1.0 INTRODUCTION

The Unified Lower Eagle River Chain of Lakes Commission (ULERCLC) has been the successful recipient of several Wisconsin Department of Natural Resources (WDNR) Aquatic Invasive Species (AIS) Control Grants since 2007 to assist with monitoring and managing the Eurasian watermilfoil (*Myriophyllum spicatum*; EWM) population in the Eagle River Chain of Lakes (Figure 1.0-1). This report specifically discusses the monitoring and control activities conducted during 2022 as well as the 2022 whole-lake point-intercept survey results. The chain-wide results will be presented first, followed by results from each lake individually. Additional information regarding the management and monitoring actions completed from 2008-2021 can be found in their respective annual reports.

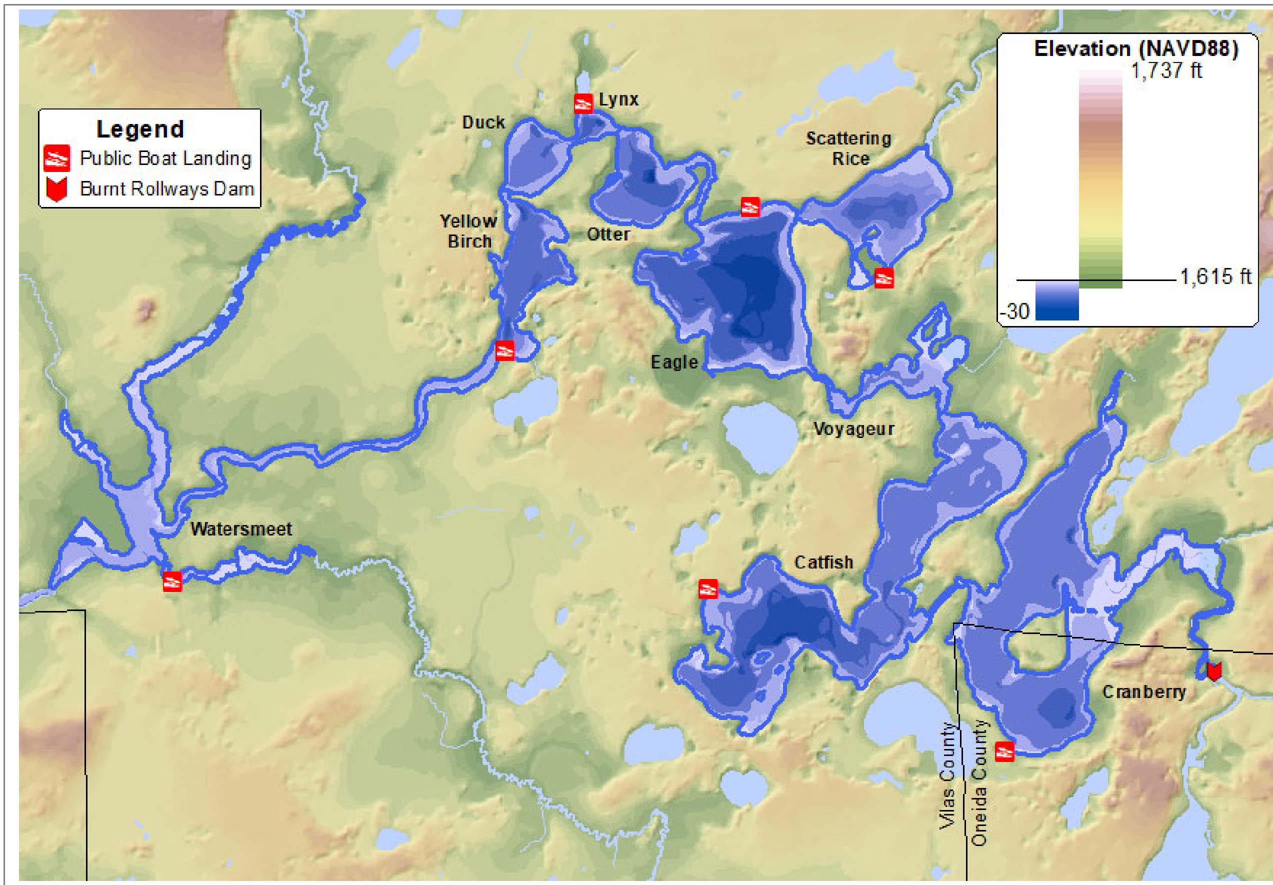


Figure 1.0-1 Lower Eagle River Chain of Lakes, Vilas-Oneida Counties.

1.1 Chain-wide Historic EWM Management

In an effort to increase the flow of information between lake stakeholders and project planners, Onterra has piloted an interactive web map application for the Eagle River Chain, allowing users to see each year's late-season EWM mapping survey results and management areas as they relate to their property or favorite recreation and fishing spots. Various layers can be turned on and off, and some layers can be selected and a pop-up window will provide additional information. This platform allows a better understanding of the EWM population dynamics and management strategies over time. To directly access this interactive map, click on the following link Interactive Web Application A link to the interactive web application is also hosted on the ULERCLC website.

Starting in 2007, late-season EWM mapping surveys commenced on the Eagle River Chain of Lakes using a consistent density rating system (Figure 1.1-1). Please note that this figure only represents the acreage of mapped EWM polygons, not EWM mapped with point-based methodologies (*single or few plants, clumps of plants,* or *small plant colonies*). Said another way, EWM marked with point-based mapping methods do not contribute to colonized acreage as shown in Figure 1.1-1.

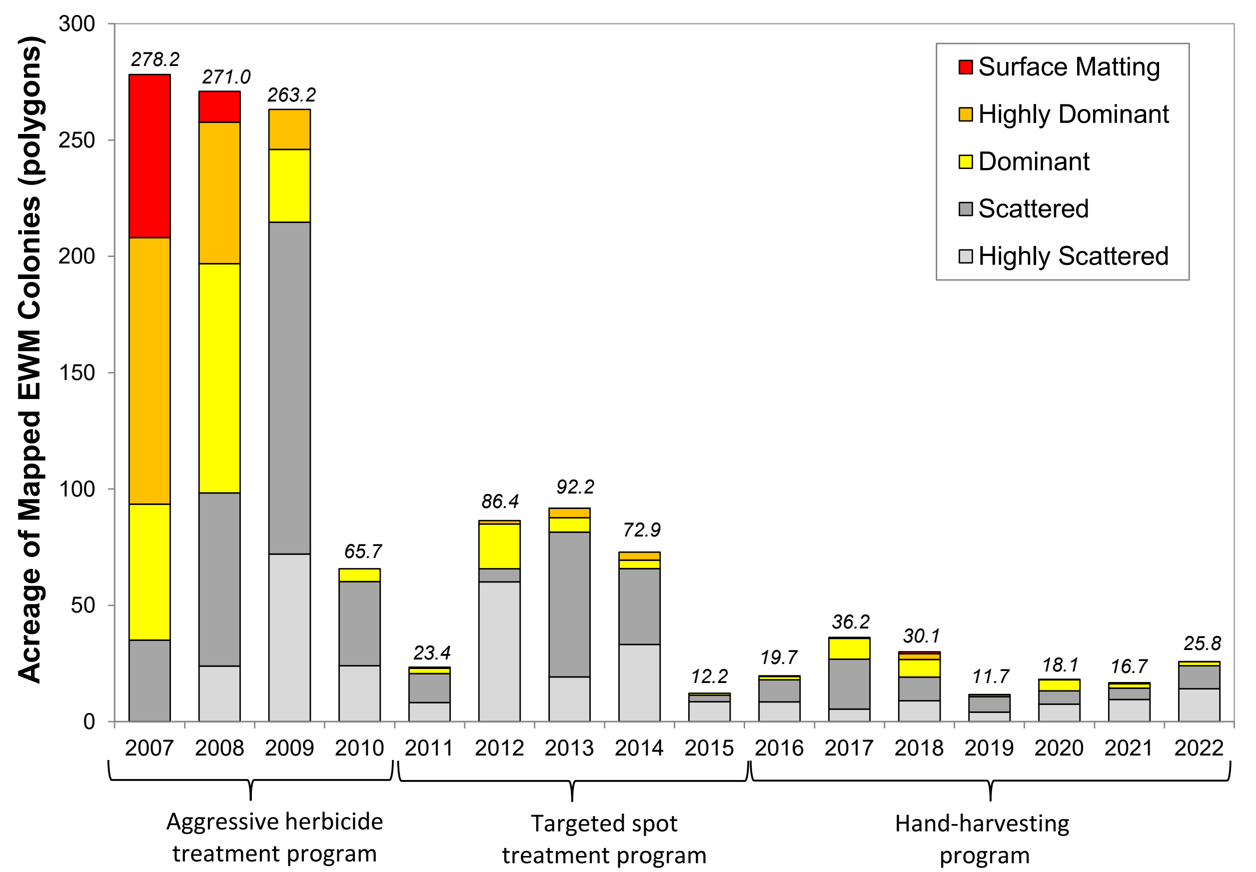


Figure 1.1-1. Chain-wide acreage of mapped EWM colonies on the Lower Eagle River Chain of Lakes from 2007-2022.

Aggressive Herbicide Treatment Program (2007-2010)

Over this same timeframe, the ULERCLC has coordinated active management of EWM. From 2007 to 2010, an aggressive herbicide treatment program occurred consisting of strategically targeted herbicide spot treatments and a few whole-lake or whole-basin herbicide treatments.

Targeted Spot Treatment Program (2011-2015)

A more directed herbicide spot treatment strategy occurred from 2011 to 2015. During this timeframe, the ULERCLC was an active participant in a Cooperative Research and Development Agreement (CRADA) between the WDNR and U.S. Army Corps of Engineers Research and Development Center that coupled field-collected herbicide concentration data with professional monitoring to understand efficacy, selectivity, and longevity of chemical control strategies. During this project, the ULERCLC found that as the spot treatments targeted increasingly smaller areas of EWM, they were not as effective as previous control strategies.

Ongoing studies stemming from this project indicate that in small spot treatments, the herbicide dissipates too rapidly to cause EWM mortality if traditional weak-acid auxin systemic herbicides like 2,4-D are used. Even in some cases where larger treatment areas can be constructed, their narrow shape or exposed location within a lake may result in insufficient herbicide concentrations and exposure times for long-term control. With this knowledge, more effective herbicide spot treatment strategies were implemented in the latter years of this phase of management. In 2015, the EWM population of the Eagle River Chain of Lakes was at its lowest levels in over a decade, with just over 12 acres of colonized EWM being documented chain-wide (Figure 1.1-1).

Between 2010 and 2015, average chain-wide summer water clarity declined by over one foot to an average of 4.4 feet. To investigate the reduction in water clarity within the chain since 2010, annual precipitation data were obtained from a station at the Eagle River wastewater treatment facility located on West Division Street. Correlation analysis between precipitation data and average summer Secchi disk depth revealed that total growing season precipitation (April-September) had the strongest negative correlation with average summer Secchi disk depth. This means that as precipitation increases, water clarity decreases. The increase in precipitation may have resulted in increased phosphorus loading to the chain, increasing algal production and reducing water clarity. The increased precipitation may have also increased the amount of dissolved humic substances within the chain, increasing the stained appearance and decreasing water clarity.

It is clear that the management program reduced the EWM population within the Eagle River Chain. But it is also important to note the role of the reduced water clarity in the system this past decade. When EWM is targeted with an herbicide treatment, and also has the added environmental stress of low water clarity, it is more difficult for the plants to rebound. The darker water has likely helped the treatments be more effective and last longer. Said another way, if the chain had clearer water during the years of treatment, the results may not have been as positive. It will be important for the ULERCLC to understand this reality and be prepared when water clarity returns.

In 2015, the ULERCLC developed a working treatment strategy where consideration for herbicide application would be given to areas of EWM if they met a specific threshold (i.e., trigger). This trigger was further revised as part of the *Eagle River Chain of Lakes Comprehensive Management Plan (Dec 2019)*. If the following trigger is met, the ULERCLC would initiate pretreatment monitoring and begin discussions, including consultation with WDNR staff, regarding conducting herbicide spot treatments:

> Colonized (polygons) areas of EWM, with preference to areas of *dominant* or greater densities, that have a size/shape/location where management is anticipated to be effective.

Based upon this established herbicide treatment strategy, no areas of EWM in the Lower Eagle River Chain of Lakes have met this threshold since 2015 and therefore no herbicide treatments have occurred since.

Hand-Harvesting Program (2016-current)

After the period of herbicide management, the remaining areas of EWM within the chain were too small to be effectively controlled using herbicide spot treatment techniques available. It was important to the ULERCLC to not abandon management completely and simply wait for EWM populations to reach levels that are again applicable for herbicide control. The ULERCLC enacted a strategy that balanced a level of EWM population tolerance while targeting other locations with a coordinated hand-harvesting approach.

Many lake groups initiate a large-scale management strategy with the intention of implementing smaller-scale control measures when EWM begins rebounding. This use of multiple control practices in a strategy that focuses on long-term control is referred to as Integrated Pest Management (IPM). With Onterra's assistance, the ULERCLC successfully secured a WDNR Established Population Control Grant (ACEI-240-20) to assist with funding a continued IPM strategy as outlined by: 1) a 3-year EWM monitoring and hand-harvesting project and 2) completion of chain-wide point-intercept surveys in 2022 as outlined within the ERCLA's *Comprehensive Management Plan*. This report discusses the management and monitoring activities that took place during the third year of this project (2022).

A series of EWM mapping surveys were used to coordinate and monitor the hand-harvesting efforts. During the EWM mapping survey, the entire littoral area of the lake is surveyed through visual observations from the boat (Photo 1.1-2). A preliminary hand harvesting strategy is developed over the fall/winter based on the results of the previous year's Late-Summer EWM Mapping Survey. In late-spring/early summer, an Early Season Aquatic Invasive Species Survey (ESAIS) is completed from which the hand-harvesting strategy was finalized. After the professional hand-harvesting activities are completed, Onterra completes the Late-Summer EWM Mapping Survey, the results of which serve as a post-harvesting assessment of the hand-removal efforts. The hand-removal program would be considered successful if the EWM population within the targeted areas was found to have been reduced and inhibited from expanding between the year before and year after Late-Summer EWM Mapping Surveys.

Photo 1.1-2. EWM mapping survey on a WI lake. Photo credit Onterra.

Diver Assisted Suction Harvest (DASH) is a form of hand-removal which involves divers removing target plants (i.e., EWM) and feeding them into a suctioned hose for delivery to the deck of the harvesting vessel. The DASH system is thought to be more efficient than manual removal alone as the diver does not have to go to the surface to deliver the pulled plants to someone on a boat. The DASH system also is believed to cause less fragmentation, as the plants are immediately transported to the surface using the pumping mechanism.

2.0 2022 EWM MONITORING & MANAGEMENT ACTIVITIES

Based on the results of the 2021 Late-Season AIS Survey, a preliminary DASH strategy was designed for areas of Catfish, Watersmeet, and Yellow Birch lakes for 2022. During the 2022 Early-Season AIS Survey (ESAIS), the extents of EWM within the proposed hand-harvesting areas were refined and a final hand-harvesting strategy was determined. Onterra provided the contracted professional hand-harvesting firm with the spatial data from the ESAIS Survey to coordinate the removal efforts.

2.1 Chain-wide Professional Hand-Harvesting Activities

The ULERCLC contracted with DASH Aquatic Services, LLC in 2022 to provide professional hand-harvesting services using Diver-Assisted Suction Harvesting (DASH) methodologies. DASH methodologies involve divers removing plants from the sediment and then feeding them into a suctioned hose for delivery to the deck of the harvesting vessel. The DASH methodology is considered a form of mechanical harvesting and thus requires a WDNR-approved permit. DASH is thought to be more efficient in removing target plants than divers alone and is believed to limit fragmentation during the harvesting process. Professional services to remove EWM do not require a permit unless DASH or a mechanical device is being used in the process.

The ULERCLC EWM Committee created a site prioritization methodology that considered EWM density from the 2021 Late Season EWM Mapping Survey, high-use areas, and other factors to outline the preliminary 2022 DASH harvest areas. Prior to the implementation of the hand-harvesting program, Onterra conducted an Early Season EWM Mapping Survey of the entire chain. The results of this survey were used to determine if changes in targeted areas or prioritization were warranted. Based upon this late-June survey, no changes were made to the initial DASH work areas outlined in the *2020 EWM Monitoring & Control Strategy Assessment Report (March 2022)* and outlined in the WDNR permit materials.

Over the course of 16 days, approximately 3,232 lbs of EWM were removed from the Eagle River Chain in 2022 (Table 2.1-1). Watersmeet Lake area A-22 was not harvested due to surface matting native plant species in the area which would have made inefficient work conditions. Further details of hand-harvesting efforts and amount of EWM removed on a site-by-site basis is discussed within the Individual Lake Sections (4.0) below, as well as can be accessed on the ULERCLC's interactive map.

Table 2.1-1. 2022 Hand-harvest summary. Summarized from Appendix A.

DASH Removal Summary		
Site	**Time Spent (Hours)**	**Total EWM Removed (lbs)***
Cat A-22	15.5	436
Cat B-22	39.0	950
Cat E-22	7.3	364
Cat F-22	14.0	702
Cat G-22	15.5	594
YBL B-22	14.5	186
Wat A-22	0	0
Total	**105.8**	**2202**

**Each harvesting event included between 5-15% non-target species*

2.2 Volunteer EWM Surveillance Monitoring

In recent years, a team of dedicated ULERCLC volunteers have conducted EWM monitoring efforts during the summer months. These efforts have been instrumental in aiding professional monitoring efforts through searching the Chain for new EWM infestations. Volunteers use a dedicated GPS unit that is loaded with the most recent professional EWM mapping survey results. The volunteer team focuses on searching for EWM in other areas of the Chain outside of where known EWM populations have been recently documented in the professional mapping surveys. In the event that the volunteers encounter a new suspected occurrence of EWM, a waypoint is taken on the GPS unit. All volunteer data is ultimately provided to Onterra prior to the next scheduled professional mapping survey. This allows the professional surveyors to visit the volunteer locations to confirm the presence of EWM. In 2022, ULERCLC volunteer monitoring efforts identified suspected EWM within Watersmeet Lake, the Eagle River between Watersmeet and Yellow Birch Lake, Yellow Birch Lake, Duck Lake, and in Catfish Lake (Figure 2.2-1).

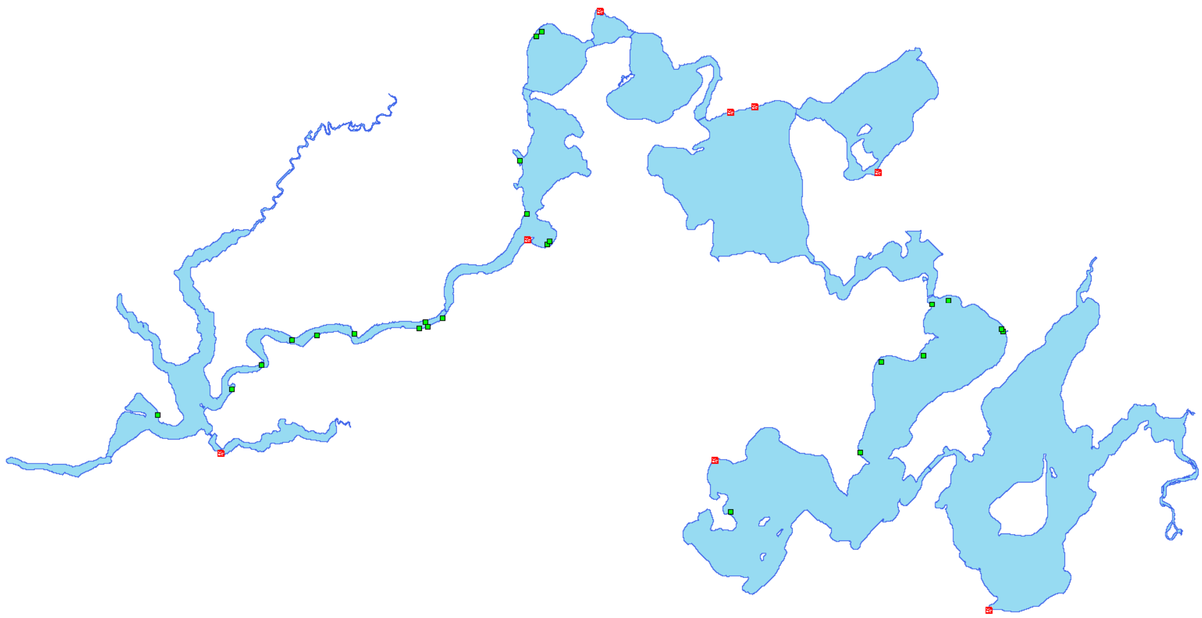


Figure 2.2-1 ELERCLC volunteer monitoring suspected EWM locations. Volunteer points displayed as green squares.

2.3 Late-Season EWM Mapping Surveys

As shown on Figure 2.3-1, 25.8 acres of EWM was located during the 2022 Late-Season EWM Mapping Survey on the Chain. This is an increase compared to the 16.7 acres mapped in 2021 and is much lower than acreages of colonized EWM documented annually from 2007-2009. Historically, the majority of the EWM acreage mapped in the Eagle River Chain of Lakes has been in Cranberry and Watersmeet Lakes. The EWM within these lakes is largely located in channelized areas where water flow is higher. Past herbicide treatments conducted in these areas revealed it is difficult to achieve the needed concentration and exposure time to achieve EWM mortality. In 2020-2022 however, EWM acreage in Cranberry Lake has been very low (1.3-acre average), aside from 2015 when no polygons were mapped at all there.

The highest EWM acreages during the 2022 Late-Season EWM Mapping Survey were from Watersmeet, Catfish, and Yellow Birch Lakes, each with 13.0, 4.7, and 4.3 acres respectively (Figure 2.3-1). All lakes within the chain, with the exception of Lynx and Yellow Birch Lakes, saw increases in EWM during 2022 when compared to 2021.

As colonized EWM populations increased chain-wide from 2021 to 2022, the amount of EWM occurrences marked with point-based methodologies has remained relatively stable during this timeframe in most areas. The majority of point data consists of *single or few plants*.

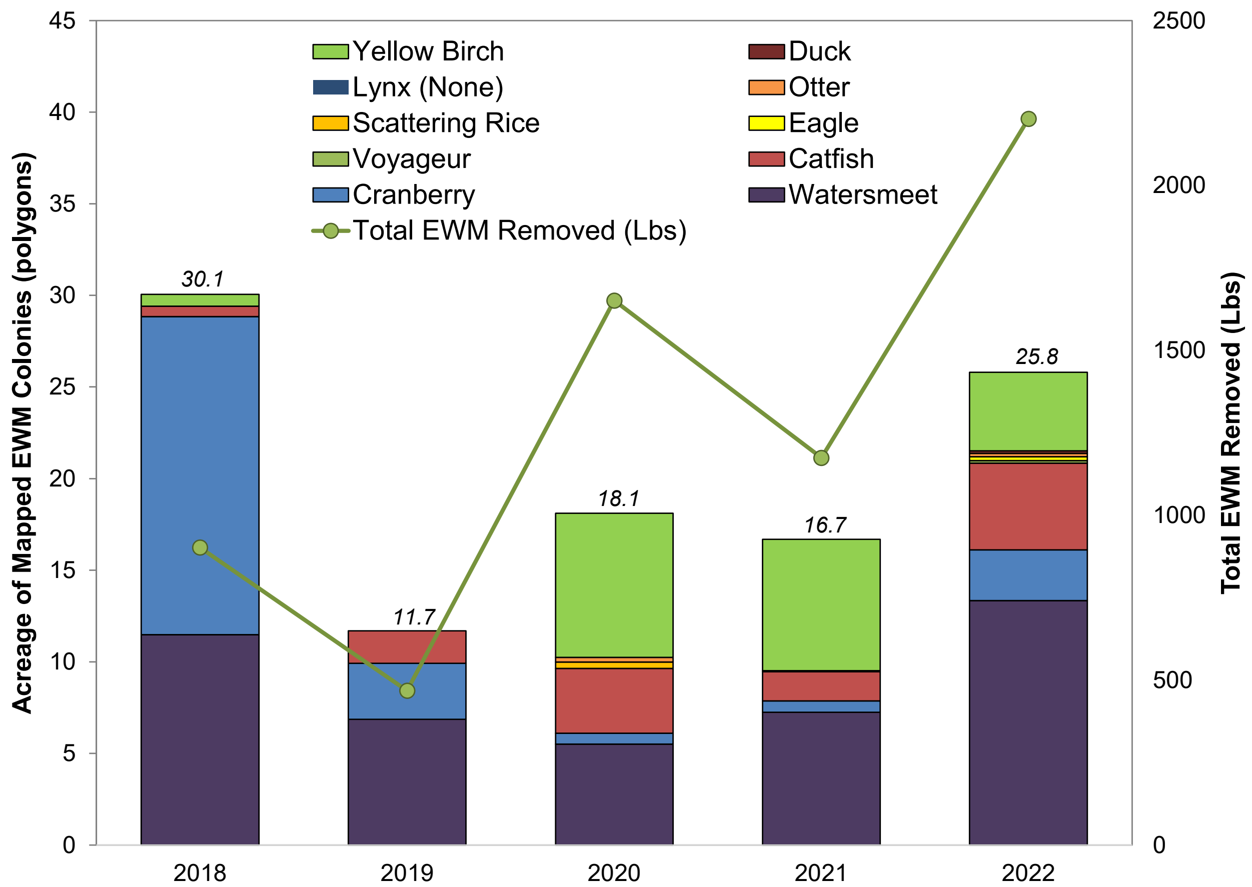


Figure 2.3-1. Distribution of acreage of mapped EWM colonies by lake in 2018-2022 (recent hand-harvesting years).

2.4 2022 Aquatic Vegetation Point-Intercept Survey Results

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 point-intercept survey can be applied at various scales. Most commonly, the point-intercept survey is applied at the whole-lake scale to provide a lake-wide assessment of the overall plant community. More focused point-intercept surveys, called sub-sample point-intercept surveys, may be conducted over specific areas to monitor an active management strategy such as herbicide treatments or mechanical harvesting. These types of focused sub-sample point-intercept surveys have been conducted on the Eagle River Chain as part of prior herbicide treatment monitoring and planning.

The whole-lake point-intercept surveys were conducted on the Eagle River Chain of Lakes on July 18-21 2022. The results of these surveys can be compared to the results from the 2005/06, 2012, and 2017 point-intercept surveys to determine if any significant changes in the abundance of plants or species composition have occurred over this period. In 2005/06, of the 3,669 point-intercept sampling locations on the Lower Eagle River Chain, 34% contained aquatic vegetation (frequency of occurrence) (Figure 2.4-1). In 2012, the frequency of occurrence of aquatic plants decreased to 27%. In 2017, the frequency of occurrence of vegetation was found to have declined further to 20%. The 2022 surveys showed the frequency of occurrence of vegetation declined again to 19% and less TRF ratings of 2 or 3 were found indicated less biomass. Overall, the frequency of occurrence of native aquatic vegetation in the chain has remained about the same since the 2017 survey.

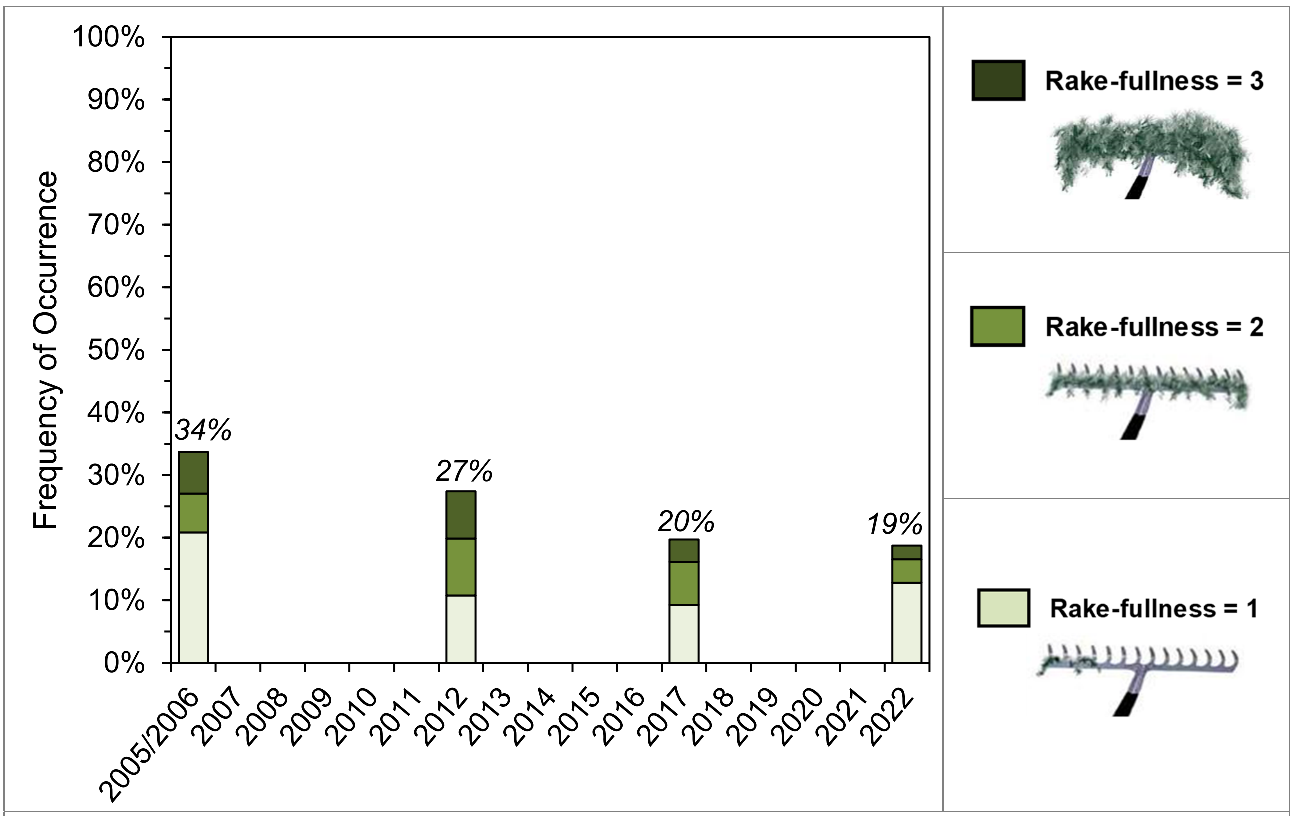


Figure 2.4-1. Eagle River Chain of Lakes littoral frequency of occurrence of aquatic vegetation and total rake fullness (TRF).

Since the herbicide (2,4-D amine and 2,4-D ester) used to control EWM on the chain has been shown to have potential adverse impacts to select native aquatic plant species, a link to the decline in the overall occurrence of aquatic vegetation from 2005 to 2017 in the chain was evaluated. The amount of acreage applied with herbicide in the chain was highest from 2008-2010, with an average of 257 acres applied with herbicide per year. The amount of acreage treated from 2011-2015 was lower with an annual average of 69 acres, and no herbicide applications took place between 2016 and 2022. Despite less acreage treated in the chain between 2012-2015 and the absence of herbicide use between 2016-2022, native aquatic plant occurrence has continued to decline.

Within the *Comprehensive Management Planning Project*, the role of reduced water clarity caused by above-normal growing season precipitation was investigated in terms of the reduction in native aquatic vegetation over this period. Average chain-wide water clarity has declined by approximately 2.0 feet in recent years, coinciding with increases in precipitation (Figure 2.4-2).

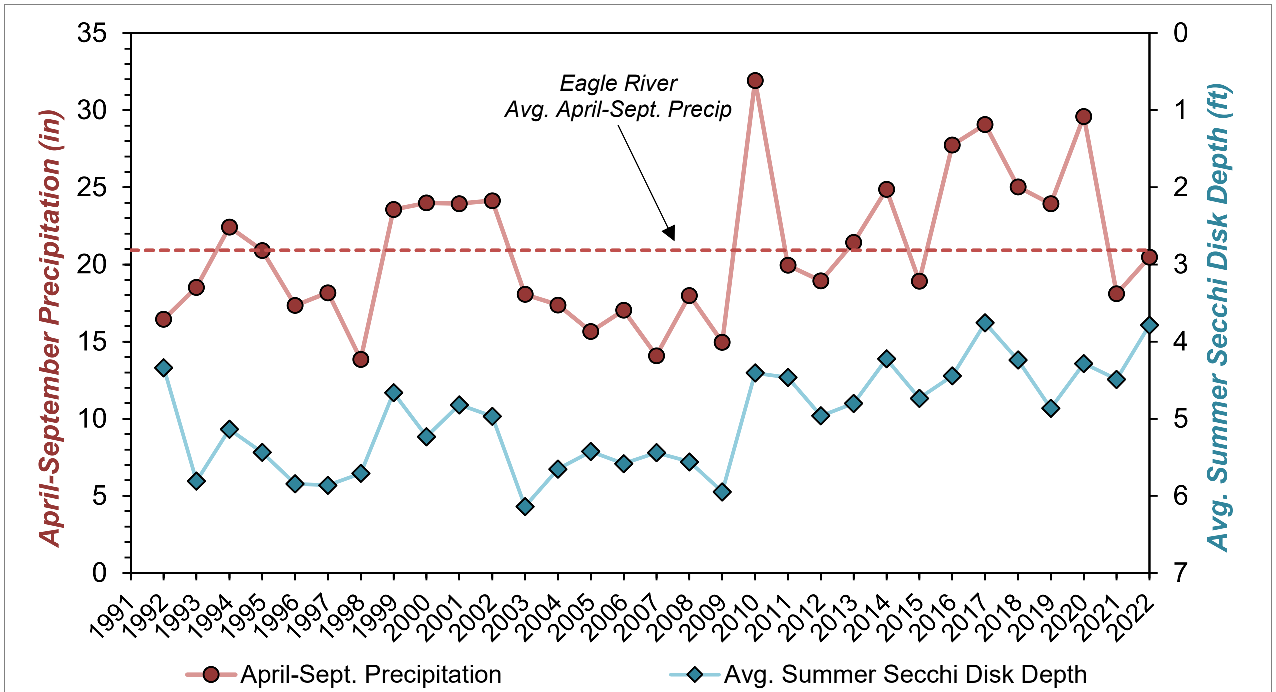


Figure 2.4-2. Eagle River total growing season (April-Sept.) precipitation and Lower Eagle River Chain of Lakes average summer (June-August) Secchi disk depth from 1992-2022. Precipitation data obtained through Midwestern Regional Climate Center data portal from Eagle River station (ID 472314).

In 2022, average chain-wide Secchi disk depth was 3.8 feet, one of the lowest values recorded since record keeping began in 1992. Response of the aquatic plant community to the reduction in water clarity is evidenced by the recorded maximum depth of plant growth during the point-intercept surveys. In 2005/2006, the chain-wide average maximum depth of aquatic plant growth was 11.7 feet (Figure 2.4-3). In 2012, the chain-wide average maximum depth of aquatic plant growth declined to 10.7 feet, which then declined further in 2017 to 7.9 feet. The reduction in light availability with decreased water clarity, caused aquatic plant growth to decline in deeper waters between 2012 and 2017. The 2022 point-intercept surveys showed a slight increase in the average maximum depth of plant growth to 8.4 feet.

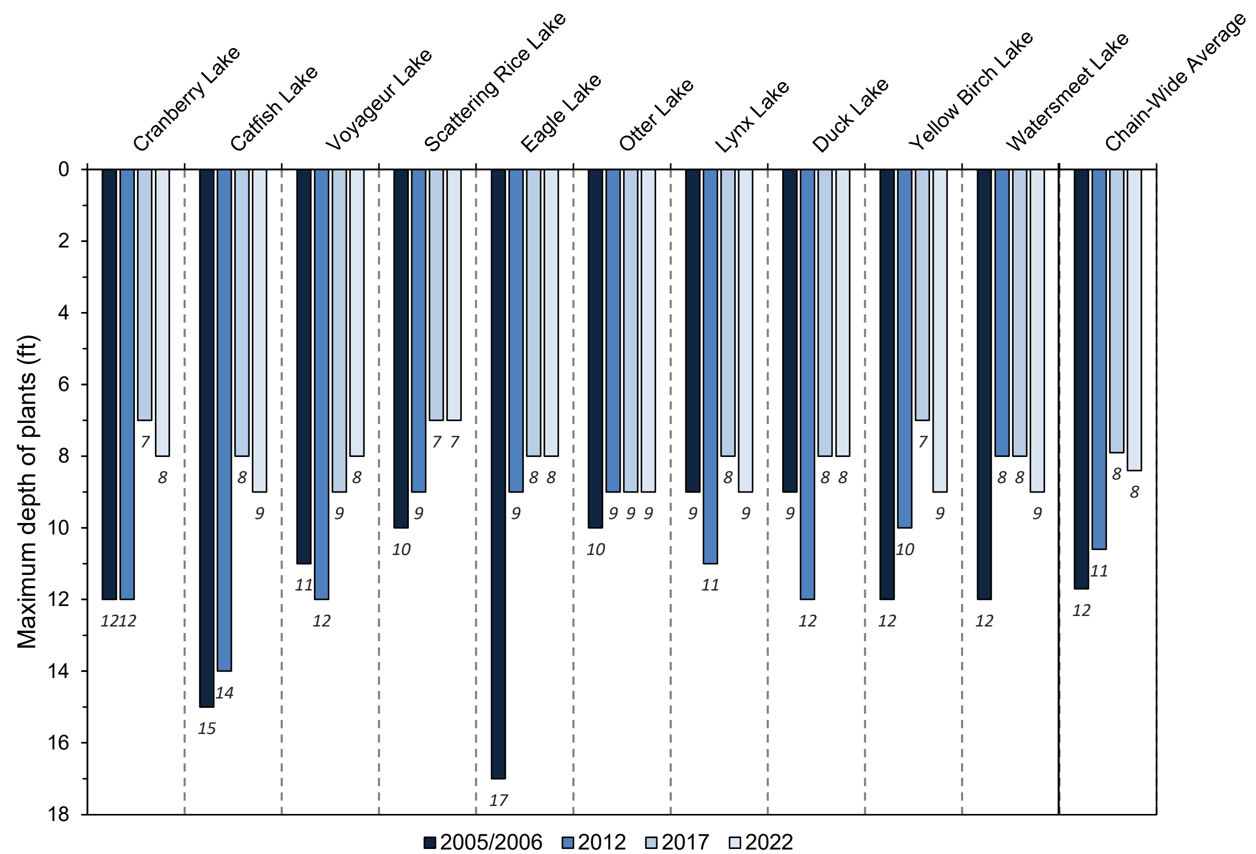


Figure 2.4-3. Recorded maximum depth of aquatic plant growth in the Lower Eagle River Chain of Lakes from 2005/06, 2012, 2017, and 2022.

Chi-square analysis (α = 0.05) was used to compare individual aquatic plant species chain-wide littoral frequencies of occurrence between the point-intercept surveys in 2005/06, 2012, 2017, and 2022 (Figure 2.4-4). The aquatic plant species that had a littoral frequency of occurrence of at least 5% in one of the four surveys are applicable for analysis. Within the some of the individual lake analysis, slender pondweed (*Potamogeton berchtoldii*) and small pondweed (*P. pusillus*) are lumped together as well as muskgrasses *Chara* spp.) & stoneworts (*Nitella* spp. due to their morphological similarity. Prior to 2011, slender pondweed (*Potamogeton berchtoldii*) was considered to be a subspecies of small pondweed (*P. pusillus*) until genetic studies warranted classification of slender pondweed as a distinct species. Of the native aquatic plant species that had a littoral occurrence of at least 5% in one of the four surveys, eight exhibited statistically valid changes in their littoral occurrence between the 2017 and 2022 surveys.

Of the eight native species which saw changes in their littoral frequency of occurrence between the 2017 and 2022 surveys, six saw statistically valid reductions in their occurrence, while two native species showed valid increases during the same timeframe (Figure 2.4-4).

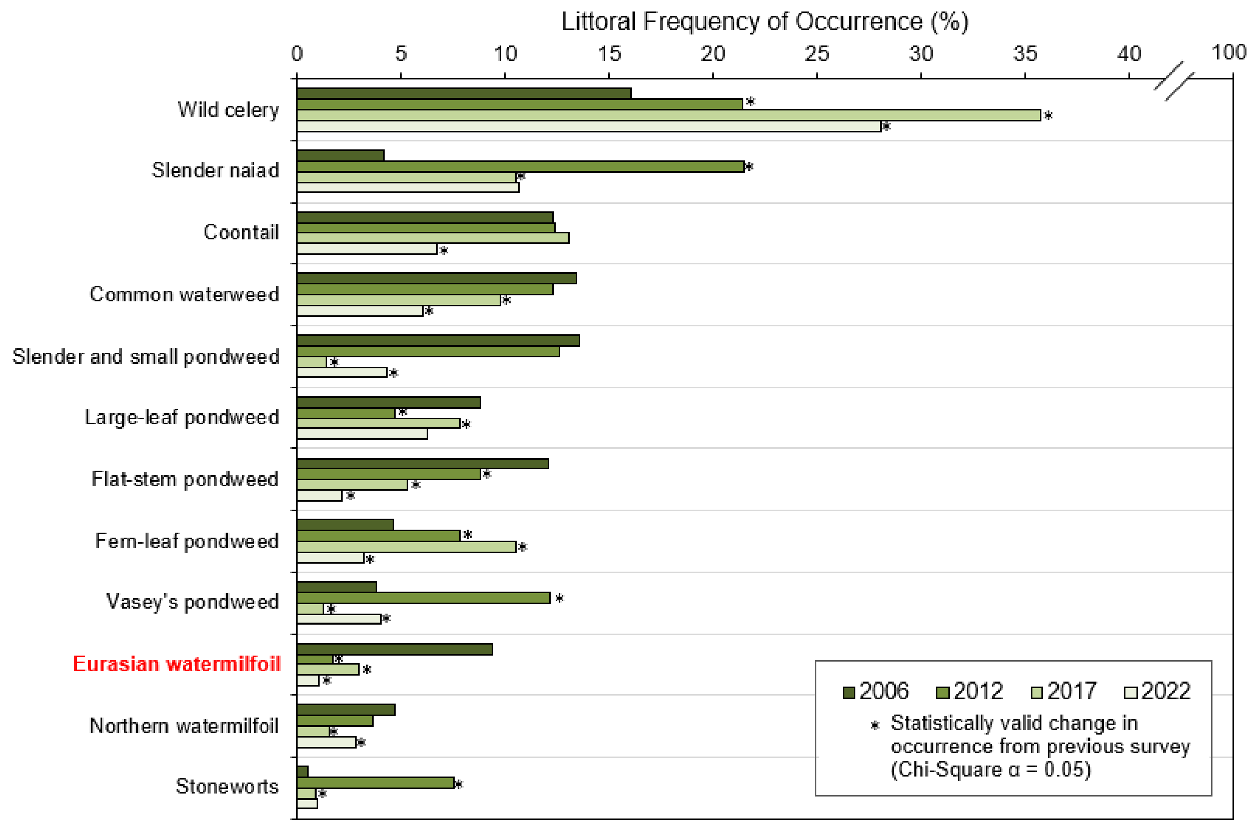


Figure 2.4-4. Eagle River Chain of Lakes littoral frequency of occurrence of select aquatic plant species from 2005/06, 2012, 2017, and 2022 point-intercept surveys. Please note that only those species with an occurrence of at least 5% in one of the surveys are displayed.

Wild celery (*Valisneria americana*) had been the most commonly encountered species during point-intercept surveys within the Eagle River Chain. Wild celery is a submerged aquatic plant with ribbon-shaped floating leaves that may grow to as long as two meters, depending on water depth (Photo 2.4-1). It is a preferred food choice by numerous species of waterfowl and aquatic invertebrates.

Coontail (*Ceratophyllum demersum*) was very stable throughout the previous surveys until the 2022 when the littoral occurrence declined by 49%. Coontail has whorls of leaves which fork into two to three segments, and provides ample surface area for the growth of periphyton and habitat for invertebrates. Unlike most of the submersed plants found in Wisconsin, coontail does not produce true roots and is often found growing entangled amongst other aquatic plants or matted at the surface. Because it lacks true roots, coontail derives most of its nutrients directly from the water (Gross, Erhard, & Ivanyi, 2003).

Like coontail, common waterweed (*Elodea canadensis*) can be found in waterbodies across Wisconsin, is tolerant of high-nutrient, low-light conditions, and can grow to nuisance levels under ideal conditions. Common waterweed has blade-like leaves in whorls of three produced on long, slender stems. Like other submersed aquatic plants, common waterweed helps to stabilize bottom sediments and provides structural habitat and food for wildlife.

Wild celery
(*Valisneria americana*)

Slender naiad
(*Najas flexilis*)

Common waterweed
(*Elodea canadensis*)

Vasey's Pondweed
(*Potamogeton vaseyi*)

Coontail
(*Ceratophyllum demersum*)

Photo 2.4-1. Five frequently encountered native aquatic plants in the Eagle River Chain of Lakes. Photo credit Onterra.

Slender naiad (*Najas flexilis*), a common annual species in Wisconsin, is considered to be one of the most important food sources for a number of migratory waterfowl species (Borman, Korth, & Temte, 1997). Their numerous seeds, leaves, and stems all provide sources of food. The small, condensed network of leaves provide excellent habitat for aquatic invertebrates.

Vasey's pondweed (*Potamogeton vaseyi*), is listed by the Wisconsin Natural Heritage Inventory as a species of special concern in Wisconsin due to uncertainty regarding its distribution and abundance in Wisconsin. Vasey's pondweed is typically found in bays of large soft-water lakes as well as in rivers and ponds. The littoral occurrences of Vasey's pondweed saw statistically valid increases over the period from 2005/06 to 2022 (Figure 2.4-4). Vasey's pondweed produces very fine, narrow leaves which alternate along a long, slender stem (Photo 2.4-1).

Aquatic plant communities are dynamic and the abundance of certain species from year to year can fluctuate depending on climatic conditions, herbivory, competition, disease, and management among other factors. Ongoing research on Wisconsin's lakes shows that native aquatic plant populations can fluctuate over short- and long-term periods, believed to be driven by natural variations in climate, growing season, water levels, etc.

The chain-wide littoral frequency of occurrence of EWM in the Eagle River Chain of Lakes was found to have exhibited a statistically valid reduction in occurrence of 64% from 2017 to 2022 (Figure 2.4-4). In 2006 the EWM littoral frequency of occurrence was 9.4%, while during the 2022 survey it was found to at its lowest of all four surveys at 1.1%.

Figure 2.4-5 displays the individual littoral frequency of occurrence of EWM within each of the Eagle River Chain of Lakes from 2005/06, 2012, 2017, and 2022. Between 2005/06 to 2017, the littoral frequency of occurrence of EWM varied within each lake from 0% to 23.3%. In 2022, the littoral frequency of occurrence of EWM in each lake ranged from 0% in Otter Lake to 2.9% in Catfish. As is discussed within the individual lake summary and conclusion sections, ecologists still observed EWM in Otter and Duck Lakes during 2022; however, EWM was not physically encountered on the survey rake during the point-intercept survey which results in an occurrence of 0%.

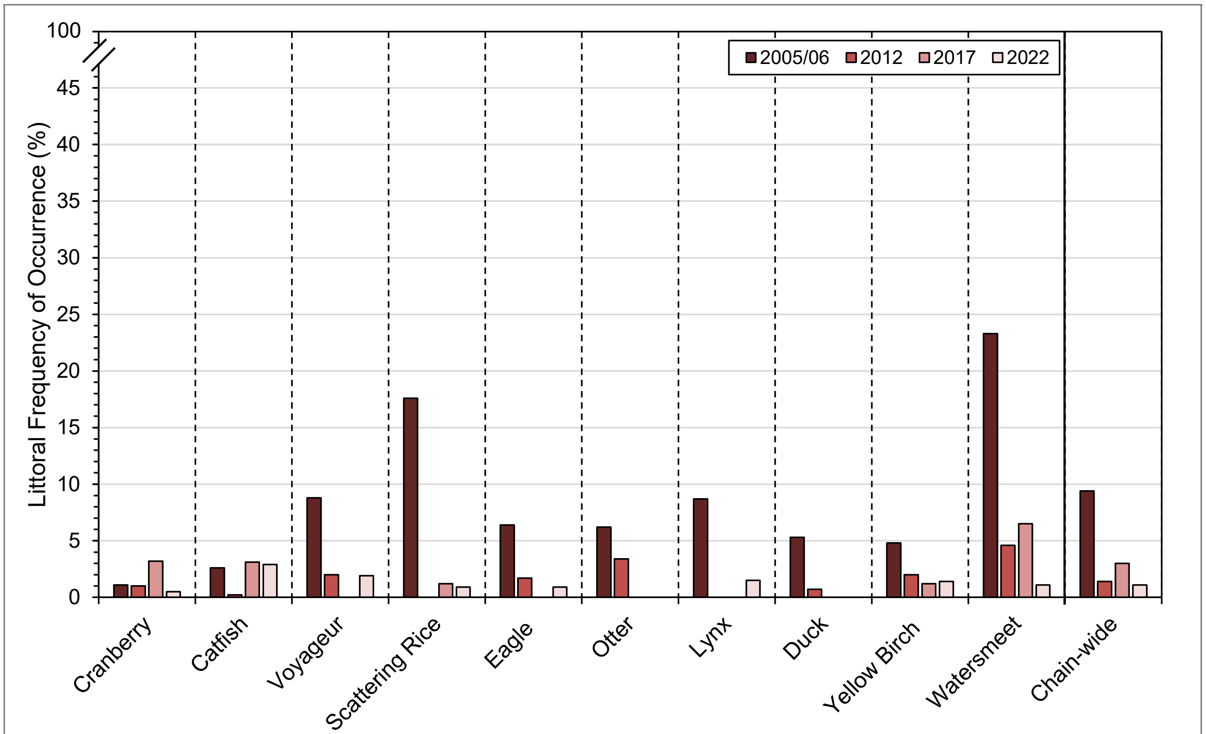


Figure 2.4-5. Lower Eagle River Chain of Lakes individual lake and chain-wide littoral frequency of occurrence of Eurasian watermilfoil from 2005/06, 2012, 2017, and 2022 point-intercept surveys.

With the exception of Watersmeet, the lakes within the Lower Eagle River Chain of Lakes have maintained EWM littoral frequencies of occurrence of 3% or less between 2012 and 2022. The 2022 surveys indicate that overall, the EWM population within the Lower Eagle River Chain of Lakes remains low and highlights the continued success of the control and monitoring program. However, areas still remain within the chain that have larger, localized populations of EWM. These areas in 2022 primarily include localized areas in Catfish Lake and the Wisconsin River branch of Watersmeet.

3.0 CHAIN-WIDE CONCLUSIONS & DISCUSSIONS

Overall, there has been a significant reduction of EWM in the Eagle River Chain since the start of the management program. The 2022 EWM population of the Eagle River Chain of Lakes continues to mostly consist of locations mapped with point-based methods or mapped with low-density colonies. Higher density EWM populations have been documented in Catfish Lake, and in river portions of Watersmeet Lake. The high flows in the Wisconsin River make reaching EWM control goals difficult. Currently some of the high-density EWM populations in Watersmeet are in low-traffic areas with navigation obstructions (i.e., stumps). No areas within the Chain meet the management plan trigger for considering herbicide control in 2022, resulting in seven consecutive years without herbicide management.

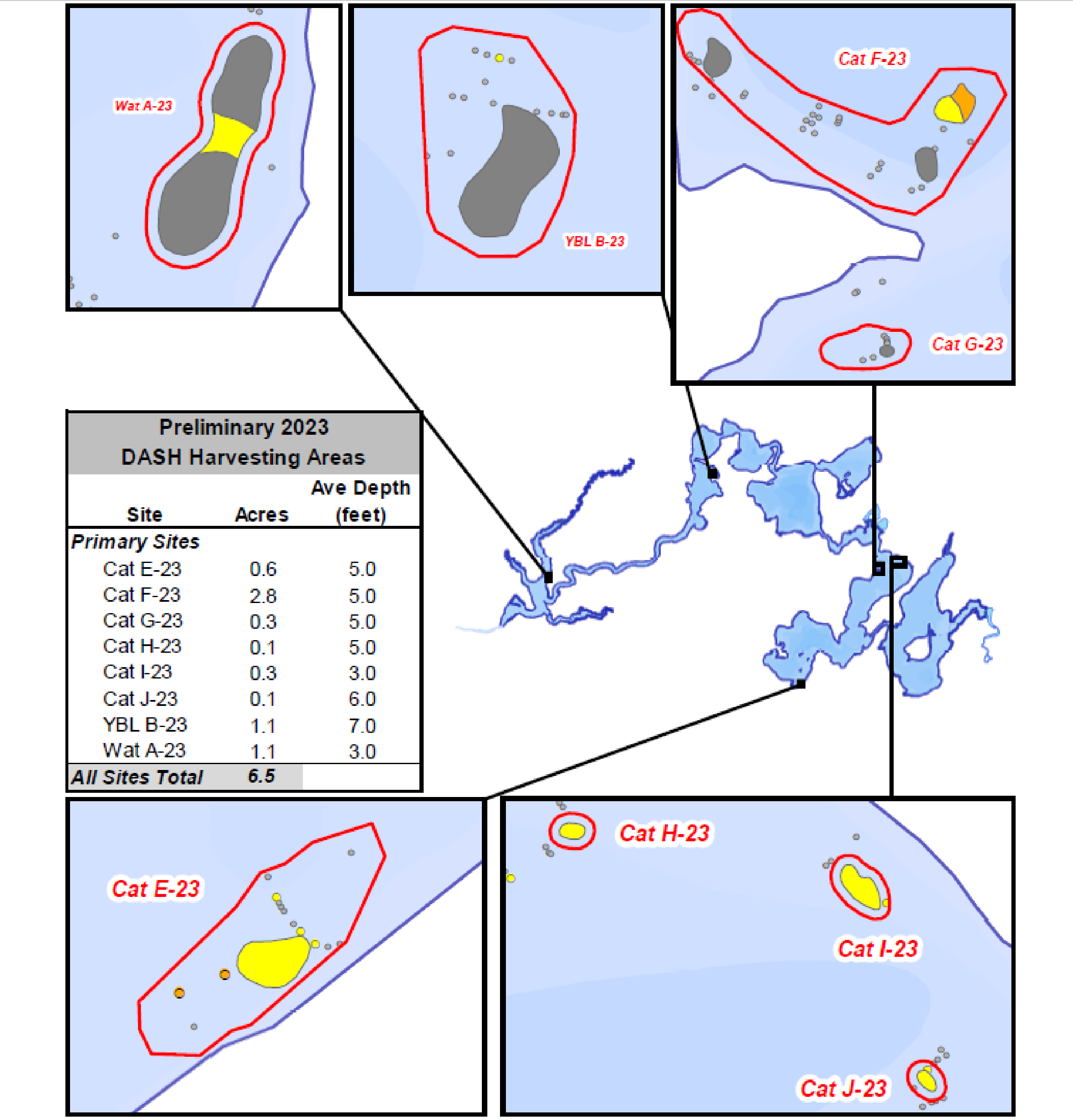
Due largely to manual removal expenditures being less than estimated within the WDNR AIS Control Grant (ACEI-240-20), the ULERCLC was able to extend this 3-year project through 2023. This project will follow the same monitoring and planning strategy utilized during the history of this project.

Using the 2022 Late-Season EWM Mapping Surveys, a preliminary professional manual removal EWM control strategy for 2023 was developed targeting 6 sites in Catfish, 1 site in Yellow Birch, and one site in Watersmeet (Figure 3.0-1). Based upon the results of the 2023 Early-Season AIS Survey, areas could potentially be added, omitted, or revised. Onterra will provide the hand-harvesting firm with the spatial data from the early-season survey to aid the removal efforts.

Low-density occurrences in the shallow bay to the east of the T-Docks Boat Landing (area locally known as the *bullpen*) would be targeted with organized volunteer-based efforts. Relatively shallow water, coupled with a modest EWM population in this site may allow for volunteers to effectively harvest EWM with minimal accessories such as fins or a snorkeling mask.

It is also important to note that each riparian owner can legally harvest EWM and native plant species in a 30-foot wide area of one's frontage directly adjacent to one's pier without a permit. A permit is only required if an area larger than the 30-foot corridor is being harvested or if a mechanical assistance mechanism, like DASH, is being used. Simply wading into the lake and removing EWM by hand with or without the aid of snorkeling accessories can be helpful in managing EWM on a small and individual property-based scale.

Following the hand-harvesting activities, a Late-Season EWM Mapping Survey will qualitatively assess the EWM removal efforts and be used to plan management and monitoring activities in 2024.



Preliminary 2023 DASH Harvesting Areas		
Site	Acres	Ave Depth (feet)
Primary Sites		
Cat E-23	0.6	5.0
Cat F-23	2.8	5.0
Cat G-23	0.3	5.0
Cat H-23	0.1	5.0
Cat I-23	0.3	3.0
Cat J-23	0.1	6.0
YBL B-23	1.1	7.0
Wat A-23	1.1	3.0
All Sites Total	***6.5***	

Figure 3.0-1. Preliminary 2023 Manual Removal Plan. Map to be submitted for NR109 permit for DASH.

4.0 INDIVIDUAL LAKE SECTIONS

The remainder of this report will focus on the 2022 EWM monitoring and management activities and point intercept survey results on a lake-by-lake basis. Some of the text will seem redundant if one reads each lake section. However, this is intentional to ensure the information is portrayed to those who only read the chain-wide sections and their individual lake-specific section.

Professional EWM monitoring surveys took place on each lake twice during 2022. An early season AIS survey (ESAIS) was completed during July 5-7, and a Late-Season EWM Mapping Survey was completed on September 13-14.

The whole-lake point-intercept surveys were conducted on the Eagle River Chain of Lakes on July 18-21, 2022, with highlights of each individual lake's results included in the individual lake sections. A table displaying the littoral frequency of occurrence of each aquatic plant species from all four point-intercept surveys is included in Appendix B.

4.2 Catfish Lake

EWM Monitoring & Management

As has occurred in past years, the EWM population in Catfish Lake was mapped professionally during Onterra's 2022 Early-Season AIS (ESAIS) and Late-Season EWM Mapping Surveys (also called EWM Peak-Biomass Survey). During the ESAIS Survey, the entire littoral zone of the Lower Eagle River Chain of Lakes was searched for EWM by Onterra field staff. Completion of an ESAIS Survey presents numerous advantages. Typically, the water is clearer during the early summer allowing for more effective viewing of submersed plants. While not at their peak growth stage (peak biomass), EWM plants are higher in the water column than most native plants during this time of year which increases the chances that even low-density and isolated EWM occurrences would be located.

The results from the ESAIS Survey were loaded onto specific ULERCLC GPS units, and trained volunteers were tasked with searching and mapping EWM in areas where Onterra did not locate it during the ESAIS Survey. Volunteers marked several locations of suspected EWM during the summer and shared the findings with Onterra in advance of the Late-Season Survey.

The ULERCLC contracted with DASH Aquatic Services, LLC to conduct professional DASH harvesting of EWM in five sites in Catfish Lake in 2022. Over a period of about 16 days in June, July, and August of 2022, a total of approximately 3,046 pounds of EWM were harvested from sites within Catfish Lake (Table 4.2-1).

Table 4.2-1. 2022 Hand-harvest summary. Summarized from Appendix A.

DASH Removal Summary		
Site	Time Spent (Hours)	Total EWM Removed (lbs)*
Cat A-22	15.5	436
Cat B-22	39.0	950
Cat E-22	7.3	364
Cat F-22	14.0	702
Cat G-22	15.5	594
YBL B-22	14.5	186
Wat A-22	0	0
Total	**105.8**	**2202**

**Each harvesting event included between 5-15% non-target species*

Site Cat B-22 saw the greatest amount of professional harvesting efforts in 2022 with approximately 950 pounds of EWM removed over six days. Monitoring shows a reduction in the EWM population in the site following the hand harvesting efforts. A *dominant* colony on the north end of the site was reduced to a *highly scattered* density, while the main body of the site was reduced from *scattered* density to *highly scattered* (Figure 4.2-1).

The EWM population before and after harvesting efforts in sites F-22 and G-22 are highlighted in Figure 4.2-1. Professional harvesting in site F-22 totaled 14 hours of dive time resulting yielding 702 pounds of harvested EWM. Nearly 600 pounds of EWM were harvested from site Cat G-22 over the course of 15.5 hours of effort. A reduction in one particular *dominant/highly dominant* colony of EWM within site F-22 is apparent when comparing the pre- and post-harvesting mapping surveys (Figure 4.2-1). A reduction in the EWM population within site G-22 was also documented when comparing the pre- and post-harvesting mapping surveys, with the main *highly dominant* colony being reduced to a smaller *scattered* colony (Figure 4.2-1).

Professional hand harvesting efforts in site E-22 resulted in the harvest of 364 pounds of EWM. The site was reduced by one density rating in 2022 from *highly dominant* to *dominant* (Figure 4.2-1). Harvesting activities at site A-22 resulted in a reduction in density from *dominant* to *highly scattered*.

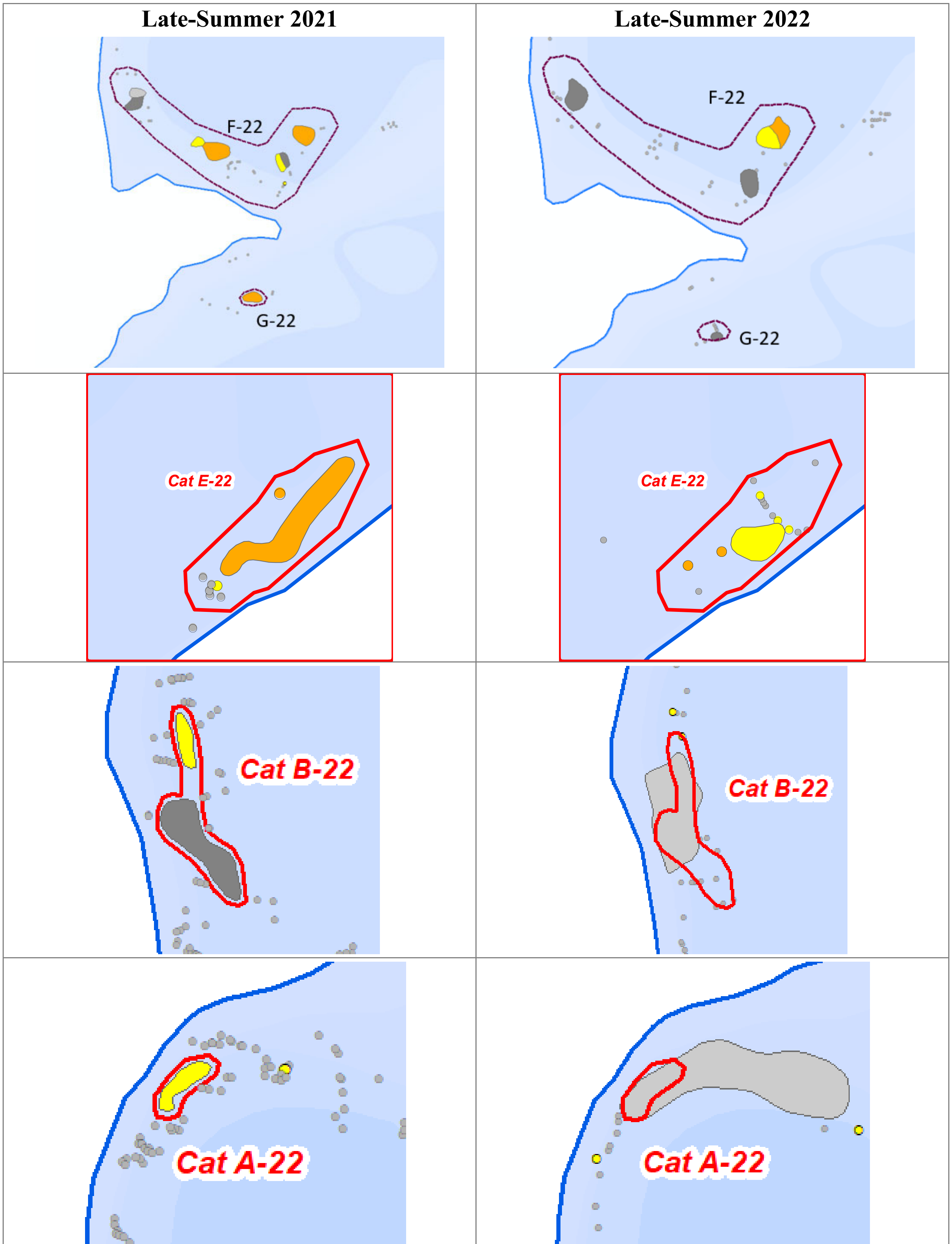


Figure 4.2-1. Before (2021) and After (2022) professional hand-harvesting at sites within Catfish Lake.

With the relatively small and low-density EWM population present in Catfish Lake in 2022, herbicide treatment is not being considered for 2023. However, six sites in Catfish Lake are being proposed for professional hand-harvesting actions in 2023 (Catfish Lake Map 2). The sites include continued efforts in former sites F-22 and G-22, as well as a number of other sites that harbor colonized EWM. The final DASH harvesting strategy is subject to change pending the results of the 2023 Early-Season AIS survey.

2022 Point-Intercept Survey Results

Onterra ecologists completed a whole-lake point-intercept survey on Catfish Lake on July 19-20, 2022. In total, 26 native aquatic plant species were encountered during the 2022 survey. Wild celery (40.8%), slender naiad (27.6%), and large-leaf pondweed (16.1%) were the most frequently encountered species in the 2022 survey (Figure 4.2-2).

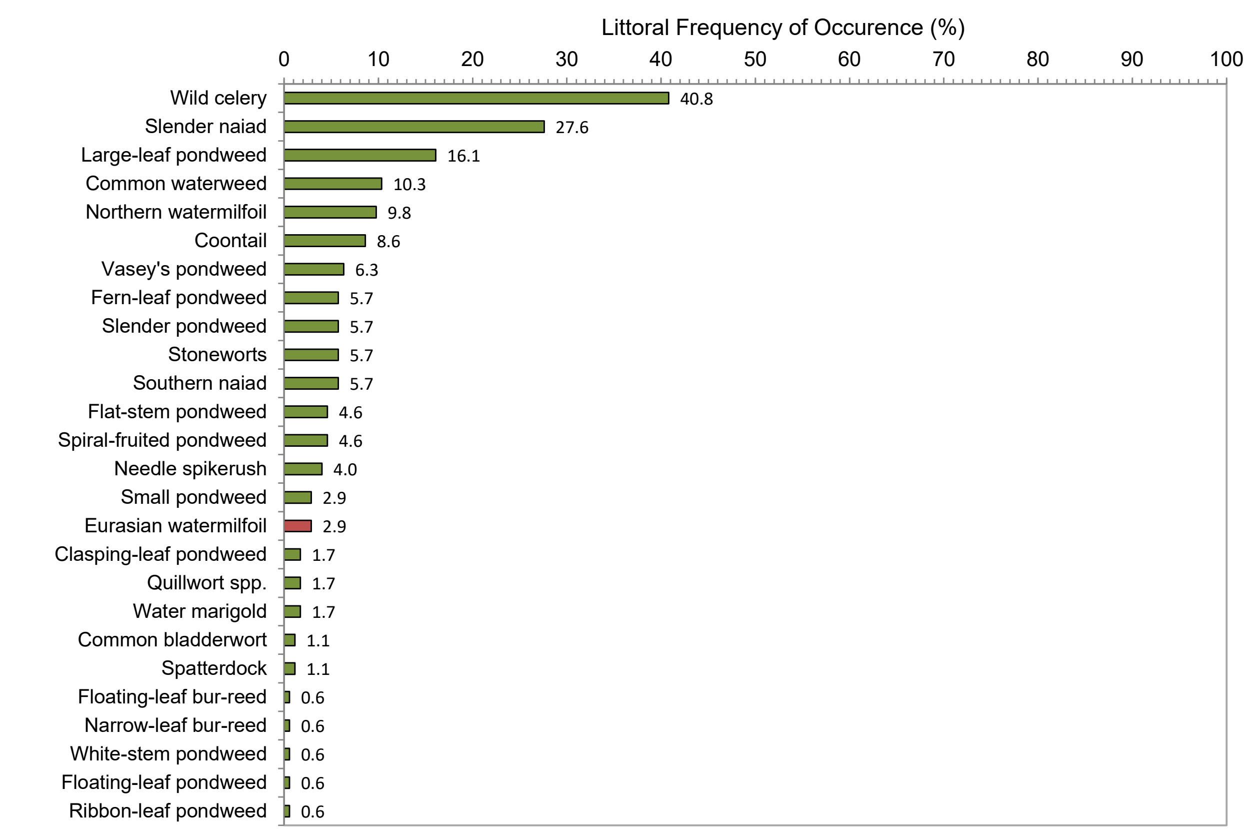


Figure 4.2-2. Catfish Lake littoral frequency of occurrence of aquatic plant species from 2022 point-intercept survey.

A chi-square analysis ($\alpha = 0.05$) was used to compare individual aquatic plant species littoral frequencies of occurrence in Catfish Lake between the point-intercept surveys in 2006, 2012, 2017, and 2022 (Figure 4.2-3). Of the 14 native aquatic plant species that had a littoral occurrence of at least 5% in one of the four surveys, six exhibited statistically valid changes in their littoral occurrence between the 2017 and 2022 surveys (Figure 4.2-3). A table displaying the littoral frequency of occurrence of each aquatic plant species from all four point-intercept surveys is included in Appendix B.

Of the six native species which saw changes in their occurrence, one species saw a statistically valid reduction in its occurrence over this time period: wild celery (Figure 4.2-3).

Five native species exhibited statistically valid increases in occurrence between 2017 and 2022: slender naiad (59.6%), slender & small pondweed (365.5%), Vasey's pondweed (100%), northern watermilfoil (295.7%), and stoneworts (100%). The littoral occurrences of common waterweed, large-leaf pondweed, spiral-fruited pondweed, and fern-leaf pondweed have remained relatively stable over the course of the four surveys. No statistically significant changes in occurrence were observed between 2017 and 2022 for any of these species.

Eurasian watermilfoil was sampled on 5 of 174 littoral sampling locations in the 2022 survey resulting in an occurrence of 2.9%. The occurrence of EWM has remained relatively low in each survey with values between 0.2% and 3.1%.

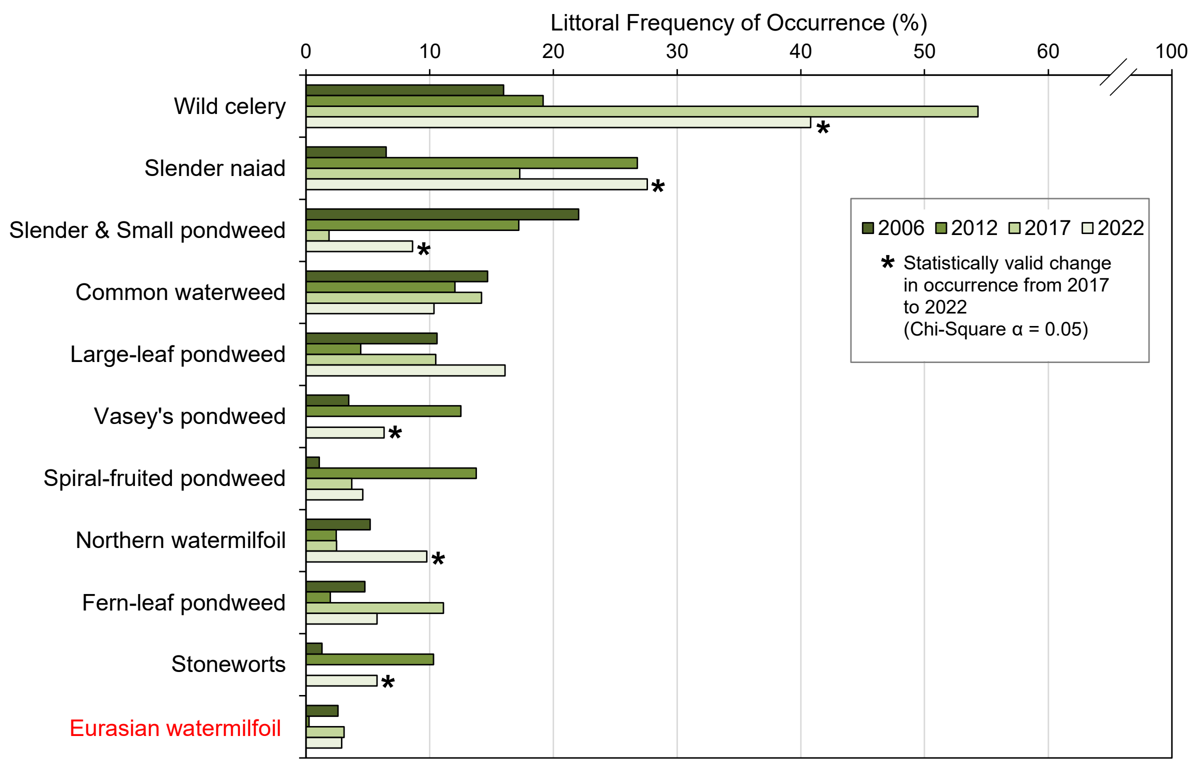
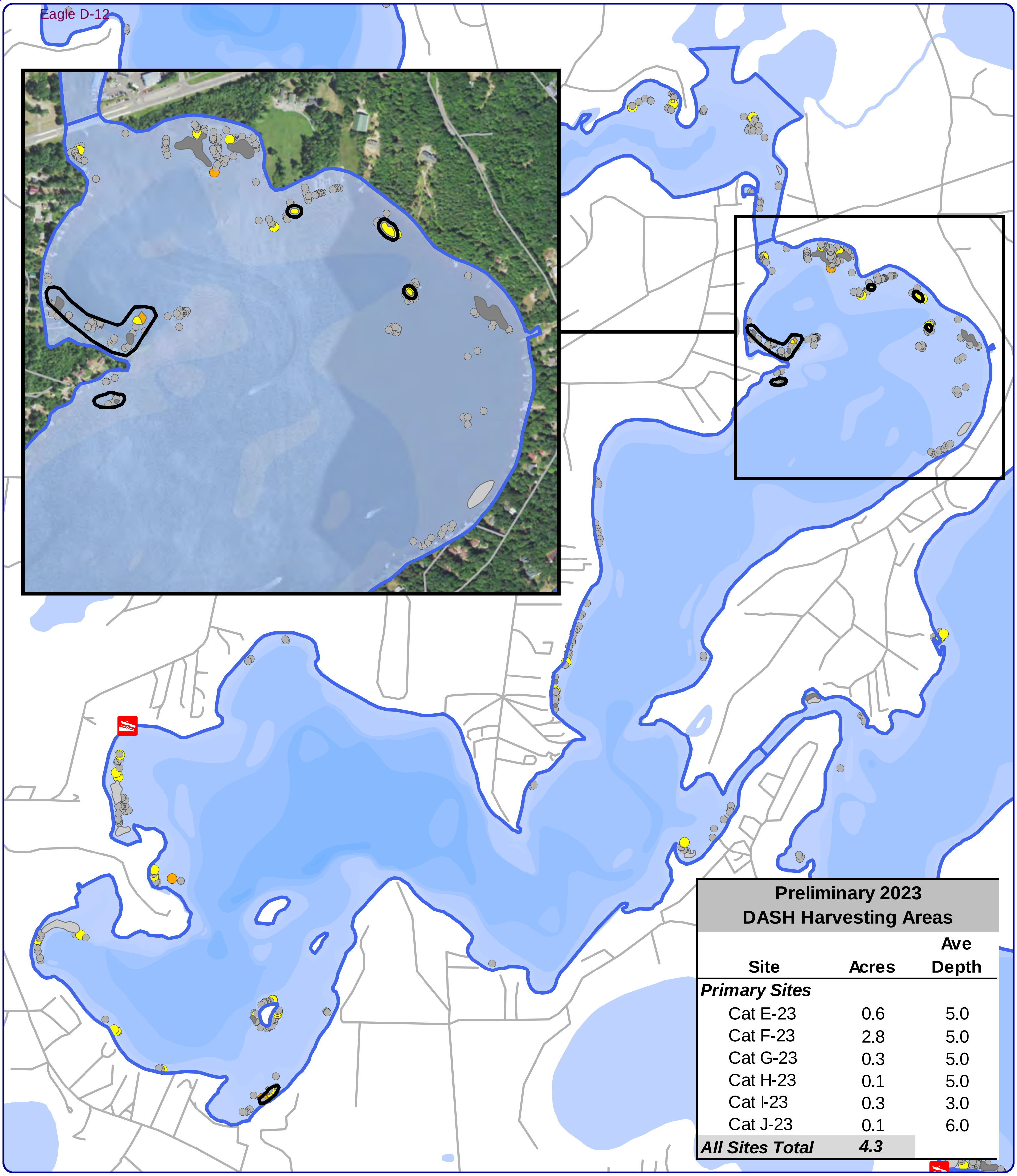


Figure 4.2-3. Catfish Lake littoral frequency of occurrence of select aquatic plant species from 2006, 2012, 2017, and 2022 point-intercept surveys. Please note that only those native species with an occurrence of at least 10% in one of the four surveys are displayed.



Preliminary 2023 DASH Harvesting Areas

Site	Acres	Ave Depth
Primary Sites		
Cat E-23	0.6	5.0
Cat F-23	2.8	5.0
Cat G-23	0.3	5.0
Cat H-23	0.1	5.0
Cat I-23	0.3	3.0
Cat J-23	0.1	6.0
All Sites Total	***4.3***	

N
W E
S

1,600

Feet

Onterra LLC
Lake Management Planning

815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Bathymetry: WDNR, Onterra digitized
Aquatic Plants: Onterra, 2022
Map Date: aPRIL 5, 2023 JMB

Legend

2022 EWMPB Survey (September 13-14, 2022)

- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single or Few Plants
- Clumps of Plants
- Small Plant Colony
- 2023 Hand-Harvest Site

Map 2
Catfish Lake
Vilas County, Wisconsin

2022 EWM Peak-Biomass Survey Results & 2023 Preliminary Hand-Harvest Plan

A

APPENDIX A

DASH Aquatic Services, LLC 2022 Harvesting Summary

DASH Aquatic Services LLC

2022 DASH SUMMARY

Harvesting of Eurasian Water Milfoil took place on the Eagle River Chain of Lakes
June 28, July 18-21, July 25-28, August 1-4, August 8-10

Catfish Lake area A-22
436 pounds were harvested over 15 ½ hours on 7/28, 8/1, and 8/2
Approx. 10% native plants harvested
EWM was scattered among native plants mostly single plants with a few small clumps in the center of the area

Catfish Lake Area B-22
950 pounds were harvested over 39 hours on 7/25, 7/27, 8/2, 8/4, 8/8, and 8/9
Approx. 10% native plants harvested
Clumps of large EWM plants were dominant in the center and north end of the area with single plants and small clumps mixed in with native plants

Catfish Lake Area E-22
364 pounds were harvested over 7 ¼ hours on 7/20
Approx. 10% native plants harvested
Clumps and single plants were mixed in with native plants

Catfish Lake Area F-22
702 pounds were harvested over 14 hours on 7/19, 7/21, and 8/10
Approx. 5% native plants were harvested
Clumps of large EWM plants were dominant with few native plants mixed in
The yellow dominant area and gray scattered area in the center were targeted, the east and west ends of the area were not harvested

Catfish Lake Area G-22
594 pounds were harvested over 15 ½ hours on 6/28, 7/18, 7/19, and 7/21
Approx. 5% native plants were harvested
Large clumps of EWM were dominant with scattered plants mixed with natives around the outside of the area

Yellow Birch Lake Area B-22 and A-22
186 pounds were harvested over 14 ½ hours on 7/26 and 8/3
Approx. 5% native plants were harvested
Scattered single plants and small clumps were found mixed with native plants
Approx. 10 small EWM plants were removed from area A-22 where the map shows single/few plants with the gray dots

Watersmeet Lake Area A-22
This area of EWM is surrounded by surface matting native plants making it difficult to place the DASH boat in a location to efficiently work without drawing the native plants into the pick up hose for the pump. To avoid significant damage to the native plant population and equipment down time, it was decided to not harvest in this area.
Harvesting this area earlier in the season would have better results

Catfish Lake

A-22	436#
B-22	950#
E-22	364#
F-22	702#
G-22	594#
	3046

Yellow Birch Lake

A-22	186#

3232# total harvest

B

APPENDIX B

Littoral Frequency of Occurrence of Aquatic Plants in the Eagle River Chain

Catfish Lake

Scientific Name	Common Name	LFOO (%)					2006-2012		2012-2017		2017-2022	
		2006	2012	2017	2022	2022	% Change	Direction	% Change	Direction	% Change	Direction
Vallisneria americana	Wild celery	16.0	19.2	54.3	40.8	40.8	19.9	▲	183.4	▲	-24.9	▼
Najas flexilis	Slender naiad	6.5	26.8	17.3	27.6	27.6	313.3	▲	-35.5	▼	59.6	▲
Potamogeton berchtoldii & P. pusillus	Slender & Small pondweed	22.0	17.2	1.9	8.6	8.6	-21.9	▼	-89.2	▼	365.5	▲
Potamogeton pusillus	Small pondweed	22.0	17.2	1.9	2.9	2.9	-21.9	▼	-89.2	▼	55.2	▲
Elodea canadensis	Common waterweed	14.7	12.0	14.2	10.3	10.3	-18.0	▼	17.9	▲	-27.1	▼
Potamogeton amplifolius	Large-leaf pondweed	10.6	4.4	10.5	16.1	16.1	-58.2	▼	137.3	▲	53.3	▲
Ceratophyllum demersum	Coontail	7.1	8.4	5.6	8.6	8.6	17.2	▲	-33.5	▼	55.2	▲
Potamogeton vaseyi	Vasey's pondweed	3.5	12.5	0.0	6.3	6.3	262.6	▲	-100.0	▼		▲
Potamogeton zosteriformis	Flat-stem pondweed	7.8	6.6	4.3	4.6	4.6	-14.7	▼	-34.9	▼	6.4	▲
Potamogeton spirillus	Spiral-fruited pondweed	1.1	13.8	3.7	4.6	4.6	1174.1	▲	-73.1	▼	24.1	▲
Myriophyllum sibiricum	Northern watermilfoil	5.2	2.5	2.5	9.8	9.8	-52.6	▼	0.5	▲	295.7	▲
Potamogeton robbinsii	Fern-leaf pondweed	4.8	2.0	11.1	5.7	5.7	-58.6	▼	465.3	▲	-48.3	▼
Nitella spp.	Stoneworts	1.3	10.3	0.0	5.7	5.7	696.3	▲	-100.0	▼		▲
Myriophyllum spicatum	Eurasian watermilfoil	2.6	0.2	3.1	2.9	2.9	-90.5	▼	1156.2	▲	-6.9	▼
Eleocharis acicularis	Needle spikerush	0.0	0.7	3.1	4.0	4.0		▲	318.7	▲	30.3	▲
Potamogeton berchtoldii	Slender pondweed	0.0	0.0	0.0	5.7	5.7		-		-		▲
Najas guadalupensis	Southern naiad	0.0	0.0	0.0	5.7	5.7		-		-		▲
Potamogeton richardsonii	Clasping-leaf pondweed	0.4	1.7	1.2	1.7	1.7	298.2	▲	-28.2	▼	39.7	▲
Nuphar variegata	Spatterdock	1.3	0.5	1.2	1.1	1.1	-62.1	▼	151.2	▲	-6.9	▼
Isoetes spp.	Quillwort spp.	0.4	0.2	1.2	1.7	1.7	-43.1	▼	402.5	▲	39.7	▲
Bidens beckii	Water marigold	0.9	0.0	0.6	1.7	1.7	-100.0	▼		▲	179.3	▲
Chara spp.	Muskgrasses	0.9	0.2	1.9	0.0	0.0	-71.6	▼	653.7	▲	-100.0	▼
Sparganium angustifolium	Narrow-leaf bur-reed	0.0	0.7	0.6	0.6	0.6		▲	-16.3	▼	-6.9	▼
Potamogeton epihydrus	Ribbon-leaf pondweed	0.0	0.7	0.6	0.6	0.6		▲	-16.3	▼	-6.9	▼
Ceratophyllum echinatum	Spiny hornwort	0.0	0.0	3.1	0.0	0.0		-		▲	-100.0	▼
Utricularia vulgaris	Common bladderwort	0.0	0.0	0.0	1.1	1.1		-		-		▲
Sparganium fluctuans	Floating-leaf bur-reed	0.0	0.0	0.6	0.6	0.6		-		▲	-6.9	▼
Schoenoplectus tabernaemontani	Softstem bulrush	0.4	0.2	0.0	0.0	0.0	-43.1	▼	-100.0	▼		-
Potamogeton praelongus	White-stem pondweed	0.0	0.2	0.0	0.6	0.6		▲	-100.0	▼		▲
Sparganium sp.	Bur-reed sp.	0.4	0.0	0.0	0.0	0.0	-100.0	▼		-		-
Potamogeton natans	Floating-leaf pondweed	0.0	0.0	0.0	0.6	0.6		-		-		▲
Potamogeton foliosus	Leafy pondweed	0.0	0.5	0.0	0.0	0.0		▲	-100.0	▼		-
Nymphaea odorata	White water lily	0.0	0.5	0.0	0.0	0.0		▲	-100.0	▼		-
Fissidens spp. & Fontinalis spp.	Aquatic Moss	0.0	0.5	0.0	0.0	0.0		▲	-100.0	▼		-
Spirodela polyrhiza	Greater duckweed	0.0	0.2	0.0	0.0	0.0		▲	-100.0	▼		-
Sagittaria sp. (rosette)	Arrowhead sp. (rosette)	0.0	0.2	0.0	0.0	0.0		▲	-100.0	▼		-
Potamogeton strictifolius	Stiff pondweed	0.0	0.2	0.0	0.0	0.0		▲	-100.0	▼		-
Potamogeton gramineus	Variable-leaf pondweed	0.0	0.0	0.6	0.0	0.0		-		▲	-100.0	▼
Potamogeton friesii	Fries' pondweed	0.0	0.2	0.0	0.0	0.0		▲	-100.0	▼		-
Lobelia dortmanna	Water lobelia	0.2	0.0	0.0	0.0	0.0	-100.0	▼		-		-
Heteranthera dubia	Water stargrass	0.0	0.2	0.0	0.0	0.0		▲	-100.0	▼		-