2021 Lake Gaston Vegetation Survey

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Lake Gaston's aquatic vegetation community is surveyed on a yearly basis to evaluate overall species diversity and distribution. A combination of point intercept and sonar surveys is used along the 350 miles of Lake Gaston's shoreline resulting in a robust understanding of the entire aquatic plant community. These surveys are completed through a collaborative effort between volunteers of the Lake Gaston Association (volunteers) and researchers from North Carolina State University's Aquatic Plant Management Group (NCSU). Funding for these surveys is provided by the Lake Gaston Weed Control Council.

There are two noxious species, hydrilla and lyngbya, that require continued monitoring for management purposes. Hydrilla, a federally listed invasive weed, has been successfully managed within the system for almost a decade. However, hydrilla deposits reproductive structures called tubers into the substrate that can lay dormant for up to 7 years before germination. Therefore, yearly monitoring of this species is critical for continued management success. Lake Gaston has also been infested with lyngbya, a native and nuisance cyanobacterium, since the 1990s. Lyngbya is a mat-forming, filamentous alga that grows in the benthic environment and proliferates upward through the water column resulting in negative impacts for an aquatic ecosystem. Current management plans target lyngbya, but this species continues to experience an explosion of growth throughout the lake and requires yearly monitoring.

Survey Methods

A point intercept survey was utilized to quantify the diversity and distribution of aquatic plants within Lake Gaston. This survey, conducted primarily by volunteer effort, recorded all aquatic plant species that were present at individual sites through a combination of visual surveys and rake toss sampling. At each site, 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. A total of 2 rake tosses were conducted at each survey site. The rake toss method utilizes 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. 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 sites were not pre-set and were chosen at random by the survey team in the field, however the targeted distance between sites was 200 feet. If lyngbya was detected at a site, that distance between survey points was reduced to 100 feet. The GPS location of surveyed sites as well as species presence were recorded on handheld tablets equipped with GIS Cloud™ software.

Sonar surveys were conducted by NCSU researchers and used to calculate the overall biovolume of submersed vegetation within the lake. By utilizing a dual sonar rig, in which a traditional boat-mounted transducer was coupled with a second transducer mounted on an extended boom arm, the survey was able to capture a large breadth of the littoral zone. The hydroacoustic data collected during this survey was post-processed using BioBase™ technology and then used in combination with point intercept data to calculate acreage of submersed species using Esri's™ ArcGIS Pro software.

Due to the life history traits of hydrilla, additional survey methods were required to evaluate the distribution of this species in Lake Gaston. The point and sonar surveys identify the current status of hydrilla within the lake, but a survey of the tuber bank within lake sediments was needed to evaluate future growth potential within the population. Tuber surveys were conducted by NCSU researchers at 18 creeks located throughout the lake. Within each creek there were 3 – 6 individual sampling sites, each of which was located in an area that historically contained standing acres of hydrilla. Individual sites are sampled on a bi-yearly basis unless tubers are detected, in which case they are then sampled on a yearly basis until the tuber bank drops below detectable levels. 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.

Point Intercept Survey Effort

The 2021 point intercept survey was conducted between September 1st and November 11th. During this timeframe, 36 teams comprised of 80 volunteers surveyed a total of 4,084 sites. These teams put in a total effort of 400 hours for the 2021 survey and accounted for 167 hours of the active surveying time. NCSU staff surveyed a total of 854 sites and accounted for 40 hours of active surveying time. In total, 4,938 sites were surveyed by both volunteers and NCSU in a time span of 207 hours. This level of sampling effort is comparable to previous survey years (Figure 1).

Aquatic Plant Community Results

Overall Vegetation

Overall, 74% of the sites surveyed contained some form of aquatic vegetation (Table 1). The aquatic plant community was made up of emergent species (70%), submergent species (5%), floating leaf plants (4%), and algal species (21%) (Figure 2). Due to the high stocking rate of Grass Carp into Lake Gaston as part of an integrated management protocol for hydrilla, the low percentage of submergent 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 percent of the

overall vegetation (48%) (Table 1; Figure 2) and has consistently been the most abundance species found within the lake since 2018. The second most abundant species found was lyngbya which represented 16% of the total vegetation reported, while chara/nitella, cattails/sawgrass, and rush each represented 5% of the total vegetation (Table 1; Figure 2). The most abundant species, water willow, lyngbya, and chara, were all well-distributed throughout the lake (Figures 3-5). Both water willow and chara/nitella are native and considered beneficial species, however lyngbya is considered noxious and can have negative impacts to the aquatic ecosystem.

Hydrilla

Hydrilla was located throughout Lake Gaston, however sites were small and patchy (Figure 6). 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 154 acres reported in 2021 (Figure 7). Percent occurrence of hydrilla within the point survey has followed this downward trend with 64% reported in 2012 and 1.4% in 2021 (Figure 7). Results from the tuber bank survey conducted in December 2021 also indicate a drastic decrease from baseline 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 2021. The western portion of the lake still contained a low density tuber bank, but overall has experienced a drastic decrease since 2012.

Lyngbya

In 2021, lyngbya represented 16% of the total aquatic plant community, was present at 20% of total sites surveyed, and was estimated to cover 1,317 acres of the lake (Table 1; Figure 8). Since 2020, Lyngbya has been the second most prevalent species found in Lake Gaston and has displayed a steady overall increase in total acreage since 2014. (Figure 8). Lyngbya forms thick filamentous mats along the bottom of the lake, therefore the annual survey also collected 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 by a 1, moderate mat density represented by a 2 or 3, and gear saturation due to high mat densities represented by a 4 (Figure 9). A rank of 0 was given to those 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 low densities represented a large proportion of the survey (44 %), however sites that contained benthic mats with moderate to high density levels represent the majority (33% and 20 % respectively). Lyngbya distribution has continued to spread throughout Lake Gaston resulting in few areas that were completely void of this noxious species.

Conclusion

For an artificial reservoir environment, the aquatic plant community at Lake Gaston is diverse. This community is represented by a host of emergent, submergent, and floating leaf species all of which provide beneficial ecosystem services to the lake. A high proportion of these species

are within the emergent group, which assist in shoreline stabilization and provide critical habitat for aquatic species. While diverse in species composition, density levels of submergent and floating leaf species are low within the lake due to the herbivory pressure that results from high stocking rates of Grass Carp for hydrilla management. While the aquatic plant community is represented by a plethora of beneficial species the noxious species, hydrilla and lyngbya, require continued monitoring for management purposes. Documenting changes in density and distribution for these two species is critical for management success.

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, noxious and harmful species.

Table 1. Aquatic plants were located at 74% of total sites surveyed during the shoreline vegetation survey at Lake Gaston, NC/VA in 2021. The total number of survey sites in which each species was identified is reported below. The diversity of the aquatic plant community was determined by calculating the percentage of total vegetation and the percentage of survey sites (total and those that only contained vegetation) that were represented by individual plant species.

LAKE GASTON AQUATIC PLANT COMMUNITY - 2021 *BY SURVEY SITES*				
	# of Sites Present	**% of Total Vegetation**	**% of Total Sites**	**% of Vegetated Sites**
AMERICAN LOTUS	62	1	1	2
ARROWHEAD	277	4	6	8
CATTAIL	334	5	7	9
CHARA/NITELLA	270	5	5	7
COMPSOPOGON	82	1	2	2
COONTAIL	26	0	1	1
EEL GRASS	123	2	2	3
EGERIA / ELODEA	4	0	0	0
HYDRILLA	68	1	1	2
LYNGBYA	987	16	20	27
NAIAD	31	0	1	1
PICKERELWEED	226	4	5	6
PONDWEED	28	0	1	1
RUSH	298	5	6	8
SPATTERDOCK	207	3	4	6
WATER WILLOW	2,996	48	61	82
WATERMILFOIL	11	0	0	0
WATERSHIELD	92	1	2	3
WHITE WATER LILY	128	2	3	4

Table 2. Hydrilla tuber bank densities (tuber / m^2) are 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 four surveys that were conducted (2018-2021). Control sites that have not received any form of herbicide treatment directed at hydrilla are indicated in italics.

LAKE GASTON HYDRILLA TUBER BANK ESTIMATES					
	2012	**2018**	**2019**	**2020**	**2021**
East of Eaton's Ferry Bridge					
Jimmies Creek	36.41	0	0	0	0
Timberline Shores	3.08	0.82	0	0	0
Cold Springs Branch	34.95	1.23	0.82	0	0
Lakeview	124.37	0	0	0	0
Lizards Creek	N/A	49.34	18.91	0	24.39
Big Stone House	31.25	0	0	0	0
Pretty Creek	38.72	0	0	0	0
Poe Creek	125.4	0	0.82	0	0
Woodland Hurst	135.67	4.93	0	0	0
Sledge Creek	8.22	0	0	0.82	0
Hamlin	*446.08*	*6.78*	*14.8*	*0*	*0*
West of Eaton's Ferry Bridge					
Hubquarter	292.73	6.78	1.64	1.64	0
Lyons Creek	293.96	29.33	7.4	0	0
Poplar Creek	89.63	0	0.82	8.22	0
Hawtree	38.03	59.41	37	6.58	4.93
Smith Creek	8.22	0	0	0	0
Flats	119.23	2.47	0	0	0
Cotton Creek	*217.9*	*67.15*	*115.11*	*42.48*	*0*

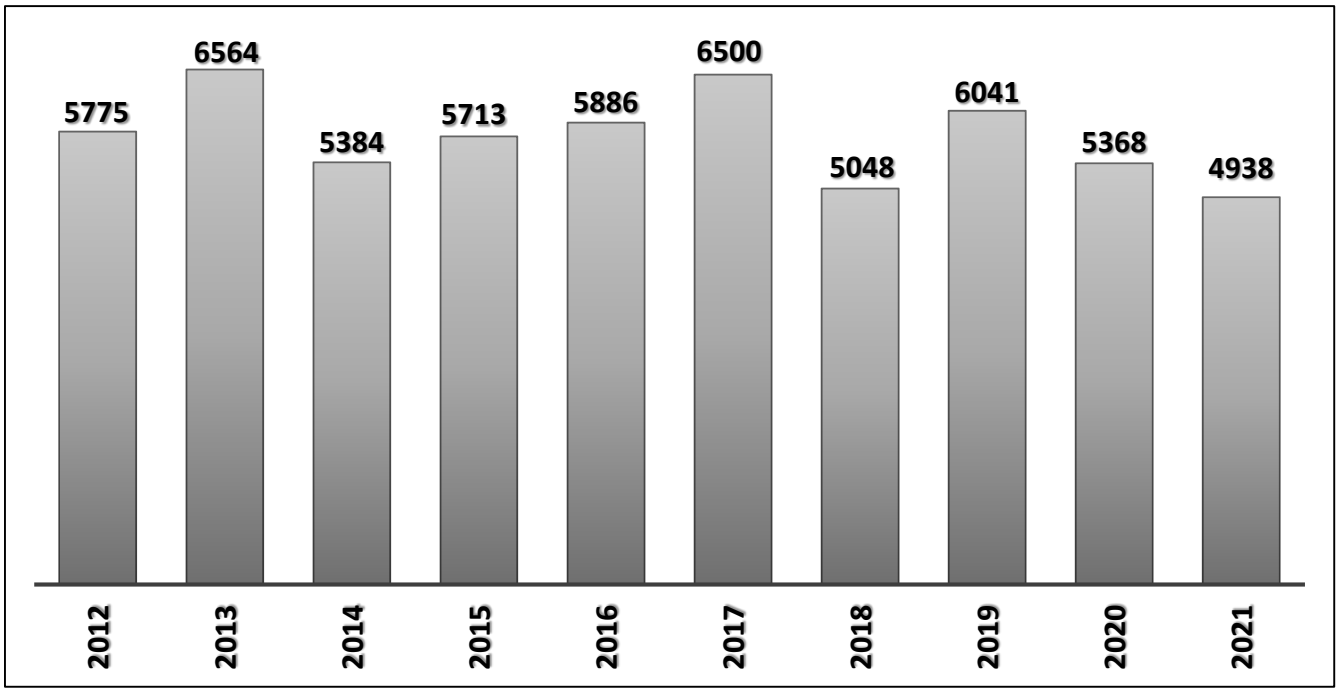

Figure 1. Bar graph representing total sites surveyed during yearly vegetation surveys conducted on Lake Gaston, NC/VA between 2012 and 2021.

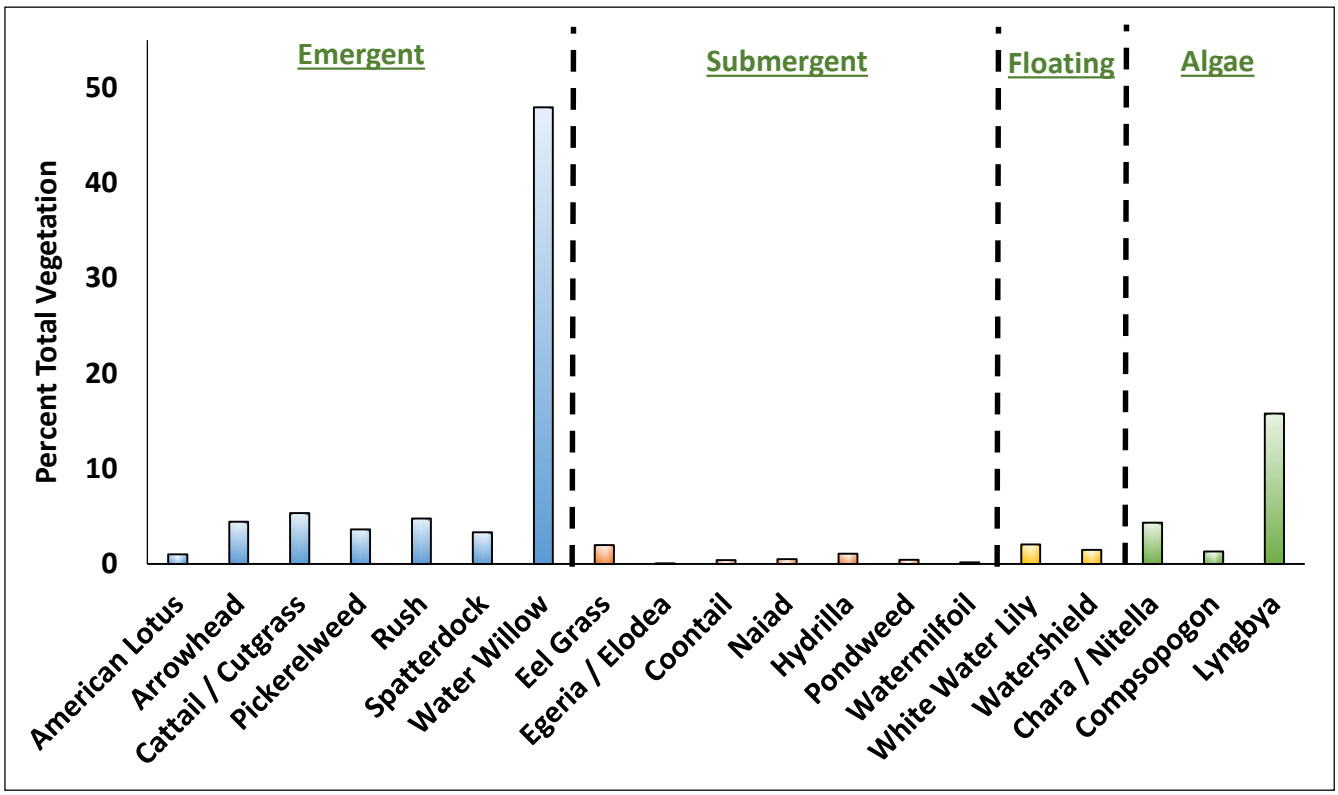

Figure 2. Bar graph representing the overall aquatic plant community of Lake Gaston, NC/VA in 2021. Overall, the community is represented by emergent (70%), submergent (5%), floating leaf (4%), and algae (21%) species.

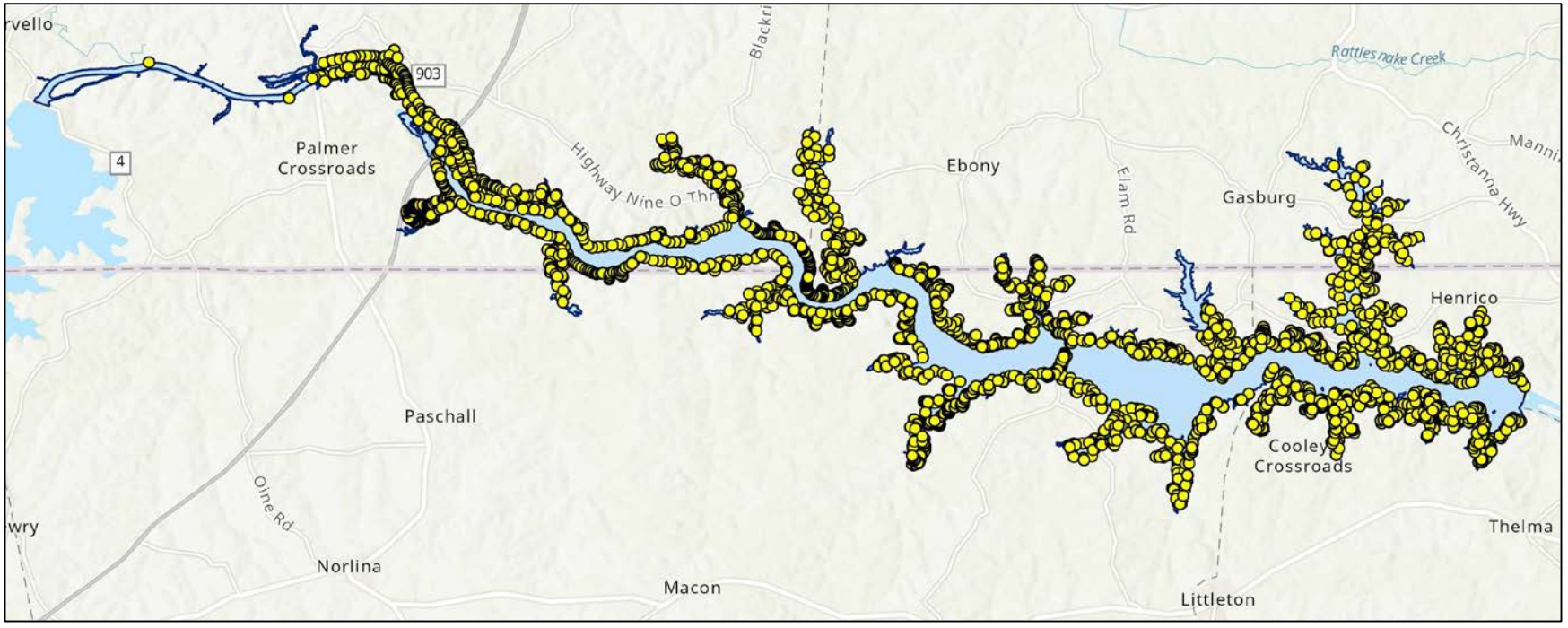

Figure 3. Map indicating sites where water willow was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2021. Water willow was the most prevalent species found in 2021.

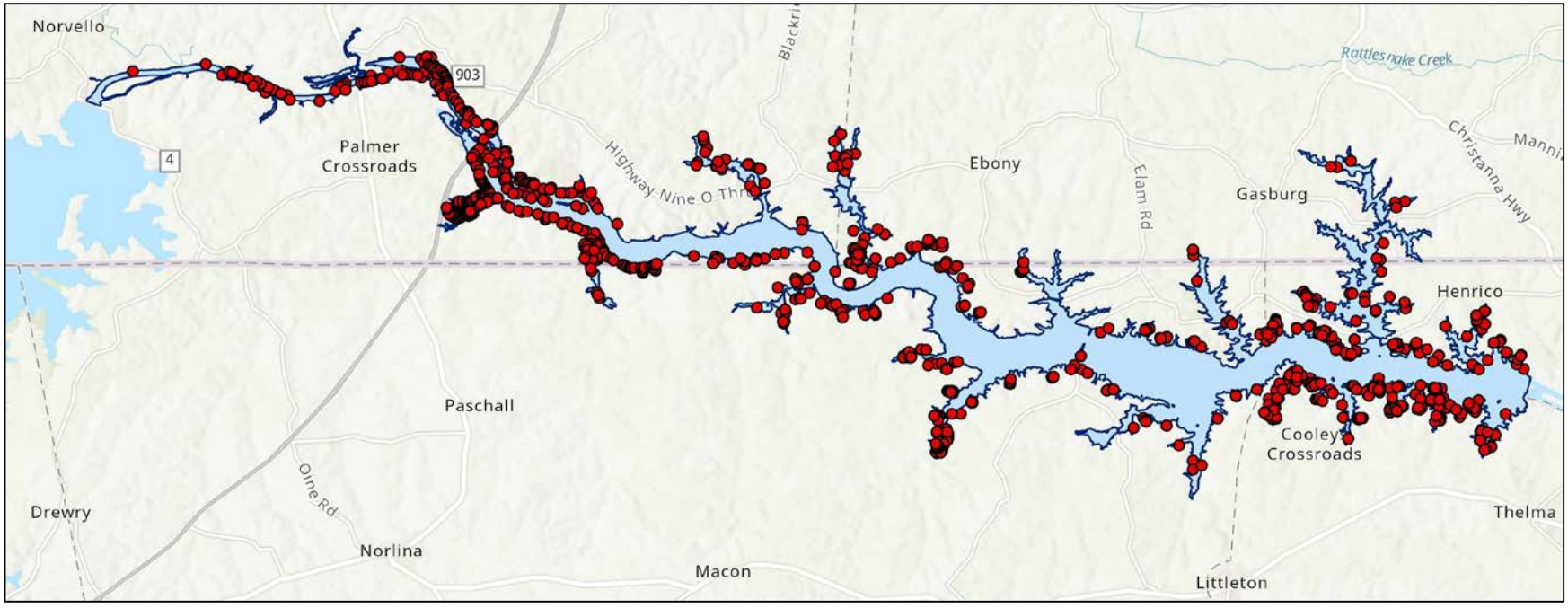

Figure 4. Map indicating sites where lyngbya was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2021. Lyngya is a native species, but is considered to be at noxious levels within the system. It was the second most prevalent species found in 2021.

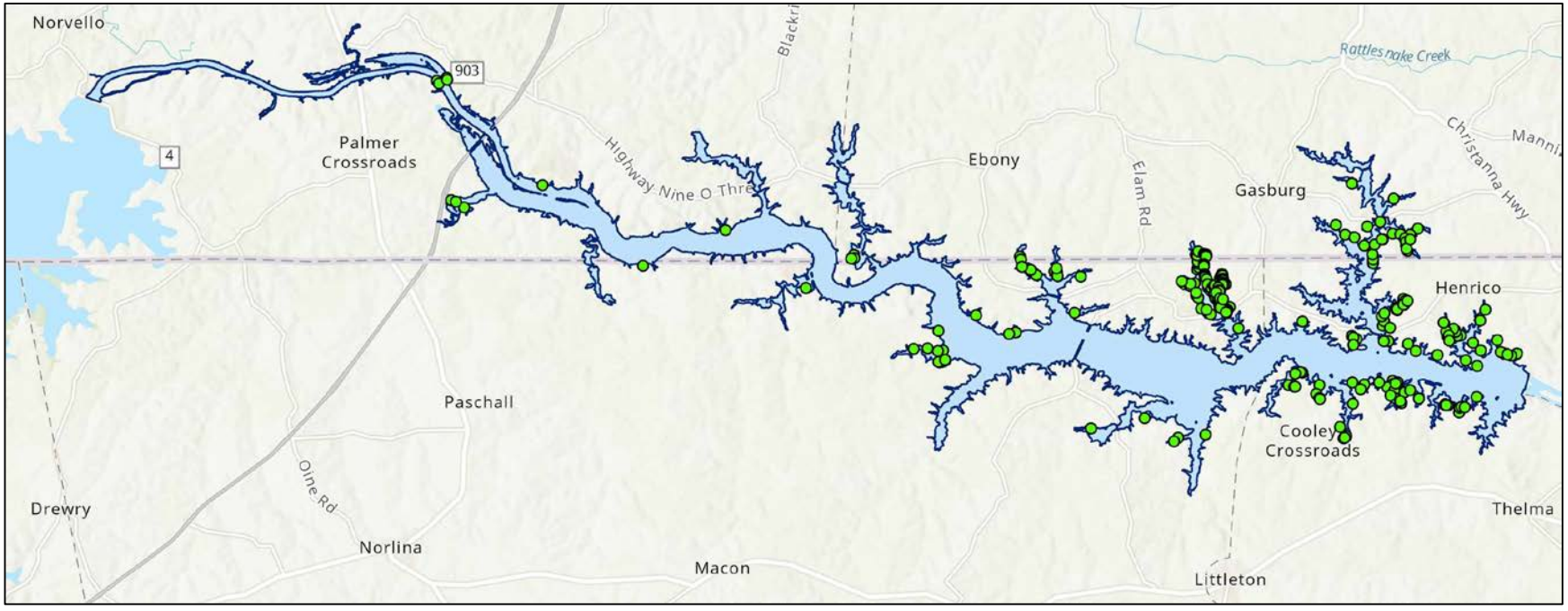

Figure 5. Map indicating sites where chara/nitella was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2021. Chara/nitella is a native species and was one of the third most prevalent species found in 2021.

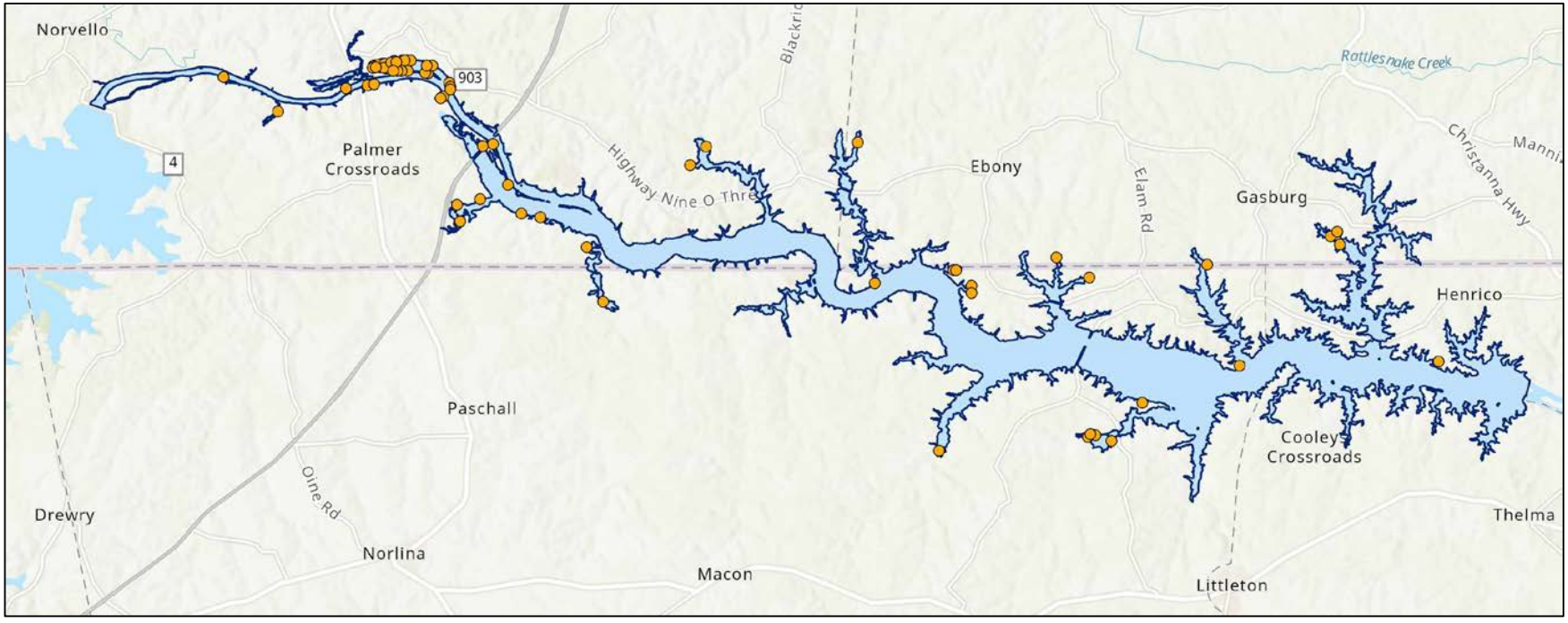

Figure 6. Map indicating sites where hydrilla was present during the shoreline vegetation survey of Lake Gaston, NC/VA in 2021. Hydrilla is a federally noxious weed and was found at 1.4% of the overall sites surveyed.

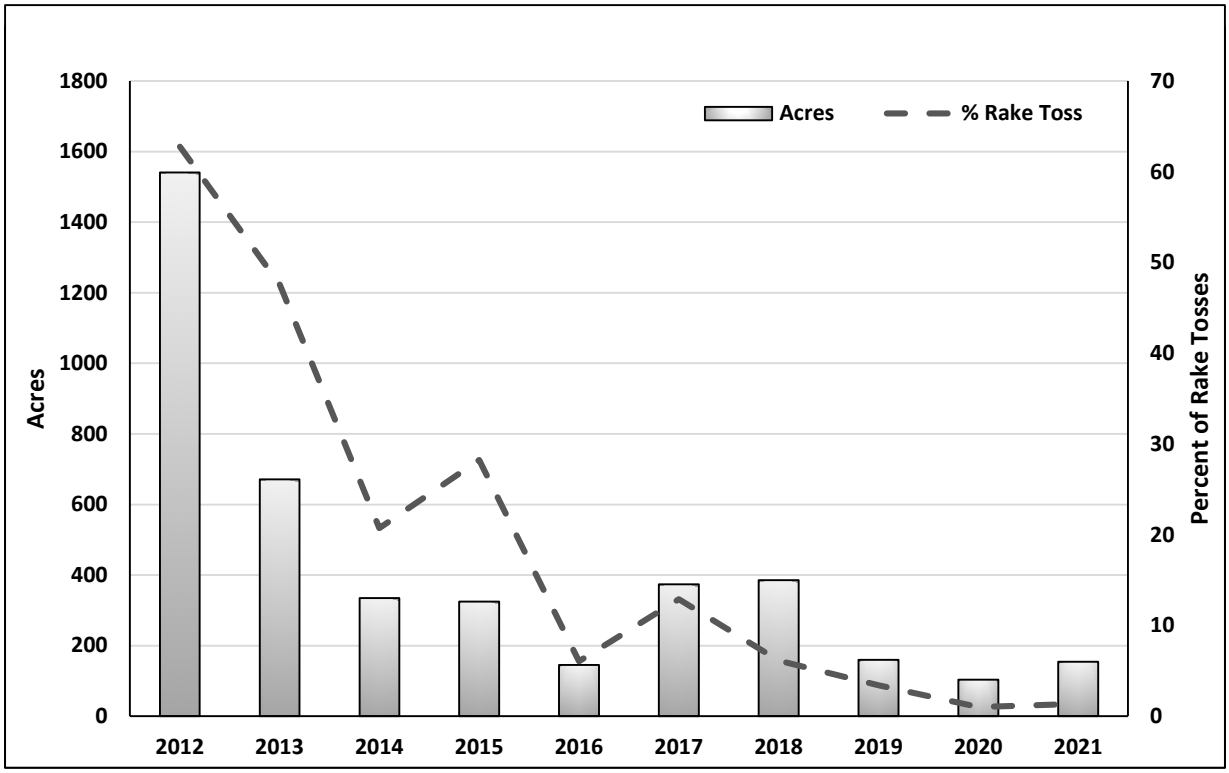

Figure 7. Estimated standing acreage (bars) and percent occurrence in the vegetation survey (line) of hydrilla in Lake Gaston, NC/VA between 2012 and 2021.

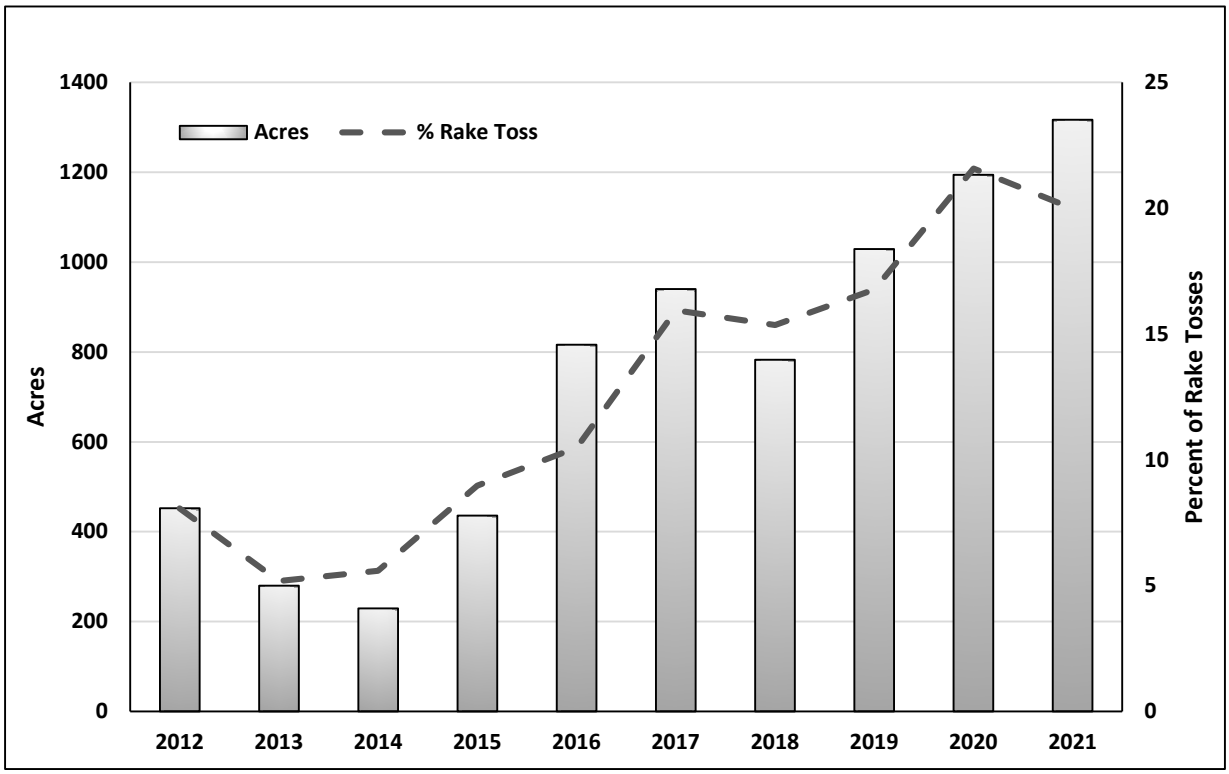

Figure 8. Estimated standing acreage (bars) and percent occurrence in the vegetation survey (line) of lyngbya in Lake Gaston, NC/VA between 2012 and 2021.

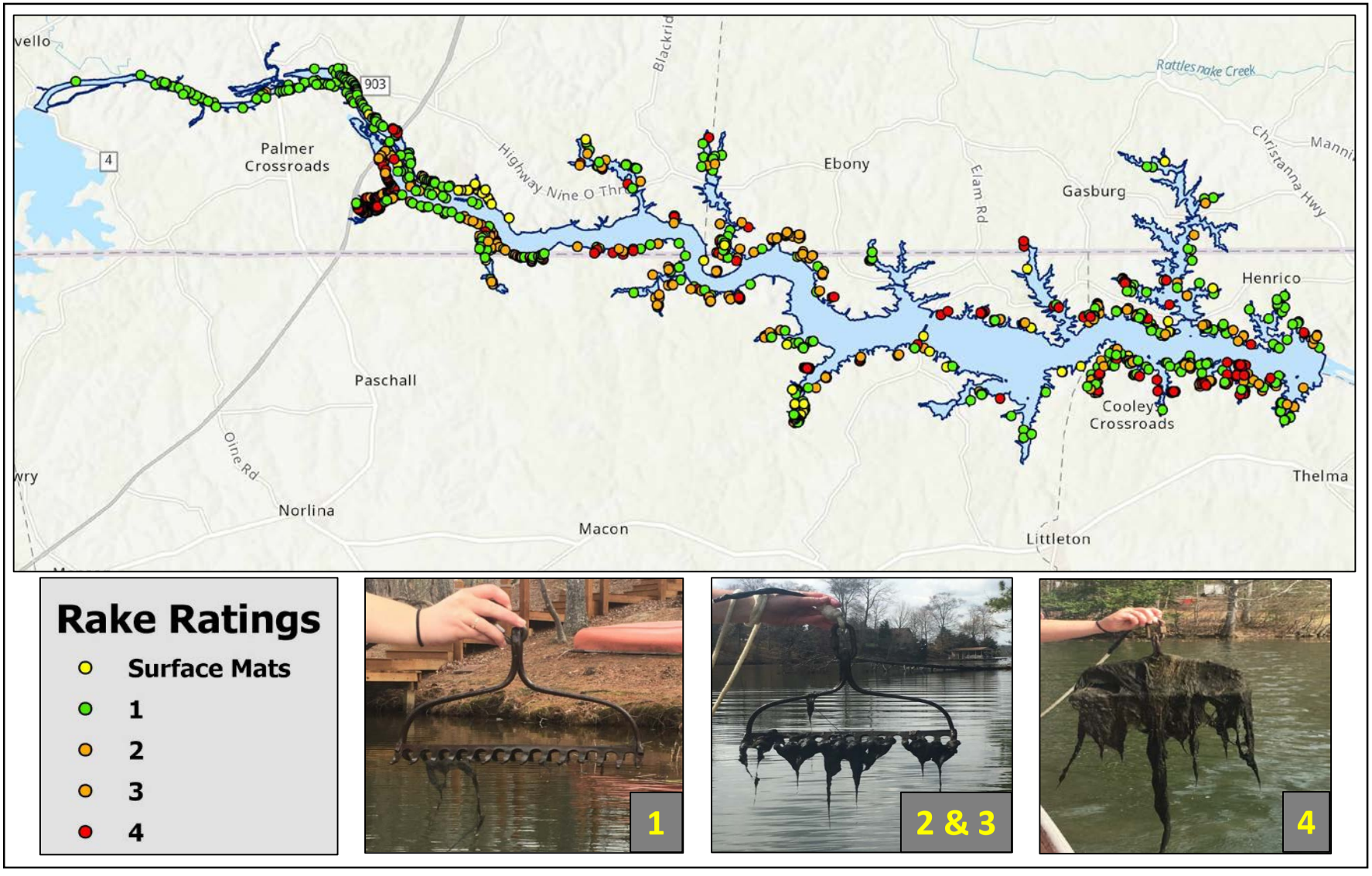

Figure 9. Map indicating the site rankings for locations that contained lyngbya during the shoreline vegetation survey of Lake Gaston, NC/VA 2021. Survey sites are incrementally ranked with 1 (green dots) representing trace detection and low mat density, 2/3 (orange dots) representing moderate detection and mat density, and 4 (red dots) representing gear saturation due to high mat densities. Yellow dots indicate areas where surface mats were detected, however mat density was not sampled.