Myriophyllum spicatum-Eurasian watermilfoil Management Analysis (herbicide, DASH, hand pull)

Cedar Lake, St. Croix County Wisconsin

2017

Treatment supported by: *Wisconsin DNR and Cedar Lake P&R District*

Data collection and analysis provided by: *Ecological Integrity Service, LLC*
Amery, WI

Abstract

An herbicide application of Aquastrike® (mixture of diquat and endothall) was conducted in a 2.6-acre bed of EWM (*Myriophyllum spicatum)* on May 9, 2017 on Cedar Lake, St. Croix County Wisconsin. A post treatment survey on July 11 resulted in a frequency of occurrence (FOO) of EWM of 46.2% and a density of 0.64 (scale of 0-3). This was a slight decrease from a September 2016 survey where the FOO was 48.7% and a mean density of 0.72. There was no statistically significant reduction in EWM based upon a chi-square analysis. There was a significant reduction of five native species based upon a chi-square analysis between 2016 and 2017 post treatment surveys. Hand pulling efforts using diver assisted suction harvest (DASH) removed approximately 5000 lbs. (wet weight) of EWM. Follow-up hand pulling with divers removed an additional 200 lbs. There was a frequency reduction (51.4% to 24.3%) in EWM within the DASH sites based upon a chi-square analysis. The mean density was also reduced. A survey before and after DASH using a sample grid around all historical EWM control areas (treatment and diver removed) also showed a frequency reduction from 30.8% to 18.8%, but was not quite significant (p=0.06). A baseline EWM evaluation on a larger, long-term sample grid was completed in September 2017 with a EWM FOO of 7.03%.

Introduction

On May 9, 2017 herbicide was applied to target the aquatic invasive species Eurasian water milfoil (EWM)- *Myriophyllum spicatum* on Cedar Lake, St. Croix County, Wisconsin. The treatment was conducted when the water temperature was 56°F with winds from the NW at 1 mph. The herbicide Aquastrike®, a mixture of endothall and diquat, was utilized. This treatment covered an area of 2.6 acres and is a subsequent treatment after an unsuccessful result with 2,4-D in 2016.

In late July, diver assisted suction harvest (DASH) was utilized to remove EWM left after the herbicide treatment. DASH harvest occurred both inside and outside of the herbicide treatment bed. In September, a small area with remaining dense stands of EWM within the DASH area, was hand pulled by diving.

This analysis is to determine the effectiveness of the control measures targeting EWM on Cedar Lake, both with the herbicide and the manual removal. The analysis involves surveys conducted in September 2016 and April and July 2017 for the herbicide analysis and July and September 2017 for the manual removal. In October, a baseline survey to reflect long-term EWM growth was conducted. This survey will be done annually to demonstrate any changes in EWM in the management area.

Analysis Methods

In September 2016 a survey was conducted following a May herbicide treatment to determine the EWM within the delineated bed and outside of the bed. The delineated area was then checked in April 2017 to verify EWM coverage and potentially adjust the treatment bed. Treatment occurred after this survey was completed.

A post treatment survey was conducted on July 6, 2016 to evaluate the frequency and density of the EWM after treatment. The post treatment survey used the same sampling points within the treatment polygon as in the pretreatment survey. A 1-meter rake tow was used at each sample point with each species (including EWM) on the rake identified and given a density rating of 1, 2 or 3. The diagram below shows the density standards.

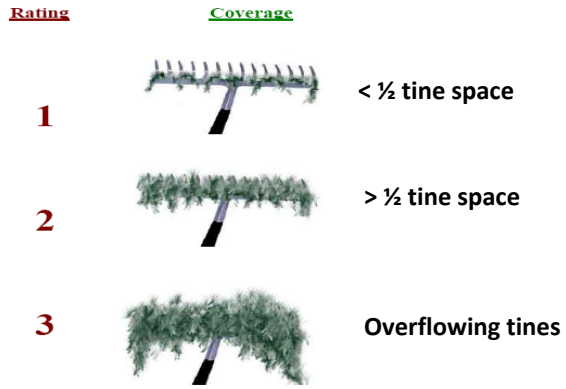

Figure 1: Density rating graphic.

After the surveys were completed, a chi-square analysis was conducted on the EWM frequency changes as well as the native plant species frequency changes. This allows for the determination of

whether the herbicide treatment reduced the frequency of EWM and whether the native plant species were adversely affected by the herbicide. Typically the pretreatment survey reference is in late summer/fall the year prior to treatment.

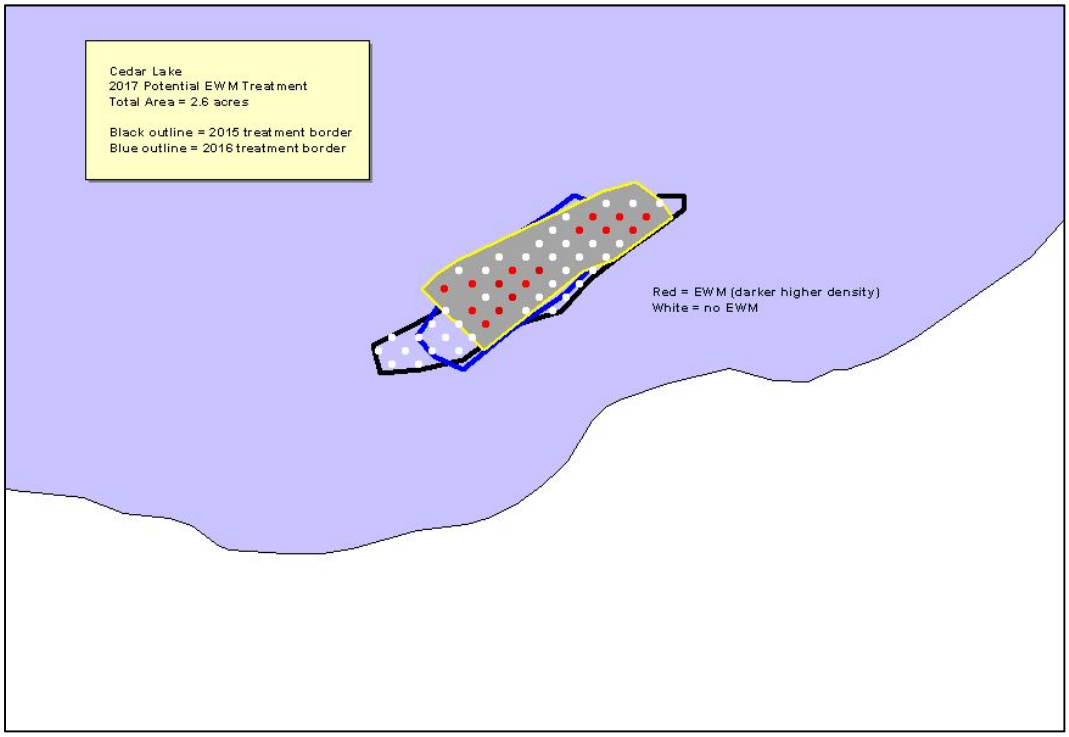

***Figure 2**: 2017 herbicide treatment area on Cedar Lake.*

Table 1 summarizes the bed characteristics, treatment and conditions during treatment.

Area (acres)	Mean depth (feet)	Acre feet	Target concentration	Gallons of herbicide applied	Water temp.	Wind speed
2.6	4.8	12.48	0.36 ppm	1.8	60°F	1 mph NW

***Table 1:** EWM treatment bed information.*

Diver assisted suction harvest (DASH) of EWM uses a suction device manned by a diver to pump EWM up to a boat with a catchment basket. The DASH is designed to remove EWM with little or no sediment removal. It also removes EWM at a much higher rate than a diver alone.

To evaluate DASH, a survey was completed before and after DASH within a sample grid created around the entire DASH sites, including any area with historical EWM. This was done to determine if the DASH is reducing the EWM in the area, and assess if spreading occurred after DASH. The rake density was recorded for EWM at each site[1]. This survey was repeated at the same locations after

[1] The 2017 Aquatic Plant Management Plan for Cedar Lake calls for a native plant record before and after DASH. The surveyor did not realize this and therefore this data is not included in 2017. It will be included in the future for all DASH evaluations.

DASH and hand pulling with divers (approximately 6 weeks later). The frequency of occurrence (FOO) change was evaluated using a chi-square analysis with $p<0.05$ as the threshold for significance.

Results

Herbcide treatment

The surveys conducted are represented by the maps in figures 3-5. The EWM frequency in September 2016 was 48.7%. After the May 2017 treatment, the post treatment survey frequency on July 11, 2017 was 46.2%. Table 2 summarizes the survey frequency and density data.

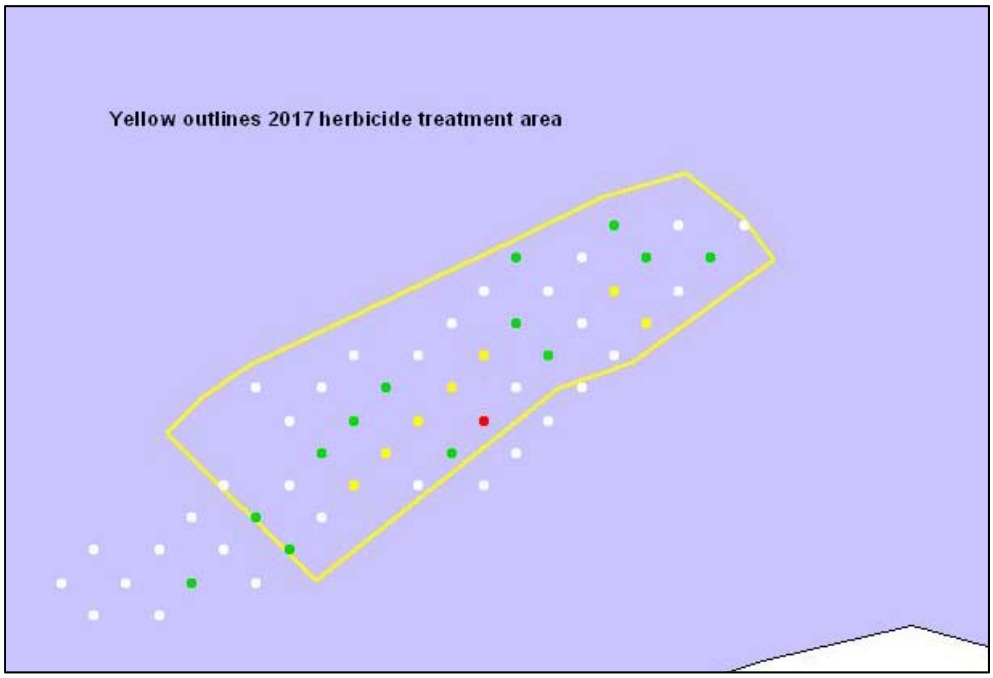

Figure 3: *EWM locations and density in September 2016.*

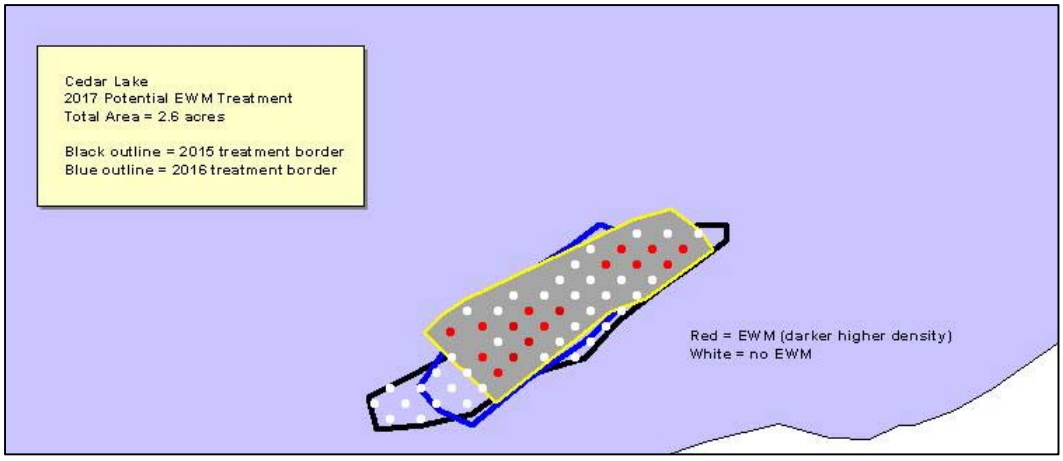

Figure 4*: EWM locations with treatment bed April 2017*

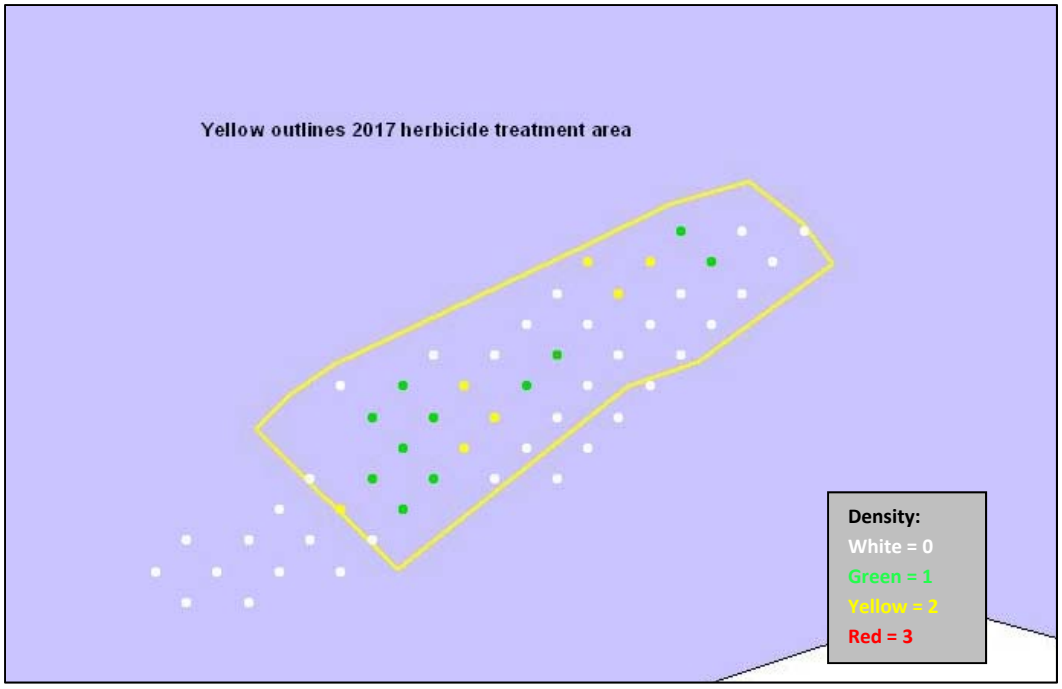

Figure 5: *EWM locations (and density) within the treatment bed, July 2017.*

Survey	Number of EWM sampled	EWM frequency of occurrence	Mean EWM Density
Sept. 2016	19/39	48.7%	0.72
Before treatment (May 2017)	16/39	41.0%	n/d
After treatment (July 2017)	18/39	46.2%	0.64
Change	Reduced by 1 sample points (increase from Sept. 2015)	Small decrease that was NOT statistically significant. (P=0.65)	Density decreased from Sept. 2016 to July 2017 slightly.

Table 2: *Summary of the frequency and density data from surveys used to evaluate treatment.*

The results of the surveys show that the herbicide treatment had virtually no effect on the reduction of the EWM. The frequency decreased slightly comparing the September 2016 and the July 2017 survey (post or after treatment). The mean density also decreased only slightly from 2016 to 2017 within the treatment bed.

In addition to targeting and reducing the invasive species, another goal is to cause no reduction in native plant species. During the July post treatment survey, all native plants were identified and evaluated with a chi-square analysis. These results were compared to the frequencies of natives in the 2016 post treatment survey.

Table 3 indicates that there were statistically significant reductions in five native plant species, and there was an increase in one native species. The herbicide used (mixture of diquat and endothall) is a broad spectrum herbicide, so all plants are susceptible to these chemicals. A concern for using this combination is the effect on the native species. It is not known that all these reductions are due

to herbicide use. Interestingly, the frequency shows no effect on EWM but reduced several native species, if indeed the herbicide killed these plants. This reduction is a concern. Some of the reductions were very profound, such as *Vallisneria americana* (wild celery) where it was found at 86% of the sample locations in 2016 and none was sampled in 2017. One beneficial side effect of the herbicide application was a reduction in the AIS *Potamogeton crispus* (curly leaf pondweed).

Native Species	Pre pts sampled 2016 frequency	Post pts sampled 2016 frequency	P value	Change	Significant Reduction in species?
Myriophyllum sibircum	0.32	0.05	0.002	-	Yes
Potamogeton pusillus	0.86	1.00	0.02	+	Increase
Potamogeton richardsonii	0.70	0.05	$4.0X10^{-9}$	-	Yes
Potamogeton strictifolious	0.14	0.00	0.02	-	Yes
Vallisneria americana	0.86	0.00	$2.3X10^{-14}$	-	Yes
Potamgeton crispus	0.65	0.21	$9.0X10^{-5}$	-	Yes (desirable as AIS)
Ceratophyllum demersum	0.08	0.08	n/a	n/c	n/a
Elodea canadensis	0.16	0.15	0.92	-	No
Heteranthera dubia	0.03	0.00	0.30	-	No
Najas flexilis	0.03	0.00	0.30	-	No
Chara sp.	0.16	0.08	0.25	-	No
Stuckenia pectinata	0.08	0.00	0.07	-	No
Potamogeton friesii	0.19	0.00	0.004	-	Yes

***Table 3**: Chi-square analysis results used to evaluate effect on native plant species.*

DASH/Hand Removal Efforts

Following the herbicide treatment, the post treatment evaluation was used to determine the follow-up strategies for EWM removal. It was determined that because the EWM was too large in area and density, that DASH would need to be utilized. The location and density of EWM was used to establish DASH priority areas.

On July 28 and 29, approximately 5000 lbs. (wet weight) of EWM was removed using DASH. Figures 8 and 9 show the density at sample sites before and after DASH removal.

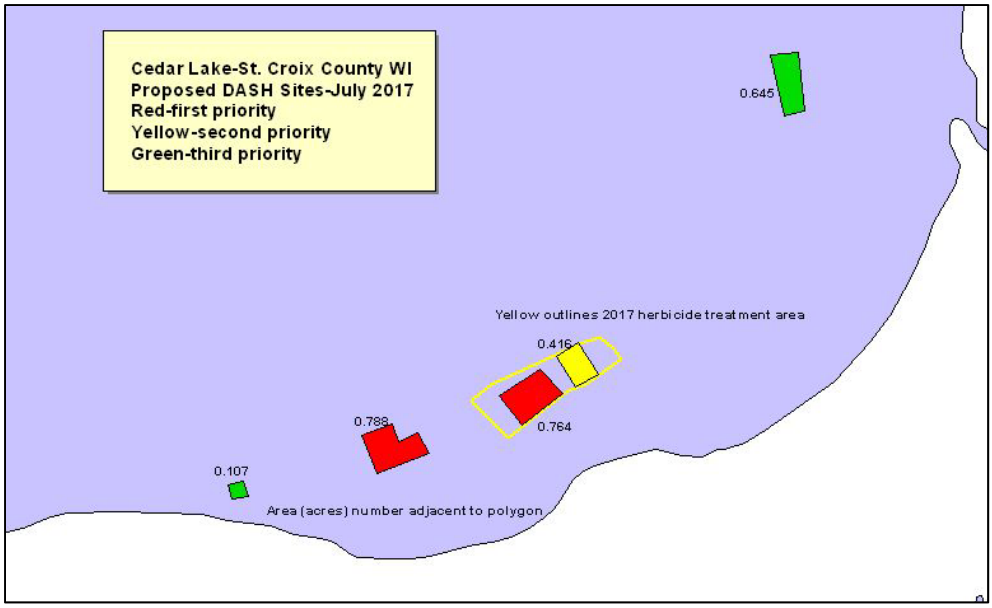

***Figure 7**: DASH locations set based upon priority for July 2017. The red and the yellow areas were the only areas where DASH removal occurred. The green areas were not managed in 2017.*

***Figure 8:** Map showing EWM density at each sample site surrounding DASH sites before DASH removal.*

Figure 9: *Map showing EWM density at each sample site surrounding DASH areas after DASH removal.*

	FOO before	**FOO after** (includes hand pulling)	**Mean Density before**	**Mean Density after**
Within DASH removal areas	51.4%	24.3%*	1.0	0.30
Entire sample grid	30.8%	18.7%#	0.54	0.20

**FOO reduction was significant based upon chi-square (p=0.02). #FOO was not significant (p=0.06)*

Table 4**: **DASH and hand removal results 2017: frequency of occurrence (FOO) and density

Following DASH, there was still some dense EWM remaining in DASH Site 1. In September 2017, divers (snorkeling) went into Site 1 to remove more EWM. Approximately 200 lbs. (wet weight) of EWM was removed at this time. The results in Table 4 include both DASH and hand pulling.

The DASH and hand pulling removal did provide a reduction in frequency and density. The frequency reduction in the entire grid was not significant, but the P value was 0.06 so it was very close ($P<0.05$ is significant). When analyzing only within the designated DASH areas, it was a significant reduction. The larger sample point grid was used around the entire area to evaluate DASH and to assess spreading following DASH. Based upon the data, there did not appear to be any EWM spreading around the DASH sites.

Long term evaluation

In order to evaluate if the EWM is changing (spreading, increasing, decreasing), a larger long-term sample point grid was produced surrounding all locations where EWM has been located in the past few years. In early October, all of these sample points were sampled for EWM and given a density rating (same ratings used in the herbicide post treatment survey). This grid will be used annually to provide a systematic evaluation of any changes to EWM. If EWM is found in other places, more sample grid will be added and annually monitored. Figure 11 shows the results of this first long term evaluation. The frequency of occurrence within the long-term sample grid was 7.03% EWM.

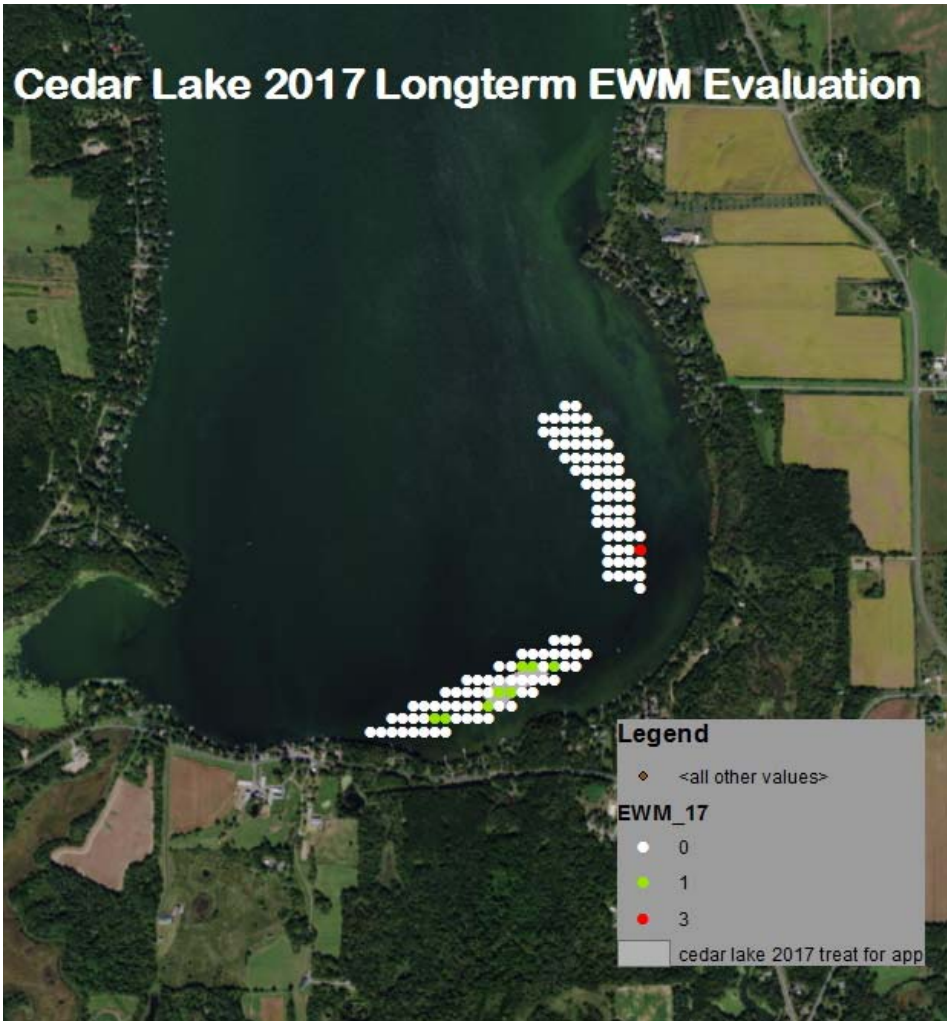

***Figure 11**: Long term evaluation EWM survey with density, September 2017.*

Discussion and recommendations

Since the discovery of EWM in 2015, the EWM was reduced initially in 2015 with herbicide treatment. In 2016 and 2017, the herbicide treatments were not effective at reducing the EWM. Table 5 shows the pre and post treatment frequency of occurrence (FOO) each year.

Year	Pre FOO	Post FOO	Significant reduction?
2015	81.2	20.3	Yes
2016	51.4	45.9	No
2017	48.7	46.2	No

Table 5: *Frequency of occurrence (FOO) of treatment bed 2015-2017.*

Although there is no data to support, speculation among professionals involved is that the location of the bed on the south end on the edge of a major depth change, may be contributing to the lack of reduction with herbicide use from water currents. This could reduce contact time of the herbicide for this small treatment area.

Since 2015, the EWM has remained in fairly high frequency and density within the original bed. In 2017, the treatment was once again unsuccessful, but the implementation of DASH did reduce EWM quite significantly. DASH appears to be a viable management tool. It provided reduction, allowed targeting the AIS (some natives were likely inadvertently removed), and gives the lake district more flexibility in responding to changing density and/or spreading. Herbicide is generally only applied in the early spring. If the treatment is not effective and/or the EWM spreads, application wouldn't occur until the following spring. The size of EWM coverage and the density will dictate the use of DASH, hand pulling and/or herbicides as outlined in the 2017 Cedar Lake Management Plan. It appears that the EWM may be managed at this time using DASH in 2018, based upon the 2017 observations and results.

References

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http://www4.uwsp.edu/cnr/uwexlakes/ecology/apmguide.asp appendix d.