Chautauqua Lake Monitoring Program
Submersed Aquatic Vegetation Survey Results
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Introduction

Chautauqua Lake, located in Western New York's Chautauqua County, is a popular destination for boating, fishing, and other forms of outdoor recreation. Its shoreline is heavily developed and spans across the towns of Busti, Chautauqua, Ellery, Ellicott, and North Harmony. The waterbody supports 42 miles of shoreline, spans over 13,000 surface acres, and is divided into two unique basins. Despite being similar in size, the southern basin tends to be shallower, warmer, and more nutrient rich when compared to the northern basin (Smith 2020; EcoLogic 2018).

The topography surrounding Chautauqua Lake has resulted in an extensive littoral zone that has the ability to support a highly productive ecosystem. Historic records and recent surveys have determined that the submersed aquatic vegetation (SAV) community of Chautauqua Lake is exceptionally diverse with over 50 total recorded aquatic plant species present since first surveyed in 1937 (Johnson 2018). Of these, five non-native SAV species, Eurasian watermilfoil (*Myriophyllum spicatum*), brittle naiad (*Najas minor*), starry stonewort (*Nitellopsis obtusa*), water chestnut (*Trapa natans*) and curly-leaf pondweed (*Potamogeton crispus*) have been periodically documented within the waterbody over time.

The growth of these non-native species can impair the recreational, ecological, and economical uses of Chautauqua Lake. To date, mechanical harvesting has been the most commonly used method for aquatic plant management in the waterbody. Throughout the 2023 growing season, nearly 10 million pounds of aquatic vegetation were mechanically removed from Chautauqua Lake (CLA 2023). More recently, select regions of the lake have also been treated with herbicides to target nuisance plant growth. Continual monitoring for abundance and distribution of both the native and non-native SAV species within Chautauqua Lake is a critical step in evaluating the overall sustainability of the aquatic ecosystem, and for determining an appropriate long-term management strategy.

This study was developed such that our results can be comparable to the research that has been done at Chautauqua Lake in previous years. SAV species presence and abundance data were collected following a point intercept-based methodology that had been previously applied within this system. Concurrently, hydroacoustic (sonar) data were recorded to determine SAV biovolume and acreage estimates.

Methods

An aquatic vegetation monitoring survey of Chautauqua Lake occurred August 12th - August 17th, 2024.

Macrophyte Survey

Point-intercept methods followed the guidelines proposed by Madsen (1999) and Racine-Johnson (2019) to provide direct survey effort and historical data comparisons between macrophyte survey years. Pre-established survey points, originally provided by Solitude Lake Management, were uploaded to an on-board GPS enabled chartplotter with ~5 ft horizontal accuracy. For the 2024 survey, an additional 70 survey points were added to the established survey sites in order to extend sampling into deeper sections of the lake's littoral zone or to achieve a refined sampling resolution in selected areas. Of the 1,070 point locations proposed for the Fall 2024 survey, 1,002 points were sampled (2023: 946; 2022: 978; 2021: 987 points; 2020: 980 points; 2019: 865 points; 2018: 1301 points). Sampling in select areas of the lake was limited due to windy weather conditions and difficulty of access to shallow sites. At each sample point location, the plants that were present on two separate rake tosses were documented and a visual estimate of whole-rake density was recorded (Table 1). Each rake received a species-specific relative abundance estimate (Figure 1). When applicable, floating and emergent shoreline species were also reported at each point location using a binary system. Abundance ratings of non-SAV were not recorded.

Sonar-Based Biovolume Survey

The survey vessel was configured with a Lowrance HDS-8 Gen3 consumer-grade fish-finding echosounder and chartplotter to record passive sonar tracks during the point-intercept survey (Figure 1). The echosounding transducer emits a 200kHz acoustic signal through the water column which is returned back to the receiver. Sonar data were saved by the echosounder to 32GB memory cards for further processing. Boat speed did not exceed 7 mph between point-intercept locations to ensure accurate interpolation of SAV presence and abundance. Sonar logs were recorded for ~2 hrs each.

Raw .Sl2 sonar data files were uploaded to BioBase C-Map cloud-based processing service to extract bathymetry estimates and SAV biovolume (quantity of the water-column occupied by SAV; *0-100%*) from boating transects. All processed sonar logs were then exported as tabular data for further GIS post-processing, mapping, and statistical analysis.

In Situ Water Quality & Turbidity Survey

Water quality parameters and water clarity measurements were recorded among 28 discrete point-intercept sampling locations. Sampling sites were defined prior to the start of the lake wide survey to ensure uniform spatial representation across the lake with 1.13 mile average spacing between points (Figure 2). Sampling sites have remained consistent during survey years.

A YSI handheld data logger was deployed at the select water quality points to measure profiles of Temperature, pH, Specific Conductivity, and Dissolved Oxygen. At each sampling point, recordings occurred 0.5 m below the water's surface, mid-water column, and 0.5 m above the sediment-water interface. At sites with less than 3 feet of water depth, a single reading was taken. These data were averaged to determine mean conditions at each site.

To determine relative turbidity, a secchi disk with industry standard recording measurements was utilized. A secchi measurement was taken when the disk was no longer visible to the surveyor when lowered in the water column. These readings can be useful in locating the boundaries of suspended solids, specifically planktonic algal blooms, between the north and south basins.

Post-Processing and Data Analytics

To create rake-toss density estimates for mapping and for relative species abundance estimates, both rake-toss throws were averaged to represent each survey point. For example, at any given point, two rake estimates of *moderate* density would be provided a weighted average score of *moderate*, whereas one rake toss of *no plants* and one rake toss of *moderate* density would be given a score of *sparse*. The weighted density values were then deployed in point and heat density mapping.

Point-intercept data was further tabulated in Microsoft Excel to provide appraisals of SAV species presence, frequency, and abundance. Species abundances were classified as *trace*, *sparse*, *moderate*, or *dense* as a function of their estimated percent cover on the rake and the respective rake fullness estimate. For example, a *sparse* rake with 50% occupancy of Eurasian watermilfoil and 50% Coontail resulted in a *trace* estimate of both Eurasian watermilfoil and Coontail at the surveyed point. Further, a *dense* rake with 100% cover of Eurasian watermilfoil resulted in a *dense* species rating for Eurasian watermilfoil. Resulting values were then used to identify native and non-native dominance and distribution throughout the lake.

Since sonar data does not provide species specific information, but rather a generalization of SAV water column occupancy and spatial breadth, point-intercept data was attributed to biovolume estimates. To provide acre estimates of SAV, specifically Eurasian watermilfoil, rake-toss point data was combined with the exported echosounding outputs from BioBase into ArcGIS Pro v.3.2.1. Survey point interpolation occurred using an inverse distance weighted (IDW) geostatistical function. An IDW is utilized to predict the non-surveyed areas between survey points. Input variables for IDW considered the mean buffered distance between rake-toss locations to account for nearest neighbor influence. That is, alike SAV species were given a higher probability of occupying an area than plants which were less prevalent in proximity. The resulting interpolation raster was then clipped to the sonar biovolume areas where a non-occupancy threshold of <10% biovolume was set. This value is standard for interpolated biovolume datasets to reduce the possibility of false-positive SAV detection when evaluating submersed plant bed breadth using sonar.

Results Summary

A total of 1,002 sites were sampled at Chautauqua Lake during the Fall 2024 survey. Of those, 994 (94%) contained aquatic vegetation (Table 2). The overall abundance of submersed species at the vegetated sites were most commonly classified as *sparse* (45%), followed by *moderate* (31%) (Table 2; Figure 3). SAV was present in trace and dense abundance at 18% and 6% of the surveyed points, respectively (Table 2; Figure 3). The average biovolume throughout the surveyed area was 31.5% (Figure 4).

Eurasian water milfoil (EWM; *Myriophyllum spicatum*), water stargrass (*Heteranthera dubia*), western waterweed (*Elodea nutalli*), wild celery (*Vallisneria americana*), and slender naiad (*Najas flexilis*) were present at the most survey sites during the Fall 2024 survey (Table 2). These top five species ranged from 64% occurrence (EWM) to 33% occurrence (slender naiad). While the species populations were widespread throughout the waterbody, species abundance for all of these species were most commonly classified as trace followed by sparse at the surveyed sites. On average, 4 species were documented per sampling site. The maximum number of species per site was 11. In total, 27 aquatic plant species comprised of submersed, emergent, floating, and algal growth forms were documented during the survey. However, 16 of these 33 documented species were present at less than 5% of the sampled sites (Table 2).

Similar to past year's survey findings, EWM was the most abundant species and was distributed throughout the lake in various abundance levels during the 2024 survey (Figure 5). It is estimated that EWM was present in 2,234 acres of Chautauqua Lake during the 2024 survey (Figure 6). In 78% of the points where EWM was present, it was classified in trace abundance (Figure 5, Table 1). This correlates to the presence of just a few stems on the retrieved rakes. EWM was sparse at 17% of the points where it was present, followed by moderate at 3% and dense at 1% (Table 1). Nearly all of the sites with dense EWM growth were located in Ellery (south of Long Point State Park) (Figure 5). EWM was topped out (i.e. biomass reaching the top of the water column) and flowering. Sonar scans of this region of the lake may not accurately assess this high biovolume as boating through the vegetation was difficult.

Other non-native SAV species present during the Fall 2024 survey included curly-leaf pondweed (CLP; *Potamogeton crispus*), brittle naiad (*Najas minor*), and starry stonewort (*Nitellopsis obtusa*). In general, brittle naiad findings were minimal, with 100% of reportings classified as trace abundance. All points where brittle naiad was present were located in the Burtis Bay region of the South Basin. CLP biomass was found at 128 surveyed points (13%). When the addition of the documented CLP turion presence, CLP was distributed within 151 surveyed points (32%) and was mainly at points located within the South Basin, although several points in the North Basin were also reported (Figure 7). The presence of turions at 23 survey sites is likely an underestimate as the rake toss sample method does not accurately collect CLP turion biomass. In 2023, turions were documented at 79 sites. The presence of CLP biomass at 128 survey sites is likely also an underestimate due to survey timing and CLP phenology.

Starry stonewort was present at 12 sampled sites in 2024. Based on this result, it estimated that 46 acres of Chautauqua Lake's littoral zone may contain starry stonewort biomass (Figure 8). It should be noted that survey surveillance increased around sample sites were starry stonewort was retrieved to refine extent estimations. In 2023, it was estimated that starry stonewort presence covered 90 acres of Chautauqua Lake's littoral zone. As in previous years, starry stonewort was producing bulbils (vegetative reproduction structures) in several collected samples during our Fall 2024 survey (Figure 9). While starry stonewort extent at Chautauqua Lake was slightly reduced from 2023 estimates, it was observed that biomass increased within survey sites, including some "pillow" growth, especially around Prendergast Point (Figure 9). Sampling was restricted in Prendergast Point due to water depth and high SAV density, so the extent of starry stonewort in this region may not have been fully revealed.

Water quality during the 2024 survey was measured at 28 sites throughout the lake. In general, sites in the South Basin had a higher pH and dissolved oxygen levels, were slightly cooler, and had reduced recorded secchi depth (water clarity) than those in the North Basin (Table 3).

What appeared to be *Gleotrichia* algae was documented at nearly all surveyed sites in 2024 in varying visual densities. Gelatinous epiphytic algal colonies (likely *Nostoc*) were also identified growing directly onto plant biomass as has been observed in previous years. Benthic algae (*Microseria* sp.), filamentous algae, and surface algal scums were also observed in 2024. The presence of dense algal growth likely continues to impact the overall condition of SAV in Chautauqua Lake.

North & Central Basin Results

Town of Chautauqua

SAV along the Town of Chautauqua's shoreline was sampled at 378 sites in 2024 (Table 4, Figure 10). This is an increase in sample points from previous years, as additional points were added along the deep edge of the littoral zone in the northern end. Water stargrass was found at 222 sites and wild celery was found at 220 sites making them the most frequently sampled species in the Town of Chautauqua (Table 4). Eurasian watermilfoil was present at 214 sites (57%) total, and was found at similar levels in 2023 (NCSU 2023). When combined with biovolume data, the estimated extent of EWM in the Town of Chautauqua covers 605 acres, staying consistent with extent estimated in previous years (Figure 20).

CLP was present at 5% of surveyed points and starry stonewort at 1% of surveyed points in the Town of Chautauqua, both reported to be in trace or sparse relative abundance where they were present. These results are consistent with previous survey observations. Rhizoid formation was present on starry stonewort collected from the Village of Mayville indicating it was in good condition and capable of regeneration.

Nearly all (97%) of the surveyed points within the Town of Chautauqua's littoral zone contained SAV (Table 4). The majority (59%) of survey points supported SAV growth that was classified as sparse. However, 25% of surveyed points were classified as *moderate* or *dense*. The Town of Chautauqua supports 22 distinct SAV species including some small populations of uncommon species including sago pondweed (*Stuckenia pectinate*), largeleaf pondweed (*Potamogeton amplifolius*), robbins pondweed *(Potamogeton robbinsii*), white water crowfoot (*Ranunculus aquatilis*), and American pondweed (*Potamogeton nodosus*). All of these species were present at less than 5 sampled points in 2024 (Table 4).

<u>Village of Mayville</u>

All 123 sites sampled along the Village of Mayville's shoreline contained SAV (Table 5; Figure 11). This result of 100% vegetated points in the Village of Mayville has been observed during all survey years by NCSU (NCSU 2023; NCSU 2022; NCSU 2021; NCSU 2020). None of the sampled points were assigned a *dense* overall rake abundance rating, and 77% were reported as *sparse* (Table 5). Water stargrass was the most common species sampled in the Village of Mayville in 2024, followed by EWM and wild celery (Table 5). Starry stonewort and CLP were present at 3 and 2 sampled sites, respectively (Table 5).

<u>Town of Ellery</u>

A total of 298 points were surveyed along the Town of Ellery's shoreline in 2024 (Table 6; Figure 12). Of those, 91% contained aquatic vegetation (Table 6). Twenty-nine total points (11%) retrieved whole rake ratings of dense in this region of the lake. The majority of sampled points in Ellery were of sparse abundance (37%), followed by moderate (32%) and trace (20%) (Table 6).

EWM was the most common species sampled, found at 74% of sites and was classified as dense at 7 total sites. This is an increase in abundance from previous survey years. The densest growth of EWM in Chautauqua Lake during the 2024 survey occurred in the Town of Ellery just north of the Village of Bemus Point. In this area, EWM was dense at 6 nearly consecutive survey points. EWM was observed to be reaching the water's surface (100% biovolume) and flowering. Biovolume may not have been reflected in our collected sonar data due to difficulty boating through the sites. It is estimated that EWM covers 737 acres in the Town of Ellery based on our 2024 survey data. Dense areas of EWM growth were clustered south of Long Point State Park during the time of survey (Figure 5). Otherwise, the majority of EWM that was documented during the survey was present in trace abundance (68%) (Table 6).

Other frequently-occurring species included water stargrass, western waterweed, wild celery and slender naiad, and the majority of these native species recorded in Ellery were present at either trace or sparse abundance (Table 6). In total, 18 distinct species were present in the Town of Ellery. Starry stonewort was not documented at any site in Ellery.

Village of Bemus Point

Twenty seven of 32 sample sites (84%) within the Village of Bemus Point contained aquatic vegetation during the 2024 survey (Table 7; Figure 13). Of the sites with vegetation, the total abundance was classified as trace at 22%, sparse at 37%, moderate at 26%, and dense at 15% (Table 7). Only 8 total submersed species were present in Bemus Point. EWM was the most abundant species, found at 81% of sampled sites. Other major species in Bemus Point included water stargrass, western waterweed, and wild celery, but they were all found at less than 40% of sampled sites (Table 7). CLP was present in trace abundance at 6 (19%) sample sites (Table 7), and were mainly concentrated around the public docks associated with the downtown area (Figure 7). Starry stonewort was not present in the Village of Bemus Point.

South Basin Results

Town of Busti

Aquatic vegetation was surveyed within the Town of Busti's littoral zone at 124 sample sites, and of those 95% contained vegetation (Table 8; Figure 14). From survey efforts, there is an estimated 393 acres of EWM within the Town of Busti (Figure 20). EWM was most frequently intermixed with western waterweed at survey sites. Western waterweed occurred in the highest abundance within Busti in 2024 and noted to be in dense abundance at 7% of sites (Table 8). Areas with most prolific submersed plant growth included regions of Sherman's Bay and points on Busti's eastern region leading out towards Chautauqua Lake's outlet (Figure 14).

Other major species present in Busti included water stargrass, slender naiad, curly-leaf pondweed, and coontail (Table 8). Nearly all of these were present in trace abundance (Table 8). Both biomass and turion structures of CLP were present in Busti, and were mostly concentrated from Sherman's Bay and east towards the outlet (Figure 7). Other non-native species presence included brittle naiad at 11 survey points and starry stonewort at 1 survey point. Brittle naiad was concentrated in points within Burtis Bay. The single starry stonewort location corresponded to a site just west of the Lakewood Rod and Gun Club (Figure 8).

Village of Lakewood

A total of 74 survey sites were contained within the Village of Lakewood's shoreline during the 2024 survey, and only 5 of which did not contain SAV (Table 9; Figure 15). As discussed above, western waterweed was highly prevalent in this section of Chautauqua Lake, and was noted to be densely growing at 4 survey sites (Table 9). The condition of the western waterweed at the time of survey was excellent, as stems were bright green and displaying active growth. Leading out of Burtis Bay, several shoreline points contained either no SAV growth or some SAV in trace abundance (Figure 15).

EWM and CLP were the second and third most abundant species in this region of the lake, occuring at 58% and 36% of sampled sites, respectively. However, nearly all EWM and CLP biomass was reported to be of trace abundance (Table 9). It should be noted that CLP presence has an increasing trend in the Village of Lakewood, where no biomass was detected in 2020 or 2022 and was found at only 2 sample sites in 2021 (NCSU 2023).

Town of Ellicott

All 49 survey sites within the Town of Ellicott contained SAV in 2024 (Table 10; Figure 16). Of these, none were classified as trace, 29% were sparse, 63% were moderate, and 8% were dense (Table 10). Survey effort was increased within the Town of Ellicott compared to previous survey years with the addition of new sample sites located between established sample sites. The goal of this was to refine sampling effort to further understand the distribution of SAV within this region of the lake. In general, the two most abundant species were western waterweed, found at almost all (96%) sampling sites, and EWM, documented at 73% of sample sites (mainly in trace abundance) (Table 10). Based on the presence of EWM at sample sites and the interpolated biovolume of SAV, it is estimated that the Town of Ellicott contains 289 acres of EWM extent (Figure 20).

CLP, brittle naiad, and starry stonewort were all present in Ellicott in 2024, all in trace abundance (Table 11). In 2023, brittle naiad was highly present in the outlet leading out to the Chadakoin River. In 2024, no brittle naiad was documented in this section, but instead was preset in centralized points within Burtis Bay. Similarly, trace CLP biomass was commonly present within Burtis Bay, with some biomass continuing into the Chadakoin River section (Figure 7). Starry stonewort presence was determined along the North Ellicott shoreline as well as a single point in close proximity to the Chautauqua Harbor Hotel's shoreline (Figure 8).

Village of Celoron

All of the 14 surveyed points in the Village of Celoron contained SAV during the Fall 2024 survey (Table 11; Figure 17). Western waterweed was the most abundant, with presence at 93% of all surveyed points (Table 11). EWM was found at 12 (86%) of sampled points, all in trace abundance (Table 11). As mentioned above, curly-leaf pondweed, brittle naiad, and starry stonewort were all documented in this region of the lake. Other native SAV species documented included water stargrass (86% occurrence), coontail (50% occurrence), and small pondweed (43% occurrence) (Table 11).

Town of North Harmony

North Harmony was surveyed at 153 sites in Fall 2024 and 141 (92%) contained SAV (Table 12; Figure 18). EWM was the most abundant species present at 61% of sampled points. Of these points, EWM was classified as *trace* in 75%, *sparse* in 20%, *moderate* in 4% and *dense* at 0% of sites (Table 12). It is estimated that the EWM extent in the Town of North Harmony covers 300 acres (Figure 20). Other major species present in North Harmony included western waterweed (52% occurrence), wild celery (48% occurrence), and water stargrass (48% occurrence) (Table 12).

CLP was present at 18 total points (12%) and was most often found in North Harmony's South Basin region (Figure 7). Starry stonewort was observed at 3 survey points in North Harmony, all of which were located in or in close proximity to Asheville Bay. Starry stonewort abundance was noted as moderate at 2 of those sites, and was actively producing rhizomes and bulbil reproductive structures (Figure 9). Starry stonewort was found in the shallow zone leading into Goose Creek, but did not extend into any sampled point within Goose Creek itself (Figure 9).

Discussion

According to our Fall 2024 survey findings at Chautauqua Lake, SAV presence and abundance remains widespread within the lake. As determined through past survey efforts, EWM continues to be one of the most abundant SAV species found lakewide, and in 2024, sampled populations were generally found to be in good condition (Figure 19). This year, EWM extent increased or has remained stable in nearly all surveyed towns (Figure 20). Despite these increases in distribution, overall density of EWM remains fairly low and intermixed with native species in most surveyed areas (Figure 21). The increase in total estimated EWM acreage (2023: 1140 Acres; 2024: 2234 Acres) and overall percent occurrence (2023: 45%; 2024: 64%) is a reflection of the species' ability to prolifically and quickly spread in aquatic ecosystems.

Native SAV was still present in robust populations during the Fall 2024 survey. In general, species presence was comparable to previous survey years with slightly increased water stargrass observations and decreased coontail populations (Figure 20). Many signs of active growth were apparent in the native plant populations, including active flowering and seed production in collected wild celery plants.

CLP also continues to be present throughout the lake, and was documented in comparable abundance to 2023 survey results (128 survey points in 2024 and 136 survey points in 2023). CLP was present as matured biomass, newly sprouted turions, and unsprouted turions during the Fall 2024 survey. Due to the timing of this survey, estimates of presence and abundance of CLP is likely underrepresented and should be reconsidered in Spring 2025 when peak biomass production of CLP is occurring.

Active mechanical harvesting of the aquatic vegetation was observed during the 2024 survey. Mechanical harvesting influences the overall abundance and extent of the entire aquatic plant community. Other SAV management strategies deployed at Chatuauqua Lake in 2024 included herbicide applications to target EWM in Ellicott and Celeron and CLP in Ellery and Busti.

The management and monitoring activities of the non-native and nuisance aquatic plant presence at Chautauqua Lake will continue to be a key factor in the effort to conserve and restore the Lake's robust aquatic ecosystem. Chautauqua Lake acts as a foundation for many important environmental and economic processes and its health and wellbeing are an important priority.

Conclusions

- EWM occurrence (64%) was the highest of all SAV species sampled during the Fall 2024 survey. In select areas, EWM populations were noted to be dense and occurring in monoculture stands. However, the majority of EWM throughout the lake was present in low abundance and intermixed with native species. Some evidence of biocontrol activity on EWM was apparent on select stems collected during the survey. In general, EWM stems were in good condition and many supported adventitious roots that aid in the species' dispersal throughout the lake.

- CLP remains present at many survey sites, especially throughout the South Basin's littoral zone. Spring surveys for CLP presence are necessary for a complete view of the population's dynamics in the Chautauqua Lake system. Management of CLP prior to turion formation (early spring) will likely help reduce CLP biomass in future years at Chautauqua Lake. A sediment sampling effort could help to inform future distribution of CLP in Chautauqua Lake by tracking the extent of CLP turions with refined methods.

- Starry stonewort was found in areas in which it had been documented in 2023, and in some cases, has increased in density within those sites. In particular, starry stonewort density appears to have increased in regions of Prendergast Point and Ashville Bay over the course of a year. These sites should continue to be monitored, especially due to their high-use locations near marinas and fuel stations. Signs of active growth and regeneration of starry stonewort were again present during the 2024 survey. As mentioned for CLP, the rake-toss methodology was not designed for sampling of vegetative reproductive structures and therefore the presence of starry stonewort bulbils is likely underestimated at this time. A more formal sediment sampling effort should be considered to better determine starry stonewort distribution and reproductive potential in Chautauqua Lake.

- Native species presence remains high in Chautauqua Lake with 19 submersed species recorded in 2023. Populations of major native species have remained stable over time, with the exception of coontail which decreased from 53% occurrence in 2022 to 35% occurrence in 2023 and 23% in 2024. Note that coontail may be free-floating or attached to sediment, but as it lacks true roots it could be more vulnerable to harvesting efforts due to being higher in the water column and/or lacking root carbohydrate reserves to regrow. No new species were found during the 2024 survey, but American pondweed and white water crowfoot have not been documented for several years.

- The lakewide average hydroacoustic biovolume estimate was 31.5%, an increase when compared to 2023 estimations (2023: 21.1%). Biovolume is highly dependent on water depth, species type/presence, and management activities.

- Measured water quality during the Fall 2024 were consistent to records during previous survey years and were of generally good levels. Some readings, such as secchi depth, were directly influenced by algal bloom presence.

- Algal blooms were present throughout the lake during the time of the survey, but were of lesser density than had been observed in previous years, with the exception of *Gloeotrichia* which was more apparent throughout the lake, and benthic filamentous algae, which could be influencing SAV abundance and distribution by competitively using space, light, and nutrients that other species depend on.

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