Roanoke Rapids Lake Vegetation Survey Report

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Introduction

Roanoke Rapids Lake is a 4,600 acre (1,861 ha) reservoir located in both Northampton and Halifax Counties just south of the Virginia-North Carolina border in northeastern North Carolina. This waterbody is situated within the Roanoke River Watershed, which flows directly into the Albemarle Sound, and is the furthest downstream reservoir in a three in-series chain of reservoirs along the Roanoke River. John H. Kerr Reservoir and Lake Gaston are directly upstream of Roanoke Rapids Lake. In total, these three reservoirs cover approximately 75,000 acres and 1,250 miles of shoreline. The Roanoke Rapids Power Station dam began operation in 1955 and powers approximately 23,000 homes as Dominion Energy Corporation. In addition to power generation, Roanoke Rapids Lake provides recreational opportunities, residential development, and habitat for fish, wildlife, and other aquatic species.

The aquatic plant community within Roanoke Rapids Lake has been periodically surveyed by the North Carolina State University Aquatic Plant Management Group over the last two decades. Following an initial survey in 1999, monitoring efforts occurred in 2012, 2014, and 2015. To preserve consistency among data collection efforts, survey sites and methods have been maintained over time with slight modifications to account for increased technological capabilities. As such, in 1999, a total of 812 sites were sampled using the point intercept method. During the 2012, 2014, and 2015 surveys, the original surveyed point locations were reduced to 263, 123, and 370, respectively, and use of hydroacoustic technology was also introduced during this time frame (Howell 2017).

Submersed aquatic vegetation provides a wide variety of desirable ecosystem services, including improved water quality and increased aquatic habitat. However, the invasion of non-native weed species threatens the utility and ecological function of freshwater systems. Previous monitoring efforts have revealed Roanoke Rapids supports a diverse presence of aquatic vegetation, but is dominated primarily with hydrilla (*Hydrilla verticillata*), Brazilian elodea (*Egeria densa*), and Eurasian watermilfoil (*Myriophyllum spicatum*). In addition to these three non-native species, Roanoke Rapids sustains populations of several desirable native species such as slender naiad (*Najas flexilis*), coontail (*Ceratophyllum demersum*), cabomba (*Cabomba caroliniana*), and slender pondweed (*Potamogeton pusillus*). Promoting a diverse population of native aquatic vegetation is essential in order to maintain a healthy aquatic ecosystem. This report aims to update the database of aquatic plant community dynamics at Roanoake Rapids Lake following a 2023 survey of aquatic vegetation to provide relevance for managers and stakeholders.

Methods

The lakewide aquatic vegetation survey at Roanoke Rapids Lake occurred on September 1st and 12th, 2023 and followed boat-based point-intercept and echosounding (sonar) techniques. Pre-established survey points were uploaded to an on-board GPS with ~5 ft horizontal accuracy. Survey points for 2023 were a subset of the georeferenced sites that had been monitored in previous efforts at Roanoke Rapids Lake. Point locations included shoreline edges, mid-lake littoral zone areas, and perpendicular transects from the shoreline where water depth varied to assess changes in plant community over a bathymetry gradient. In total, 314 points were accessible during the 2023 survey of Roanoke Rapids, with a section of the lake being inaccessible due to topped out plant biomass (Figures 1 - 2).

Among each point location, a double-sided sampling rake was deployed to collect submersed plant material. Vegetation collected per rake were provided a species-specific relative density estimate from 0 to 4 based on rake coverage (**0**: not present, **1**: <25% or trace coverage, **2**: 50% or sparse coverage, **3**: 75% or moderate coverage, **4**: 100% or very dense). When applicable, floating and emergent shoreline species were also documented at each point.

The survey boats were configured with Lowrance HDS-7 Gen3 consumer-grade fish finding echosounder and chartplotter units to record sonar data during point-intercept survey. The echosounding transducer emits a 200kHz acoustic signal through the water column which is returned back to the receiver. Sonar data was saved by the echosounder to 32 GB memory cards for further processing. Sonar logs were recorded for approx. 2 hrs. Raw .Sl2 sonar data files were uploaded to BioBase C-Map cloud-based processing service to extract bathymetry estimates and biovolume of submersed aquatic vegetation (SAV) (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. Due to the shallow environment on the northwest portion of the lake, sonar data were only collected among depths >3 feet and regions void of submersed hazards.

Results and Discussion

Overall Vegetation

A total of 314 points were surveyed at Roanoke Rapids in fall 2023 (Figure 3). Of those points, aquatic vegetation was recorded at 223 (71%) sites in varying abundances (Table 1).

Eight submersed species were documented during the 2023 survey of Roanoke Rapids (Table 1). These included hydrilla, coontail, Brazilian elodea, Eurasian watermilfoil, slender naiad, brittle naiad (*Najas minor*), cabomba, and slender pondweed (Table 1; Figures 4 - 12). The most abundant shoreline species recorded during the fall 2023 survey at Roanoke Rapids was

water willow (*Justicia americana*), which was observed at 45 (14%) of all sites visited.

Submersed vegetation biovolume averaged 21% within Roanoke Rapids during the 2023 survey (Figure 13). Due to navigational restrictions of topped out plant biomass and low water levels throughout the reservoir during the time of the survey, this biovolume evaluation is likely underestimated. Although biovolume in some areas of the reservoir was physically observed *in situ*, post-processing interpolation tools did allow for these inaccessible areas to be estimated within the waterbody.

Hydrilla

Hydrilla is a non-native, invasive submersed aquatic plant. Hydrilla is ranked as the highest priority species (#1) of concern according to the North Carolina Aquatic Nuisance Species Management Plan. During the fall 2023 survey, the plant was recorded at 160 (51%) of all sites surveyed, making hydrilla the most abundant submersed species at Roanoke Rapids (Table 1; Figure 4). It is hypothesized that the abundance of hydrilla currently present at Roanoke Rapids Lake is higher than the percentage recorded during the fall 2023 survey due to aforementioned accessibility issues. Hydrilla has historically been the dominant species within the waterbody and continues to occupy most of the littoral ranges within the reservoir (Figure 14). Due to the long-term presence of hydrilla within the lake, management activities could be increasingly challenging due to the established propagule (subterranean turions) bank that has likely accumulated in lake sediments over time.

Brazilian Elodea

Brazilian elodea was documented at 33% of surveyed points at Roanoke Rapids in 2023 (Table 1; Figure 5). This species was found throughout the reservoir, but tended to be most dense in the western portion along the Roanoke River channel. Brazilian elodea is ranked as the #25 species on the North Carolina Aquatic Nuisance Species Management Plan and is categorized as “medium” priority. Brazilian elodea was noted as sparse at present; however, the 2000 survey of Roanoke Rapids found the plant had been abundant prior to that survey effort (Kay et al. 2000). This evidence suggests that Brazilian elodea has been present in the reservoir for at least 25 years.

Eurasian Watermilfoil

Eurasian watermilfoil has been consistently documented in Roanoke Rapids since 1999 (Figure 14). In 2023, Eurasian watermilfoil presence was concentrated on the western side of the reservoir, with most dense locations recorded in the upper river channel and the southwestern shoreline (Figure 7). Like hydrilla, Eurasian watermilfoil is listed as a noxious aquatic weed in North Carolina and is regulated by the North Carolina Department of Agriculture and Consumer Services.

Coontail

Coontail is a native, rootlessaquatic plant species that can be found free-floating in the water column. In 2023, coontail was present at 28% of survey sites in Roanoke Rapids Lake, making it the third most abundant species documented during the survey, and was primarily concentrated in the central and eastern portions of the waterbody (Table 1; Figure 6). Under ideal conditions, coontail can accumulate to nuisance levels due to rapid growth rates and uncontrolled means of distribution throughout a system. During the 2023 survey, coontail biomass limited boating access due to the development of dense floating mats along the lake's shoreline that extended into deeper sections of the reservoir.

Conclusions and Management Implications

- The overall plant community within Roanoke Rapids has remained relatively stable over time, however the distribution of these aquatic plant species within the system has varied between surveys.
- Native aquatic plant species are present in the lake and were documented in a range of abundance, including coontail (high abundance; 28% occurrence) and slender pondweed (low abundance; 5% occurrence).
- Hydrilla remains the most prevalent aquatic plant species in Roanoke Rapids Reservoir. Since 1999, hydrilla has been present at 50% or more of the surveyed sites within the waterbody.
- Other non-native weed species continue to persist in Roanoke Rapids Lake including Eurasian watermilfoil, brittle naiad, and Brazilian elodea.
- The overall abundance and distribution of invasive SAV within the lake may pose ecological and anthropogenic threats, including habitat sustainability and public access to the reservoir. As seen on other systems, dense SAV growth can also negatively impact the operations of hydroelectric power generation by increasing the probability of intake pipes becoming clogged, leading to increased costs of maintenance and loss of efficiency.

References

Dominion Energy: Roanoke Rapids Power Station, 2023. Accessed from: https://www.dominionenergy.com/projects-and-facilities/hydroelectric-power-facilities-and-projects/roanoke-rapids-power-station

Howell, AH. 2017. Detecting, Mapping, and Quantifying Macrophytes Using Novel Boat-based Remote Sensing Technologies. Master's Thesis 141-164.

Kay S, Hoyle S, DeMont D, Kurilla P, Haley T, Dillistin B. 2000. Roanoke Rapids Lake weed survey, spring 2000. Report to the Roanoke Rapids Lake Management Association.

Tables and Figures

Table 1: Overview of the 2023 aquatic vegetation survey results at Roanoke Rapids.

Roanoke Rapids

2023 Vegetation Survey Results

Survey Overview		#	%
Total Surveyed Points		314	
Total Vegetated Points		223	71%
Submersed Species			
Hydrilla	*Hydrilla verticillata*	160	51%
Coontail	*Ceratophyllum demersum*	89	28%
Brazilian Elodea	*Egeria densa*	105	33%
Eurasian Watermilfoil	*Myriophyllum spicatum*	49	16%
Slender Naiad	*Najas flexilis*	77	25%
Brittle Naiad	*Najas minor*	43	14%
Cabomba	*Cabomba caroliniana*	33	11%
Slender Pondweed	*Potamogeton pusillus*	15	5%
Emergent Species			
Water Willow	*Justicia americana*	45	14%
Bulrush	*Scirpus sp.*	10	3%
Arum	*Arum sp.*	2	1%

Figure 1: Example of submersed vegetation abundance and density during the 2023 survey at Roanoke Rapids (left: hydrilla; right: coontail).

Figure 2: Example of topped out biomass preventing boating access during the 2023 survey at Roanoke Rapids.

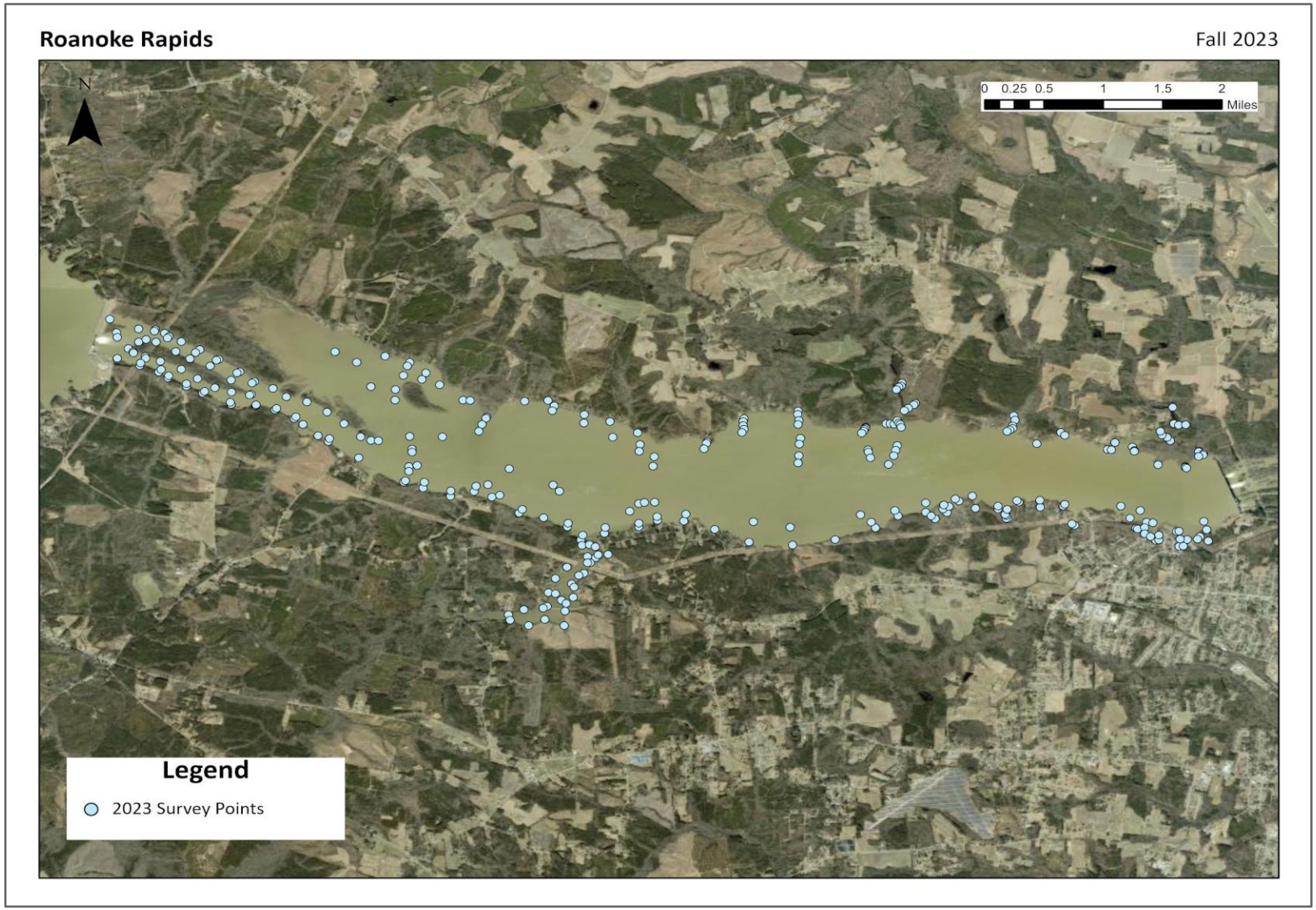

Figure 3: Point-intercept locations visited during the fall 2023 survey of Roanoke Rapids.

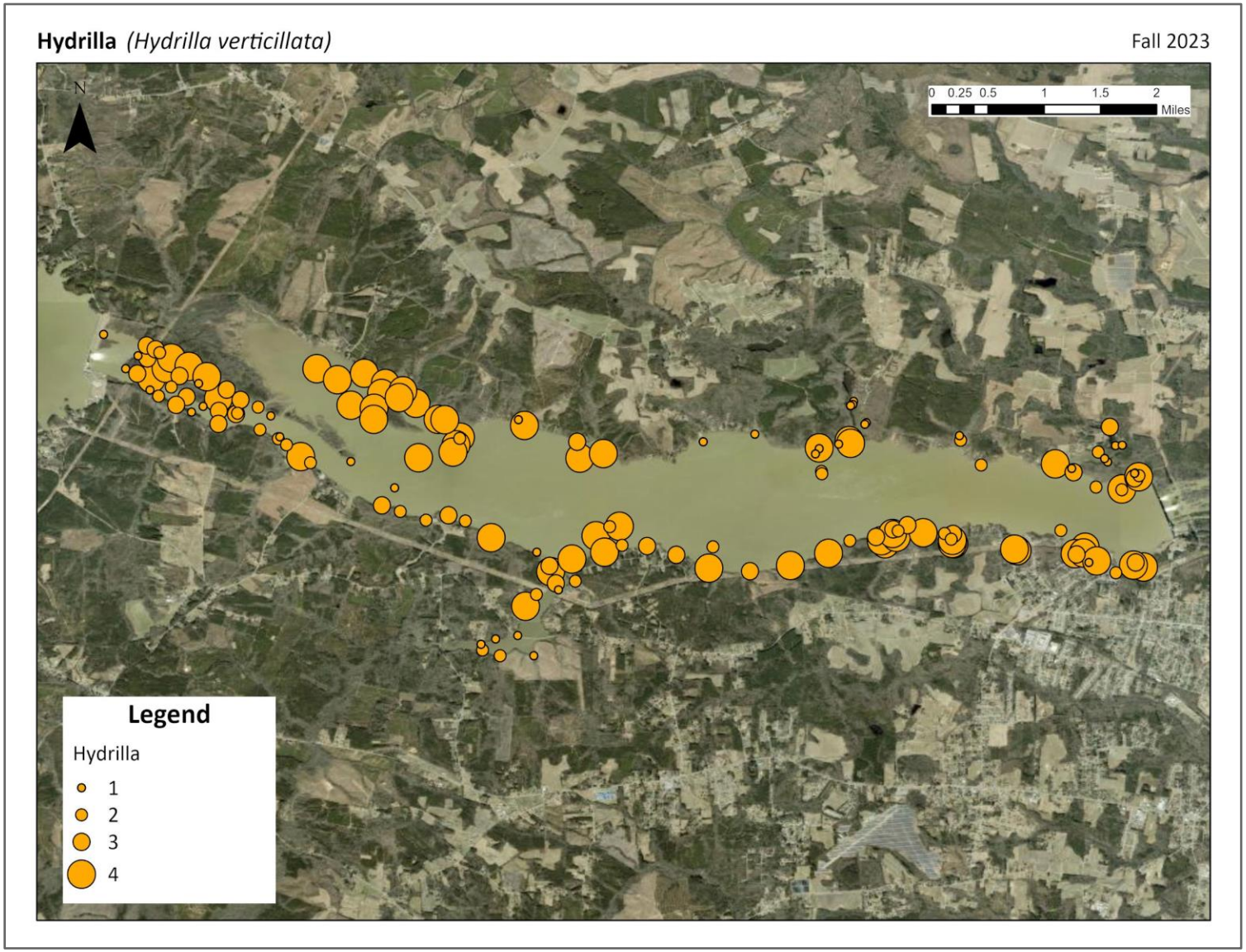

Figure 4: Distribution and abundance of hydrilla (*Hydrilla verticillata*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

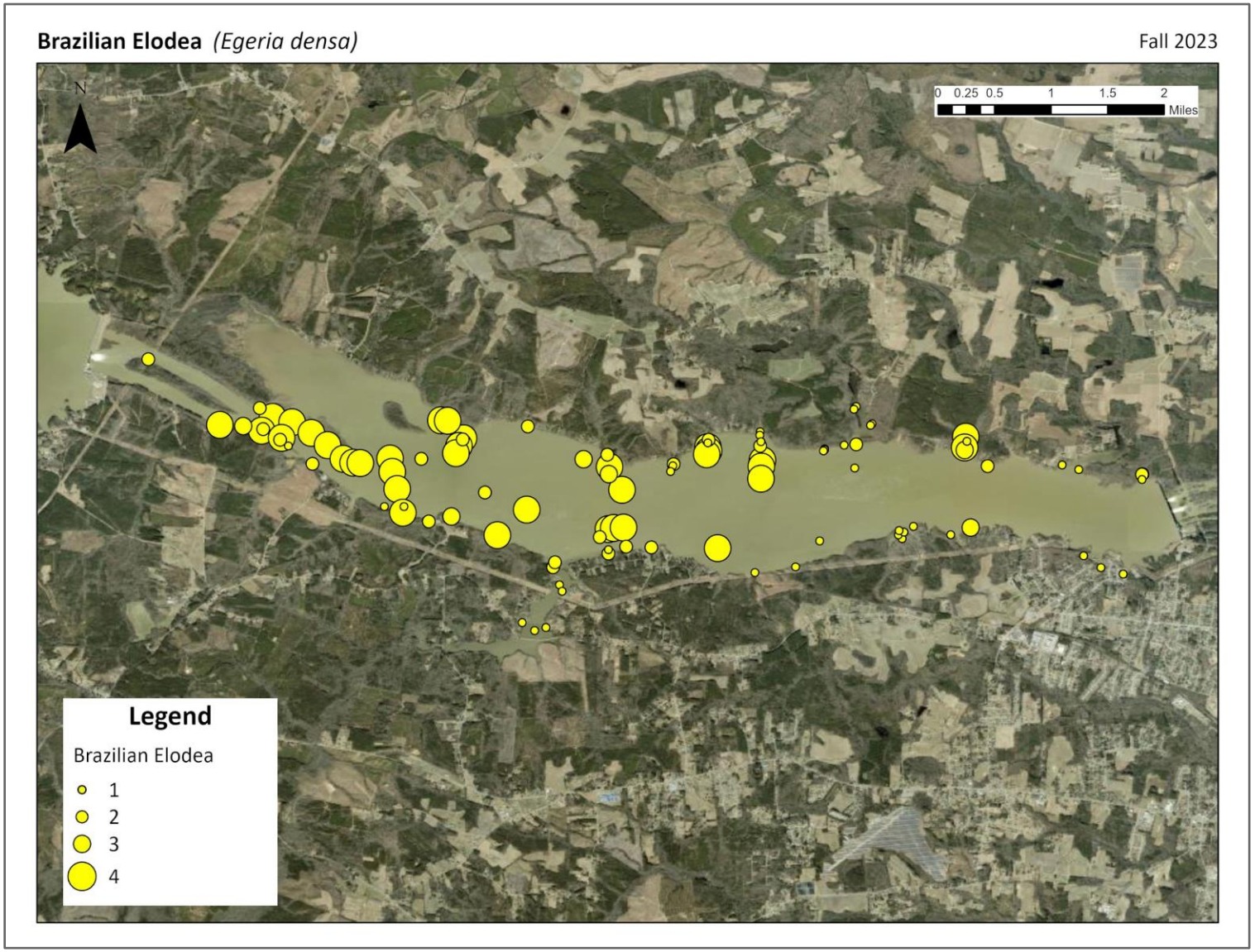

Figure 5: Distribution and abundance of Brazilian Elodea (*Egeria densa*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

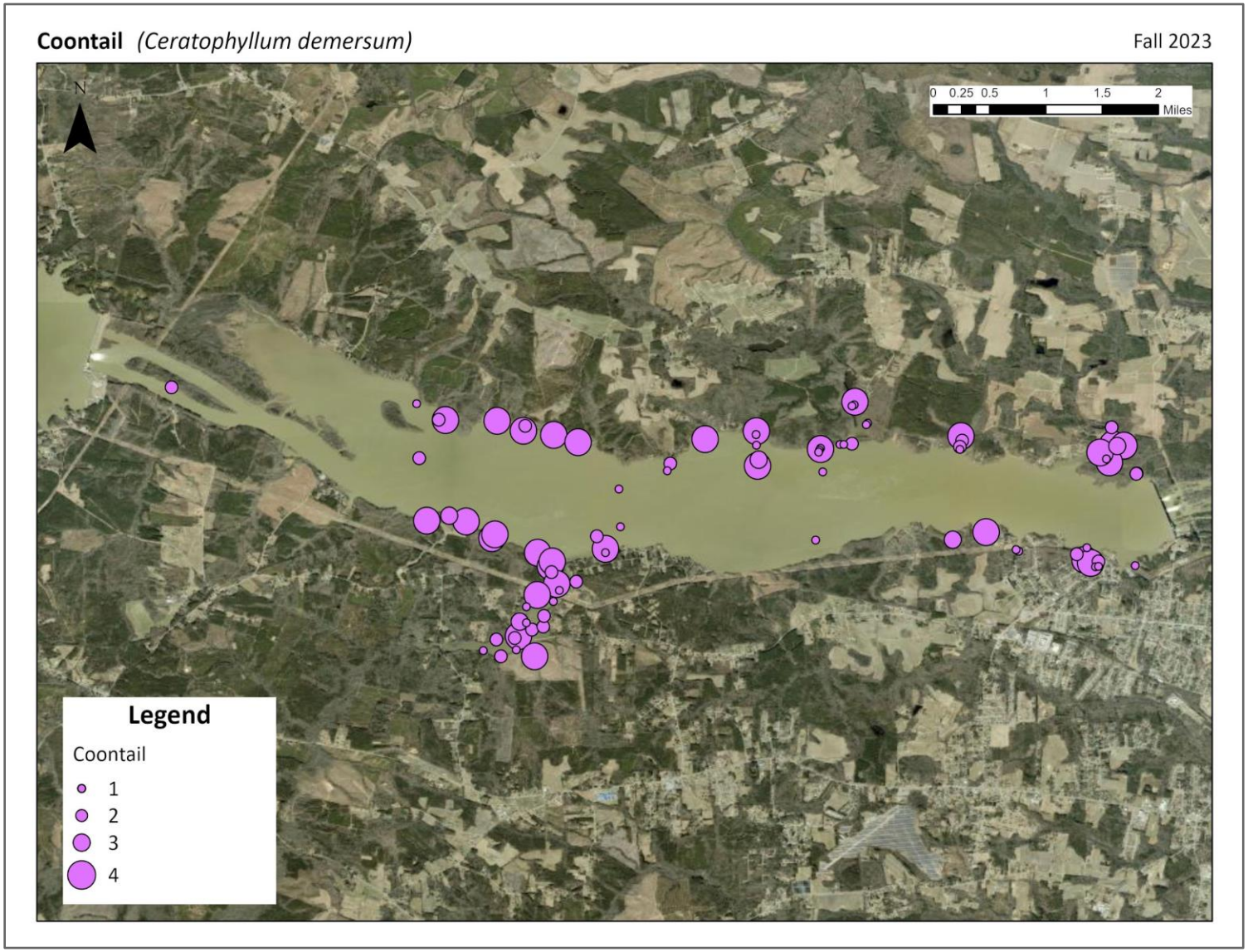

Figure 6: Distribution and abundance of Coontail (*Ceratophyllum demersum*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

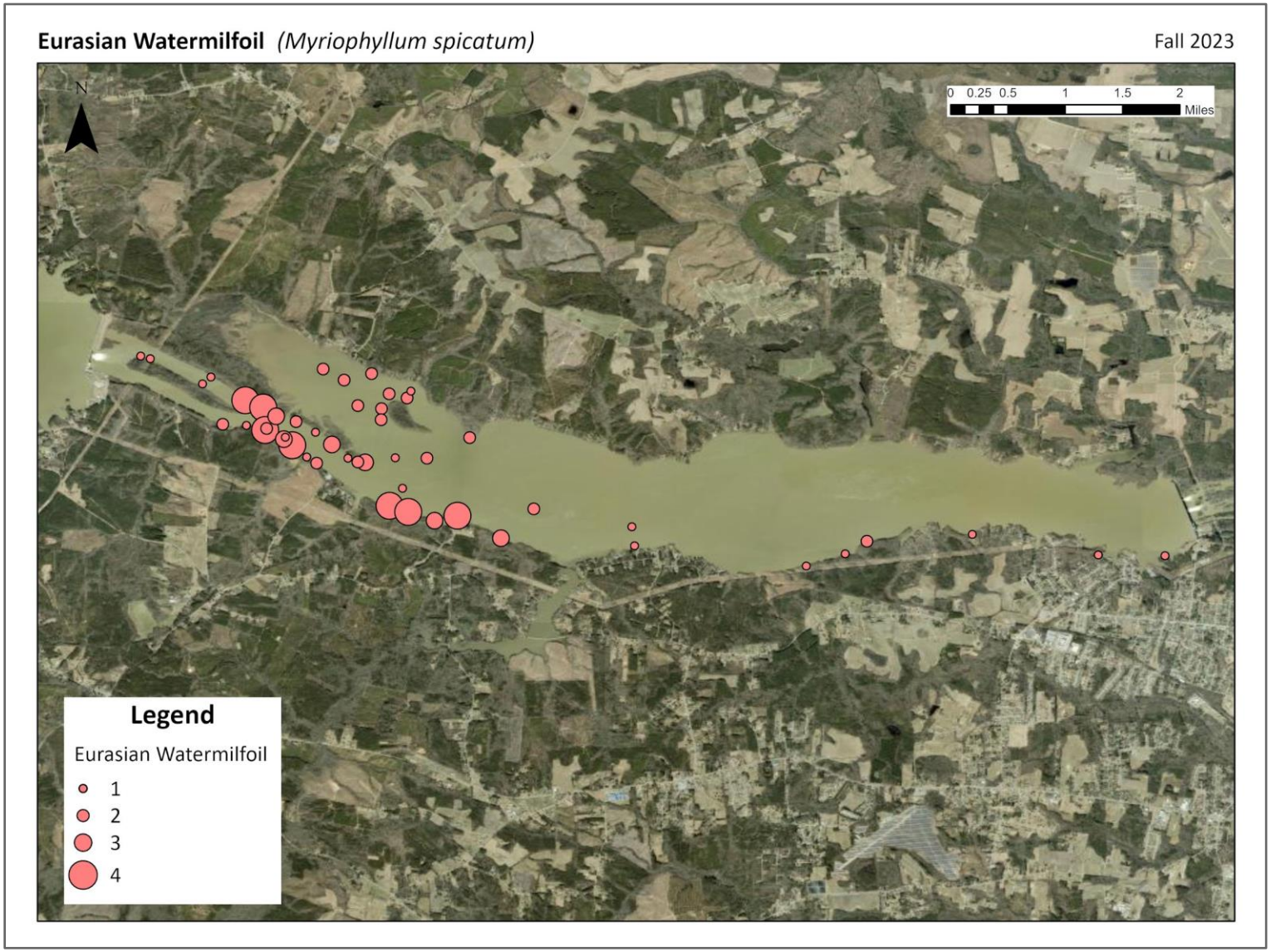

Figure 7: Distribution and abundance of Eurasian Watermilfoil (*Myriophyllum spicatum*) in Roanoke Rapids Lake during the 2023 survey.

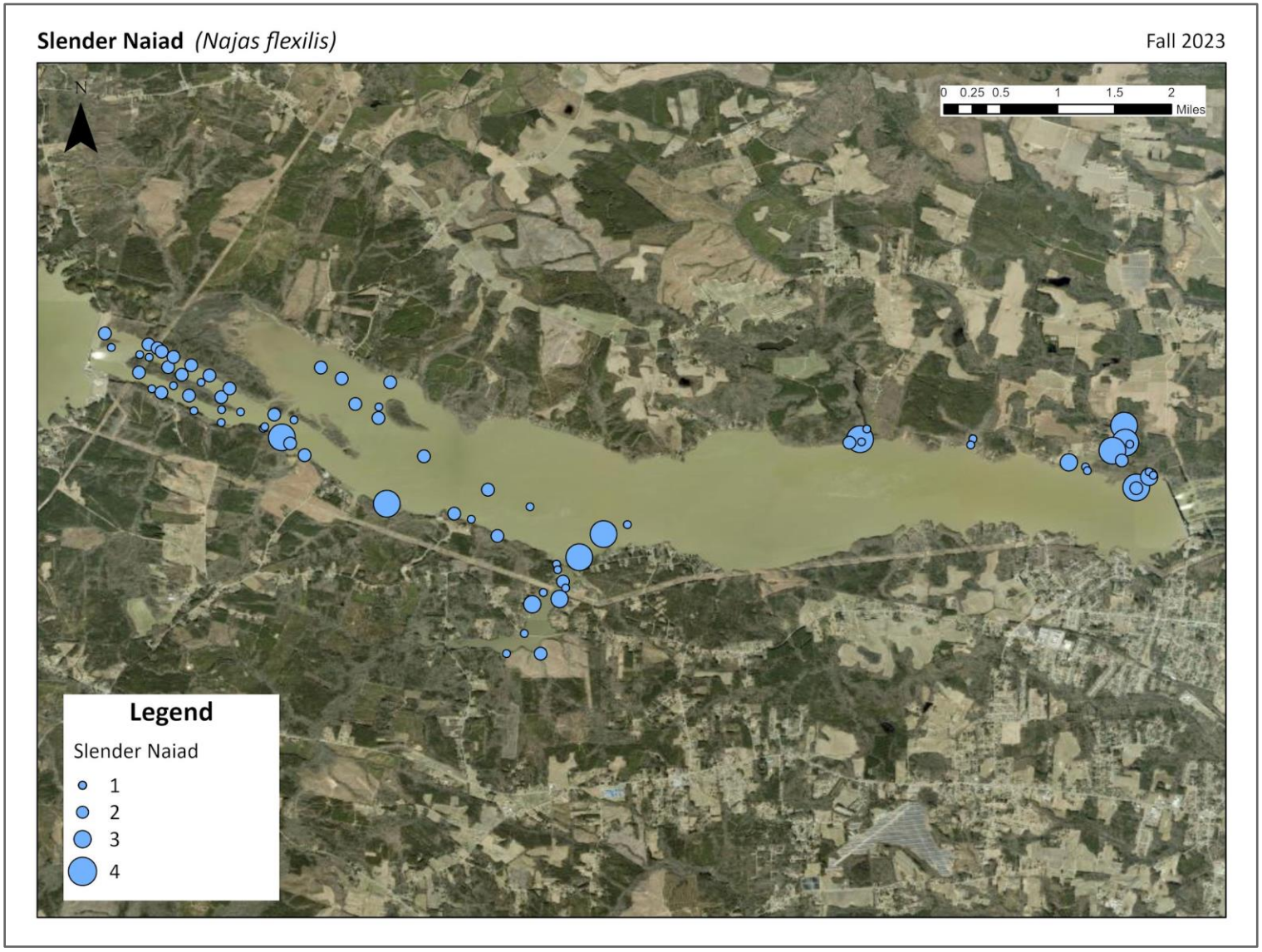

Figure 8: Distribution and abundance of slender Naiad (*Najas flexilis*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

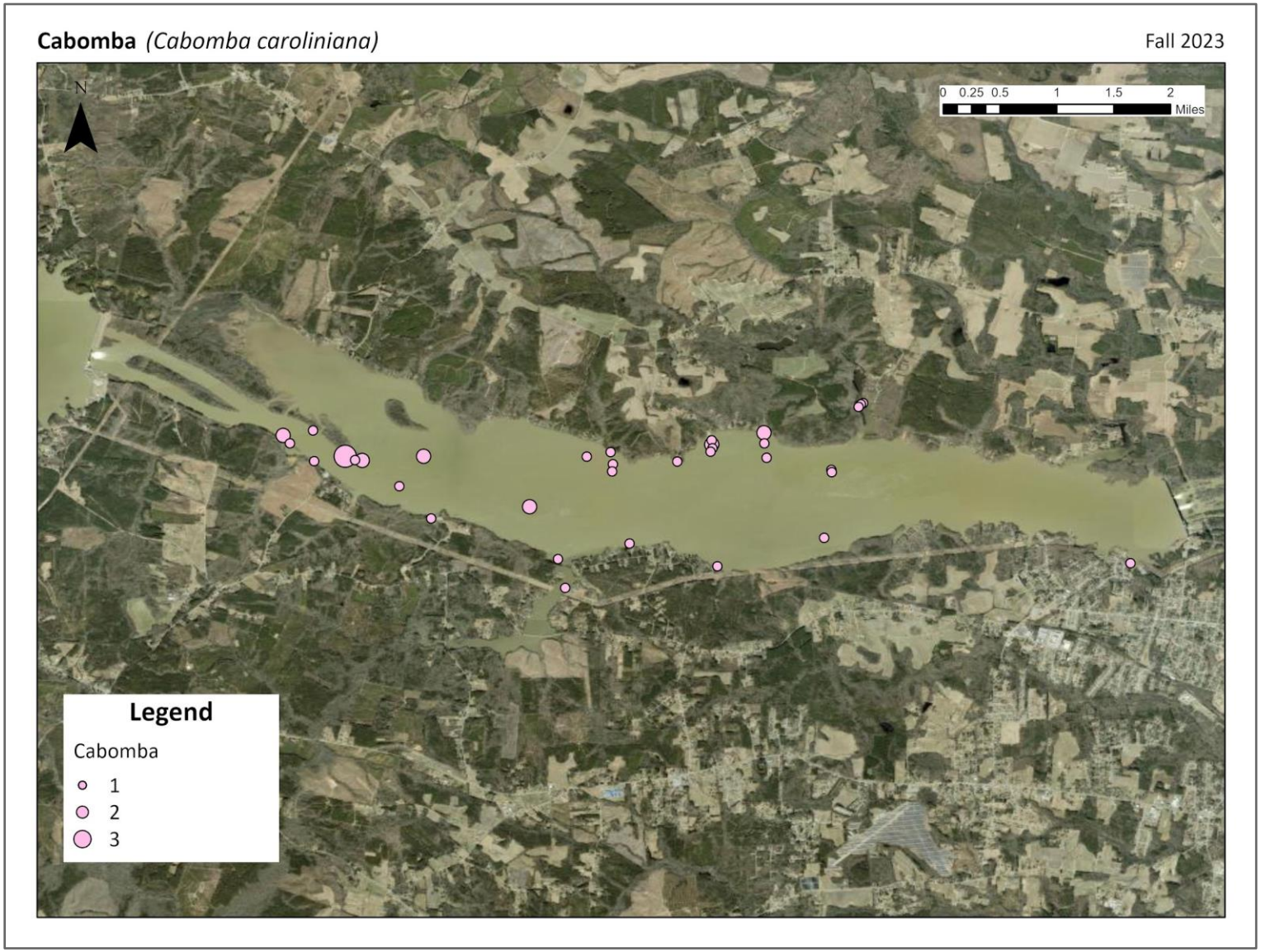

Figure 9: Distribution and abundance of Cabomba (*Cabomba caroliniana*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

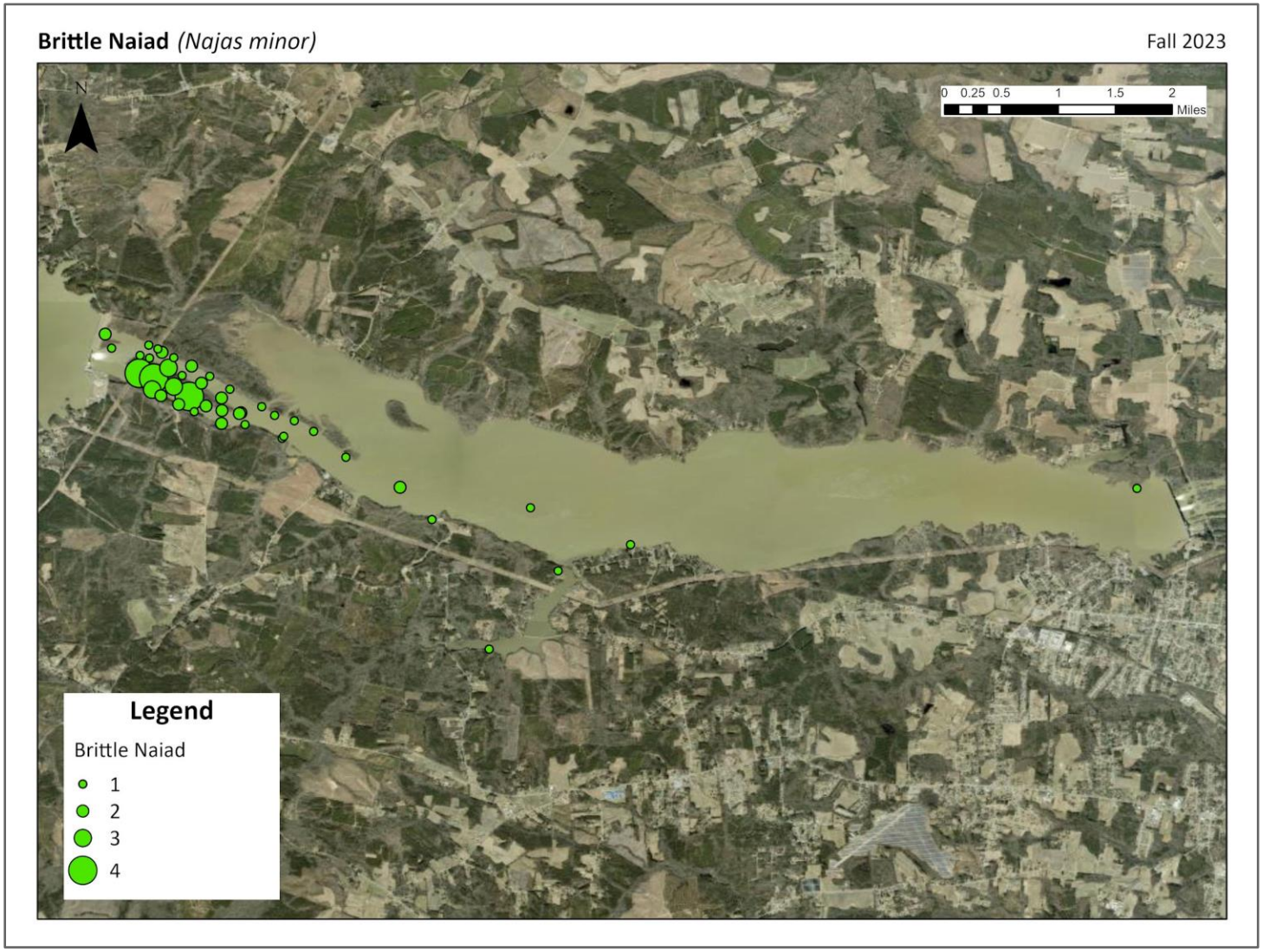

Figure 10: Distribution and abundance of Brittle Naiad (*Najas minor*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

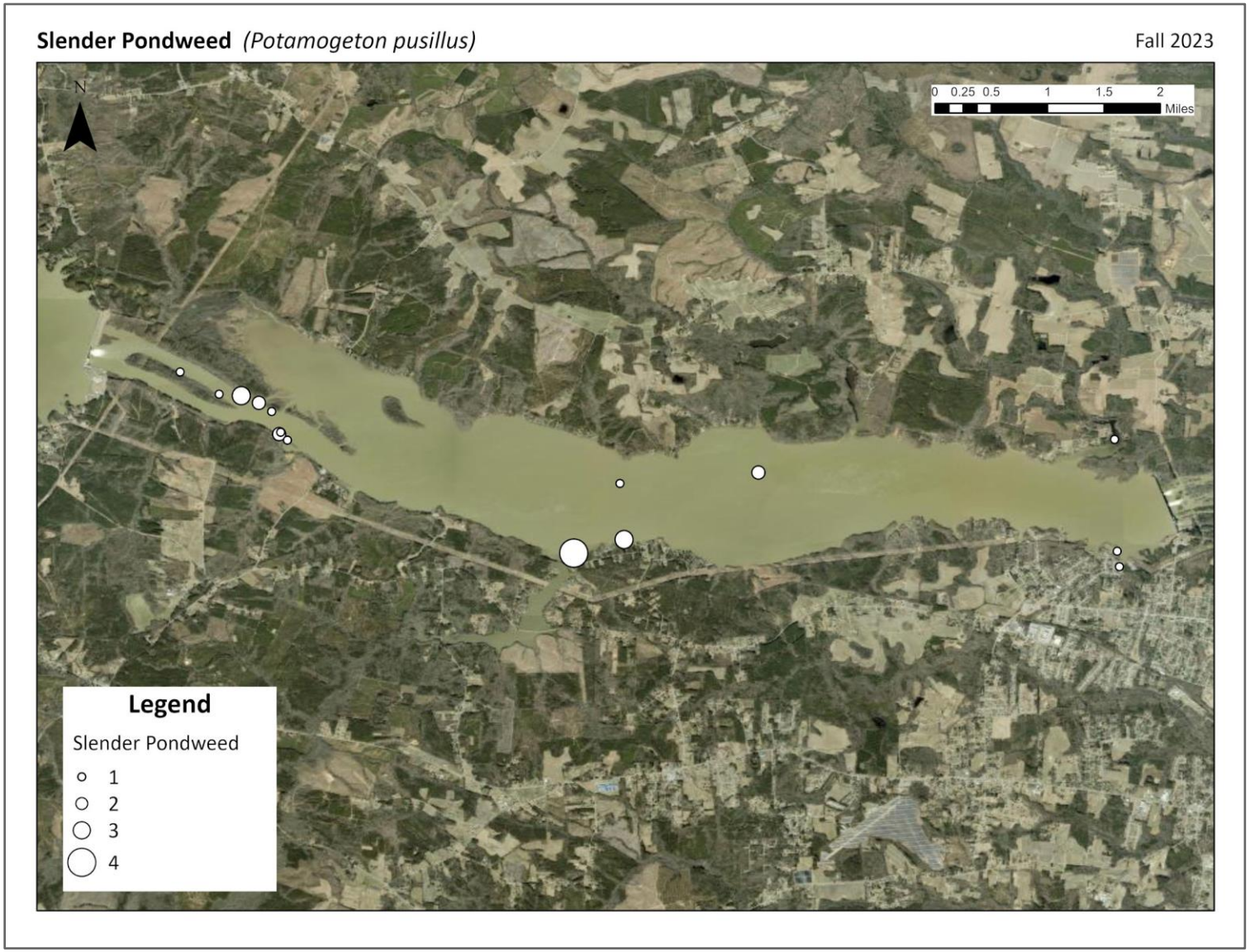

Figure 11: Distribution and abundance of Slender Pondweed (*Potamogeton pusillus*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

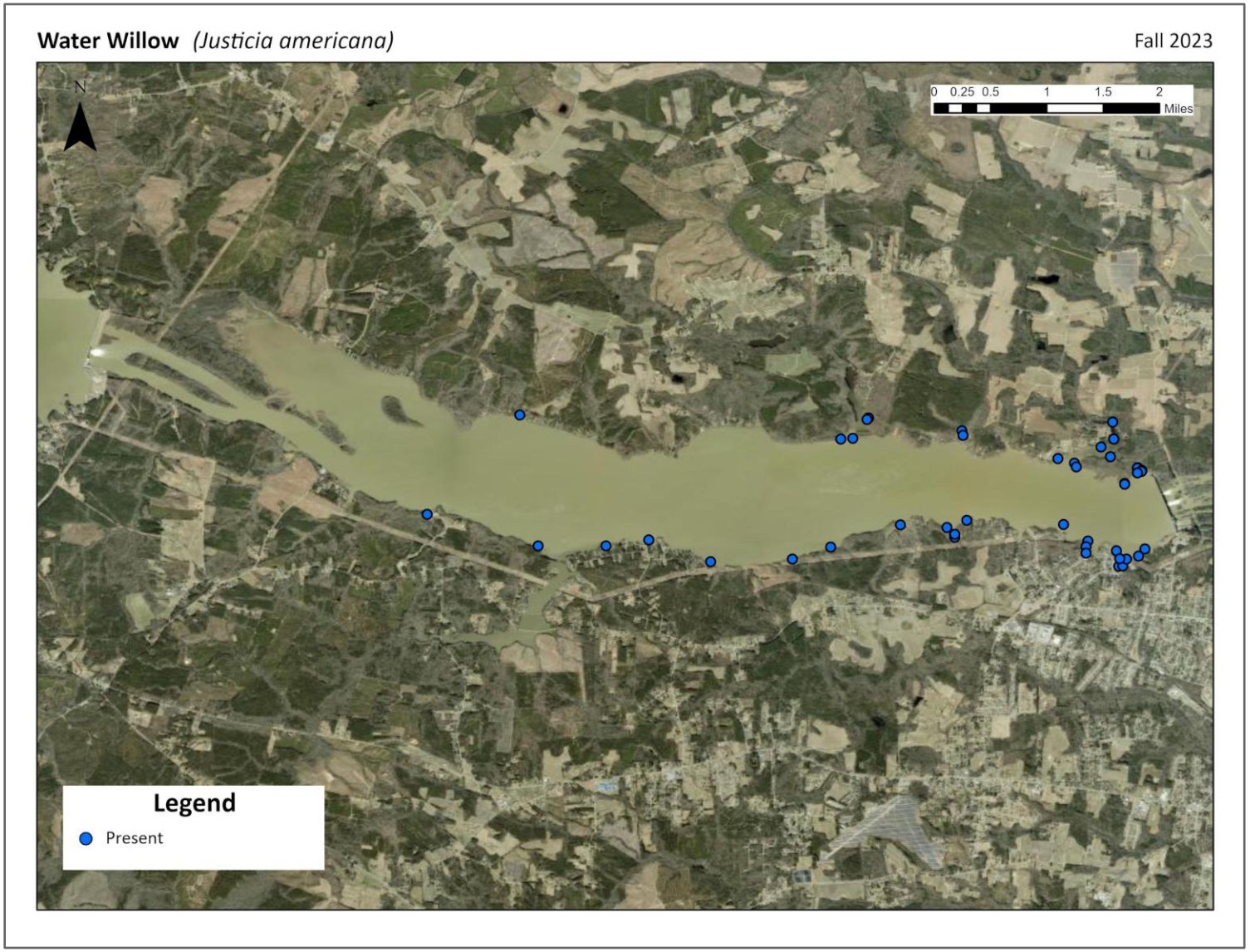

Figure 12: Distribution and abundance of Water Willow (*Justicia americana*) in Roanoke Rapids Lake during the 2023 aquatic vegetation survey.

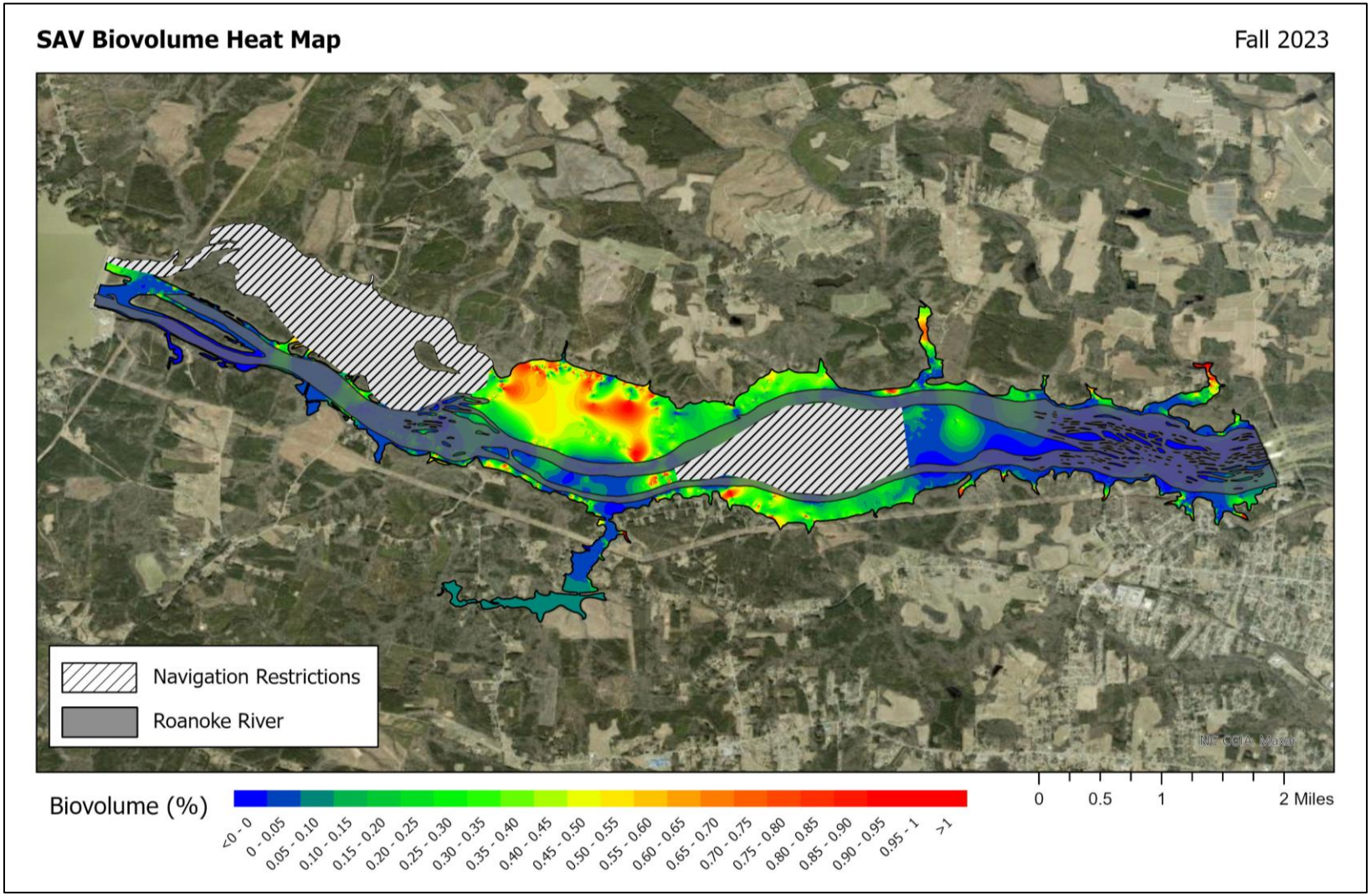

Figure 13: Interpolated biovolume estimation of SAV in Roanoke Rapids during the Fall 2023 survey. Biovolume is the ratio of submersed plant height and water depth and is recorded via boat-based sonar technology. Warm (red) colors represent high biovolume and cool (blue) colors represent low biovolume. Due to dense biomass and low water levels, some areas of the reservoir were unsuitable for accurate data collection, resulting in increased area of interpolated data during post-processing.

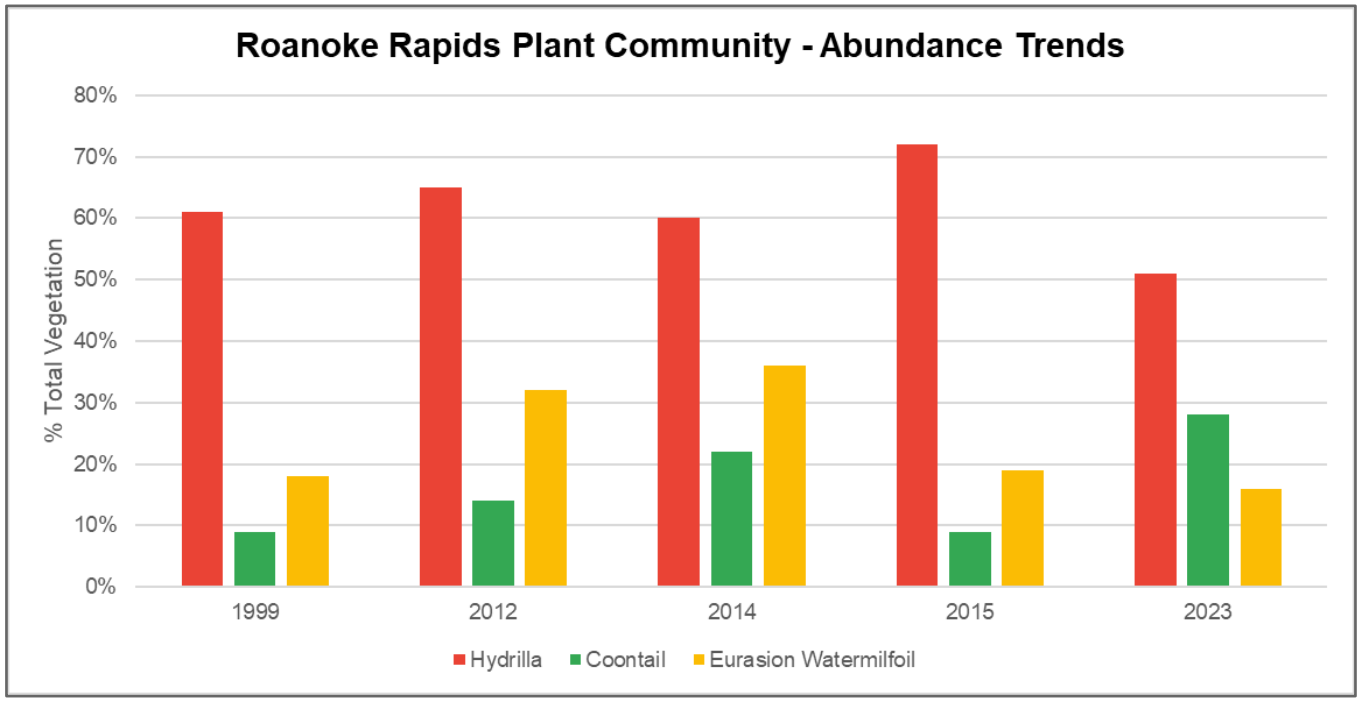

Figure 14: Trends in the relative abundance of aquatic plant species surveyed in Roanoke Rapids lake from 1999 to 2023. Relative abundance was calculated as the number of sites in which a specific species was present out of the total number of sites surveyed for that respective survey year.