

## 2019 Big Roche A Cri Aquatic Plant Surveys

Prepared for  
Big Roche A Cri Lake District



September 2019



In 2019, the Big Roche A Cri Lake District completed aquatic plant surveys of Big Roche A Cri during late May and late July to assess the distribution and growth density of plants in the lake. This document summarizes the results of the aquatic plant surveys.

## Summary of Results

The lake's 2019 plant community was healthy, diverse, and of high quality. Wild celery, a native species, dominated the plant community, occurring at two thirds of littoral sample sites and often impaired navigation. Changes since 2008 include increased overall plant frequency, increased number of native species, a decreased tolerance of the plant community to degradation (higher C value), increased quality of the plant community (higher FQI value), and increased plant density.

A total of 3 aquatic invasive species (AIS) were observed in 2019 (curly-leaf pondweed, Eurasian watermilfoil, and narrow-leaved cattail). A comparison of 2008 and 2019 data indicate (1) the frequency of Eurasian watermilfoil significantly declined in 2019; (2) the frequency of curly-leaf pondweed collected on the rake did not change significantly; and (3) the frequency of visual observations of curly-leaf pondweed near sample locations significantly increased in 2019. Narrow-leaved cattail was not observed in 2008, but was observed upstream and downstream from the bridge in 2019. In 2019, both stands of narrow-leaved cattail appeared to be spreading along the shoreline in nearly monotypic stands.

## 2019 Plant Survey Methods

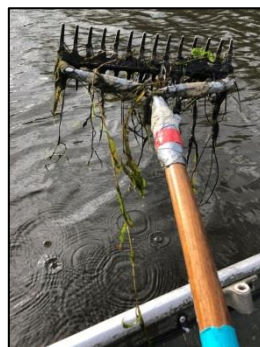
An aquatic plant survey was performed on May 25, 2019 to assess the distribution and growth density of Eurasian watermilfoil and curly-leaf pondweed. A second aquatic plant survey was performed on July 31, 2019 to assess all plants in Big Roche A Cri. The point intercept plant surveys were completed using a rake to collect plant samples at 455 equally spaced sample points (Figures 1 and 2). In May, the quantity of Eurasian watermilfoil and curly-leaf pondweed on the rake at each sample location were determined to evaluate the density of each species. In July, the overall quantity of plants on the rake at each sample location was determined to evaluate plant density. Next, the individual species collected on the rake were identified. After identification of each species, the quantity of each individual species was determined to evaluate the plant density of each species at each sample location. Rake fullness was used to determine the overall quantity (density) of plants and the quantity (density) of individual species at each sample location. Rake fullness is measured on a scale of 1 to 3 where:

- 1 = A few plants on the rake head.
- 2 = Rake head is about ½ full of plants and can easily see top of rake head.
- 3 = Rake is overflowing with plants and cannot see top of rake head.

Water depth and dominant sediment type were determined and documented for each sample location.



**Figure 1. Big Roche A Cri Plant Survey Sample Points**  
(Map Credit: Endangered Resource Services, LLC)



**Figure 2. A rake, pictured to the left, was used to collect the plants in the plant survey**  
(Photo Credit: Endangered Resource Services, LLC)

## 2019 Plant Survey Results

The 2019 plant survey results indicated the Big Roche A Cri plant community was healthy and diverse. A total of 33 species plus filamentous algae were observed, more than double the median value for lakes in the same ecoregion (median number of species in North Central Hardwood Forests ecoregion is 14) (Nichols 1999)<sup>1</sup>. The maximum depth of Big Roche A Cri during the July plant survey was 18 feet and plants were found growing up to the 13.5 foot depth. The area of the lake where plants grow is called the littoral area. Of the 412 sample points found in the littoral area of Big Roche A Cri, 360 had plants. Hence, plants were found in 87 percent of the sample sites in the littoral area. Wild celery, a native species, dominated the plant community, occurring at two thirds of littoral sample sites and often impaired navigation. Filamentous algae, coontail, water star-grass, common waterweed, and small pondweed occurred at more than 10 percent of littoral sample points while all other plant species occurred at less than 10 percent of littoral sample points (Figure 3). Many species were primarily found in the creek inlet or in the upstream one third of the lake (upstream of the bridge). Nine species occurred primarily in the creek inlet –small pondweed, curly-leaf pondweed, large-leaf pondweed, Fries' pondweed, muskgrass, ribbon-leaf pondweed, short-stemmed bur-reed, bottle brush sedge, and bald spikerush – and four species in the upstream one third of the lake–slender naiad, softstem bulrush, broad-leaved cattail, and horned pondweed. Dense, nearly monotypic stands of narrow-leaved cattail occurred just above and below the bridge.

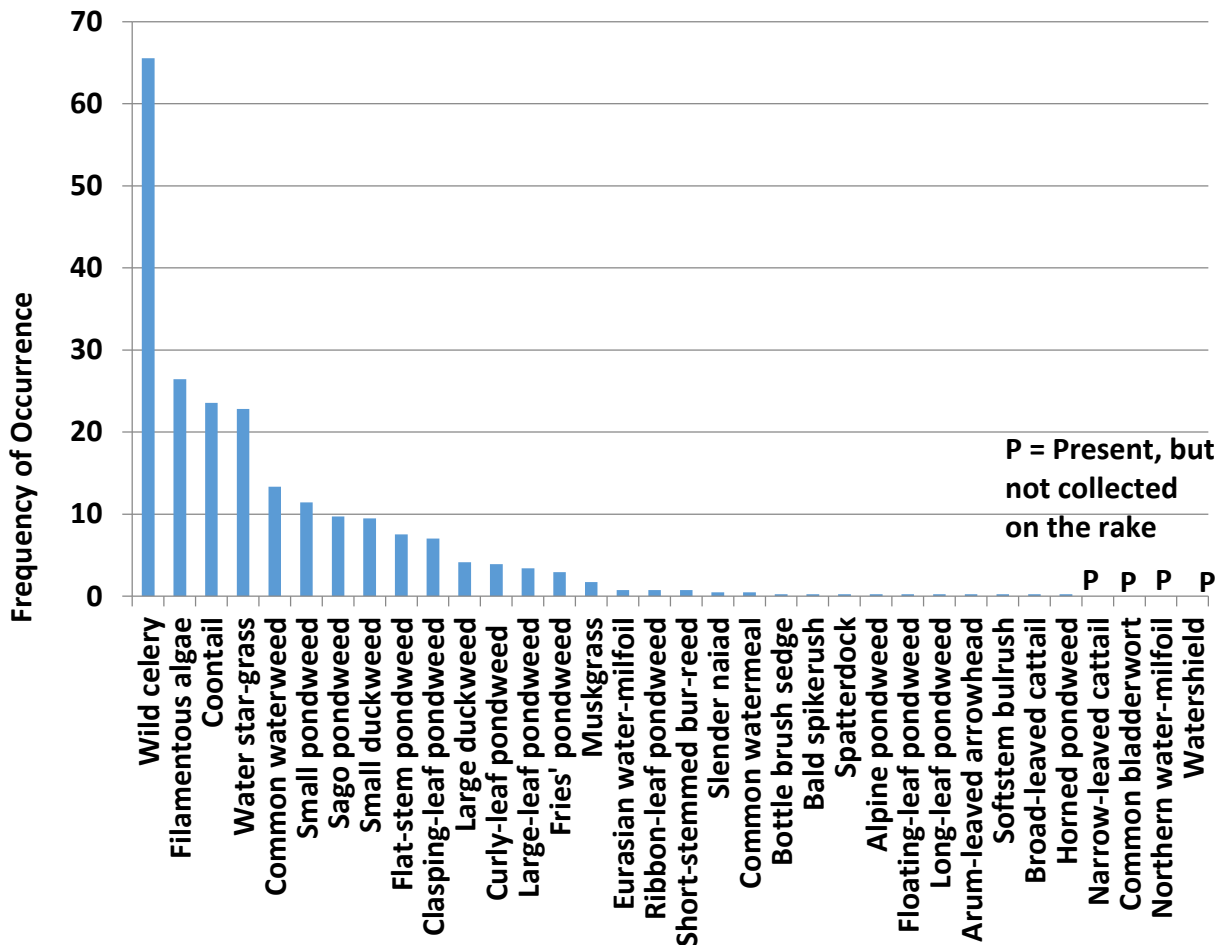
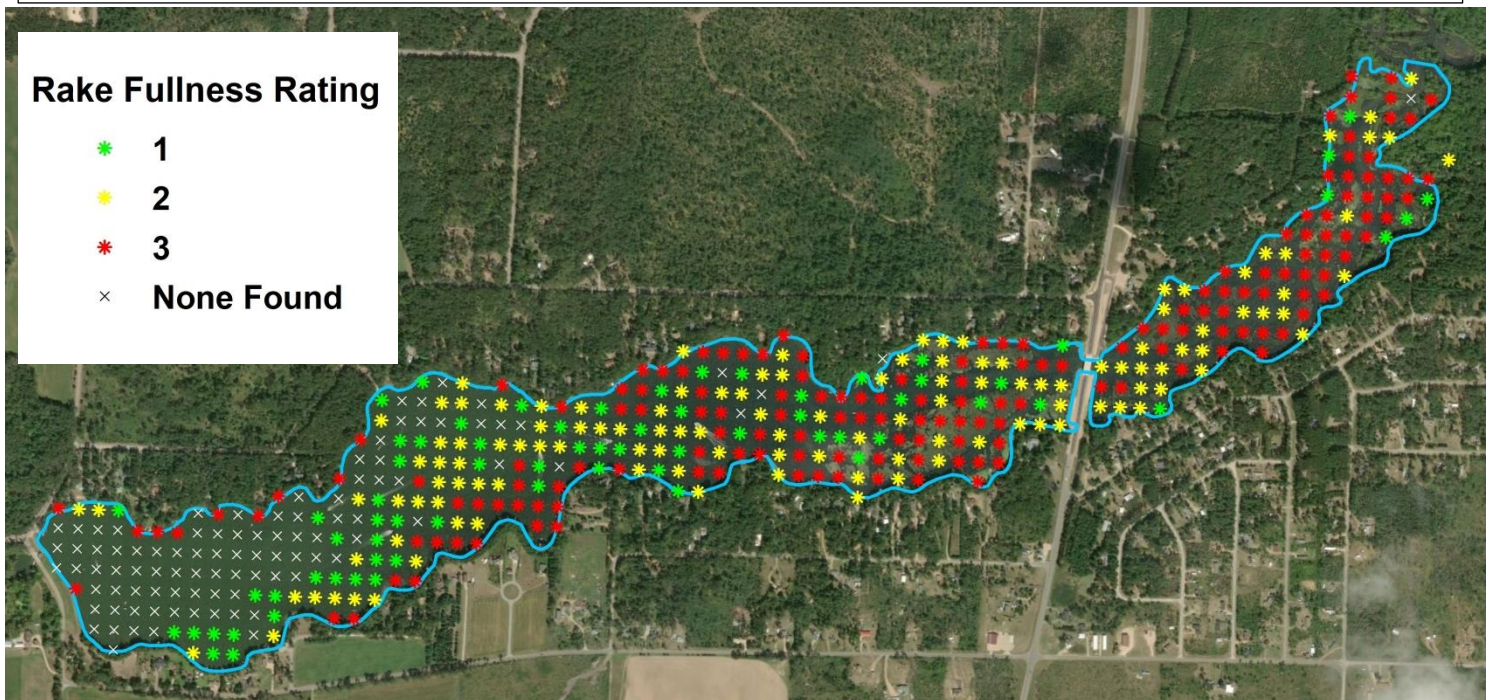


Figure 3. Frequency of Occurrence of Individual Species in the Littoral Area of Big Roche A Cri on July 31, 2019

<sup>1</sup> Nichols, S.A. 1999. "Floristic Quality Assessment of Wisconsin Lake Plant Communities with Example Applications." *Journal of Lake and Reservoir Management* 15 (2): 133-141.

Plant density in Big Roche A Cri was measured by rake fullness on a scale of 1 (low) to 3 (high). In 2019, average plant density ranged from low to high (Figure 4). The average rake fullness in the lake's vegetated sample sites was 2.3. Nearly half of the individual species had an average rake fullness of 1, indicating a low density. Nearly half of the individual species had an average rake fullness of 2, indicating moderate density. Two species (alpine pondweed and floating-leaf pondweed) had an average rake fullness of 3, indicating high density (Figure 5), but were only observed at a single location within the lake.

Although only 2 species had an average rake fullness of 3 (high density), filamentous algae and 10 additional plant species observed a rake fullness of 3 at one or more locations. Wild celery, the dominant plant in the lake, frequently occurred at high density, noting a rake fullness of 3 at 105 of the 273 locations at which it was observed. Water star-grass was occasionally dense, especially in areas with some flowing water, noting a rake fullness of 3 at 8 of the 110 sites at which it was observed. Small pondweed occurred as canopied mats in the creek inlet, noting a rake fullness of 3 at 11 of the 54 sites at which it was observed. Sago pondweed was occasionally dense, especially in shallow sandy areas near the creek inlet, noting a density of 3 at 14 of the 47 sites in which it was observed. Other species noting a density of 3 at one or more sample points include common waterweed (8 of the 58 sites observed), filamentous algae (7 of 109 sites observed), clasping-leaf pondweed (6 of the 34 sites observed), flat-stem pondweed (3 of the 42 sites observed), large-leaf pondweed (1 of the 15 sites observed), small duckweed (1 of the 39 sites observed), and ribbon-leaf pondweed (1 of 4 sites observed).



**Figure 4. Average Plant Density (Rake Fullness) Per Sample Point at Big Roche A Cri Sample Locations on July 31, 2019 (Map Credit: Endangered Resource Services, LLC)**

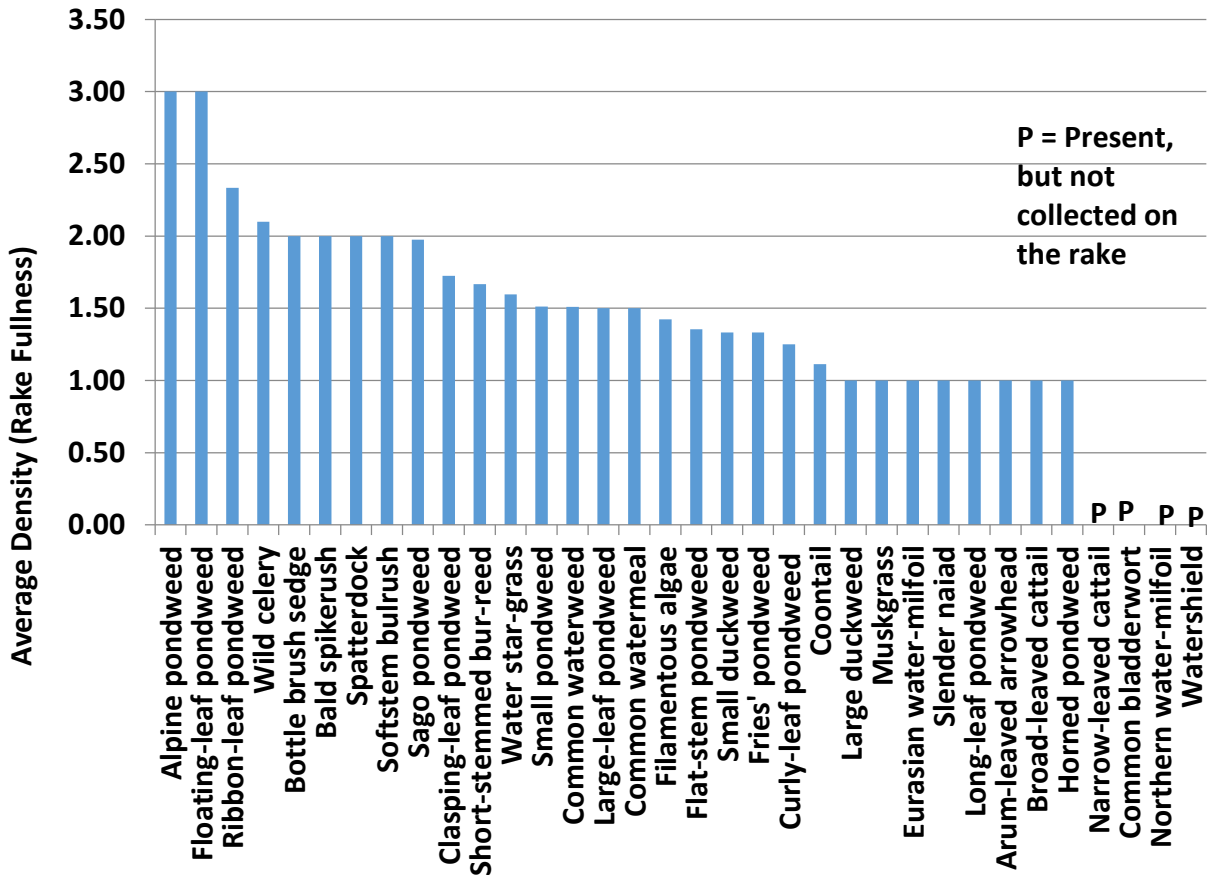
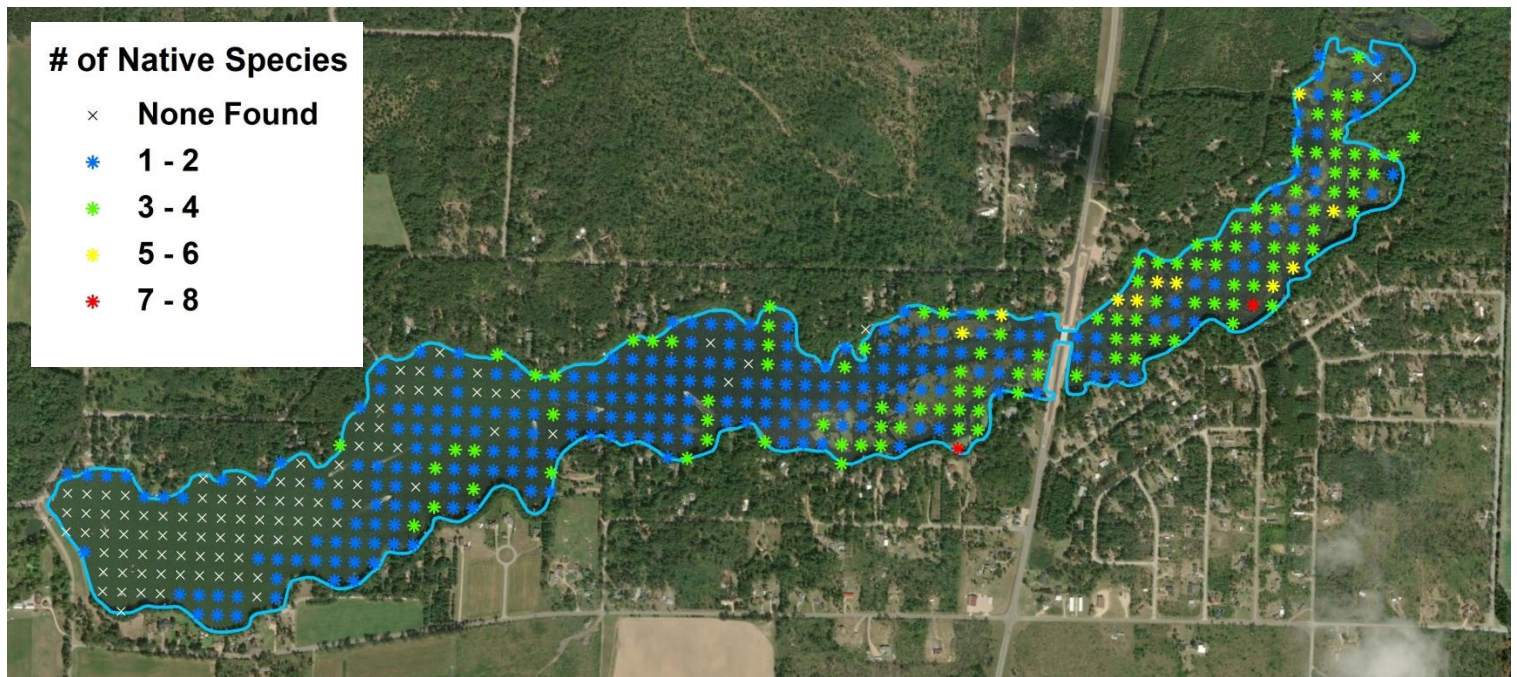


Figure 5. Average Density (Rake Fullness) of Individual Species in Big Roche A Cri on July 31, 2019

The Simpson Diversity Index was used to estimate the diversity of the 2019 Big Roche A Cri plant community. The index, with scores ranging from 0 to 1, considers both the number of species present and the evenness of species distribution. The scores represent the probability that two individual plants randomly selected from the lake will belong to different species. A high score indicates a more diverse plant community—a higher probability that two randomly selected plants will represent different species. Big Roche A Cri had a score of 0.84 during the July 31 plant survey, which indicates the probability that two randomly selected plants will belong to different species is 84 percent. Hence, plant diversity in Big Roche A Cri in 2019 was fairly high.

The 2019 diversity in the Big Roche A Cri plant community was also measured by the number of plant species found at each sample site. The average number of individual species (includes non-native species) collected from vegetated sample sites was 2.2 and the range was 1 to 8. The average number of native species collected from vegetated sample sites was 2.1 and the range was 1 to 8 (Figure 6). Diversity was higher upstream of the bridge (Figure 6).



**Figure 6. Number of Native Species Per Sample Point in Big Roche A Cri on July 31, 2019  
(Map Credit: Endangered Resource Services, LLC)**

The quality of the Big Roche A Cri aquatic plant community was measured by the Floristic Quality Index (FQI). The number of native species collected on the rake during the aquatic plant survey (27) and the average tolerance of the plant community to degraded conditions are used to compute FQI. The average tolerance of the plant community to degraded conditions is measured by a value called the C value. Plant species are assigned C values on a scale of 0 to 10, with increasing values indicating plants are less tolerant of degraded conditions and of better quality. An average of the C values for individual species within a lake's plant community indicates the average tolerance of the community to degraded conditions. The average C value for the Big Roche A Cri plant community in 2019 was 5.6 which is slightly above the midpoint of the scale (higher means less tolerant of degraded conditions). The Big Roche A Cri FQI value in 2019 was 29.1. This value is higher than the median FQI value for lakes in the same ecoregion (20.9) (Nichols 1999<sup>1</sup>). The higher than median FQI indicates (1) the plant community is less tolerant to development and other human disturbances; (2) the plant community has less degradation by human impacts, and/or (3) the lake has a higher water quality than the average lake within the same ecoregion.

## Comparison of 2008 and 2019 Big Roche A Cri Aquatic Plant Data

Big Roche A Cri aquatic plant data collected by the rake during mid-August 2008 by the Wisconsin Department of Natural Resources were compared with data collected by the rake during July 31, 2019 by the Big Roche A Cri Lake District to document significant changes in the frequency of plant species. A statistical tool, Chi Squared Analysis, was used to identify significant frequency changes. The analysis documented significant increases in frequency for 7 species and significant decreases in frequency for 4 species (Figures 7 and 8). One of the species that significantly declined in 2019 was Eurasian water milfoil, a positive change for the lake. Eurasian watermilfoil was collected on the rake at 77 sites in 2008 and was collected on the rake at only 3 sites in 2019.

Overall plant frequency increased by 10 percent between 2008 and 2019, from 77 percent in 2008 to 87 percent in 2019. The plant frequency increase is statistically significant at the 95 percent confidence level.

Between 2008 and 2019, not only did overall plant frequency increase, but increases were also documented for the number of native species collected on the rake (from 19 in 2008 to 27 in 2019), the average C value of the plant community, (from 5.3 in 2008 to 5.6 in 2019), and FQI (from 22.9 in 2008 to 29.1 in 2019) indicating the 2019 plant community was more diverse, less tolerant to degraded conditions, and of higher quality. Additionally, plant density increased in 2019, from a mean plant density (rake fullness) in 2008 of 1.86 to a mean plant density (rake fullness) of 2.26 in 2019.

The significant decline in Eurasian watermilfoil in 2019 resulted in a decrease in the average number of species per sample site in 2019 (from 2.5 in 2008 to 2.2 in 2019). The average number of native species per sample site also declined slightly in 2019 (from 2.2 in 2008 to 2.1 in 2019).

The 2019 Simpson Diversity Index value of 0.84 was the same as the 2008 value. As noted previously, the value is based upon both the number of species and distribution. The value indicates that in both 2008 and 2019, the probability that two randomly selected plants will belong to different species is 84 percent.



**Wild celery in Big Roche A Cri, pictured above, significantly increased in density in 2019 (Photo Credit: Endangered Resource Services, LLC)**



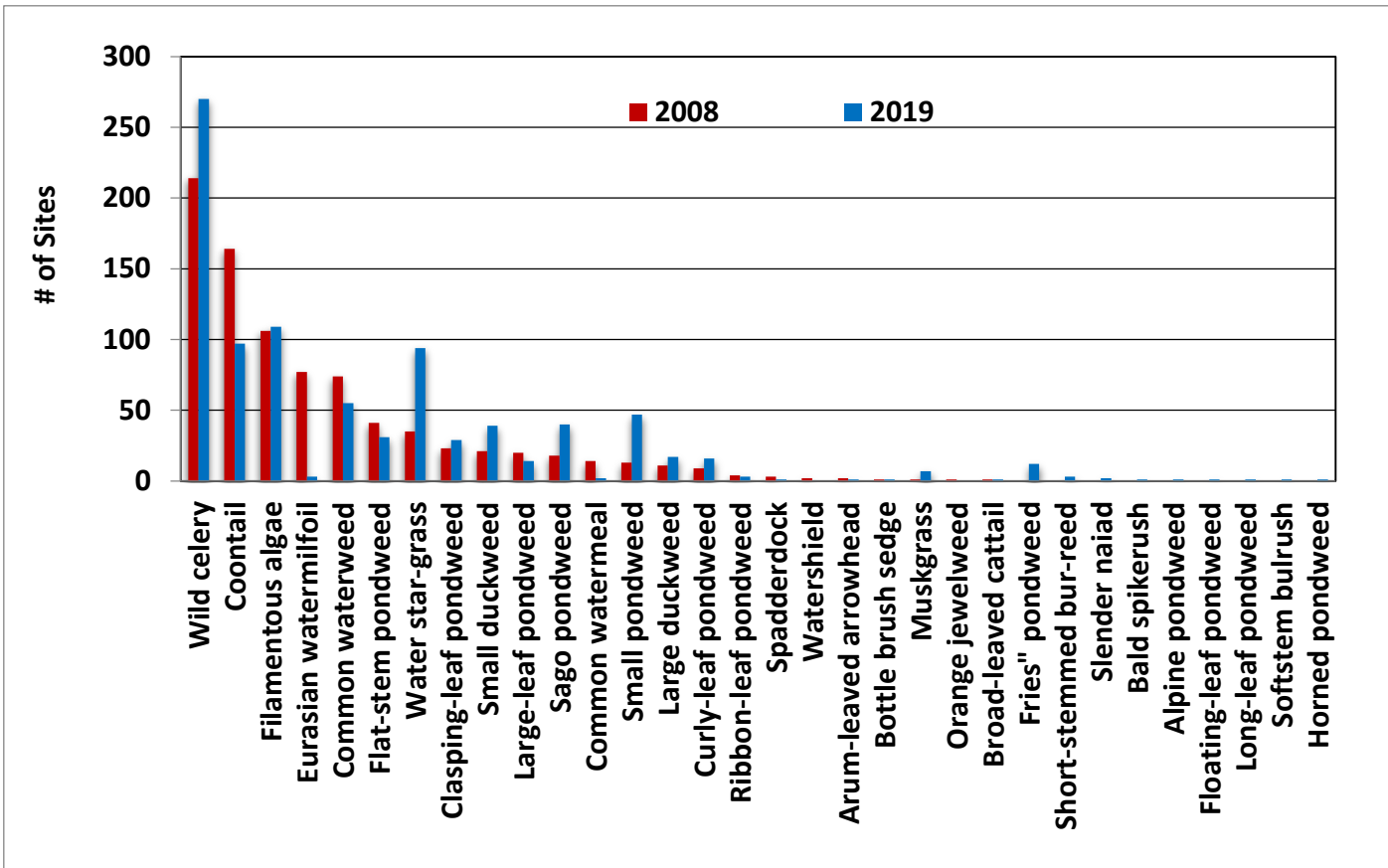


Figure 7. Comparison of 2008 and 2019 Frequency Differences for All Species in Big Roche A Cri (Number of Sites Collected on the Rake during 2008 and 2019) (2008 Data Collected by Wisconsin Department of Natural Resources)

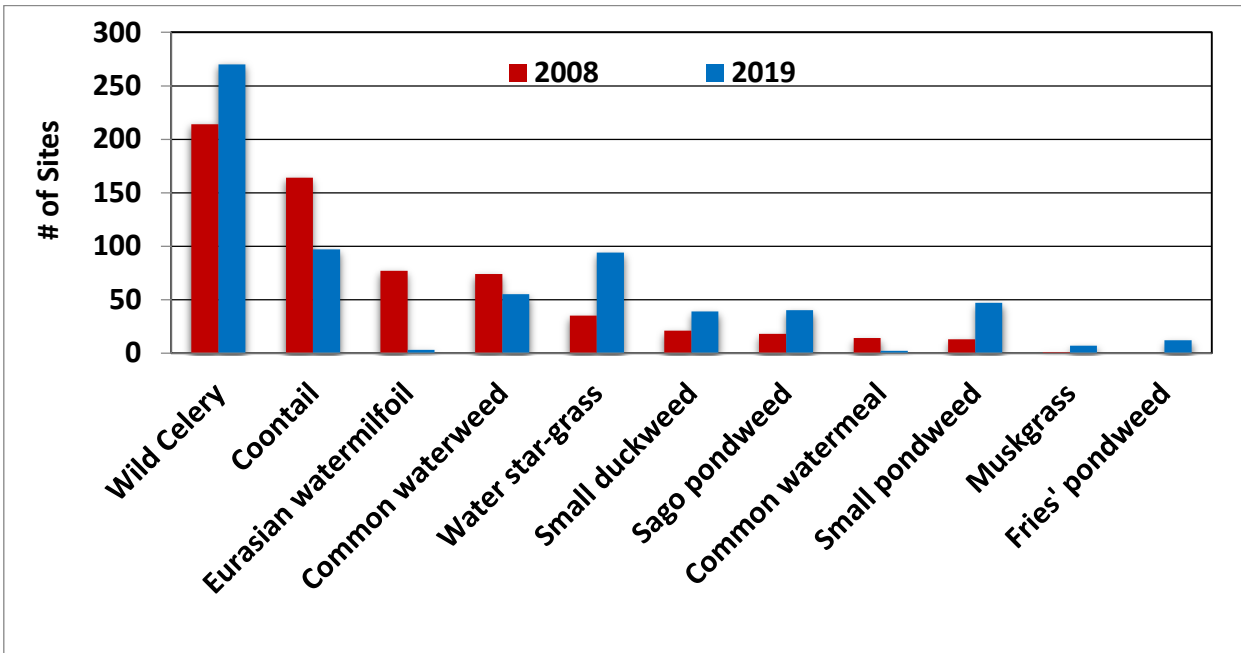


Figure 8. Species with Significant Frequency Differences Between 2008 and 2019 in Big Roche A Cri (Number of Sites Collected on the Rake during 2008 and 2019) (2008 Data Collected by Wisconsin Department of Natural Resources)

## Aquatic Invasive Species (AIS)

AIS are nonnative species that have the potential to cause serious problems. Because they are not native, they lack predators and can rapidly spread, displacing native species and dominating the community.

The 2019 aquatic plant survey indicated three AIS were present in the lake (curly-leaf pondweed, Eurasian watermilfoil, and narrow-leaved cattail). Two AIS was observed during the 2008 plant survey (curly-leaf pondweed and Eurasian watermilfoil).

Curly-leaf pondweed (*Potamogeton crispus*) was monitored on May 25 and July 31, 2019. On May 25, curly-leaf pondweed was collected on the rake at 14 locations (Figure 9). On July 25, curly-leaf pondweed was collected on the rake at 16 sample locations and observed near an additional 14 locations (Figure 10).

Curly-leaf pondweed frequency was higher in 2019 than 2008. In mid-August of 2008, curly-leaf pondweed was collected on the rake at 9 sample locations and visually observed near one additional location (Figure 11). The 2019 increase in number of sites where curly-leaf pondweed was collected on the rake is not statistically significant at the 95 percent confidence level. However, the July 31, 2019 increase in the number of sites where curly-leaf pondweed was visually observed near sample locations is a statistically significant increase at the 95 percent confidence level.

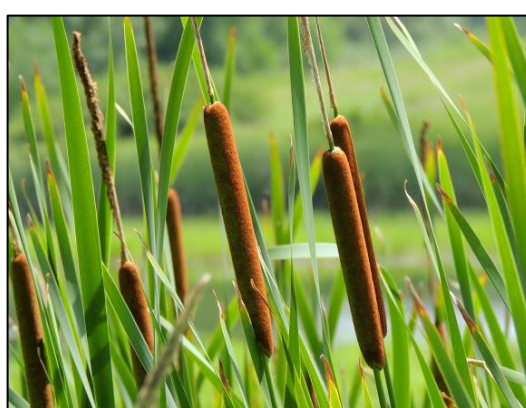
Average curly-leaf pondweed density (rake fullness) was slightly higher in 2019 than 2008. Average rake density was 1.0 in 2008 compared with 1.4 in May of 2019 and 1.1 in July of 2019.

Eurasian watermilfoil was monitored on May 25 and July 31, 2019. On May 25, Eurasian watermilfoil was collected on the rake at 2 locations and visually observed near one additional sample location (Figure 12). On July 31, 2019, Eurasian watermilfoil was collected on the rake at 3 locations and visually observed near 7 additional sample locations (Figure 13). In July, Eurasian watermilfoil was widely scattered except in the bay just southwest of the bridge - even here it was extremely patchy/low density. Eurasian watermilfoil frequency was lower in 2019 than 2008 and the decline was statistically significant at the 95 percent confidence level. In mid-August of 2008, Eurasian watermilfoil was collected on the rake at 77 sample locations and visually observed near 21 additional locations (Figure 14).

Average Eurasian watermilfoil density (rake fullness) declined slightly in 2019 from 1.2 in 2008 to 1.0 during both May and July of 2019.

Cattails within Big Roche A Cri were monitored during mid-August of 2008 and July 31, 2019. Narrow-leaved cattail was not observed in 2008, but was observed upstream and downstream from the bridge in 2019. In 2019, both stands of narrow-leaved cattail appeared to be spreading along the shoreline in nearly monotypic stands.

**Pictured below, curly-leaf pondweed (left), Eurasian watermilfoil (middle) and narrow-leaved cattails (right)**



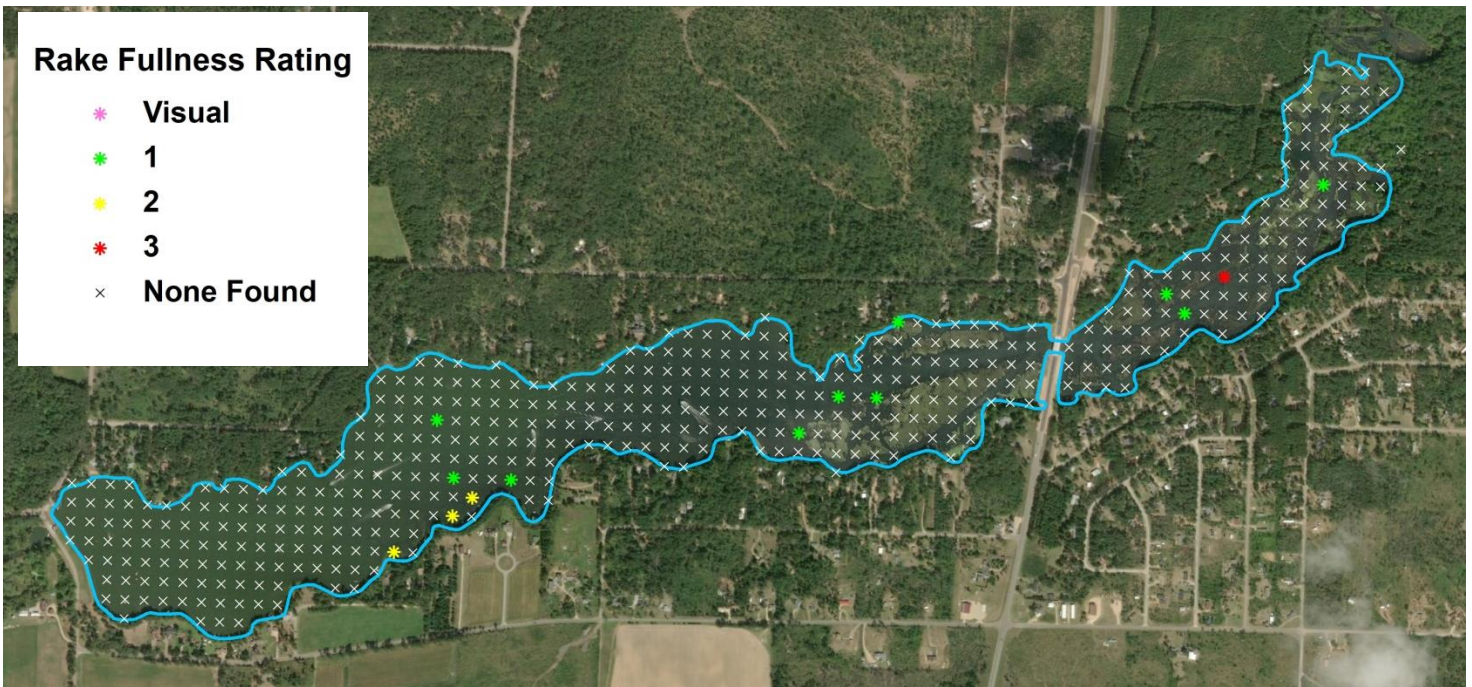


Figure 9. May 25, 2019 Curly-leaf Pondweed Locations in Big Roche A Cri (Map Credit: Endangered Resource Services, LLC)

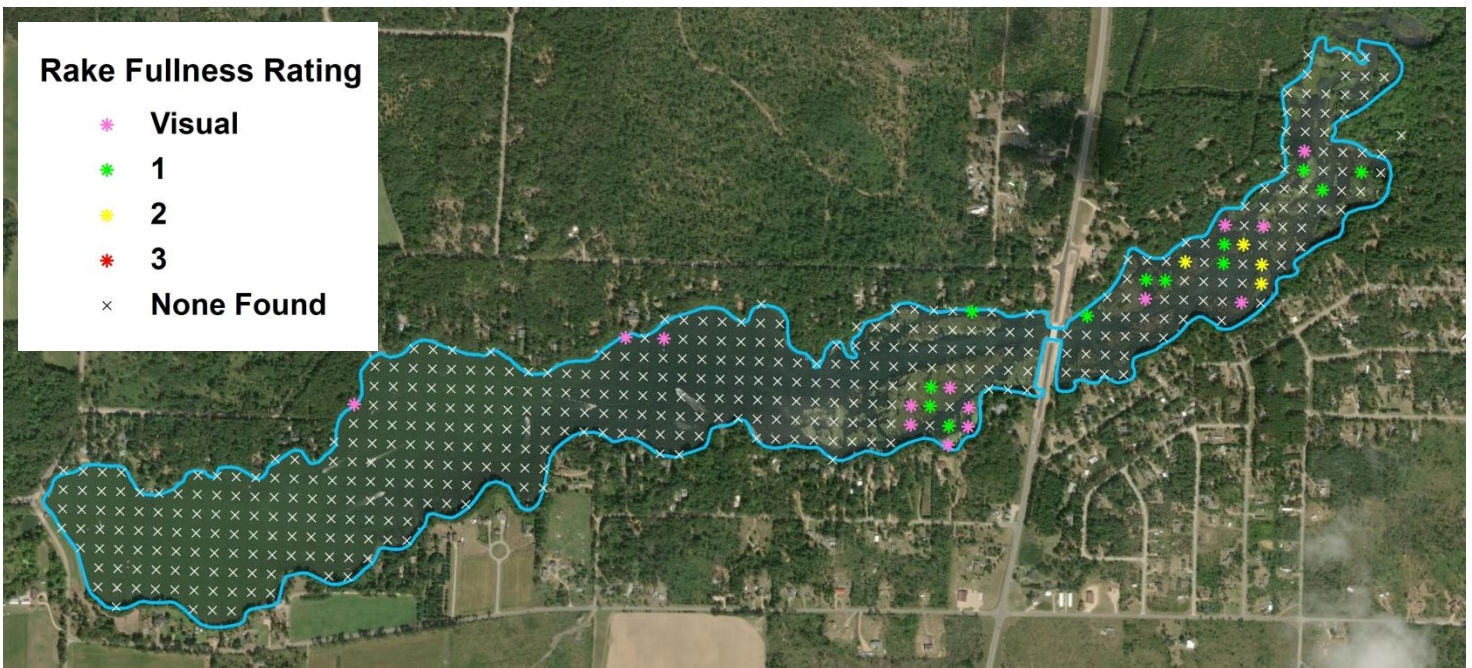


Figure 10. July 31, 2019 Curly-leaf Pondweed Locations in Big Roche A Cri (Map Credit: Endangered Resource Services, LLC)

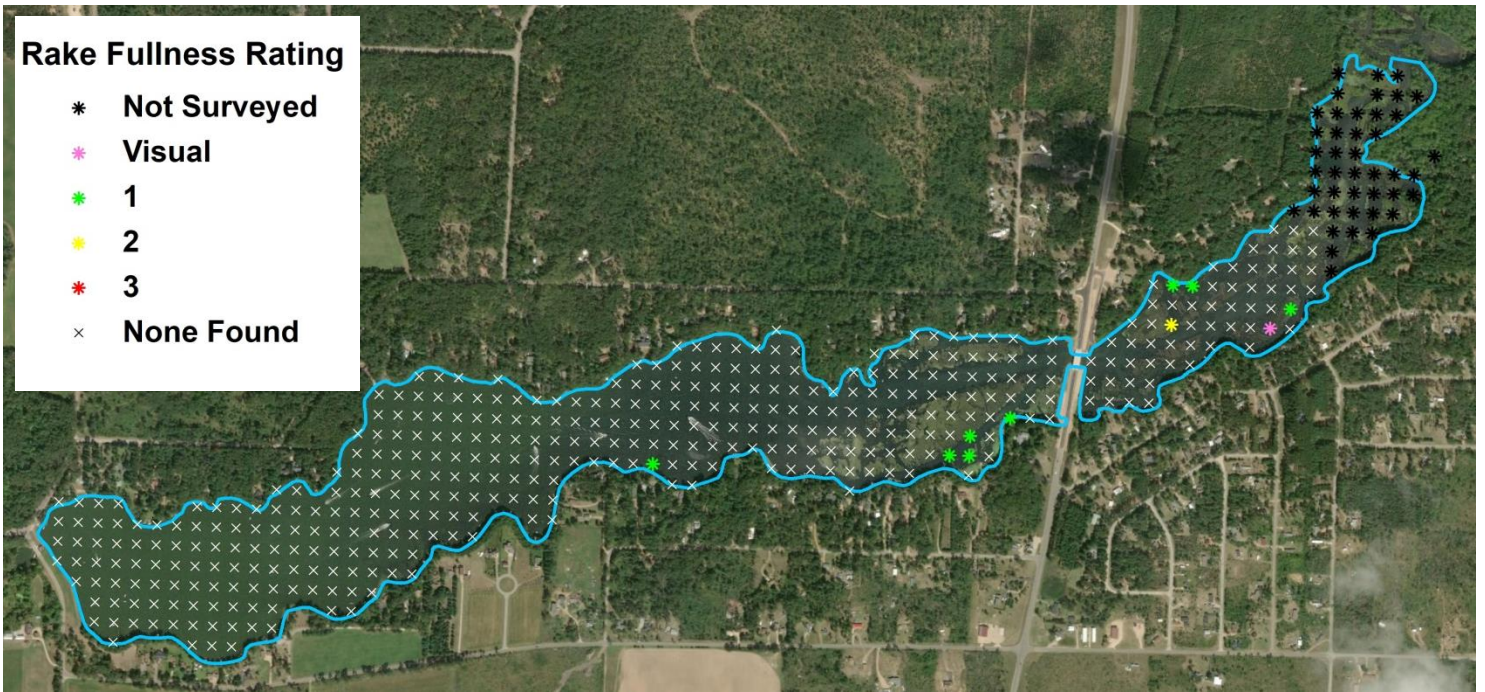


Figure 11. Mid-August 2008 Curly-leaf Pondweed Locations in Big Roche A Cri (2008 Data Collected by Wisconsin Department of Natural Resources) (Map Credit: Endangered Resource Services, LLC)

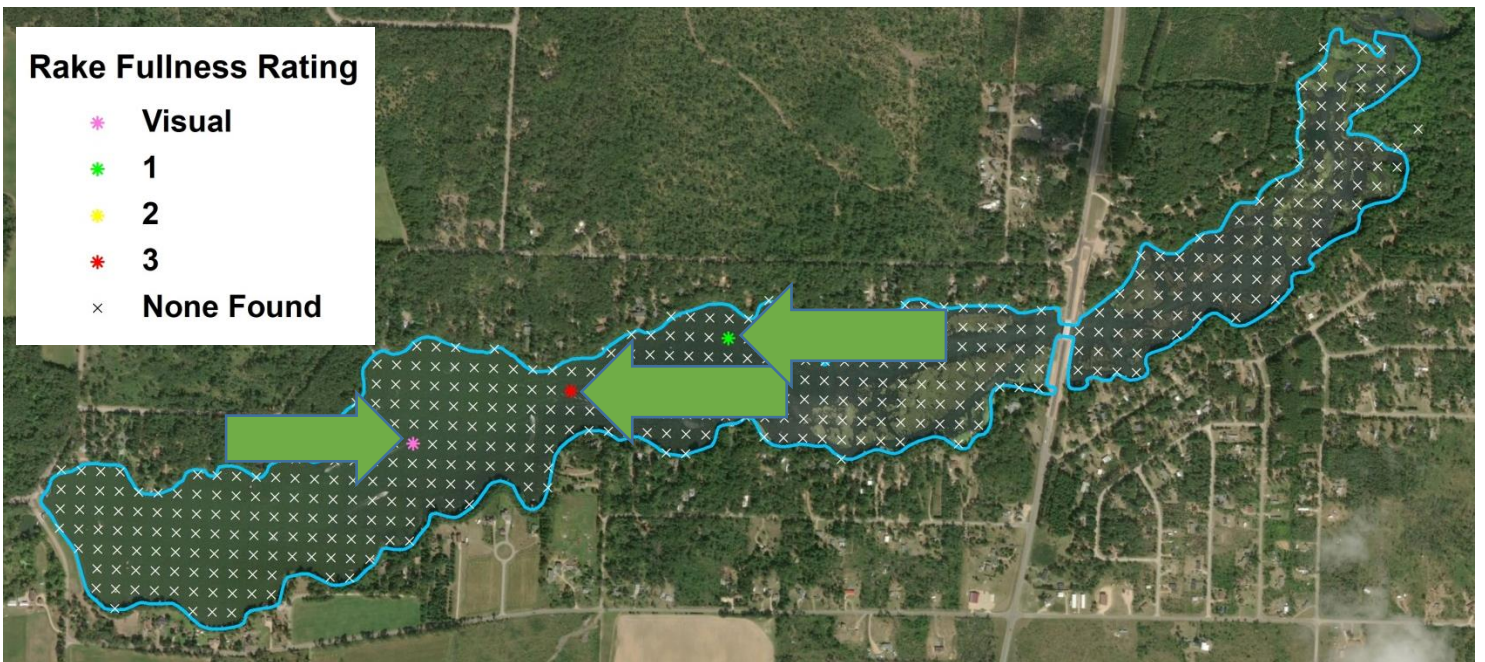


Figure 12. May 25, 2019 Eurasian watermilfoil Locations in Big Roche A Cri (Map Credit: Endangered Resource Services, LLC)

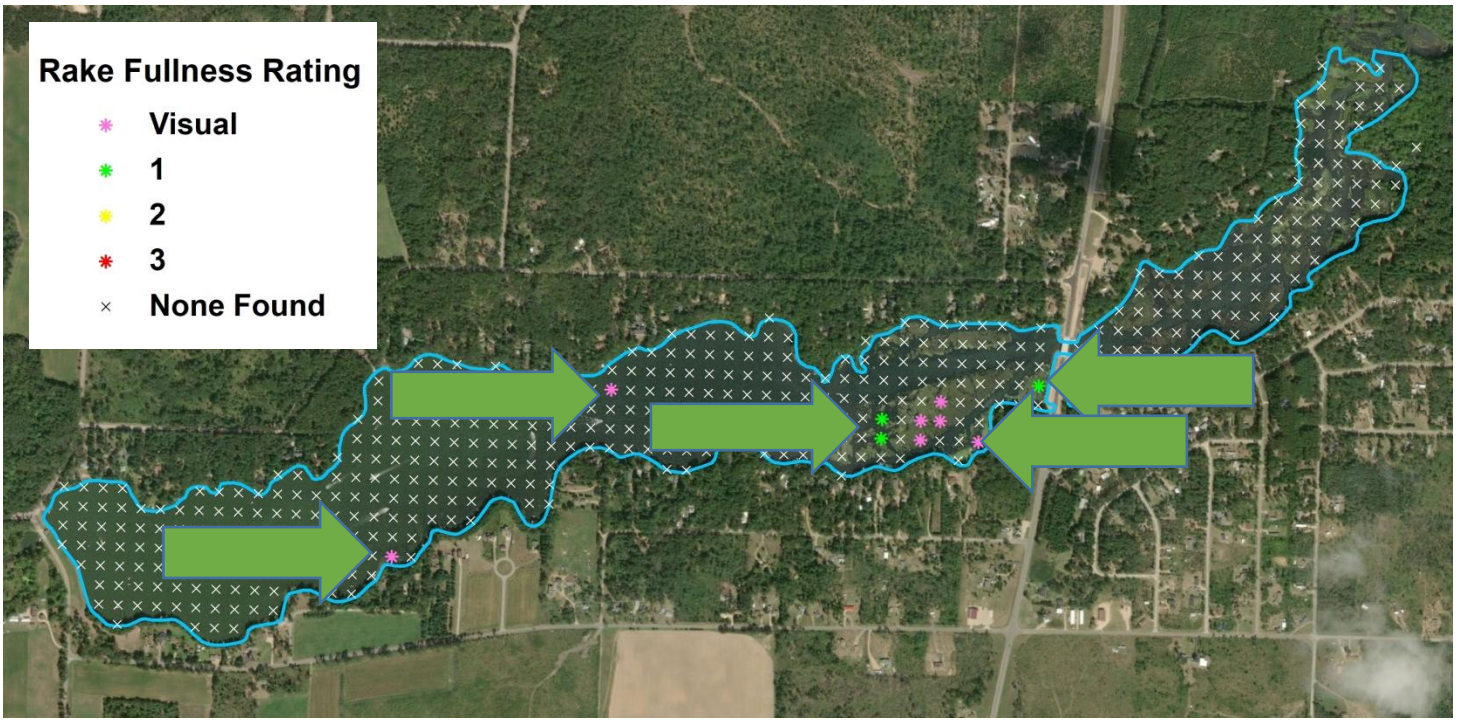


Figure 13. July 31, 2019 Eurasian watermilfoil Locations in Big Roche A Cri (Map Credit: Endangered Resource Services, LLC)

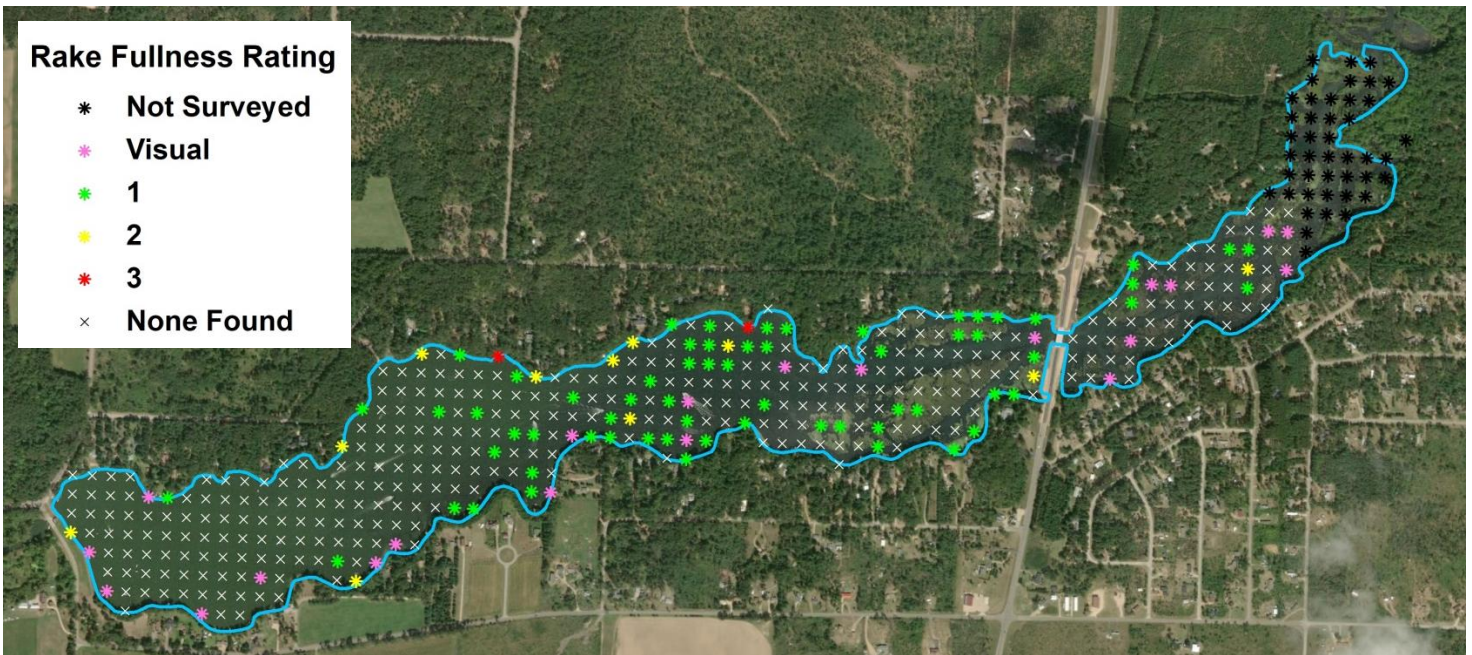


Figure 14. Mid-August 2008 Eurasian watermilfoil Locations in Big Roche A Cri (2008 Data Collected by Wisconsin Department of Natural Resources) (Map Credit: Endangered Resource Services, LLC)