2023 Lake Gaston Vegetation Survey Report

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Prepared By:

North Carolina State University

Dr. Rob Richardson, Professor and Extension Specialist

Jessica R. Baumann, Extension Associate

Aquatic Plant Management Program

Raleigh, NC 27607

Submitted To:

Lake Gaston Weed Control Council

Littleton, NC 27850

NC STATE UNIVERSITY

Aquatic Plant Management Program

Introduction

Lake Gaston is a 20,000 acre reservoir located along the Roanoke River and is situated between the border of North Carolina and Virginia. Lake Gaston is situated between two other Roanoke River chain reservoirs, which includes Kerr Lake (50,000 acres; US Army Corps of Engineers) upstream and Roanoke Rapids Lake (4,600 acres; Dominion Energy) downstream. Lake Gaston was impounded in 1964 by the Virginia Electric Power Company and maintains a normal pool of 200 feet above sea level. Water levels are mandated to remain within one foot of normal pool, except in the case of emergency. Lake Gaston's primary utilities are to generate hydroelectric power for Dominion Energy and provide drinking water to Virginia Beach, VA. However, the lake also provides opportunities for recreational boating and sporting activities and has >350 miles of highly developed shoreline.

Lake Gaston's aquatic vegetation community is surveyed on an annual basis to evaluate the diversity, abundance, and distribution of aquatic plant species throughout the system. A combination of point intercept and sonar surveys are performed along the lake's shoreline to provide a robust evaluation of the aquatic plant community. These surveys are completed through a collaborative effort between the Lake Gaston Association (volunteers) and researchers from the North Carolina State University (NCSU) Aquatic Plant Management Group. Funding for these surveys is provided by the Lake Gaston Weed Control Council.

Currently, there are two problematic aquatic species found in Lake Gaston; the noxious submersed weed, hydrilla, and the nuisance alga, lyngbya. Both of these species require continued monitoring for management direction. Hydrilla, a federally listed invasive species, has been successfully managed within the system for almost a decade. However, hydrilla produces reproductive structures (turions and tubers) that have the potential to lay dormant for up to 7 years before germination (Nawrocki et al. 2016). Lake Gaston has also been infested with lyngbya, a native and nuisance cyanobacterium, that was first identified in the mid 1990's. Lyngbya is a mat-forming, filamentous alga that grows in the benthic environment, but proliferates upward through the water column during the warmer summer months. The presence of lyngbya results in negative impacts for both the surrounding aquatic ecosystem and for stakeholders that can no longer utilize the affected shoreline areas.

Management response to both problematic species has been extensive at Lake Gaston. In 2012, hydrilla was reported to cover over 1,500 acres of Lake Gaston's shoreline. An integrated management program using a combination of chemical and biological (grass carp) control methods has greatly reduced the level of hydrilla infestation. In 2012, approximately 230 acres of lyngbya were reported within Lake Gaston and to date, the infestation has continued to increase >1,000 acres. Yearly monitoring of both species is critical for continued management success.

Methods

Vegetation Survey

A point intercept survey was utilized to quantify the diversity and distribution of aquatic plants within Lake Gaston between August 19th and November 3rd, 2023. This survey, conducted primarily by volunteer effort, recorded all aquatic plant species that were present at individual points using a combination of visual surveys and rake toss sampling. At each point, the presence of emergent and floating leaf species were recorded using a visual survey of the shoreline, while submersed and algal species were recorded using a rake toss method. The rake toss method utilized a double sided metal rake, created by welding two steel garden rake heads together, attached to a rope that is thrown towards the shoreline and dragged along the bottom to collect any submersed plant material. A total of 2 rake tosses were conducted at each survey site. If a nuisance species, (hydrilla or lyngbya) was detected at a site, additional data was collected. If hydrilla was present, average plant length was recorded. If lyngbya was present, the density of mat material collected by the survey rake was ranked and recorded. Survey points were not pre-determined and were chosen at random by the survey team in the field; however, the targeted distance between points was 200 feet. The GPS location of surveyed points, along with the species present, was recorded on handheld tablets equipped with GIS Cloud™ software.

Sonar surveys were conducted by NCSU researchers and were used to calculate the overall biovolume of submersed vegetation within the lake. The data collected during this survey was post-processed using BioBase™ cloud-based technology and then used in combination with the point intercept data to calculate the acreage of submersed species using Esri™ ArcGIS Pro software.

Tuber Survey

Due to the life history traits of hydrilla, additional survey methods were required to evaluate the distribution of this species in Lake Gaston. While the point intercept and sonar surveys identify the current status of hydrilla within the lake, a survey of the tuber bank within lake sediments was also needed to evaluate future growth potential within the population. Tuber surveys were conducted by NCSU researchers at 11 creeks located throughout the lake. Within each creek there were 1 to 4 individual sampling sites, each of which were located in an area that historically contained hydrilla. Tubers were collected utilizing a core sampler that removes a circular plug of sediment from the substrate and that sediment core was then washed over a screen to expose any tubers that were present. Depending on tuber detectability, 30 to 50 core samples were collected at each individual site. Tuber densities (tuber per m^2) were calculated per site and then averaged over all sites within a creek to determine the overall tuber bank density for each creek.

There were a total of 71 historical tuber survey sites used to capture the extent and density of the hydrilla tuber bank across 18 creeks at Lake Gaston. Due to decreased hydrilla abundance and distribution throughout the reservoir, individual survey sites were prioritized in 2023 for sampling based on the number of years since hydrilla had been detected (plant biomass or tuber occurrence). If biomass was detected in areas adjacent to survey sites during the current year's vegetation survey, or if tubers were detected during the previous year, these sites were considered priority (1) and tuber sampling occurred during 2023 efforts. Priority (2) sites will be sampled on a bi-annual basis and were identified as sites that had low and inconsistent detection of plant biomass and/or a tuber bank over the past 7 years. Priority (3) sites have not documented plant biomass and/or a tuber bank in over 5 years and the hydrilla population is considered below detectable limits. Priority (3) sites will not be actively sampled but will remain closely monitored and future sampling will occur if hydrilla is detected in areas adjacent to the survey sites.

Results

Point Intercept Survey Effort

The 2023 point intercept survey was conducted between August 19th and November 3rd. During this timeframe, 85 teams comprised of 152 volunteers surveyed a total of 5,995 sites. These teams put in a total effort (includes both preparation and active surveying time) of 572 hours for the 2023 survey and accounted for 235 hours of the active surveying time. NCSU staff surveyed a total of 316 sites and accounted for 12 hours of active surveying time. In total, 6,311 sites were surveyed by both volunteers and NCSU in a time span of 247 hours. This level of sampling effort is comparable to previous survey years (Figure 1). Due to sampling errors related to GPS and collection software connectivity, 125 sites were removed from data analysis.

Overall Vegetation

Overall, 82% of the sites surveyed contained aquatic vegetation (Table 1). The aquatic plant community was primarily comprised of emergent species (58%), submersed species (11%), floating leaf species (4%), and algal species (27%) (Table 1; Figure 2). Due to the high stocking rate of Grass Carp within Lake Gaston as part of an integrated management protocol for hydrilla, the low percentage of submersed and floating leaf species was to be expected. Grass Carp will target these species along with hydrilla, while emergent and algal species are not preferred food sources. Within the aquatic plant community, water willow made up the largest presence of the overall vegetation (39%) (Table 1; Figure 2) and the emergent plant has consistently remained the most abundant species found within the lake since 2018. The second most abundant species were represented by two algal species, lyngbya and chara, both of which made up 13% of the total vegetation (Table 1; Figure 2). Water willow and lyngbya are both well-distributed throughout Lake Gaston; however, chara seems to be more associated with those areas that are not heavily infested with lyngbya (Figures 3-5).

Both water willow and chara are considered native beneficial species, while lyngbya is considered a nuisance alga that can have negative impacts to aquatic ecosystems.

Hydrilla

Hydrilla was located throughout Lake Gaston (Figure 6) and an increase in overall acreage was reported from 2022 to 2023 (Figure 7). Several areas of the system experienced increased levels of hydrilla growth, including Poplar Creek's upper eastern arm (Figure 8) where hydrilla was observed to be topped out at the water's surface. NCSU has been actively involved in the management of the aquatic plant community since 2012 and in that time the standing acreage of hydrilla has decreased from 1,541 acres in 2012 to 329 acres reported in 2023 (Figure 7). Percent occurrence of hydrilla within the point intercept survey has followed a negative trend with 64% reported in 2012 and 7% in 2023 (Figure 7). Results from the tuber bank survey conducted in winter of 2023 also indicate a drastic decrease from initial samples collected in 2012 (Table 2). The tuber bank located within the eastern portion of the lake (east of Eaton Ferry's Bridge) was almost at an undetectable level in 2023. A majority of the eastern sites were moved into a monitoring protocol (Priority 3) where sites will be closely monitored and future sampling will occur if hydrilla is detected in areas adjacent to the survey sites. Lizard Creek is the only creek in which a persistent tuber bank has been detected over the last three sampling years. The western portion of the lake (west of Eaton Ferry's Bridge) still contained a relatively low density tuber bank, but the area of the Flats was the only site that was moved into the monitoring protocol (Priority 3). Hawtree Creek has consistently reported higher levels of tuber bank densities over the past 5 years.

Lyngbya

In 2023, lyngbya represented 13% of the total aquatic plant community, was present at 21% of total sites surveyed, and was estimated to cover 1,134 to 1,377 acres along the shoreline of Lake Gaston (Table 1; Figure 9). A range of acreage was determined for 2023 due to an increase in growth displayed by cladophora (*Cladophra* sp.), a common native species of filamentous green algae that can be distinguished microscopically from lyngbya but is almost impossible to distinguish from visual observation alone in-field. However, cladophora does not produce the robust benthic mats displayed by lyngbya and therefore will have the highest likelihood of misidentification when compared to lyngbya that has minimal growth density (trace). To acknowledge this potential misidentification and lyngbya acreage estimate variability (243 ac), two methods were used for acreage calculations: where 1) the dataset included all sites where lyngbya was identified as present (higher estimate) and 2) the dataset excluded all sites in which lyngbya growth was identified as trace (lower estimate).

Since 2020, lyngbya has become the second most prevalent species found in Lake Gaston and has displayed a steady overall increase in total acreage since 2014 (Figure 9). Lyngbya forms thick filamentous mats along the bottom of the lake and therefore the annual survey also

collects data to determine the density of those benthic mats at each survey site. Sites that contain lyngbya were incrementally ranked from 1 to 4, with trace detection and low mat density represented as a [1], moderate mat density represented as a [2 or 3], and gear saturation due to high mat densities represented as a [4] (Figure 10). A rank of [0] was provided to sites where visual surveys indicated surface mats were present, but environmental conditions prevented a rake from being tossed. Lyngbya sites that contained benthic mats at trace densities represented a large proportion of the survey (33%), however sites that contained benthic mats with moderate to high density levels represent the majority (44 and 22%, respectively). Lyngbya distribution has continued to spread throughout Lake Gaston resulting in few areas that were completely void of this noxious species.

Eel Grass

Eel grass, *Valiseneria neotropicalis,* is a native and beneficial submersed species that has displayed increased distribution and abundance at Lake Gaston (Figure 11). In 2023, eel grass represented 2% of the total aquatic plant community, was present at 3% of total survey sites, and was estimated to cover 130 acres of shoreline (Table 1; Figure 11). Eel grass is primarily found in the lower, eastern section of the lake and was noted to be dense at many sites within the Jimmie's Creek area (Figure 12). Samples of eel grass were collected from Lake Gaston in 2023 and their genetics were analyzed by the Thum Lab at Montana State University. The results of that study concluded that the samples were classified as a native species of eel grass, *V. neotropicalis*, and were closely related to other eel grass samples collected from populations in North Carolina, South Carolina and Florida (R. Thum, personal communication).

Conclusion and Management Implications

- For an artificial reservoir environment, the aquatic plant community at Lake Gaston is diverse. This community is represented by a host of emergent, submersed, and floating leaf species, which all provide beneficial ecosystem services to the lake. Though diverse in species composition, density levels of submersed and floating leaf species are low within the lake likely due to the herbivory pressure that results from high stocking rates of Grass Carp for hydrilla management.
- Hydrilla remains at low density levels throughout the system and the current management strategy seems to be effective at maintaining this invasive species. However, abundance and distribution within the system has increased from 2022 with Poplar Creek displaying significant levels of topped out growth. Overall, tuber bank detections remained relatively stable except for Hawtree Creek and Poplar Creek which both displayed increased tuber densities.

Conclusion and Management Implications (con't)

- Currently, there is an active management program directed towards lyngbya within Lake Gaston, with treatment efforts targeting 376 acres throughout the system. The success of this treatment program could potentially be reflected in the stability of reported lyngbya acreage from 2021 to 2023. However, distribution of lyngbya is still widespread throughout the whole system and displays dense growth in many areas.
- The eel grass population continues to increase in distribution and abundance at Lake Gaston. Although it has been confirmed to be the native *V. neotropicalis*, continued monitoring and sample collection is recommended and will be valuable for any future management decisions.
- Continued yearly surveying of Lake Gaston's aquatic plant community is recommended to monitor growth and distribution in both native and beneficial communities, as well as, nuisance, noxious, and additional potentially harmful species.

References

Nawrocki JJ, Richardson RJ, Hoyle ST. 2016. Monoecious hydrilla tuber dynamics following various management regimes on four North Carolina reservoirs. Journal of Aquatic Plant Management. 54: 12 – 19.

Table 1. The abundance and diversity of the aquatic plant community as reported during the 2023 shoreline vegetation survey at Lake Gaston, NC/VA.

LAKE GASTON AQUATIC PLANT COMMUNITY - 2023				
	# of Total Sites	**% of Total Sites**	**% of Total Vegetation**	**% of Total Vegetation (2022)**
SURVEYED SITES	6,186			
VEGETATED SURVEY SITES	5,086	82		75
Emergent				
AMERICAN LOTUS	101	2	1	1
ARROWHEAD	346	6	4	4
CATTAIL / CUTGRASS	499	8	5	5
PICKERELWEED	255	4	3	4
RUSH	395	6	4	5
SPATTERDOCK	300	5	3	3
WATER WILLOW	3,758	61	39	47
TOTAL EMERGENT SPECIES	*5,654*	*91*	*63*	*70*
Submersed				
EEL GRASS	212	3	2	2
EGERIA / ELODEA	16	0	0	0
COONTAIL	101	2	1	0
NAIAD	155	3	2	0
HYDRILLA	431	7	4	1
PONDWEED	93	2	1	0
WATERMILFOIL	18	0	0	0
TOTAL SUBMERSED SPECIES	*1,026*	*17*	*9*	*5*
Floating Leaf				
WHITE WATERLILY	208	3	2	2
WATERSHIELD	183	3	2	1
TOTAL FLOATING LEAF SPECIES	*391*	*6*	*5*	*3*
Algae				
CHARA / NITELLA	1,301	21	13	4
COMPSOPOGON	21	0	0	1
LYNGBYA	1,295	21	13	17
TOTAL ALGAE SPECIES	*2,617*	*42*	*23*	*22*

Table 2. Hydrilla tuber bank densities (tuber / m^2) calculated on a yearly basis for 18 creeks throughout Lake Gaston, NC/VA. Average density estimates for each creek are shown for the initial survey (2012) and the last five surveys that were conducted (2019-2023). Results for the 2023 survey season that are represented in italics indicate sites in which the hydrilla population has fallen below detectable levels and therefore are not sampled on a regular basis.

LAKE GASTON HYDRILLA TUBER BANK ESTIMATES							
	Years Since Last Tuber Detection	**Starting Bank Density (2012)**	**2019**	**2020**	**2021**	**2022**	**2023**
East of Easton's Ferry Bridge							
Jimmies Creek	0	*36.41*	0	0	0	0.82	12.33
Timberline Shores	*5*	*3.08*	0	0	0	0	*n/a*
Cold Springs Branch	*4*	*34.95*	.82	0	0	0	*n/a*
Lakeview	*9*	*124.37*	0	0	0	0	*n/a*
Lizard Creek	0	*N/A*	18.91	0	24.39	53.72	15.90
Big Stone House	0	*31.25*	0	0	0	0	7.40
Pretty Creek	*7*	*38.72*	0	0	0	0	*n/a*
Poe Creek	*4*	*125.4*	0.82	0	0	0	*n/a*
Woodland Hurst	5	*135.67*	0	0	0	0	0
Sledge Creek	*1*	*8.22*	0	0.82	0	2.47	*n/a*
Hamlin	4	446.08	14.8	0	0	0	0
West of Easton's Ferry Bridge							
Hubquarter	3	*292.73*	1.64	1.64	0	0	0
Lyons Creek	4	*293.96*	7.4	0	0	0	0
Poplar Creek	0	*89.63*	0.82	8.22	0	0	31.52
Hawtree	0	*38.03*	37	6.58	4.93	22.61	84.28
Smith Creek	0	*8.22*	0	0	0	3.70	0.62
Flats	*5*	*119.23*	0	0	0	0	*n/a*
Cottons Creek	0	217.9	115.11	42.48	0	5.76	13.16

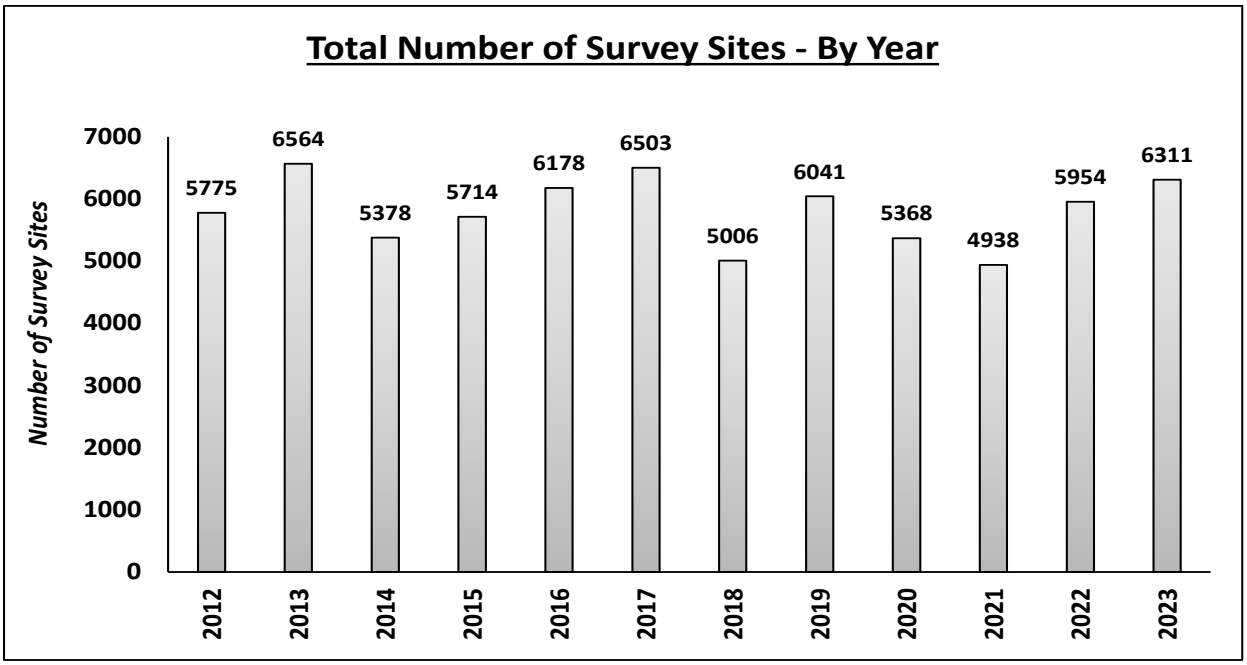

Figure 1. Bar graph representing total sites surveyed during yearly vegetation surveys conducted on Lake Gaston, NC/VA between 2012 and 2023.

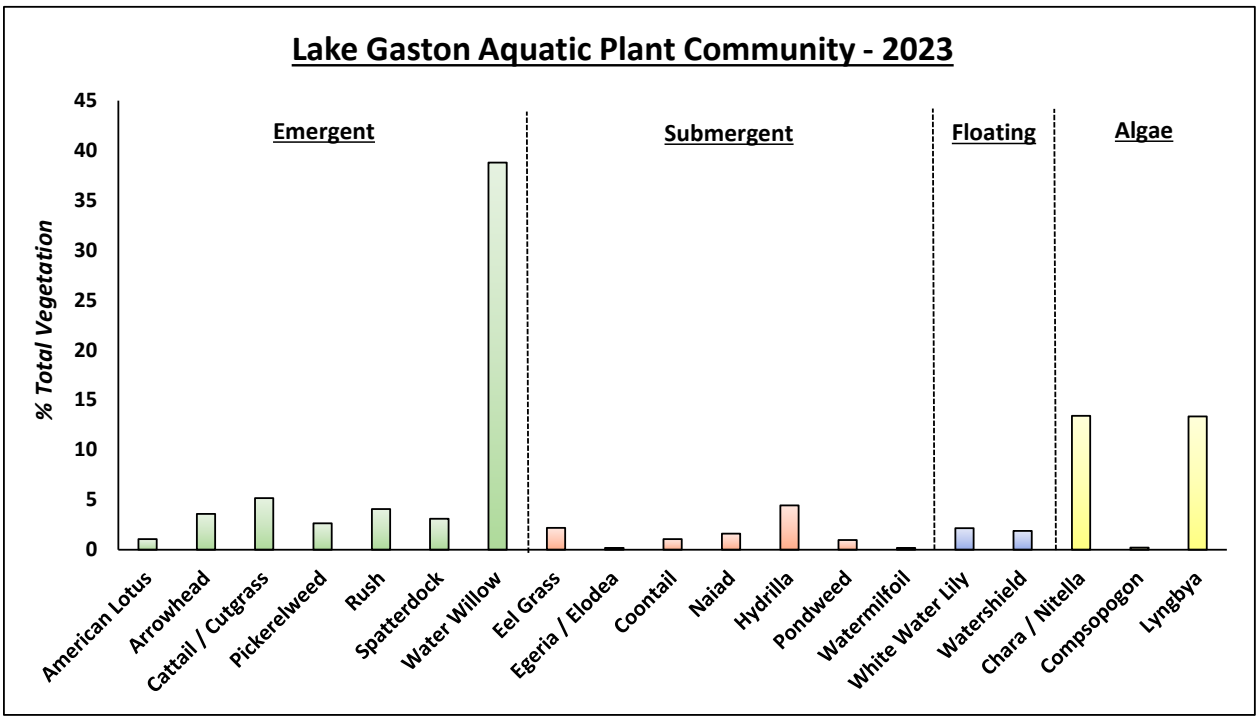

Figure 2. Bar graph representing the overall aquatic plant community of Lake Gaston, NC/VA in 2023. Overall, the community is represented by emergent (58%), submersed (11%), floating leaf (4%), and algae (27%) species.

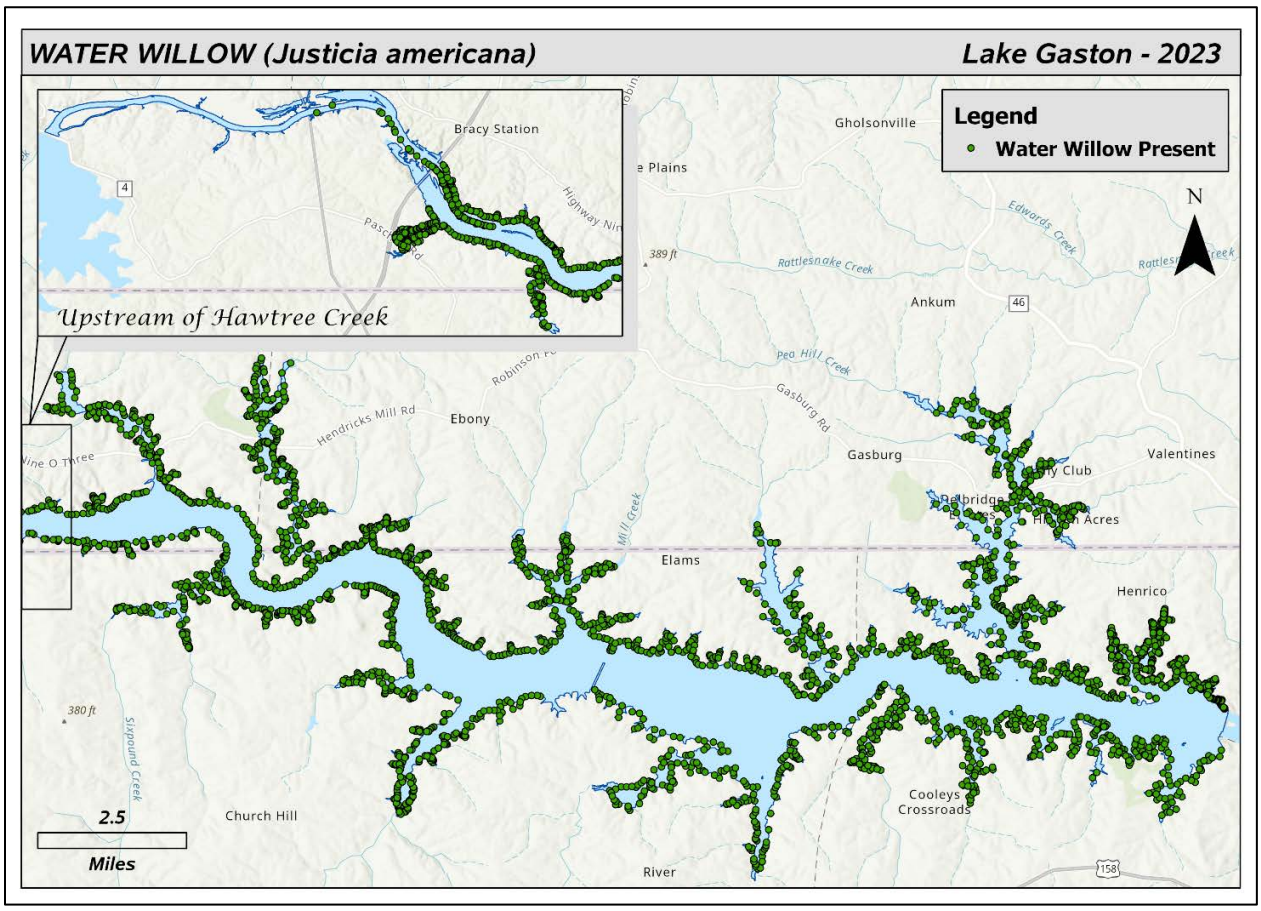

Figure 3. Map indicating sites where water willow was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2023. Water willow was the most prevalent species found in 2023.

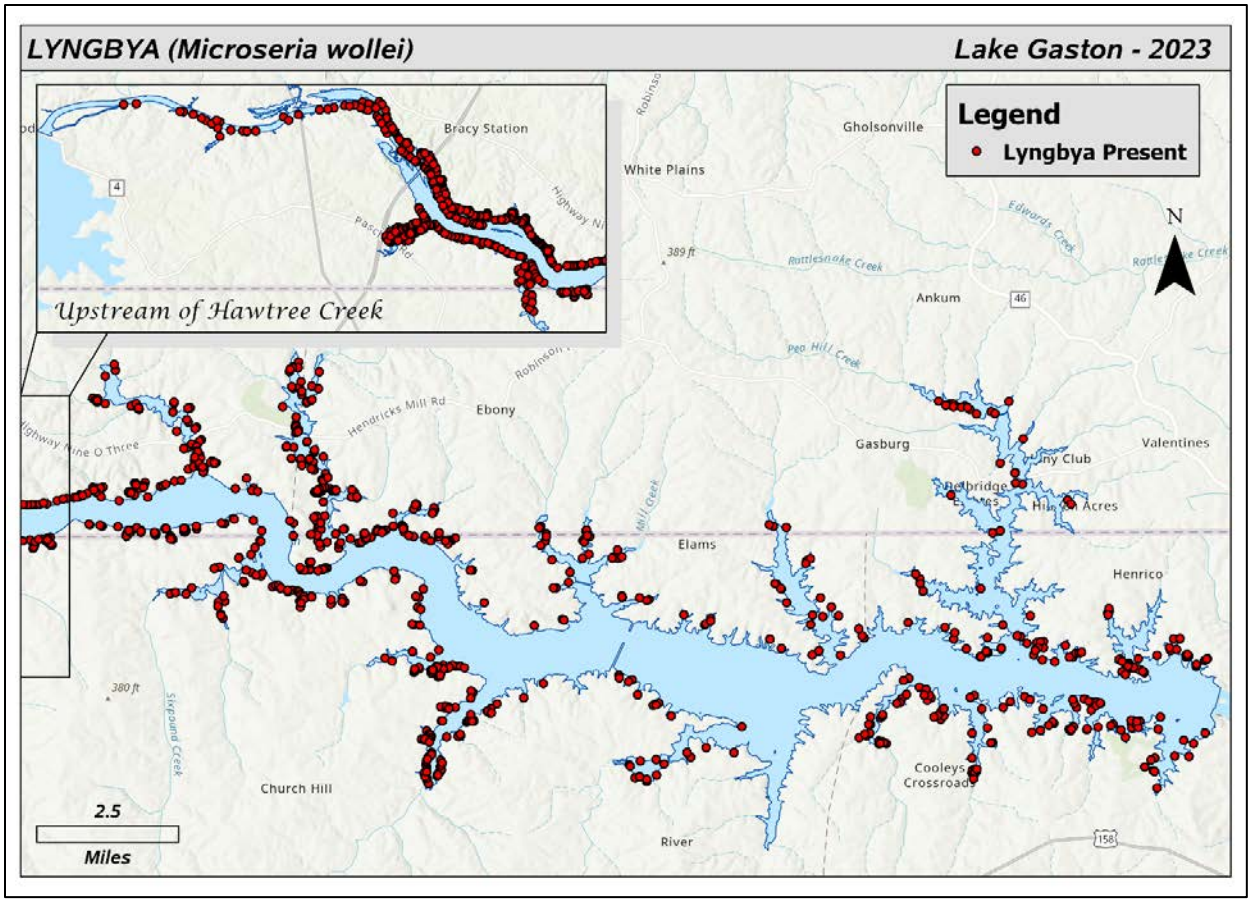

Figure 4. Map indicating sites where lyngbya was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2023. Lyngbya is a native species, but is considered to be at noxious levels within the system. Lyngbya was the second most prevalent species found in 2023.

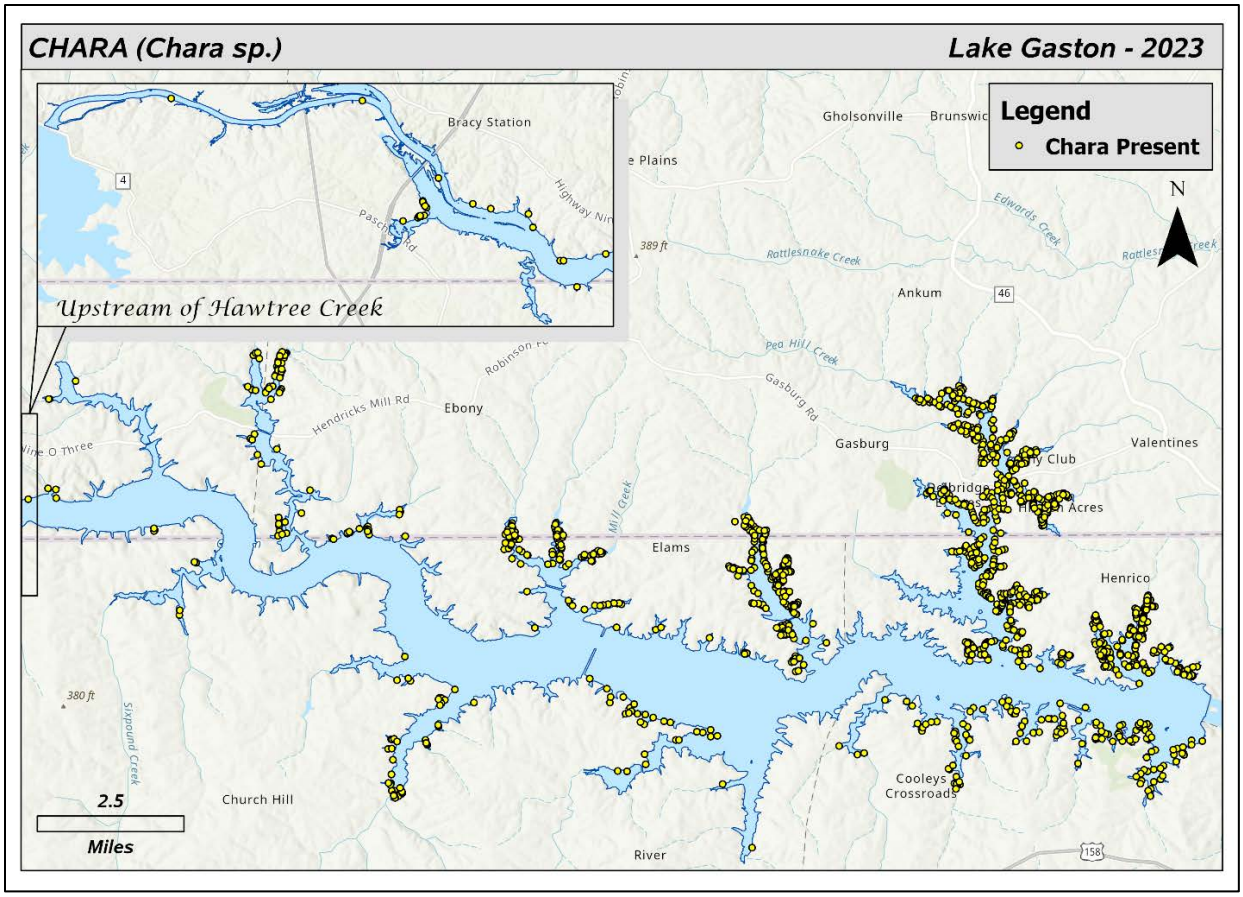

Figure 5. Map indicating sites where chara/nitella was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2023. Chara/nitella is a native species and was one of the third most prevalent species found in 2023.

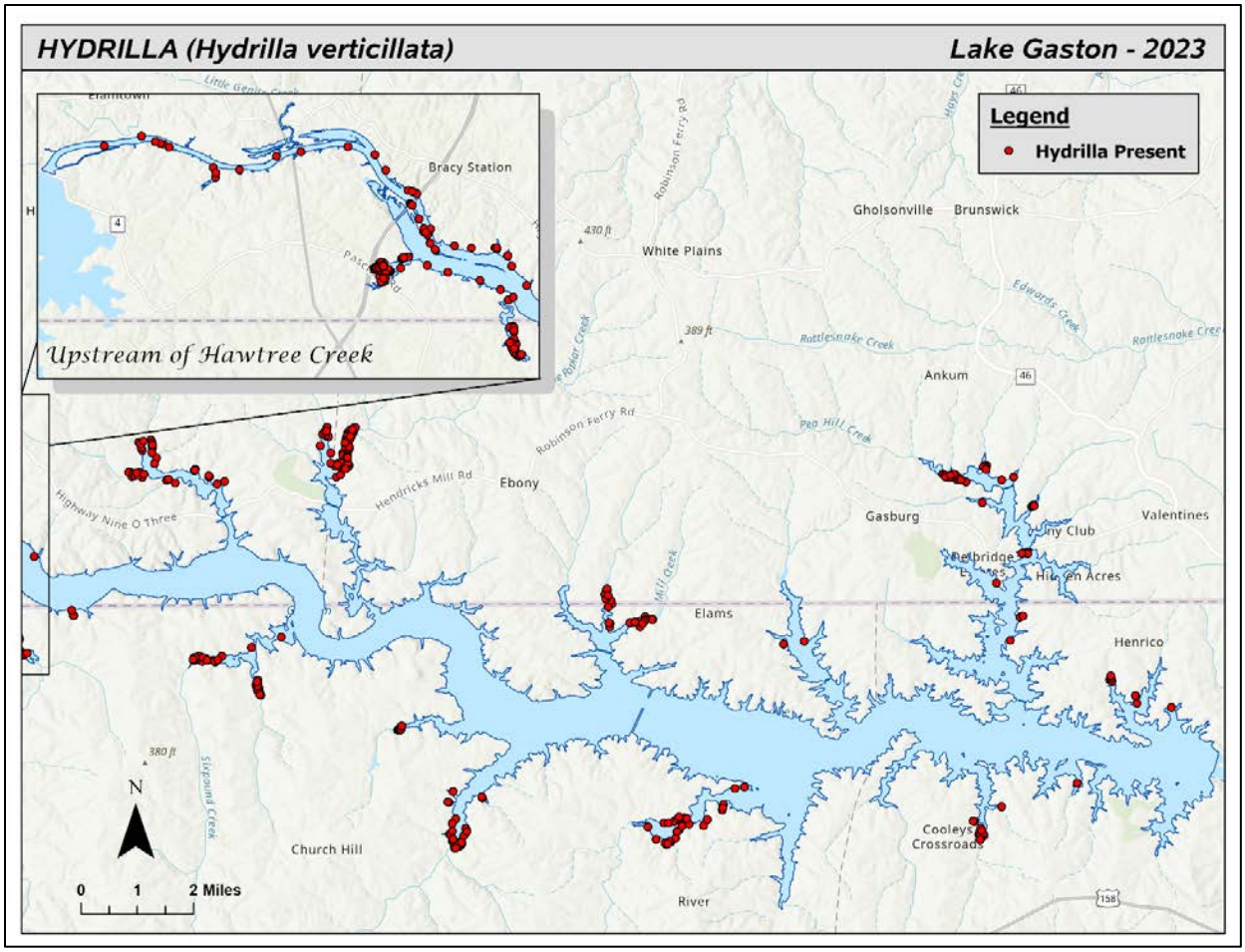

Figure 6. Map indicating sites where hydrilla was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2023. Hydrilla is a federally noxious weed species and was the most prevalent submersed species found in 2023.

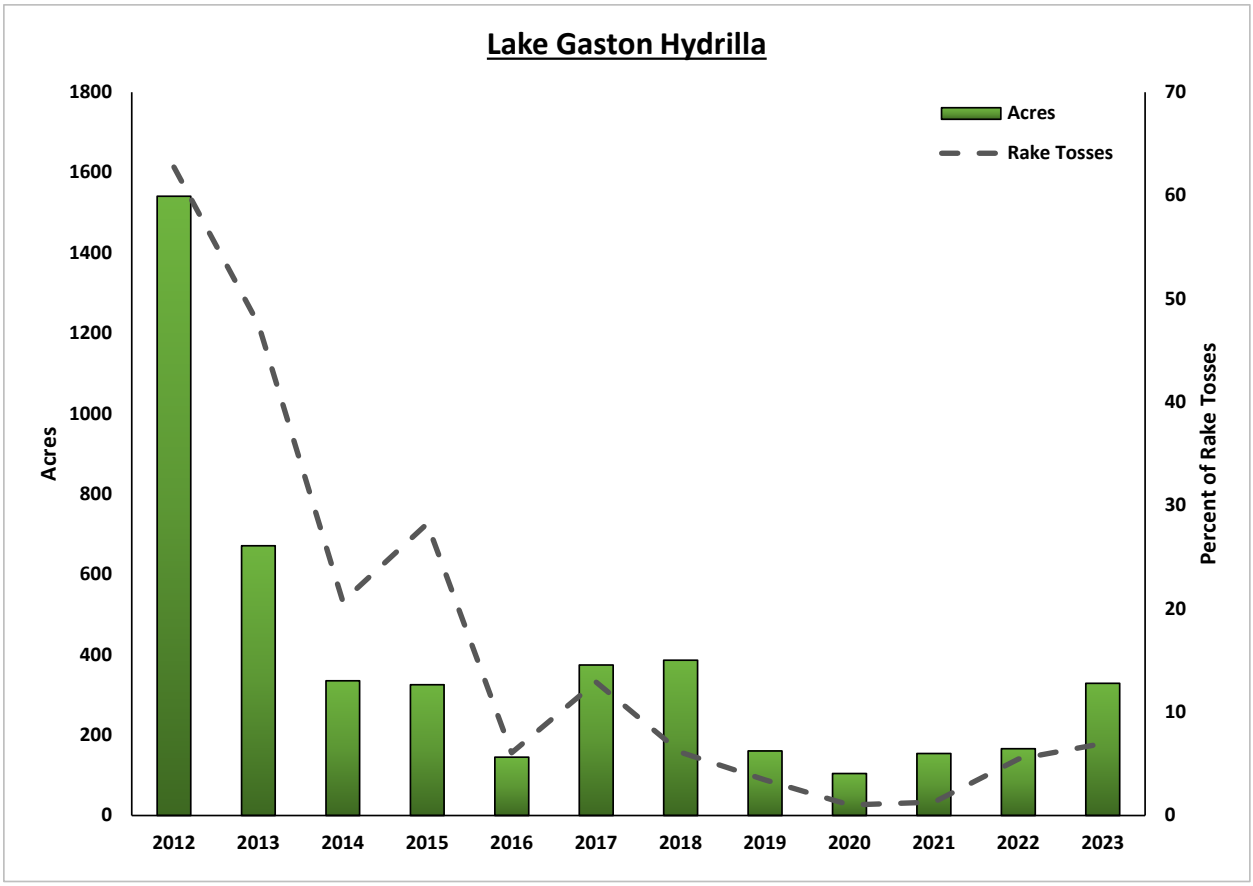

Figure 7. Estimated standing acreage (bars) and percent occurrence in the vegetation survey (line) of hydrilla in Lake Gaston, NC/VA between 2012 and 2023.

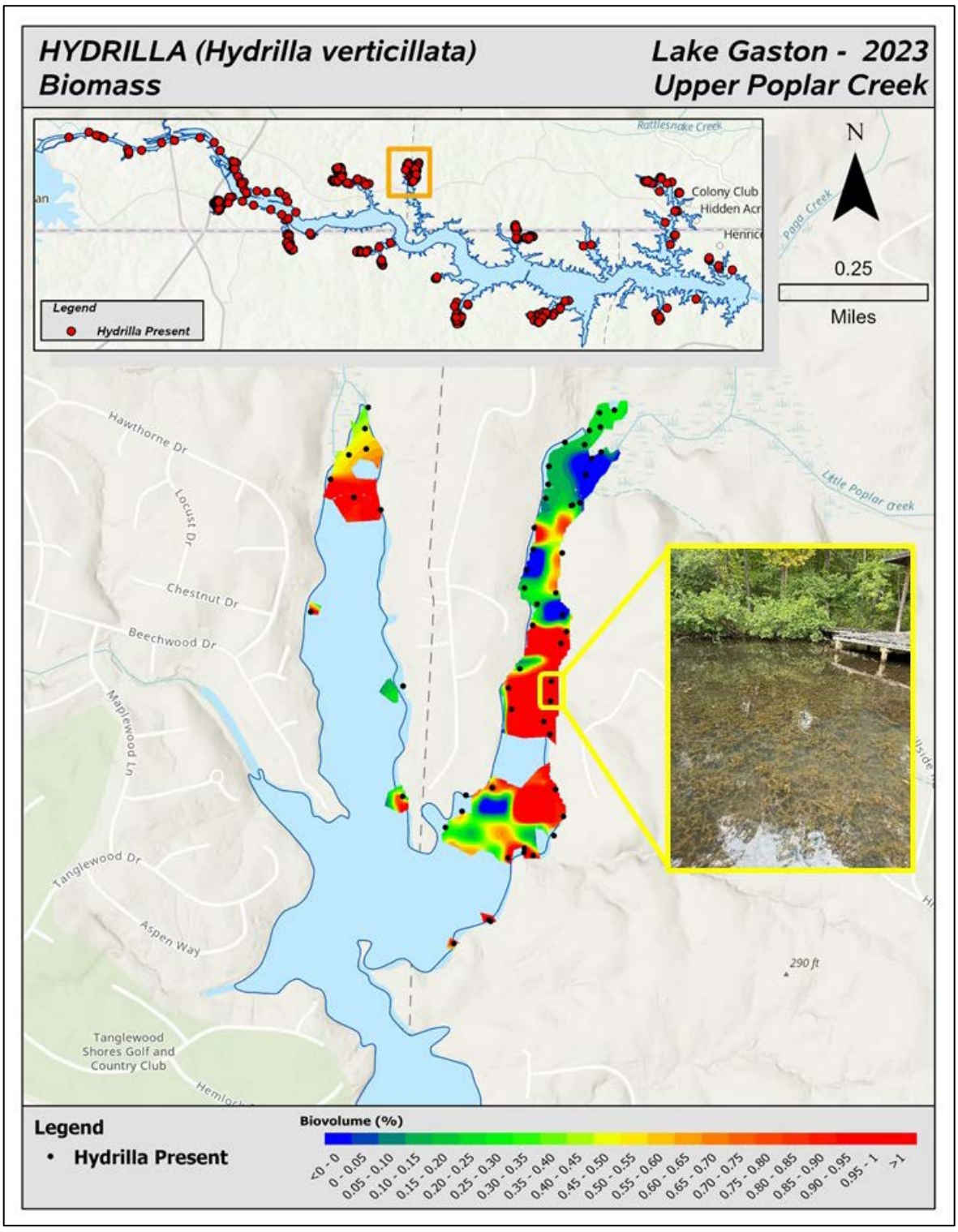

Figure 8. Map showing hydrilla distribution and biovolume densities in upper Poplar Creek during the 2023 survey. Interpolated biovolume estimates of submerged aquatic vegetation are displayed using cool (blue) colors to represent low biovolume and warm (red) colors to represent high biovolume. It should be noted that shallow depths can result in false-positive biovolume estimates.

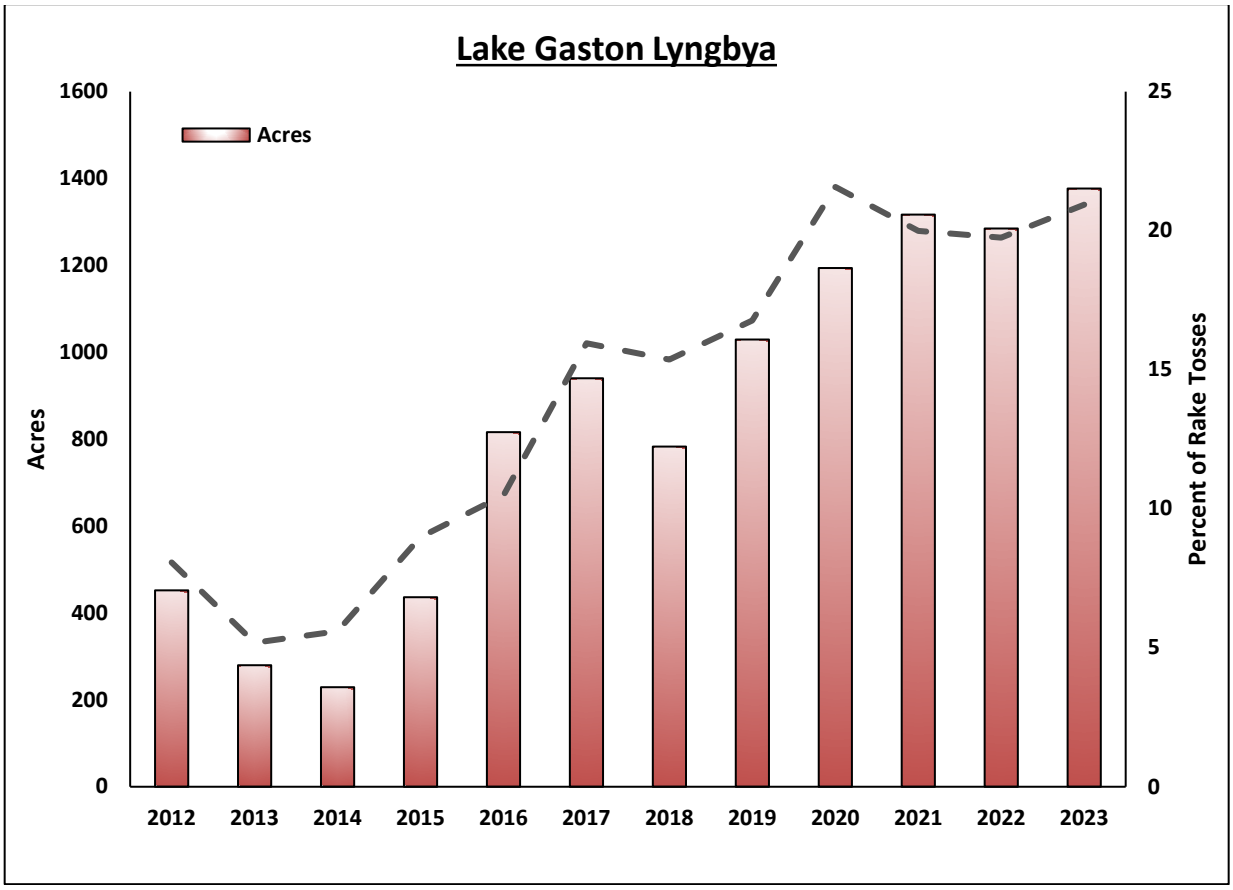

Figure 9. Estimated standing acreage (bars) and percent occurrence in the vegetation survey (line) of lyngbya in Lake Gaston, NC/VA between 2012 and 2023.

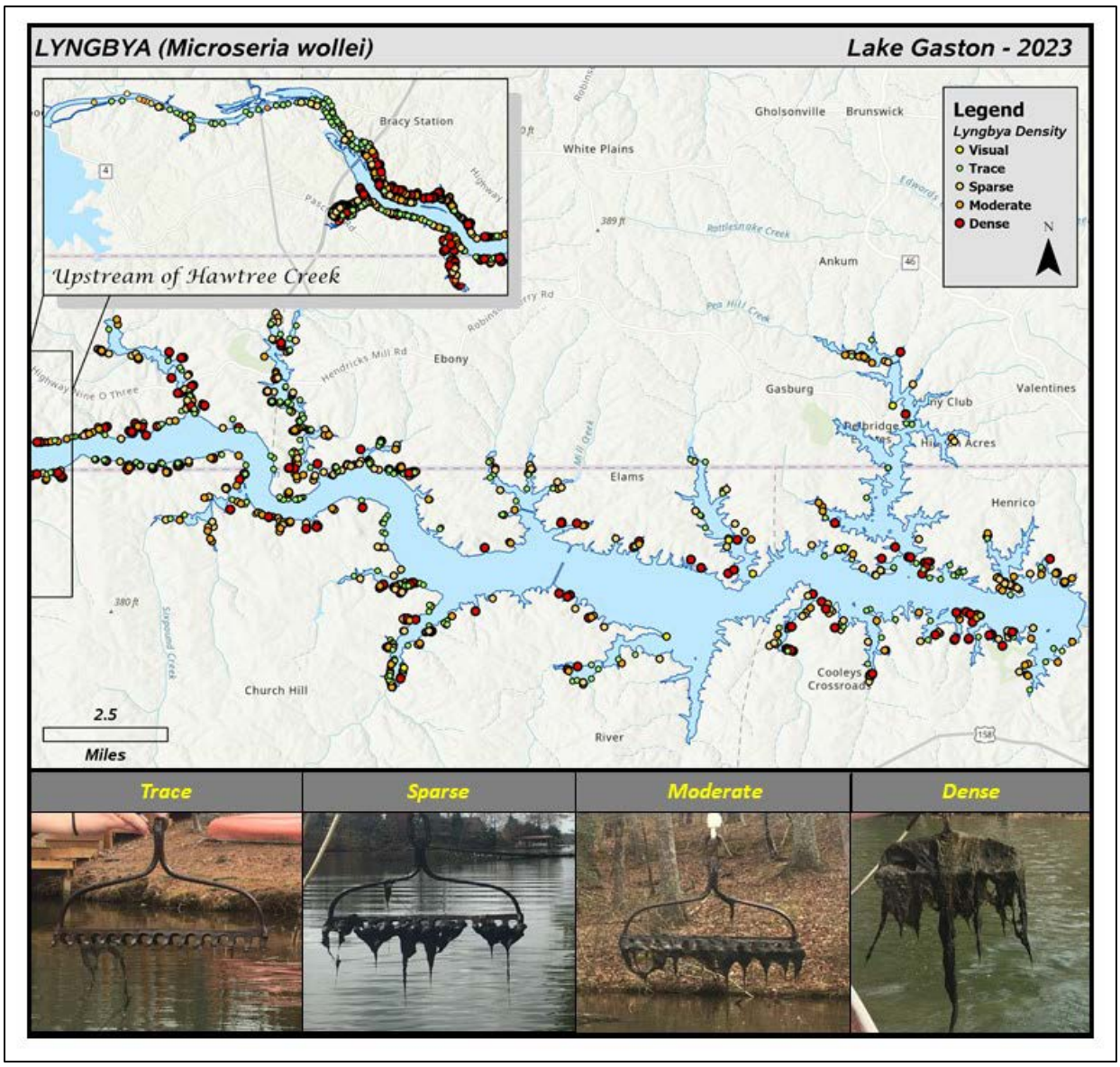

Figure 10. Map indicating the site rankings for locations that contained lyngbya during the shoreline vegetation survey of Lake Gaston, NC/VA 2023. Survey sites are incrementally ranked with 1 (green dots) representing trace detection and low mat growth density, 2/3 (orange dots) representing sparse to moderate growth density, and 4 (red dots) representing gear saturation due to high mat growth densities. Yellow dots indicate areas where surface mats were detected, however mat density was not sampled.

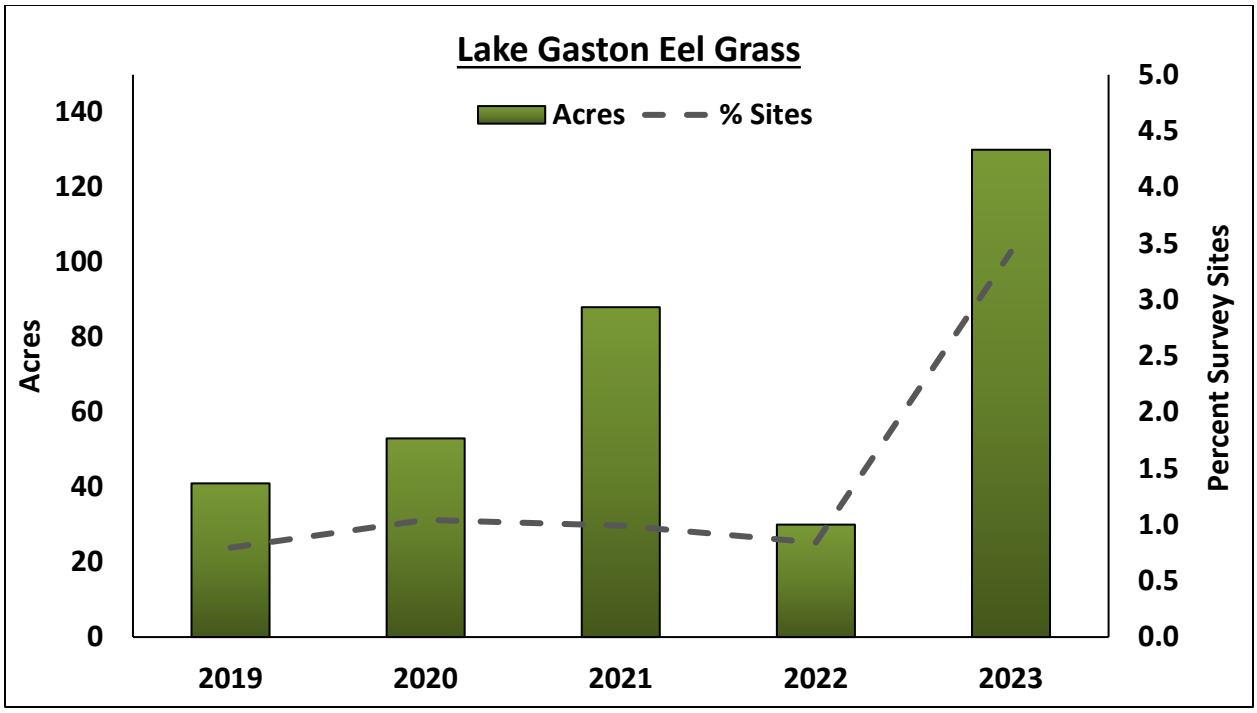

Figure 11. Estimated standing acreage (bars) and percent occurrence in the vegetation survey (line) of eel grass in Lake Gaston, NC/VA between 2019 and 2023.

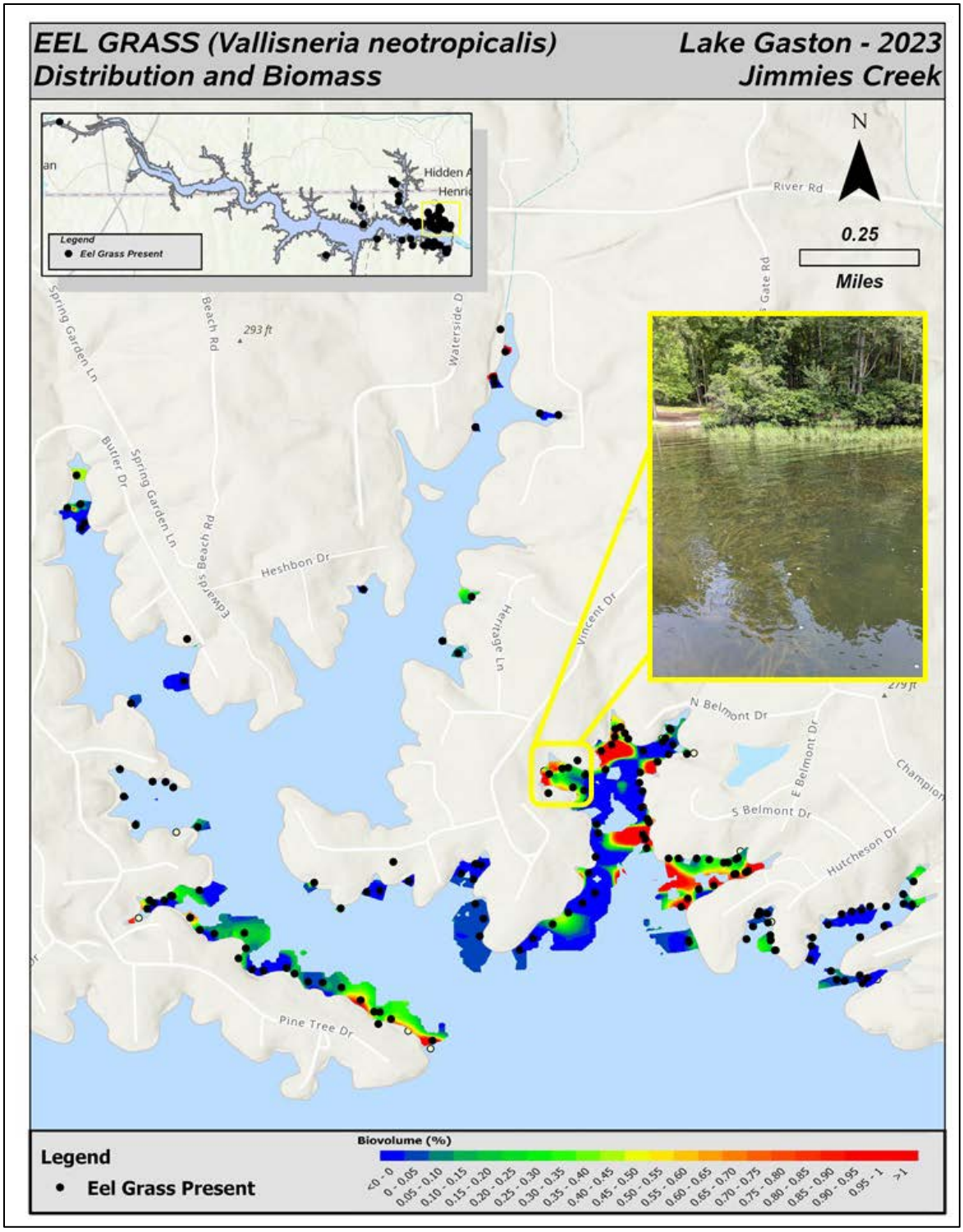

Figure 12. Map showing eel grass distribution and biovolume densities in the Jimmie's Creek area during the 2023 survey. Interpolated biovolume estimates of submerged aquatic vegetation are displayed using cool (blue) colors to represent low biovolume and warm (red) colors to represent high biovolume. It should be noted that shallow depths can result in false-positive biovolume estimates.