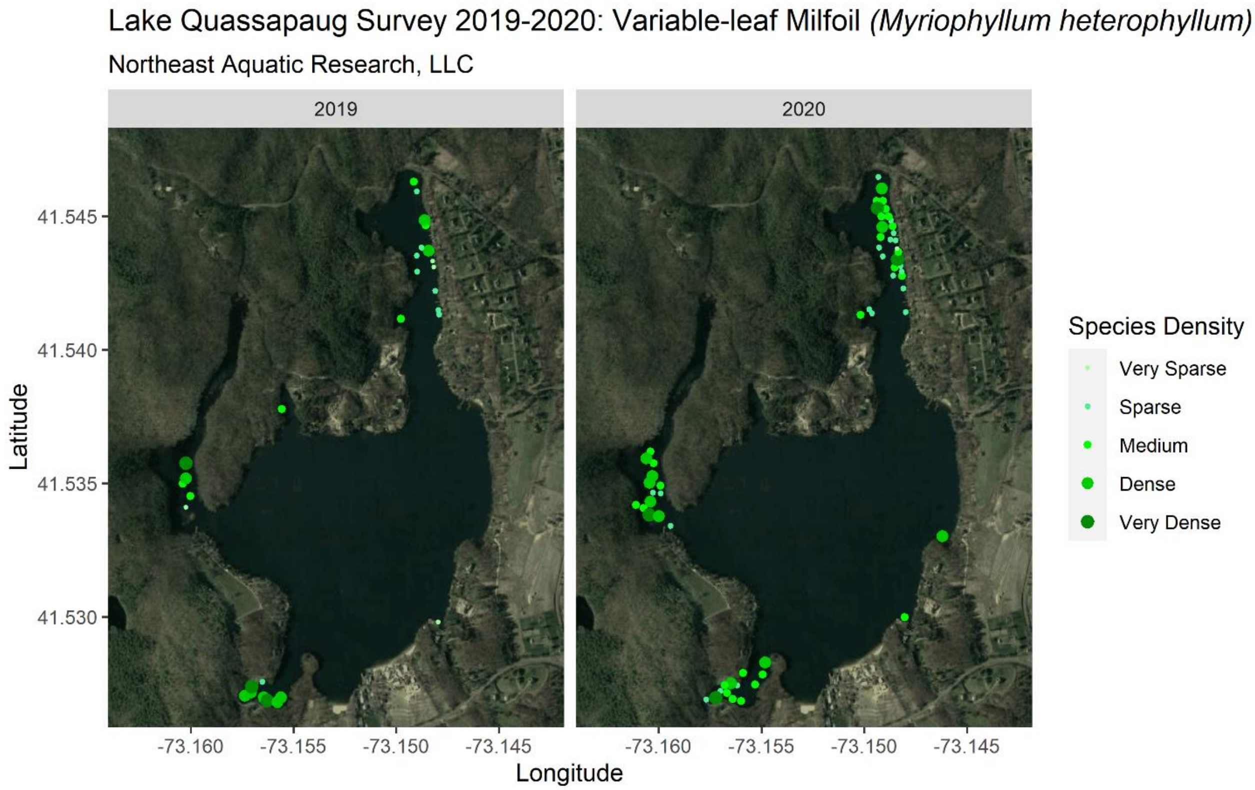
Oxygen profile monitoring was conducted on five dates throughout the 2020 season. There are some unusual values that need to be clarified with volunteer monitors prior to a full analysis of the 2020 oxygen data. The worst level of complete oxygen loss (anoxia) recorded in 2020 was from September 9th, where the anoxic water extended from the lake bottom all the way to 8-meters from the surface. That is very similar to the maximum anoxia measured in 2019, but it is worse than average based on data collected since 2013. The 2021 oxygen sampling should include a September monitoring event that samples oxygen loss at up to 12 locations around the lake to assess the spatial extent of annual anoxia. This type of sampling will improve the overall internal nutrient loading assessment and help determine if any in-lake nutrient treatments may be warranted in the future.

To clarify, the lack of oxygen at the lake bottom is not an alarming problem in itself, as the process of bottom-water oxygen loss over centuries is normal and related to the lake shape, geology, and long-term watershed loading history. The issue with oxygen loss is that it changes the chemistry of the bottom sediments, which could result in a very large pool of bioavailable phosphorus and nitrogen to feed plants, algae, and cyanobacteria. Hence, why bottom nutrient concentrations tend to be much higher than surface concentrations during the summer months. The only realistic way to remedy ‘leaking’ Quassapaug sediments is to treat them with a phosphorus locking technology like Phoslock or Alum. As explained at the public presentation, other lakes have chosen to try to control ‘leaking’ sediments via aeration or oxygenation systems, but I do not believe that to be the best course of action for Quassapaug because it disrupts the natural oxygen regimes and many aeration systems destroy thermal conditions – which can create unintended consequences for water clarity, fish, and other aquatic life.

Aquatic Plants

Invasive Species Survey Results

The 2020 aquatic plant survey at Lake Quassapaug was conducted on 9/18/2020. Invasive Variable milfoil (*Myriophyllum heterophyllum*) was located at 29% of the survey waypoints. The long-term density reduction of Variable milfoil is apparent, compared to the beginning years of the suction-harvesting program. Variable milfoil density has effectively been cut in half, with a lakewide average density now hovering around 33-35% across 2018, 2019, and 2020. Despite a reduction in milfoil biomass in the coves during the season, there is consistent annual regrowth of Variable milfoil after suction harvesting.



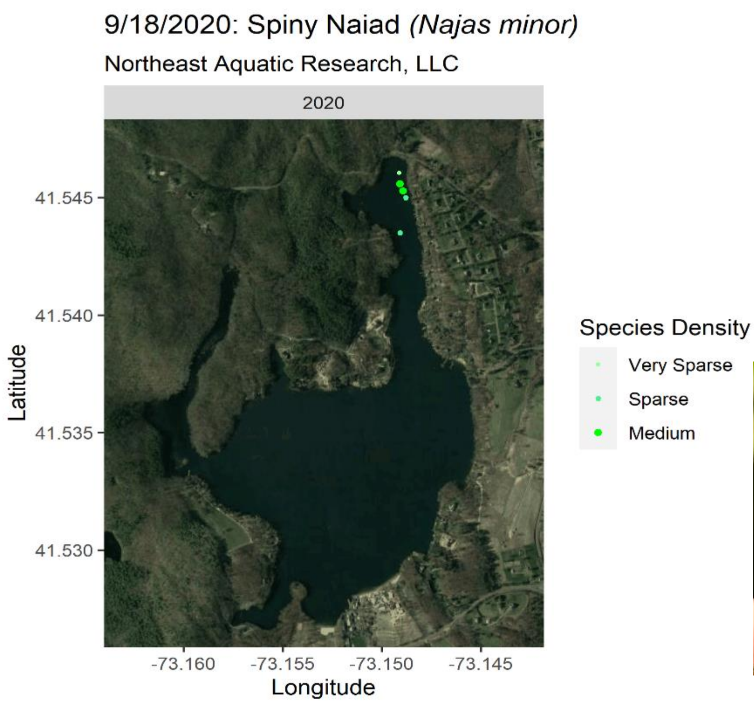
Long Term Reductions Variable Milfoil Frequency, Density, and Overall %

Little change in frequency % occurrence over time suggests regrowth common and eradication via suction-harvesting not likely.

2015	**2016**	**2017**	**2018**	**2019**	**2020**
%occur	%occur	%occur	%occur	%occur	%occur
34	31	29	34	23	29
AVG%	AVG%	AVG%	AVG%	AVG%	AVG%
68	56	66	33	35	34
Overall%	Overall%	Overall%	Overall%	Overall%	Overall%
23	17	19	11	8	10

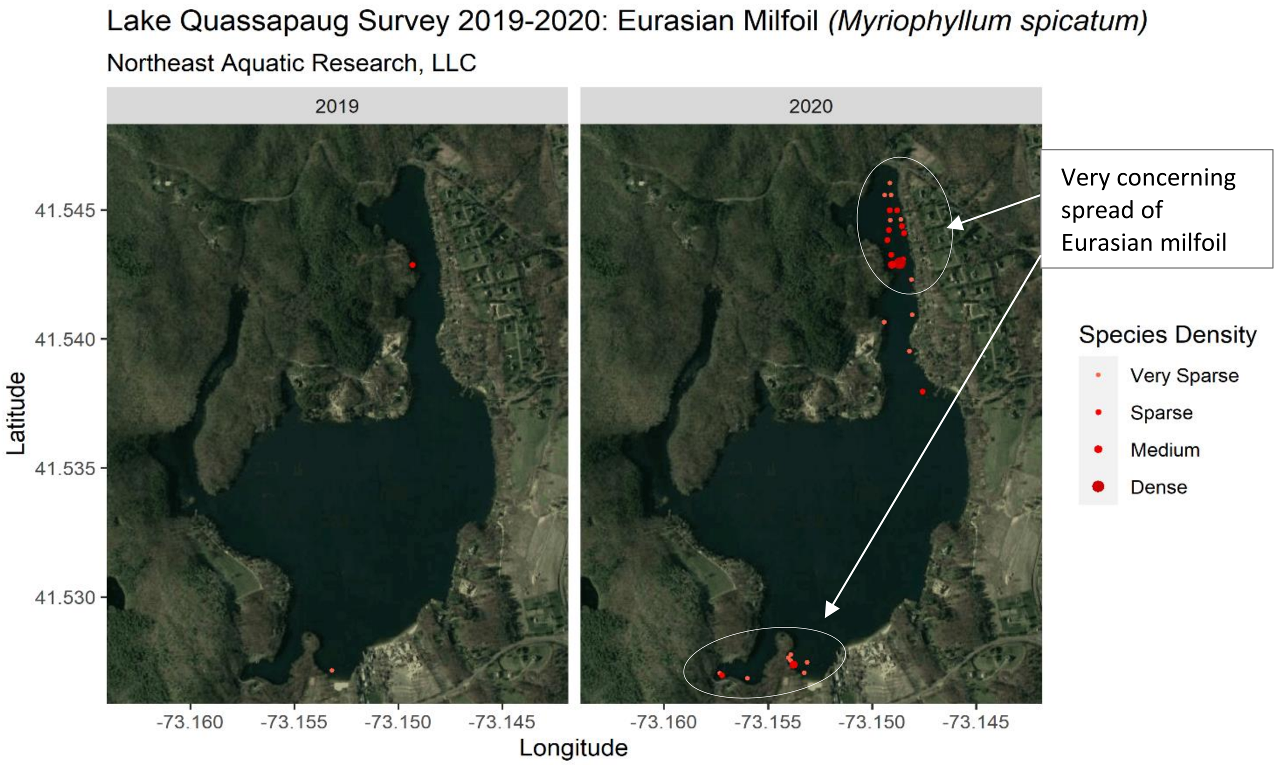
Last three years, plant average density hasn't changed considerably (after initial dramatic decrease in density).

There are now obvious laneways in the coves, and the suction harvesting has maintained these open access lanes in areas that used to be 100% invasive Variable leaf milfoil. <u>That fact should be seen as a success, but after six years of suction harvesting, it is worth re-evaluating the end goal for Variable leaf milfoil management</u>. The suction harvesting logs from 2019 and 2020 demonstrate that despite almost double the number of “buckets” of plant material removed in the lake in 2020, there were few areas where the Variable milfoil has been eradicated. Nearly all harvested areas have annual regrowth. It is also apparent that the open laneways and open sediments in Tyler and Long coves are being repopulated by native species, like Purple bladderwort (*Utricularia purpurea*) and Ribbon-leaf pondweed (*Potamogeton epihydrus*). Native species are better than excessive invasive Variable milfoil, but native plants can also grow dense enough to become a nuisance to recreational activities. Furthermore, as the density of native plants increases in the coves, the number of harvested “buckets” may start to represent more than just Milfoil. Another <u>new invasive species, Spiny Naiad (*Najas minor*)</u> was found for the first time in Tyler Cove in 2020.



We would like to have an open discussion with the board members to establish short and long-term plant management goals for specific areas in the lake.

In 2017, Eurasian milfoil was found at 11 locations. In 2018, this species was not found in the lake at all, after a very successful eradication via diver removal. In 2019, only 2 locations had sparse and very sparse Eurasian milfoil. Unfortunately, the 2020 survey found that Eurasian milfoil had expanded significantly and was present at 29 locations. The 2020 average density of Eurasian milfoil was sparse, but two locations in the Tyler cove arm had medium-dense patches. Moderately dense patches of Eurasian milfoil are nearly impossible to eradicate with diver suction harvesting. Suction harvesting may not be delicate enough to adequately remove Eurasian milfoil roots in moderate-dense patches in Tyler Cove. It's also possible that Eurasian milfoil may be able to gain foothold in the newly exposed areas that were opened by the hydro-raking Waterlily removal effort.

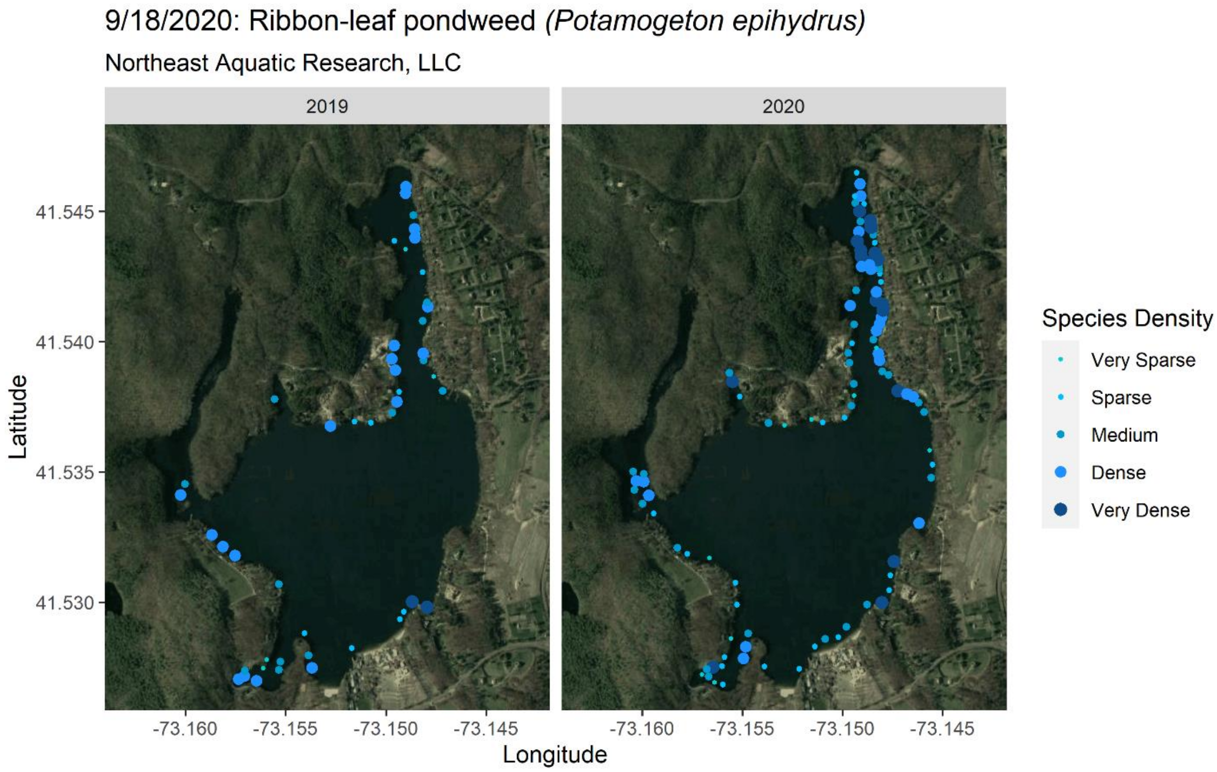


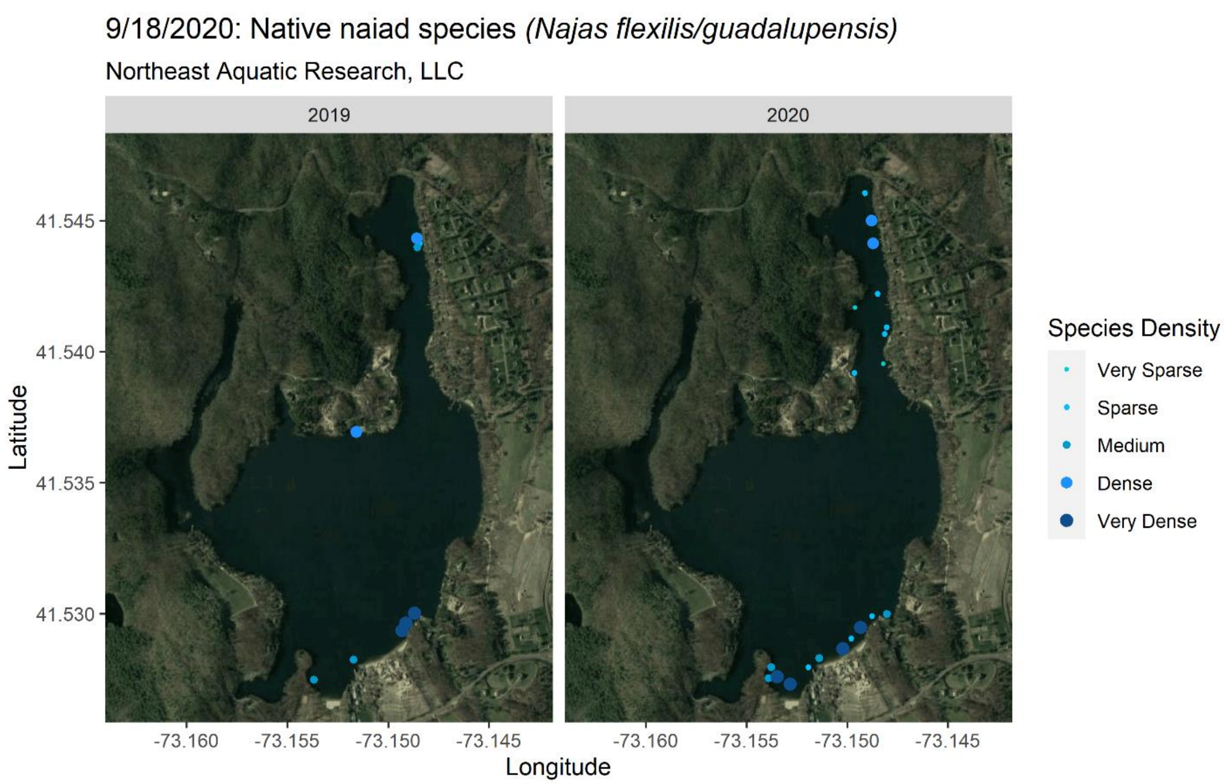
It is critical that the Eurasian milfoil in the south cove and south bay be prioritized for removal in 2021. These patches were very sparse, frequently just a small clump of plants at each spot and delicate hand-removal is required. Divers should use our GPS points (loaded to Google maps) to navigate to the exact locations of the Eurasian milfoil in the southern part of the lake for careful removal. Eurasian milfoil is much easier to fragment and spreads much more quickly than invasive Variable leaf milfoil. Any expansion of Eurasian milfoil in the southern cove/bay could be devastating to boating and recreation.

The expansion of Eurasian milfoil in the Tyler cove arm is likely due to the inherent difficulty of removing Eurasian milfoil roots. Poor visibility during suction harvesting in this cove also makes Eurasian milfoil fragmentation likely. Large patches of Eurasian milfoil are not as practical to control via suction harvesting as is Variable milfoil. Eurasian milfoil stems are thin and are harder to remove than Variable milfoil plans. Divers must be extremely careful when removing small clumps of Eurasian milfoil, and depending on the size of the patch, it is probably best to do so by hand, not using the suction pump.

There are other options for Eurasian and Variable leaf milfoil control. Until now, the LQA board has been opposed to any use of aquatic herbicides, but we would like to be able to have that discussion, for the sake of future planning. We understand the general hesitancy towards aquatic herbicide use, but there are options that could be both environmentally and fiscally responsible.

Notable increases in native aquatic plant growth/distribution from 2019 to 2020:





9/18/2020: Native Bladderwort species *(Utricularia radiata/purpurea/macrorhiza/gibba)*

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