Anderson Lake

Oconto County, Wisconsin

2021-2023 Final EWM
Management & Monitoring Report

January 2024

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1.0 INTRODUCTION

Anderson Lake, Oconto County, is a 177-acre drainage lake with a maximum depth of 40 feet (Figure 1.0-1). A small dam exists on the lake's outlet (Weso Creek) before draining into the Oconto River, downstream of Chute Pond. The public has access to the lake via a boat launch on the north shoreline near the dam.

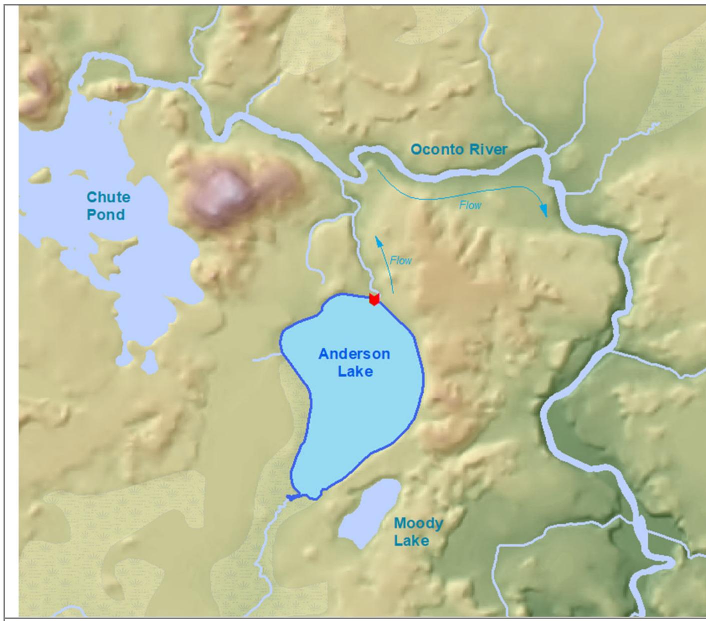


Figure 1.0-1. Anderson Lake, Oconto County, WI..

Eurasian watermilfoil (EWM) was initially discovered in Anderson Lake in 2015. In mid-August 2015, regional staff from the Wisconsin Department of Natural Resources (WDNR) conducted a point-intercept survey, identifying EWM at a specific sampling location. Subsequently, a rise in the EWM population in the summers of 2016 and 2017 was observed. In the late summer of 2017, Onterra carried out a meander-based EWM mapping survey, confirming the presence of colonized EWM and individual EWM plants in various parts of the lake's littoral area. At the time of EWM's discovery, Anderson Lake Association (ALA) was the citizen-led organization overseeing management activities on Anderson Lake. Following the creation of the Anderson Inland Lake District in 2023, EWM management on the lake is now being transitioned to the responsibility of the district.

The ALA outlined a three year project targeting the management of Eurasian watermilfoil. The project was initiated with *year before treatment* monitoring and planning activities occurring in 2021. With Onterra's assistance, the ALA received over $44,000 in grant funds to cost-share management and monitoring efforts in 2021-2023. This included a whole-lake herbicide treatment in early spring 2022. This final report details the efforts conducted during this three-year project, serving as the final grant deliverable for ACEI-266-21.

1.1 Recent EWM Management and Monitoring History

Following the discovery of EWM in Anderson Lake, the ALA utilized funds from the WDNR Aquatic Invasive Species (AIS) Early Detection and Response Grant (AIRR-232-18) to implement manual removal methods targeting EWM. Despite multiple trials conducted over several years, it became apparent that a hand harvesting approach would not significantly alter the overall trajectory of the EWM population in the lake.

Oconto County collaborated with the University of Wisconsin – Stevens Point to develop lake management strategies for numerous lakes in the county, including Anderson Lake. While these strategies provided valuable foundational research and management recommendations, they lacked a precise aquatic plant control plan, a requirement for grant eligibility. In response, the ALA partnered with Onterra to address this gap and develop a WDNR-approved *Aquatic Plant Management Plan*.

Onterra outlined a detailed EWM control and monitoring Plan for the ALA in a report issued in March 2020. The Plan outlined the ALA's intended EWM management strategy, incorporating a whole-lake herbicide treatment, with subsequent hand harvesting actions as part of a comprehensive, long-term integrated pest management strategy. The Plan also expressed the ALA's intention to apply for an AIS Control grant in the fall of 2020 to secure funding for implementing the EWM management plan. With some additional nuance, APM Plans are generally good for five years, with the ALA needing to consider their next APM Plan update in 2025.

During the November 2020 grant cycle, with Onterra's support, the ALA successfully secured a 3-year WDNR AIS-Established Population Control Grant. This grant included a dedicated plan for controlling and monitoring Eurasian watermilfoil (EWM), involving a whole-lake 2,4-D amine herbicide treatment in the second year of the project in 2022. No active EWM management occurred in 2021, during which pretreatment data was collected through a whole-lake point-intercept survey and a late-summer EWM mapping survey.

1.2. 2022 EWM Herbicide Treatment Summary

In the winter/spring of 2022, supply shortages and escalating costs of 2,4-D prompted the ALA and project partners to explore alternatives for managing EWM on a whole-lake scale in 2023. Following thorough reviews of evolving best management practices, herbicide risk assessments, and discussions involving the ALA, herbicide applicator, WDNR, and Onterra, it was decided to use florpyrauxifen-benzyl, the active ingredient in ProcellaCOR™ instead of 2,4-D amine in the 2022 EWM management strategy. While traditionally used for spot treatments, Onterra recently adopted ProcellaCOR™ as a whole-lake or whole-basin treatment option on various Wisconsin lakes. The 2022 herbicide treatment strategy included applying ProcellaCOR at 2.75 prescription dose units (PDUs)/acre-ft across seven areas totaling 32 acres (Map 1). The herbicide application was completed during the morning of June 7, 2022 by Schmidt's Aquatic, LLC. Details of the 2022 herbicide treatment strategy development, implementation, and *year of treatment* monitoring results are included within the *Anderson Lake 2022 EWM Management & Monitoring Report* (Jan 2023).

Aquatic vegetation monitoring form this treatment would include comparative late-season EWM Mapping Surveys and whole-lake point-intercept surveys being completed the *year prior to treatment* (2021), *year of treatment* (2022), and *year after treatment* (2023) (Maps 2 and 3).

The calculated potential whole-lake concentration was approximately 0.5-0.6 ppb of florpyrauxifen-benzyl, with the initial measured concentrations of this active ingredient meeting these predictions within the application areas but falling short in the center of the lake monitoring location. The active ingredient concentration decreased to near zero by 14 days after treatment. Florpyrauxifen acid, the primary measured breakdown product, remained above detection limits through the duration of the post treatment monitoring with measured concentrations near 0.2 ppb at 28 days after treatment. It is not known the duration for which the acid remained above detection limits; however, more recent monitoring in other lakes in Wisconsin has shown the acid can remain detectable through ten weeks after treatment. It is unclear the role of which florpyrauxifen acid plays in contributing towards EWM impacts and this continues to be a topic of further study in the state. Details of the herbicide concentration monitoring results were reported on in the *2022 EWM Management and Monitoring Report* (Jan 2023).

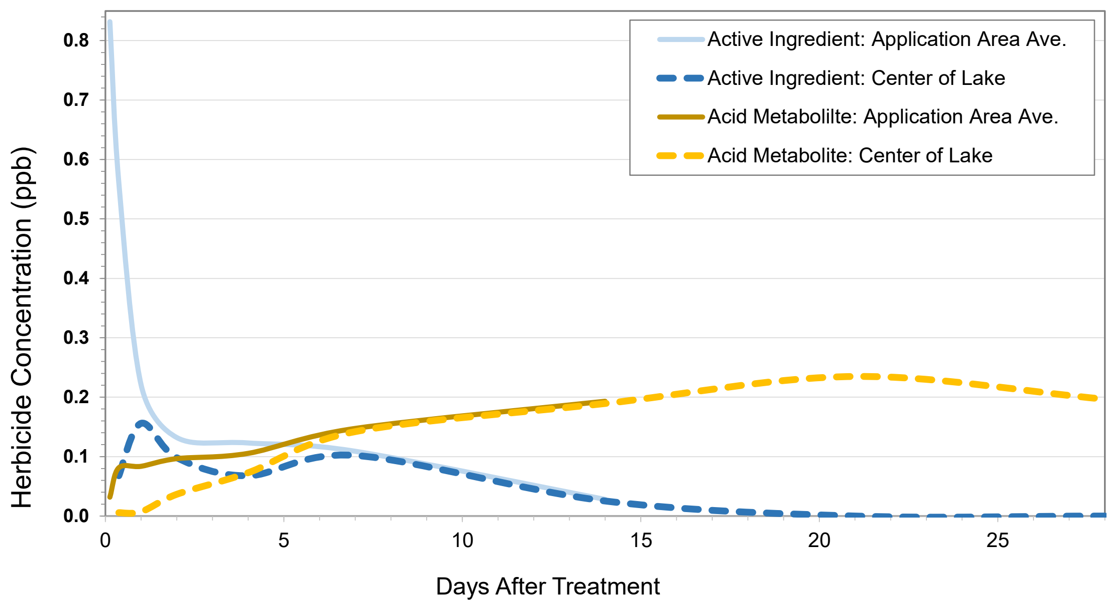


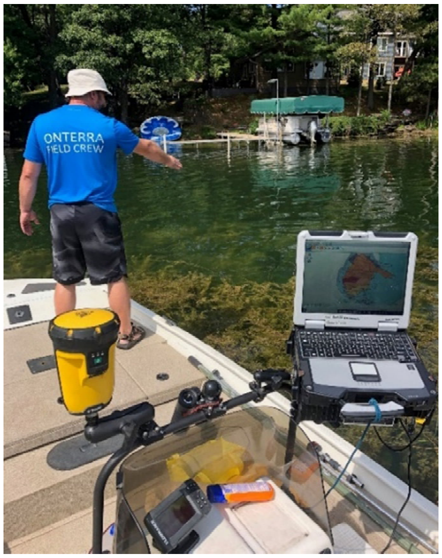
Figure 1.2-1. Anderson Lake 2021 herbicide concentrations. Active ingredient: Florpyrauxifen-benzyl, Acid metabolite: Florpyrauxifen acid

2.0 2023 MONITORING SURVEY RESULTS

It is important to note that two types of surveys are discussed in the subsequent materials: 1) point-intercept surveys (Photograph 2.0-2) and 2) HWM mapping surveys (Photograph 2.0-1). The point-intercept survey provides a standardized way to gain quantitative information about a lake's aquatic plant population through visiting predetermined locations and using a rake sampler to identify all the plants at each location. The survey methodology allows comparisons to be made over time, as well as between lakes. The point-intercept survey can be applied at various scales. The point-intercept survey is most often applied at the whole-lake scale. The whole-lake point-intercept survey has been conducted on Anderson Lake in 2015, 2019, 2021, 2022, and 2023.

While the point-intercept survey is a valuable tool to understand the overall plant population of a lake, it does not offer a full account (census) of where a particular species exists in the lake. During the EWM mapping survey, the entire littoral area of the lake is surveyed through visual observations from the boat (Photograph 2.0-1). Field crews supplement the visual survey by deploying a submersible camera along with periodically doing rake tows. The EWM population is mapped using sub-meter GPS technology by using either 1) point-based or 2) area-based methodologies. Large colonies >40 feet in diameter are mapped using polygons (areas) and are qualitatively attributed a density rating based upon a five-tiered scale from *highly scattered* to *surface matting*. Point-based techniques were applied to AIS locations that were considered as *small plant colonies* (<40 feet in diameter), *clumps of plants*, or *single or few plants*.

Overall, each survey has its strengths and weaknesses, which is why both are utilized in different ways as part of this project.



Photograph 2.0-1. HWM mapping survey on a Wisconsin lake. Photo credit Onterra.

Photograph 2.0-2. Point-intercept survey on a Wisconsin lake. Photo credit Onterra.

2.1 Quantitative Monitoring: Whole-Lake Point-Intercept Survey

The point-intercept method as described in the WDNR publication (WDNR PUB-SS-1068 2010) was used to complete this study. A point spacing of 39 meters was used resulting in 469 total sampling locations, with between 90-120 sampling locations being located within the littoral zone during the period of study (Figure 2.1-1). The maximum depth of plants has fluctuated from a maximum of 10-14 feet within these surveys. This survey allows for a quantitative analysis of the aquatic plant community in the lake and is directly comparable to past or future surveys completed with the same methodology. Onterra ecologists completed a whole-lake point-intercept survey on Anderson Lake on August 1, 2023. The results of the 2023 point-intercept survey are highlighted below as well as a comparison of the five surveys that have been completed to date.

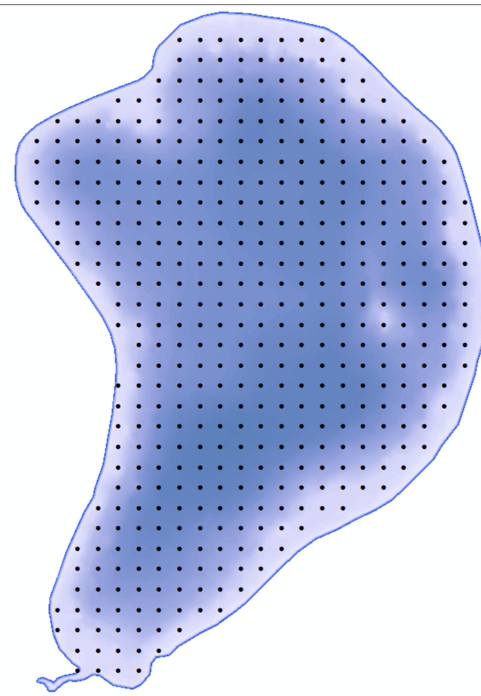


Figure 2.1-1. Anderson Lake point-intercept survey sampling locations.

Species List

In total, 40 species have been recorded from Anderson Lake over the course of these five surveys, with 30 having a submergent growth form (Table 2.1-1). The list also contains the species' scientific name, common name, status in Wisconsin, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in growth forms that are present, can be an early indicator of changes in the ecosystem.

Table 2.1-1. Aquatic plant species located in Anderson Lake during point-intercept surveys.

Growth Form	Scientific Name	Common Name	Status in Wisconsin	Coefficient of Conservatism	2015	2019	2021	2022	2023
Emergen	*Eleocharis palustris*	Creeping spikerush	Native	6		X	X		
	Pontederia cordata	Pickerelweed	Native	9		X		X	
	Schoenoplectus acutus	Hardstem bulrush	Native	5		X	X	X	X
FL	*Brasenia schreberi*	Watershield	Native	7	X	X	X	X	X
	Nuphar variegata	Spatterdock	Native	6	X	X	X	X	X
	Nymphaea odorata	White water lily	Native	6	X	X	X	X	X
	Sparganium fluctuans	Floating-leaf bur-reed	Native	10	X		X	X	X
Submergent	*Bidens beckii*	Water marigold	Native	8	X	X	X	X	
	Ceratophyllum demersum	Coontail	Native	3	X	X	X	X	X
	Chara spp.	Muskgrasses	Native	7	X	X	X	X	X
	Elodea canadensis	Common waterweed	Native	3	X	X	X	X	X
	Elodea nuttallii	Slender waterweed	Native	7		X		X	X
	Heteranthera dubia	Water stargrass	Native	6	X	X	X	X	
	Isoetes spp.	Quillwort spp.	Native	8		X	X		
	Myriophyllum sibiricum	Northern watermilfoil	Native	7	X	X	X		
	Myriophyllum spicatum	Eurasian watermilfoil	Non-Native - Invasive	N/A	X	X	X		
	Najas flexilis	Slender naiad	Native	6	X	X	X	X	X
	Nitella spp.	Stoneworts	Native	7	X	X	X	X	X
	Potamogeton amplifolius	Large-leaf pondweed	Native	7	X	X	X	X	X
	Potamogeton berchtoldii	Slender pondweed	Native	7			X		X
	Potamogeton berchtoldii & P. pusillus	Slender and small pondweed	Native	7		X	X	X	X
	Potamogeton epihydrus	Ribbon-leaf pondweed	Native	8	X	X	X		X
	Potamogeton foliosus	Leafy pondweed	Native	6	X		X		X
	Potamogeton friesii	Fries' pondweed	Native	8	X	X	X		X
	Potamogeton gramineus	Variable-leaf pondweed	Native	7	X	X	X	X	X
	Potamogeton illinoensis	Illinois pondweed	Native	6	X	X			X
	Potamogeton natans	Floating-leaf pondweed	Native	5		X		X	X
	Potamogeton praelongus	White-stem pondweed	Native	8	X	X	X	X	X
	Potamogeton pusillus	Small pondweed	Native	7		X	X	X	X
	Potamogeton richardsonii	Clasping-leaf pondweed	Native	5	X	X	X	X	X
	Potamogeton robbinsii	Fern-leaf pondweed	Native	8				X	
	Potamogeton strictifolius	Stiff pondweed	Native	8		X	X		X
	Potamogeton zosteriformis	Flat-stem pondweed	Native	6	X	X	X	X	X
	Sagittaria sp. (rosette)	Arrowhead sp. (rosette)	Native	N/A	X	X			X
	Stuckenia pectinata	Sago pondweed	Native	3	X	X		X	X
	Utricularia minor	Small bladderwort	Native	10	X	X	X	X	X
	Utricularia vulgaris	Common bladderwort	Native	7	X	X	X		X
	Vallisneria americana	Wild celery	Native	6	X	X	X	X	X
S/E	*Eleocharis acicularis*	Needle spikerush	Native	5	X	X	X	X	X
	Eleocharis acicularis & Schoenoplectus subterminalis	Needle spikerush & water bulrush	Native	N/A	X	X	X	X	X
	Schoenoplectus subterminalis	Water bulrush	Native	9		X	X		X
FF	*Lemna trisulca*	Forked duckweed	Native	6		X	X		

X = Located on rake during point-intercept survey; I = Incidentally located; not located on rake during point-intercept survey
FL = Floating-leaf; F/L = Floating-leaf & Emergent; S/E = Submergent and/or Emergent; FF = Free-floating

Frequency of Occurrence

Littoral frequency of occurrence is used to describe how often each species occurred in the points that are within the maximum depth of plant growth (littoral zone), and is displayed as a percentage. Figure 2.1-2 displays the littoral frequency of occurrence of aquatic plants located in the 2023 point-intercept survey. A total of 31 species were physically encountered on the survey rake during the 2023 survey with muskgrasses, wild celery, and slender naiad being the most-frequently encountered native aquatic plant species. The maximum depth of plant growth in the 2023 survey was 11 feet compared to 14 feet in 2021; however, EWM was the only species sampled in depths greater than 10 feet in the 2021 survey.

The littoral frequency of occurrence of aquatic plants for each of the five point-intercept surveys that have taken place in Anderson Lake are included within Appendix A of this report. Figure 2.1-2 looks at the most frequently encountered plants in Anderson Lake from the *year prior to treatment* (2021), the *year of treatment* (2022), and the *year after treatment* (2023). Four native aquatic plant species exhibited statistically valid decreases in occurrence between the *pretreatment survey* (2021) and the *year after treatment* (2023) including northern watermilfoil, watershield, water marigold, and water stargrass. Clasping-leaf pondweed, slender/small pondweed, and stoneworts exhibited valid increase in occurrence over the same time period while many other species did not show a statistically valid change.

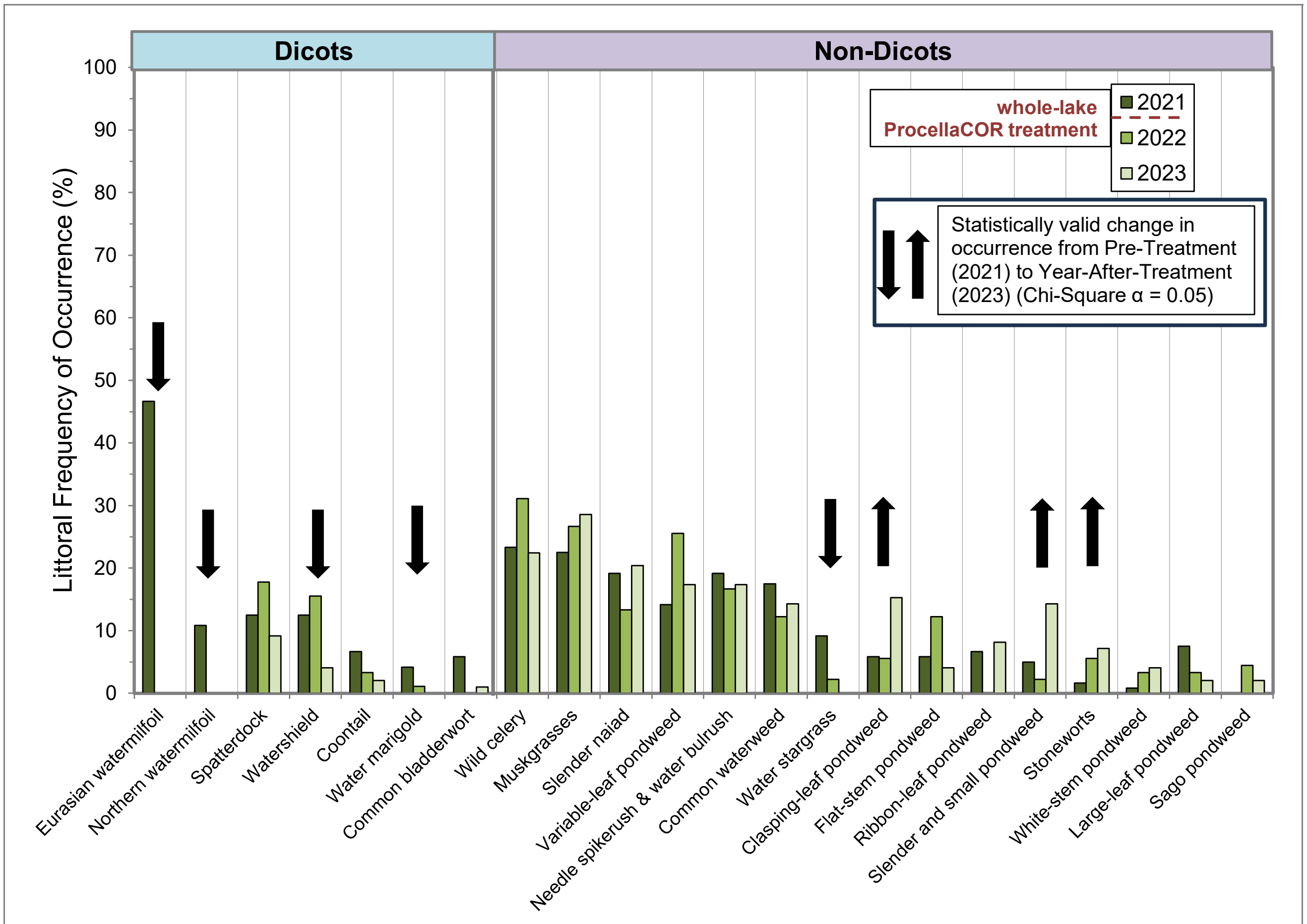


Figure 2.1-2. 2021, 2022, and 2023 Littoral Frequency of Occurrence of aquatic plant species in Anderson Lake.

EWM was found at 56 of the sampling locations during the 2021 point-intercept survey resulting in a littoral frequency of occurrence of 46.7%, making it the most frequently encountered species at that time. EWM was present on over 90% of the sampling locations that were between 6-7 feet of water depth and was the only species found to be growing beyond 10 feet of depth in the 2021 survey. Following the spring 2022 ProcellaCOR™ herbicide treatment, the occurrence of EWM was reduced to 0% in the 2022 and remained at 0% in the 2023 survey (Figure 2.1-3).

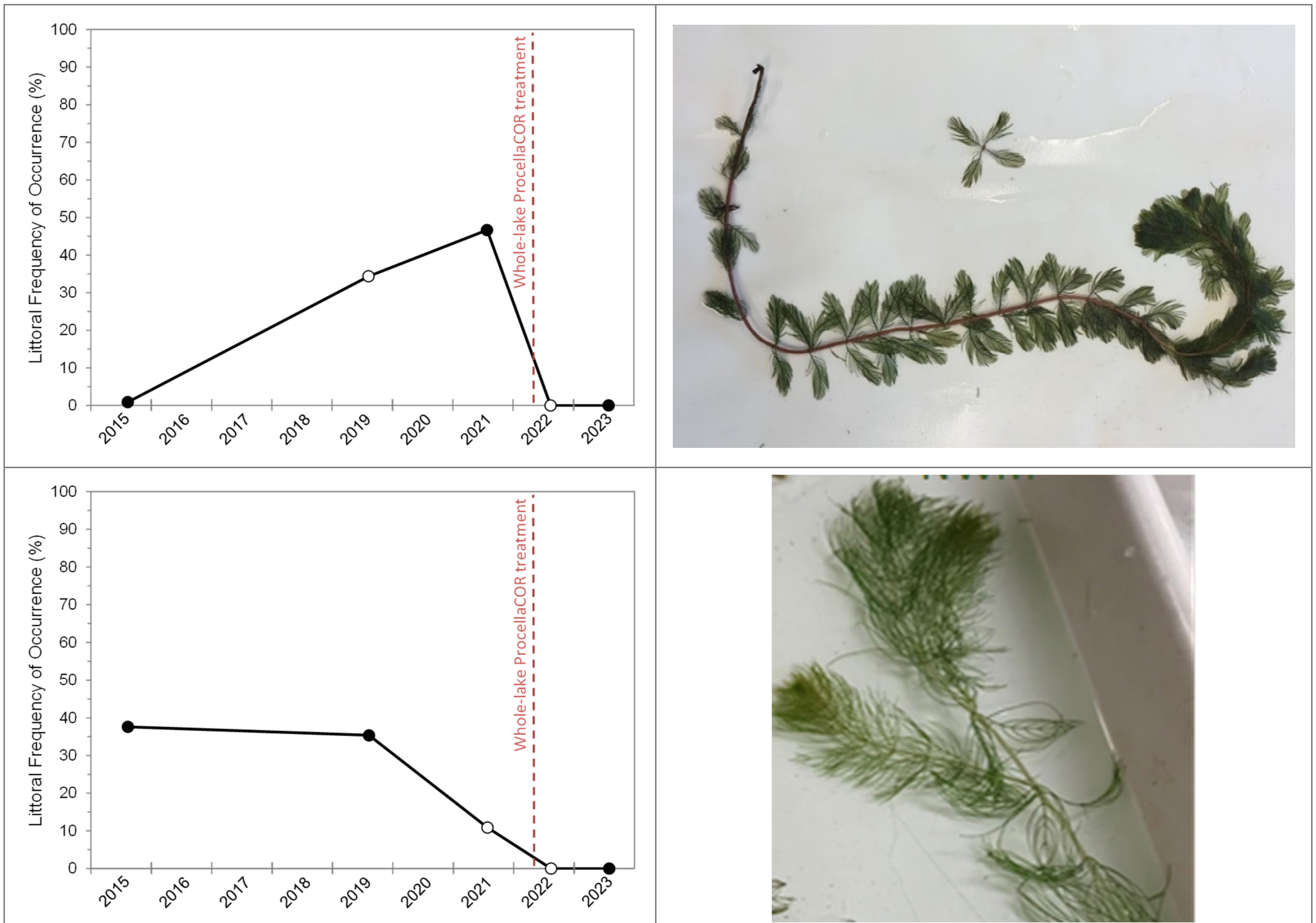


Figure 2.1-3. Littoral frequency of occurrence of EWM (top) and Northern watermilfoil (bottom). Open circle represents statistically valid change from previous survey (Chi-Square α = 0.05). Photo credit Onterra.

Northern watermilfoil was one of the most frequently encountered species in Anderson Lake during the 2015 and 2019 point-intercept survey (37.6% and 35.4% respectively). The occurrence of northern watermilfoil exhibited a statistically valid decrease in occurrence between 2019-2021 during a period of no herbicide management and increased EWM growth (Figure 2.1-3). Northern watermilfoil has typically been found to be growing in the same locations as EWM making it likely that these species are competing with one another within the lake. This species has shown to be highly susceptible to ProcellaCOR™ treatments with the occurrence typically reduced to zero or near-zero following treatment with little signs of recovery in the following year. Northern watermilfoil was not located in Anderson Lake during the 2022 or 2023 post treatment point-intercept surveys resulting in a statistically valid 100% decrease in occurrence since 2021.

Similar to northern watermilfoil, water marigold and coontail populations decreased by relatively substantial amounts over time prior to treatment. After the 2022 treatment, water marigold declined from 4.2% in 2021 to 1.1% in 2022 and declined further to 0.0% in 2023. Coontail was reduced from 6.7% in 2021 to 3.3% in 2022 and declined further to 2.0% in 2023.

Bladderworts (*Utricularia* spp.) are *insectivorous*, meaning they supplement their nutrient demand by trapping and digesting small insects and crustaceans. These plants possess small sac-like bladders containing small hairs, which when touched by unsuspecting prey trigger a door on the trap to open rapidly drawing in water and the insect. Trapped within the bladder, the insect is slowly digested. Two species of bladderworts are known from Anderson Lake, common bladderwort and small bladderwort (*U. minor*). Small bladderwort populations declined slightly from 3.3% in 2021 to 1.0% in 2023 and common bladderwort was reduced from 5.8% in 2021 to zero in 2022 but was found at 1.0% in 2023 (Figure 2.1-4). While water stargrass is a monocot plant, ongoing studies are indicating impact from ProcellaCOR™ treatments. Water stargrass declined from 9.2% in 2021 to 2.2% in 2022 and declined further to 0% in 2023.

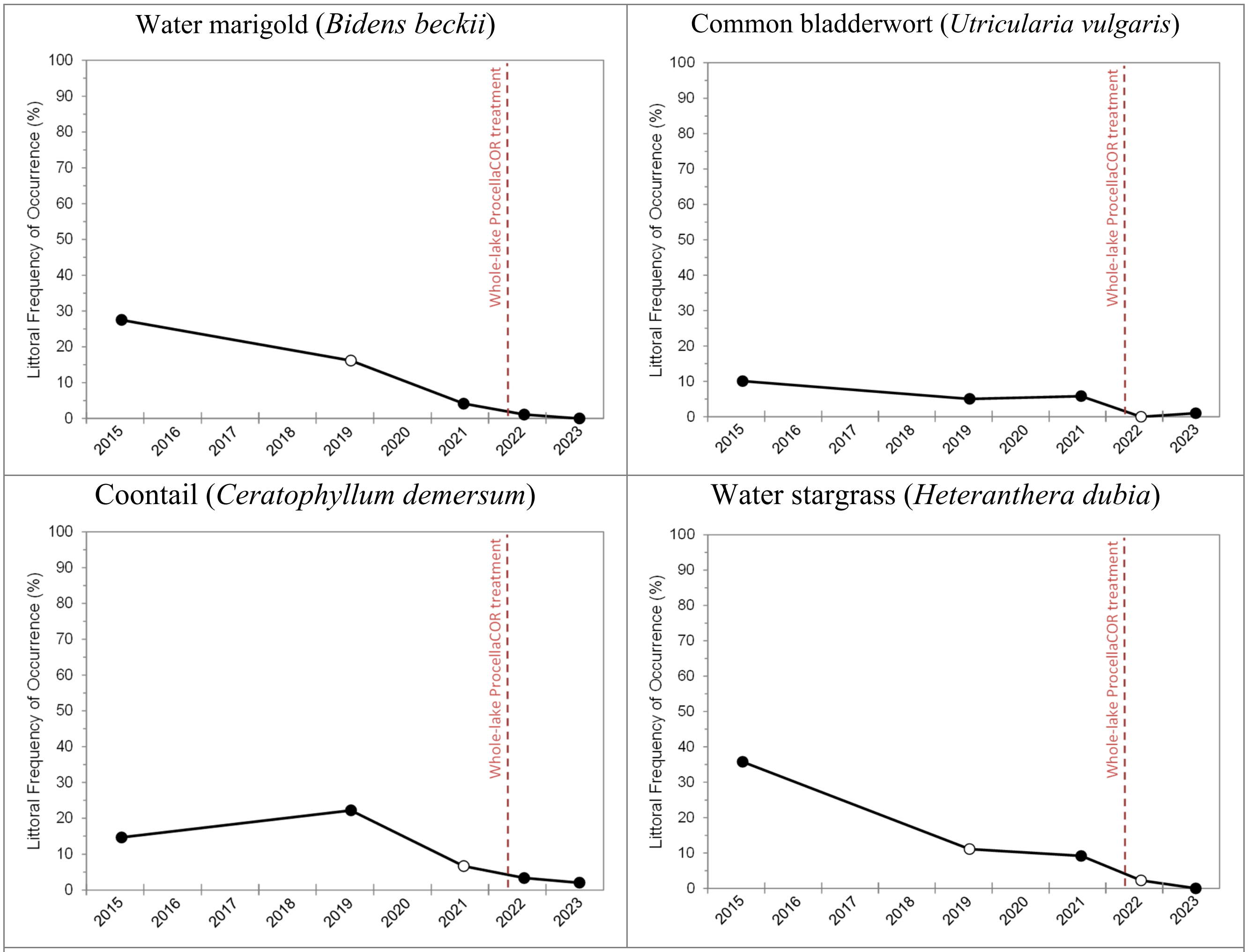


Figure 2.1-4. Littoral frequency of occurrence of select aquatic plant species from point-intercept surveys. Open circle represents statistically valid change in occurrence from previous survey.

Wild celery was the second-most frequently encountered native aquatic plant in 2023 with a littoral frequency of occurrence of 22.4% (Figure 2.1-5). Wild celery is relatively tolerant of low-light conditions and is able to grow in deeper water. Wild celery produces long, grass-like leaves which extend in a circular fashion from a basal rosette. The leaves, fruits, and winter buds of wild celery are food sources for numerous species of waterfowl and other wildlife and are an important component of the Anderson Lake ecosystem. The occurrence of wild celery has remained relatively stable between the 2021 and 2023 surveys (Figure 2.1-5). Wild celery typically emerges later in the growing season than many other native species which may limit its potential to be impacted by early season herbicide use patterns.

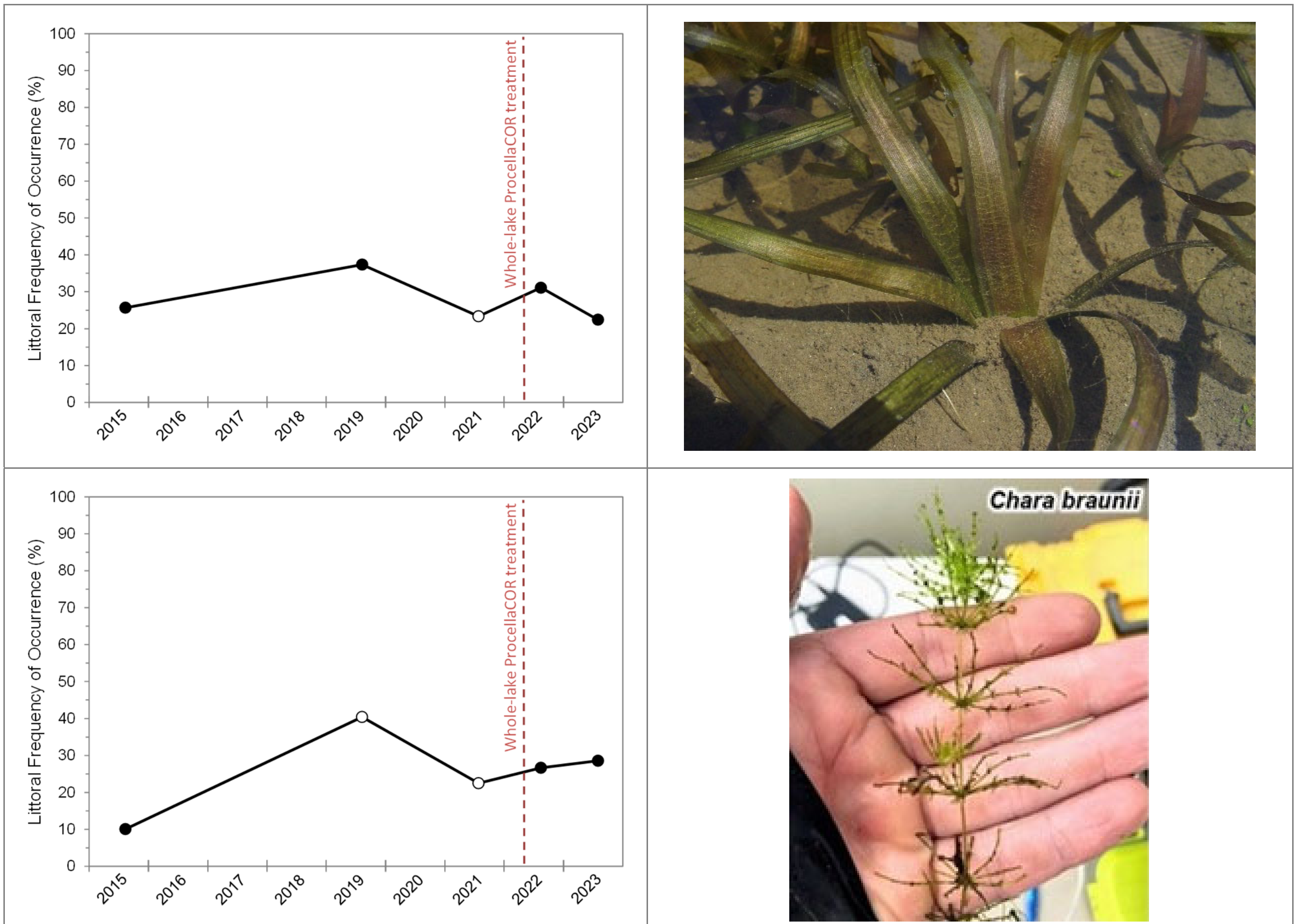


Figure 2.1-5. Littoral frequency of occurrence of wild celery (top) and muskgrasses (bottom). Open circle represents statistically valid change from previous survey (Chi-Square α = 0.05). Photo credit Onterra.

Muskgrasses were the most frequently encountered native plant in Anderson Lake, being located in 2023 at 28.6% of the sampling points within the littoral zone (Figure 2.1-5). Muskgrasses require lakes with good water clarity, and their large beds stabilize bottom sediments. Studies have also shown that muskgrasses sequester phosphorus in the calcium carbonate incrustations which form on these plants, aiding in improving water quality by making the phosphorus unavailable to phytoplankton (Coops 2002). The change in occurrence of muskgrasses was not statistically different between the 2021, 2022, and 2023 surveys as this species is typically not impacted by herbicide treatments targeting EWM (Figure 2.1-5).

Floristic Quality Assessment

The floristic quality of a lake's aquatic plant community is calculated using its native *species richness* and their *average conservatism*. Species richness is the number of native aquatic plant species that were physically encountered on the rake during the point-intercept survey. Average conservatism is calculated by taking the sum of the coefficients of conservatism (C-values) of the native species located and dividing it by species richness. Every plant in Wisconsin has been assigned a coefficient of conservatism, ranging from 1-10, which describes the likelihood of that species being found in an undisturbed environment. Species which are more specialized and require undisturbed habitat are given higher coefficients, while species which are more tolerant of environmental disturbance have lower coefficients. Higher average conservatism values generally indicate a healthier lake as it is able to support a greater number of environmentally-sensitive aquatic plant species. Low average conservatism values indicate a degraded environment, one that is only able to support disturbance-tolerant species.

On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality. The floristic quality is calculated using the species richness and average conservatism value of the aquatic plant species that were solely encountered on the rake during the point-intercept surveys (equation shown below). This assessment allows the aquatic plant community of Anderson Lake to be compared to other lakes within the region and state.

$$\text{FQI} = \text{Average Coefficient of Conservatism} * \sqrt{\text{Number of Native Species}}$$

Data collected during the aquatic plant surveys was also used to complete a Floristic Quality Assessment (FQA) which incorporates the number of native aquatic plant species recorded on the rake during the point-intercept survey and their average conservatism. The data used for these calculations does not include any incidental species (visual observations) but only considers plants that were sampled on the rake during the point-intercept survey. Figure 2.1-6 displays the species richness, average conservatism, and floristic quality of Anderson Lake along with ecoregion and state median values.

Anderson Lake's native plant species richness values range from 26-35 and are all well above the median values for lakes within the NLFL ecoregion (21) and lakes across Wisconsin (19). In 2022 the species richness fell from 32 in 2021 to 26 in 2022 which was the year of treatment. Some of these species not observed in 2022 were quillwort spp., northern watermilfoil, ribbon-leaf pondweed, leafy pondweed, fries' pondweed, common bladderwort, and stiff pondweed. Northern watermilfoil was an anticipated population decline but the other species are not known to be susceptible to ProcellaCOR treatments in Onterra's experience.

Anderson Lake's average species conservatism has ranges between 6.4-6.7 in all surveys falling at or below the ecoregion median (6.7) and slightly above the state median (6.3). Using the species richness and average conservatism values, Anderson Lake's Floristic Quality Index has been above the ecoregion and state medians in all years with the 2023 value being the third highest of any survey at 36.8.

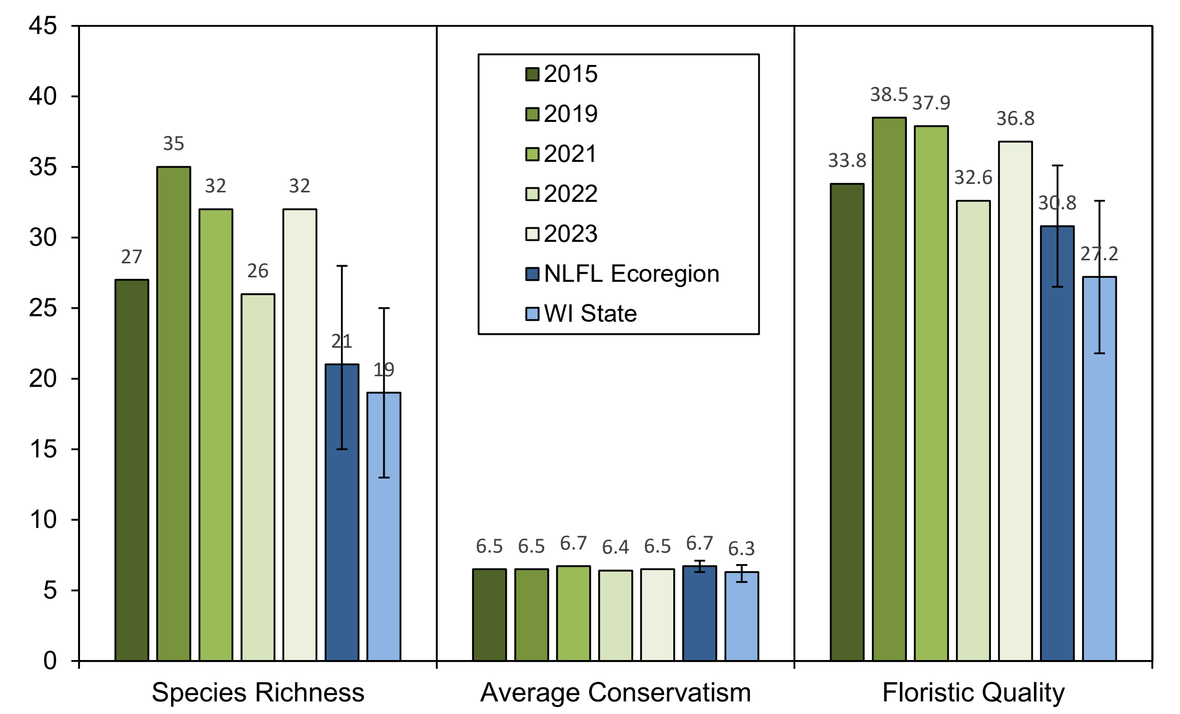


Figure 2.1-6. Anderson Lake Floristic Quality Assessment. Created using data from point-intercept surveys. Analysis following Nichols (1999) where NLFL = Northern Lakes & Forests - Lakes Ecoregion.

Species Diversity

Species diversity is often confused with species richness. Species richness is simply the number of species found within a given community. While species diversity utilizes species richness, it also takes into account evenness or the variation in abundance of the individual species within the community. For example, a lake with 10 aquatic plant species that had relatively similar abundances within the community would be more diverse than another lake with 10 aquatic plant species were 50% of the community was comprised of just one or two species.

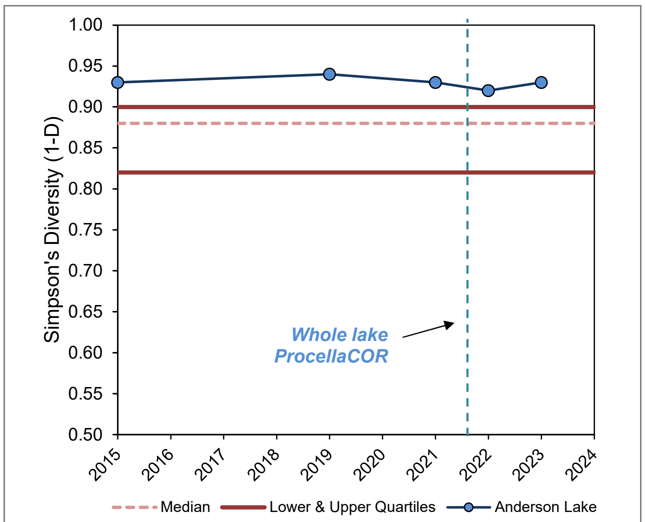


Figure 2.1-7. Anderson Lake Simpson's Diversity Index. Created using data from point-intercept surveys.

If a lake has a diversity index value of 0.90, it means that if two plants were randomly sampled from the lake there is a 90% probability that the two individuals would be of a different species. The Simpson's Diversity Index value from Anderson Lake is compared to data collected by Onterra and the WDNR Science Services on lakes within the Northern Lakes and Forests ecoregion and on lakes throughout Wisconsin (Figure 2.1-7). While a method for characterizing diversity values of fair, poor, etc. does not exist, lakes within the same ecoregion may be compared to provide an idea of how Anderson Lake's diversity values rank. Anderson Lake's Simpson's Diversity Index value has been consistent at 0.92-0.94 over the course of the four point-intercept surveys, falling above the ecoregion upper quartile.

Additional Aquatic Plant Metrics

Figure 2.1-8 displays number of sampling locations that contained native plants, EWM and native plants, or EWM only from the point-intercept surveys. These data indicate the expanding EWM population as the sampling points with EWM increased from 1 in 2015 to 34 in 2019 and 56 in 2021. After the spring 2022 herbicide treatment, EWM was not present on any sampling sites. The number of sampling points containing native plants decreased somewhat during the year of treatment from 90 to 76 before increasing to 88 sampling locations in 2023.

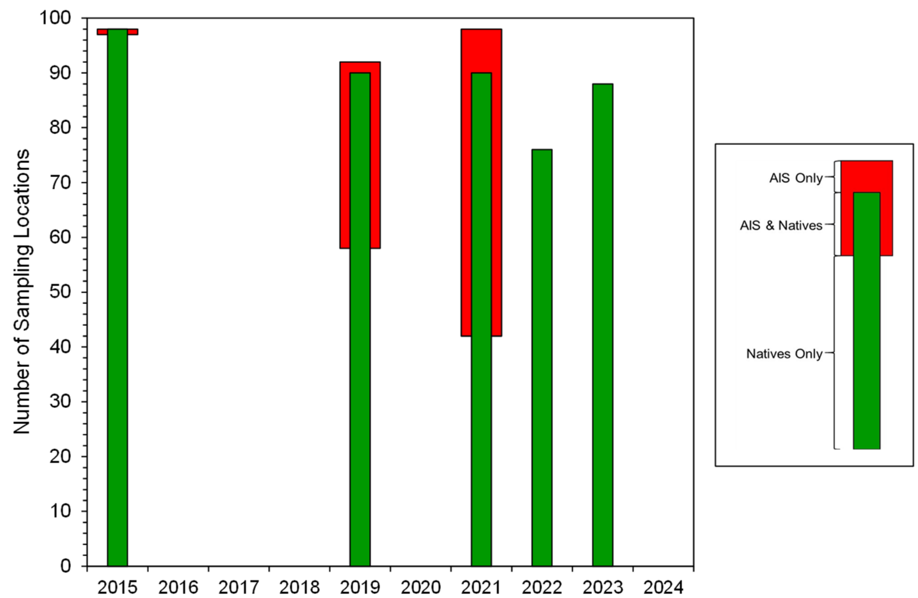


Figure 2.1-8. Number of Point-Intercept Survey Locations with Native Species and/or EWM in Anderson Lake. Created using data from 2015-2023 point-intercept surveys.

Another metric that assesses the native plant community in the lake over time is through comparing the average number of native plant species per sampling location from the point-intercept surveys. In Anderson Lake, 2.97 species per/point were present during the 2015 point-intercept survey, compared to 3.47 in 2019 (Figure 2.1-9). From 2019 to 2021, this value decreased to 2.26 species per sampling point. This value was relatively unchanged during the year of treatment with 2.24 species present per point in 2022, and decreased slightly during 2023 to 2.14. Overall, these data show fewer

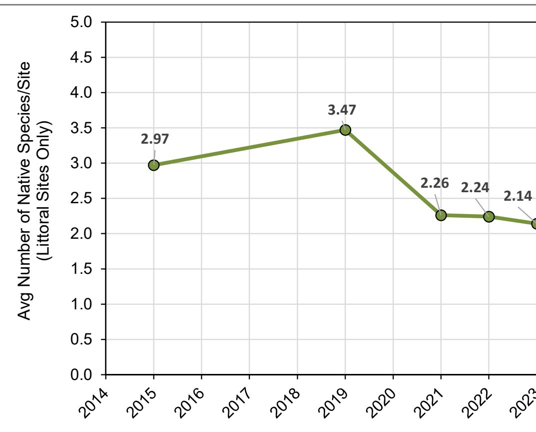


Figure 2.1-9. Anderson Lake Number of Native Aquatic Plant Species per Sampling Site. Created using data from 2015-2023 point-intercept surveys.

native species per point in the past three years compared to earlier surveys.

2.2 Qualitative Monitoring: EWM Mapping Surveys

The efficacy of the 2022 herbicide treatment strategy on EWM were also evaluated through comparative Late-Summer EWM Mapping Surveys conducted before and after treatment. The pretreatment EWM population was documented on an August 19, 2021 mapping survey which showed a nearly contiguous EWM colony of variable densities around the lake (Map 1). The growth of the EWM colonies was limited by water depth on the lakeward side of the colonies and the population was generally sparse in shallower waters near riparian docks, with exception of an area on the northern shoreline where dense EWM extended all the way to the shoreline. A total of 11.4 acres of colonized EWM was located during the August 2021 survey. Of these 11.4 acres, 6.8 acres consisted of relatively dense colonies of *dominant* or *highly dominant* plants, while another 4.6 acres consisted of less dense colonies described as *highly scattered* and *scattered*.

A late-season EWM mapping survey occurred on Anderson Lake on September 22, 2022. No EWM was located during a visual meander survey through the past EWM colonies, and no EWM was detected following the deployment of a submersible camera in select locations around the lake. Survey crews noted that northern watermilfoil was also not observed in the lake, while an abundance of native pondweed species including clasping-leaf pondweed were present.

2023 Early Season AIS Survey

Onterra ecologists conducted an early-season EWM mapping survey on June 7, 2023. In an attempt to identify EWM occurrences early for hand harvesting efforts to occur during the summer season if necessary. During their visit, the field crew utilized a submersible camera for a closer look at deeper areas where EWM existed prior to treatment. No EWM was detected in the lake during the survey.

2023 Late-Summer EWM Mapping Survey

Onterra ecologists later conducted a late-summer EWM mapping survey on Anderson Lake on September 21, 2023. The survey crews focused their search for EWM within previously known dense colonized areas, near riparian piers, and in a site where a local volunteer observed suspected EWM during the summer at a location on the northern side of the lake. Several *single or few plants* were identified, mainly on the northern side of the lake in the vicinity where the volunteer had identified the location (Map 3). Survey crews also noted a visual occurrence of northern watermilfoil on the southern side of the lake, within a community of floating-leaf (e.g. water lily) species.

3.0 CONCLUSIONS AND DISCUSSION

Aquatic plant monitoring in 2023 served to assess the plant community in Anderson Lake the year after a whole lake ProcellaCOR treatment that took place in 2022. The *year after treatment* results have continued to display good treatment efficacy with only point-based EWM occurrences found during the late-season EWM survey. Most native aquatic plant were relatively resilient to the herbicide treatment and were relatively unimpacted by the treatment shown through the 2022 and 2023 point-intercept survey results. Collateral impacts were largely contained to northern watermilfoil, water marigold, and water stargrass; all species predicted to be impacted during pretreatment risk assessment discussions. A few pondweed species were shown to increase following treatment. Continued monitoring in 2024 and beyond will monitor for signs of recovery of northern watermilfoil and the population dynamics of other species that have trended lower over the past several point-intercept surveys.

The EWM monitoring results indicate that the 2022 treatment strategies met expectations with reductions in EWM extending through the *year after treatment*. While few whole-lake ProcellaCOR™ treatment studies have progressed to the point of being multiple years post treatment, the results from this treatment to-date suggests that the EWM population will be below pretreatment levels for 3-5 years or beyond.

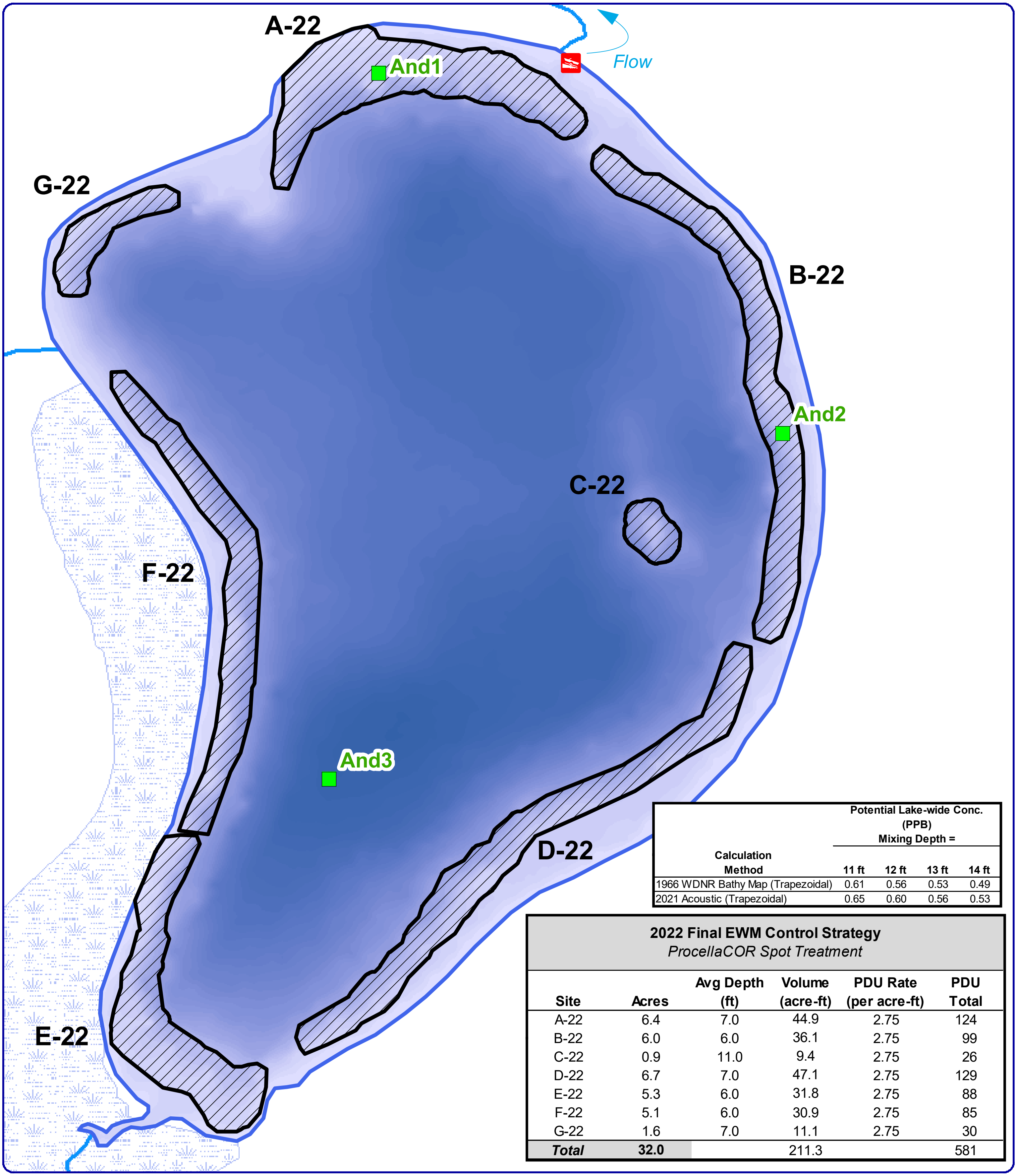
Onterra field crew staff in 2023 talked to multiple property owners who perceived seeing increased amounts of surface water algae scum in the lake compared to previous years. Unlike free-floating algae that gives lakes their green hue, this type of algae is not measured by the volunteer-based water quality monitoring program that is in place on Anderson Lake. The lifecycles of the type of algae that form surface scums are complex, but it is unlikely there would be a strong connection to the herbicide treatment that was conducted roughly 16 months earlier. If localized algae scums continue, it may be advised to contact WDNR staff to investigate what species are present.

3.1 2024 EWM Monitoring & Management Strategy Development

While the ALA's current AIS Control grant is scheduled to conclude with this report, leftover funds likely remain available for continued monitoring and possibly professional EWM manual removal efforts to take place in 2024. Once a strategy has been determined, the ALA and newly formed Anderson Inland Lake District will need to work with the WDNR to determine the level of funding that remains as well as possibly requesting a grant extension to cover the extended period of monitoring and management.

Targeting a rebounding EWM population early in this process can have the greatest likelihood of slowing the population progression and could help preserve the gains made by the 2022 whole-lake treatment. Volunteer EWM surveillance monitoring is encouraged and any isolated plants should be targeted for hand removal during the 2024 growing season. Depending on the amount of EWM rebound occurring, professionally contracted manual removal services many need to be considered.

A 2024 late-season EWM mapping survey would serve to monitor the EWM population, evaluate the manual removal program, and be used to develop a preliminary strategy for the following year. Some lake groups may also consider a professionally conducted early-season EWM mapping survey (June), to aid in locating EWM and prioritizing the manual removal strategy for 2024. A strategy planning meeting is scheduled to occur in the first quarter of 2024 to discuss some of the above actions for the upcoming year. A wrap-up meeting is also set to occur in spring of 2024, providing a presentation to the general membership on the results of this project.



Calculation Method	Potential Lake-wide Conc. (PPB) Mixing Depth = 11 ft	12 ft	13 ft	14 ft
1966 WDNR Bathy Map (Trapezoidal)	0.61	0.56	0.53	0.49
2021 Acoustic (Trapezoidal)	0.65	0.60	0.56	0.53

2022 Final EWM Control Strategy
ProcellaCOR Spot Treatment

Site	Acres	Avg Depth (ft)	Volume (acre-ft)	PDU Rate (per acre-ft)	PDU Total
A-22	6.4	7.0	44.9	2.75	124
B-22	6.0	6.0	36.1	2.75	99
C-22	0.9	11.0	9.4	2.75	26
D-22	6.7	7.0	47.1	2.75	129
E-22	5.3	6.0	31.8	2.75	88
F-22	5.1	6.0	30.9	2.75	85
G-22	1.6	7.0	11.1	2.75	30
Total	**32.0**		211.3		581

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Feet

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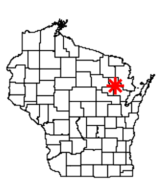
Sources
Roads and Hydro: WDNR
Bathymetry: Onterra 2021
Aquatic Plants: Onterra, 2021
Map Date: June 3, 2022 - EJH



Project Location in Wisconsin

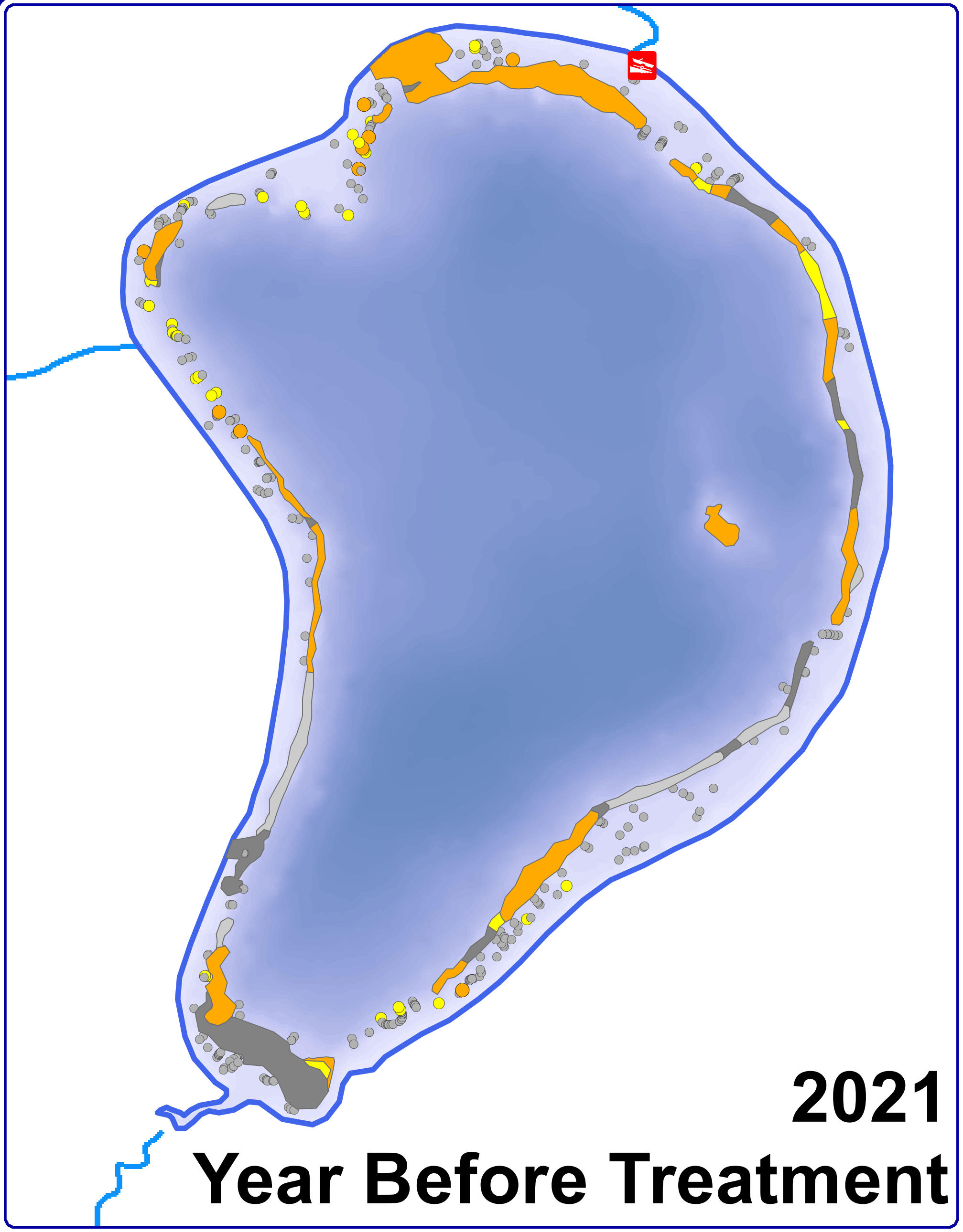
Legend

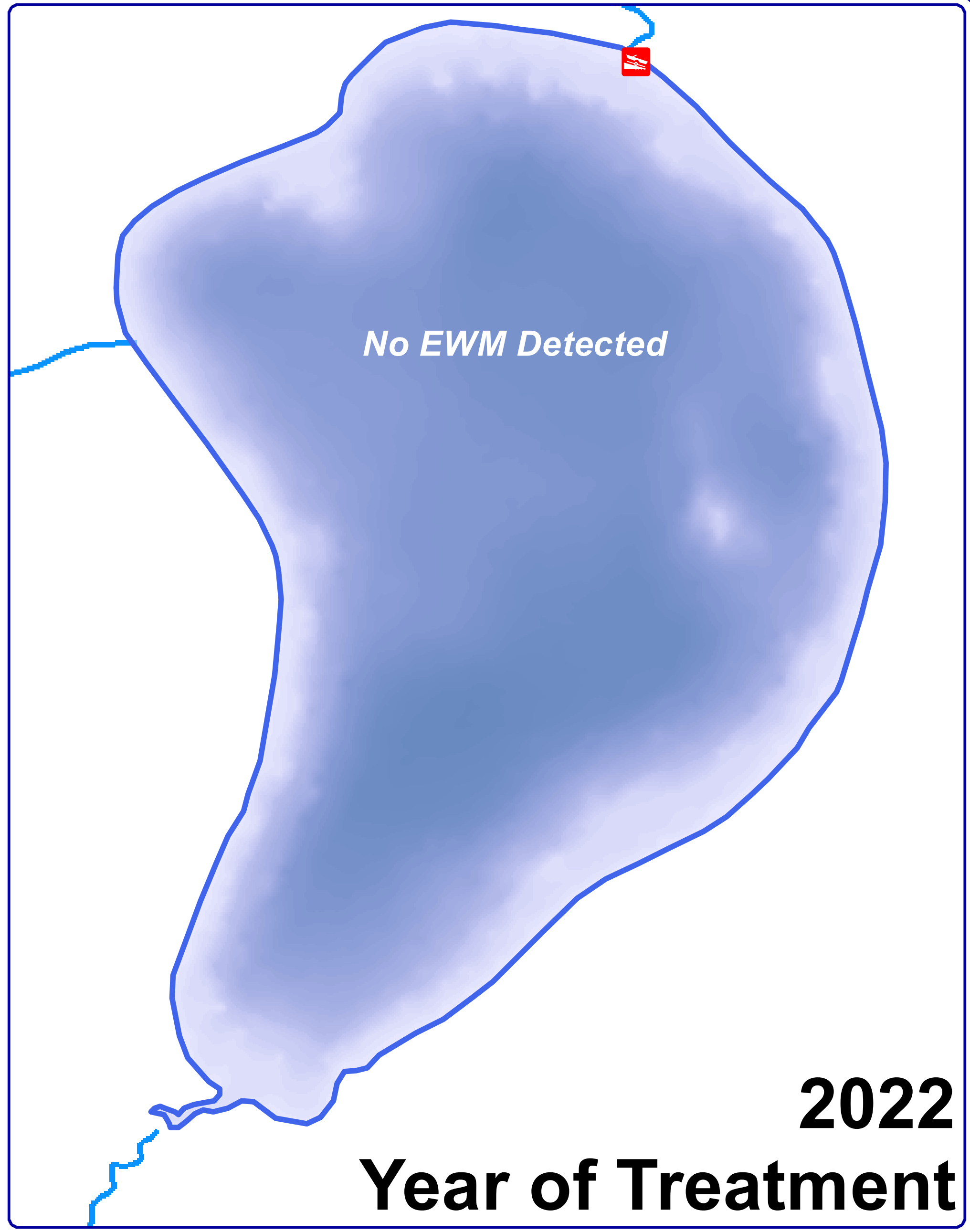
Final 2022 Applicaiton Area

Herbicide Concentration Sampling Location

Map 1
Anderson Lake
Oconto County, Wisconsin

Final 2022 EWM Treatment Strategy





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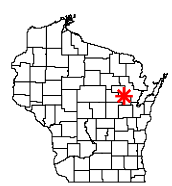
Sources:
Roads and Hydro: WDNR
Bathymetry: Onterra, 2016
Orthophoto: NAIP 2020
Aquatic Plants: Onterra, 2022
Map Date: October 4, 2022 - EJH



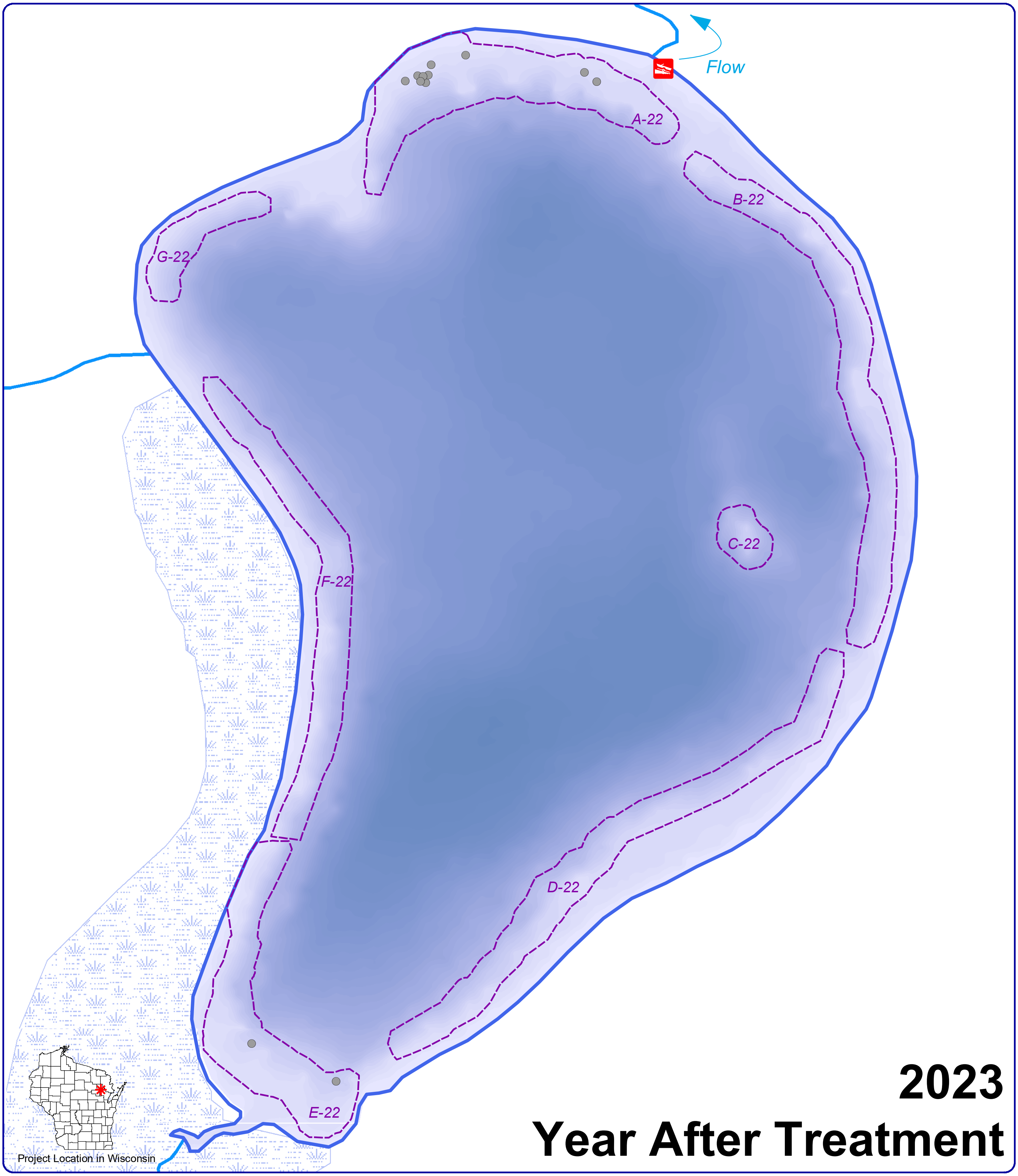
Project Location in Wisconsin

Legend

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony

Map 2
Anderson Lake
Oconto County, Wisconsin

Late-Season EWM Survey Results



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Sources
Roads and Hydro: WDNR
Bathymetry: Onterra 2021
Aquatic Plants: Onterra, 2023
Map Date: September 27, 2023 - EJH

Legend

EWM Mapping Survey (9/21/2023)
- Single or Few Plants
- Clumps of Plants *(none found)*
- Small Plant Colony *(none found)*

Final 2022 Applicaiton Area

Map 3
Anderson Lake
Oconto County, Wisconsin
2023 Late-Season EWM Mapping Survey Results

A

APPENDIX A

Anderson Lake Point-Intercept Survey Littoral Frequency of Occurrence Matrix: 2015-2023

Scientific Name	Common Name	LFOO (%)				
		2015	2019	2021	2022	2023
Vallisneria americana	Wild celery	25.7	37.4	23.3	31.1	22.4
Chara spp.	Muskgrasses	10.1	40.4	22.5	26.7	28.6
Najas flexilis	Slender naiad	20.2	18.2	19.2	13.3	20.4
Potamogeton gramineus	Variable-leaf pondweed	10.1	22.2	14.2	25.6	17.3
Eleocharis acicularis & Schoenoplectus subterminalis	Needle spikerush & water bulrush	0.9	20.2	19.2	16.7	17.3
Elodea canadensis	Common waterweed	14.7	17.2	17.5	12.2	14.3
Myriophyllum spicatum	Eurasian watermilfoil	0.9	34.3	46.7	0.0	0.0
Myriophyllum sibiricum	Northern watermilfoil	37.6	35.4	10.8	0.0	0.0
Nuphar variegata	Spatterdock	15.6	10.1	12.5	17.8	9.2
Schoenoplectus subterminalis	Water bulrush	0.0	12.1	15.8	0.0	16.3
Heteranthera dubia	Water stargrass	35.8	11.1	9.2	2.2	0.0
Brasenia schreberi	Watershield	12.8	12.1	12.5	15.6	4.1
Potamogeton richardsonii	Clasping-leaf pondweed	2.8	13.1	5.8	5.6	15.3
Ceratophyllum demersum	Coontail	14.7	22.2	6.7	3.3	2.0
Bidens beckii	Water marigold	27.5	16.2	4.2	1.1	0.0
Potamogeton zosteriformis	Flat-stem pondweed	8.3	10.1	5.8	12.2	4.1
Potamogeton epihydrus	Ribbon-leaf pondweed	4.6	11.1	6.7	0.0	8.2
Potamogeton berchtoldii & P. pusillus	Slender and small pondweed	0.0	1.0	5.0	2.2	14.3
Potamogeton pusillus	Small pondweed	0.0	1.0	4.2	2.2	13.3
Eleocharis acicularis	Needle spikerush	0.9	9.1	5.8	16.7	1.0
Nitella spp.	Stoneworts	6.4	3.0	1.7	5.6	7.1
Potamogeton praelongus	White-stem pondweed	7.3	8.1	0.8	3.3	4.1
Utricularia vulgaris	Common bladderwort	10.1	5.1	5.8	0.0	1.0
Potamogeton amplifolius	Large-leaf pondweed	1.8	7.1	7.5	3.3	2.0
Stuckenia pectinata	Sago pondweed	11.9	1.0	0.0	4.4	2.0
Nymphaea odorata	White water lily	1.8	2.0	0.8	1.1	4.1
Utricularia minor	Small bladderwort	1.8	4.0	3.3	1.1	1.0
Sparganium fluctuans	Floating-leaf bur-reed	3.7	0.0	0.8	4.4	1.0
Potamogeton illinoensis	Illinois pondweed	6.4	2.0	0.0	0.0	1.0
Potamogeton foliosus	Leafy pondweed	3.7	0.0	0.8	0.0	3.1
Potamogeton friesii	Fries' pondweed	1.8	1.0	0.8	0.0	3.1
Fissidens spp. & Fontinalis spp.	Aquatic Moss	4.6	3.0	0.8	0.0	0.0
Schoenoplectus acutus	Hardstem bulrush	0.0	1.0	0.8	3.3	1.0
Pontederia cordata	Pickerelweed	0.0	3.0	0.0	4.4	0.0
Elodea nuttallii	Slender waterweed	0.0	3.0	0.0	2.2	1.0
Potamogeton strictifolius	Stiff pondweed	0.0	1.0	0.8	0.0	2.0
Sagittaria sp. (rosette)	Arrowhead sp. (rosette)	0.9	2.0	0.0	0.0	1.0
Potamogeton natans	Floating-leaf pondweed	0.0	1.0	0.0	2.2	1.0
Potamogeton berchtoldii	Slender pondweed	0.0	0.0	0.8	0.0	2.0
Lemna trisulca	Forked duckweed	0.0	2.0	1.7	0.0	0.0
Potamogeton robbinsii	Fern-leaf pondweed	0.0	0.0	0.0	3.3	0.0
Eleocharis palustris	Creeping spikerush	0.0	1.0	1.7	0.0	0.0
Isoetes spp.	Quillwort spp.	0.0	1.0	0.8	0.0	0.0