

Introduction

Eurasian water milfoil (EWM) was first documented from Crooked, Gilkey, and Bass Lakes in 2002. Since 2008, the Crooked Lake Protection & Rehabilitation District (CLPRD) has been actively managing the EWM population through strategically targeted herbicide spot treatments.

During the 2012 Late-Summer EWM Peak-biomass Survey, Onterra ecologists only located low-density occurrences of EWM within the Crooked Lake system. Overall the 2012 herbicide treatment strategy was deemed successful, with one site in Crooked Lake requiring additional treatment in 2013. In order to increase efficacy of control in this area, an expanded buffer (40-foot) and a higher herbicide dose (4.0 ppm ae) was proposed for this site in 2013 (Map 1, Site A-13). Maintaining the aggressive treatment strategy that is outlined within the *Crooked, Gilkey, & Bass Lakes Aquatic Plant Management Plan – June 2012*, two small treatment areas were also proposed in Gilkey Lake.

Pretreatment Confirmation and Refinement Survey

On May 15, 2013, Onterra conducted the EWM spring Pretreatment Confirmation and Refinement Survey on the Crooked Lake system. During this survey, all the proposed treatment sites were visited. Sufficient EWM warranting treatment was confirmed in all of the originally proposed treatment areas. No alterations of the treatment area were made, however the average depth of each of the treatment area was modified slightly based upon the results of the survey.

Although the EWM appeared reddish brown from the surface during the May 15 survey, closer examination of the plants revealed that they were green and actively growing. Onterra recommended that the treatment occur as soon as logistically possible. The treatment was conducted by Schmidt's Aquatic Plant Control during the morning of May 16, 2013. The applicator reported 3-5 mph winds out of the northeast during the application.

Hand-harvesting Control Methods

During the summer of 2013, CLPRD volunteers conducted approximately 20.5 person-hours of EWM hand-harvesting over 6 days (Table 1). Most of these efforts were focused in Bass Lake, but some hand-harvesting also occurred within Crooked Lake and Gilkey Lake.

Table 1. CLPRD 2013 hand-harvesting records. Provided by CLPRD volunteer (Dean Stoller).

Date	Amount of Effort (Person-hours)	Notes
June 8, 2013	1 person x 1hr = 1 person-hour	Northwest shoreline of Bass Lake
June 20, 2013	2 people x 1hr = 2 person-hours	Bass Lake
June 23, 2013	1 person x 2.5hr = 2.5 person-hours	Crooked Lake (within A-13)
July 6, 2013	3 people x 2.5hr = 7.5 person-hours	West & Northwest shoreline of Bass Lake
August 3, 2013	4 people x 1.5hr = 6 person-hours	Eastern part of Bass Lake & Gilkey Lake (C-13)
August 29, 2013	1 person x 1.5hr = 1.5 person-hours	North shoreline of Bass Lake
Total	20.5 person-hours	

Late-season EWM Peak-biomass Survey

Like most native aquatic plants, EWM continues to grow and spread throughout the summer. For this reason, a late-summer EWM survey was conducted to understand the peak growth (peak-biomass) of the EWM population during 2013. Comparing the 2012 and 2013 EWM Peak-biomass Surveys allows for a qualitative evaluation of the May 2013 treatment. Also, the results of the 2013 EWM Peak-biomass Survey are important in developing the following year's treatment strategy.

Prior to Onterra's survey, location data of EWM occurrences were provided by volunteers from the CLPRD (Pat and Jane Porubcan). The data were then integrated into Onterra's onboard computer system to serve as focus areas for the Late-season EWM Peak-biomass Survey.

On September 19, 2013 Onterra ecologists meandered the entire littoral zone of the Crooked Lake system. During the meander survey, no colonized EWM plants were located within the Crooked Lake system. During this post treatment assessment, no EWM was located within C-13, and a small number of *Single or Few Plants* were located within each of A-13 and B-13. This indicates that the 2013 herbicide treatment was highly effective at controlling EWM. It is also important to note that some volunteer-based hand-harvesting efforts were conducted in A-13 and C-13 following the treatment, but prior to Onterra's survey.

The few more EWM occurrences were located in the southwestern part of Crooked Lake than during the late-summer of 2012, indicating that some amount of regrowth or re-colonization is occurring within this 2012 treatment area (Map 1).

Even with the targeted CLPRD hand-harvesting efforts applied in Bass Lake, there continues to be a slow increase in the amount of EWM within the lake (Map 1, Figure 1). Currently the population remains at low levels, with all occurrences being mapped as either *Single or Few Plants* or *Clumps of Plants*.

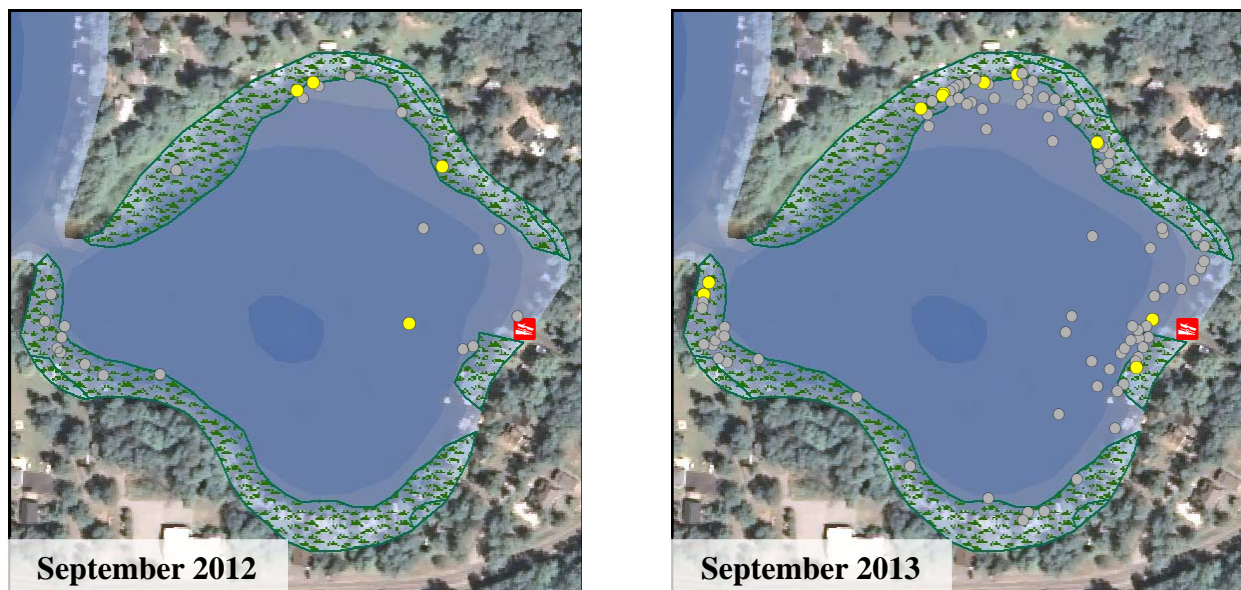


Figure 1. Bass Lake EWM locations from September 2012 and September 2013 surveys. Gray Point = Single or Few Plants; Yellow Point = Clumps of Plants; Green-outlined Polygon = Emergent and/or Floating-leaf Plant Community.

2013 Conclusions & Discussion

Overall, the 2013 EWM control program on the Crooked Lake system was met with encouraging results. The 2013 herbicide treatment was effective at controlling EWM with only minimal regrowth observed within these areas. The CLPRD's follow-up hand-harvesting efforts also aided in the successes observed in these sites. With the low level of EWM currently existing in Crooked Lake and Gilkey Lake, the proposed 2014 control strategy does not include an herbicide treatment of these two lakes. Volunteer-based hand-harvesting efforts would be extremely beneficial, especially within the shallow parts of Gilkey Lake and along the southwest shore of Crooked Lake. EWM occurrences within other parts of Crooked Lake, especially within A-13, may be more suitable for hand-removal by volunteers with advanced snorkeling or scuba abilities.

Following the 2012 Late-Season EWM Peak-biomass Survey, Onterra ecologists investigated the applicability of targeting the sparse, low-density EWM occurrences in Bass Lake. Due to Bass Lake's small water volume, almost any spot-treatment that would be conducted in this basin would have whole-lake implications. Therefore, Onterra recommended that a whole-lake treatment would be the most appropriate way to target the EWM within Bass Lake. Unlike spot treatments that rely on a short exposure (hours) of a high dose of herbicide, this strategy involves applying a low dose of 2,4-D to the entire lake understanding that the effective exposure time of the herbicide would be 14-28 days. While this technique can be extremely effective at controlling EWM, particular native plants may also be impacted by this strategy. The 2012 late-summer EWM survey suggested that there was not sufficient EWM within the system to warrant such an all-encompassing treatment strategy. Instead, it was determined to focus volunteer-based hand-harvesting within Bass Lake that may result in reducing or maintaining the level of EWM within the lake.

While the EWM populations of Crooked Lake and Gilkey Lake have been effectively managed and brought down to levels that can be effectively targeted with hand-harvesting methods, the EWM population of Bass Lake continues to increase. While the hand-harvesting efforts conducted by the CLPRD in 2013 have likely slowed the increase of EWM density within Bass Lake, the efforts were not sufficient to decrease the EWM population within the lake.

Discussed below are two potential control strategies that Onterra proposes the CLPRD consider, with slight preference to Option 2.

Option 1: Whole-lake Treatment of Bass Lake in 2014

It may be argued that the EWM population within Bass Lake is serving as a source population that sacrifices the long-term control goals of the CLPRD. For this reason, it may be appropriate to take an aggressive approach to EWM management and implementing a whole-lake 2,4-D treatment during the spring of 2014. This strategy would involve applying liquid 2,4-D to the 13.3 acre lake at 0.35 ppm ae. This strategy would also allow the hand-harvesting volunteers to shift their efforts away from Bass Lake and focus on the more manageable populations within Crooked and Gilkey Lakes.

Because of the whole-lake impacts of a whole-lake strategy, additional aquatic plant monitoring steps are required to understand the target and non-target effects of the treatment strategy. Ideally, whole-lake point-intercept surveys should be conducted the summer prior (pretreatment) and summer immediately following (post treatment) implementation of the whole-lake treatment

strategy. Since a pretreatment point-intercept survey was not completed during the summer of 2013, it is proposed that a pretreatment point-intercept survey be completed prior to the treatment during the spring of 2014. Comparing the spring 2014 survey with a summer 2014 survey will allow a quantitative understanding of how much the EWM population was reduced by the treatment. However, most native plants are not actively growing during the spring of the year. Therefore the summer 2011 point-intercept data, collected as part of the aquatic plant management planning project, will serve as the pretreatment dataset for evaluating the native plant community. The EWM population has increased within this lake since the summer of 2011; therefore this dataset is too outdated to understand the impacts on EWM.

It is proposed that herbicide concentration samples be collected surrounding the whole-lake treatment following protocols developed by the United States Army Corps of Engineers (USACE). Members of the CLPRD would collect samples at various locations within the lake at different locations and time-periods following the treatment. The properly preserved samples would be sent to the USACE for laboratory analysis. Under the current program, there would be no analysis costs for the USACE to run the samples. However, it is uncertain if this will hold true in 2014. Coupling the herbicide concentration data with the point-intercept data will be valuable for assessing the whole-lake treatment.

Option 2: Continued Hand-harvesting Program of Bass Lake in 2014, possible whole-lake treatment in 2015 if warranted.

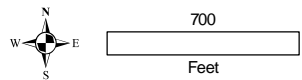
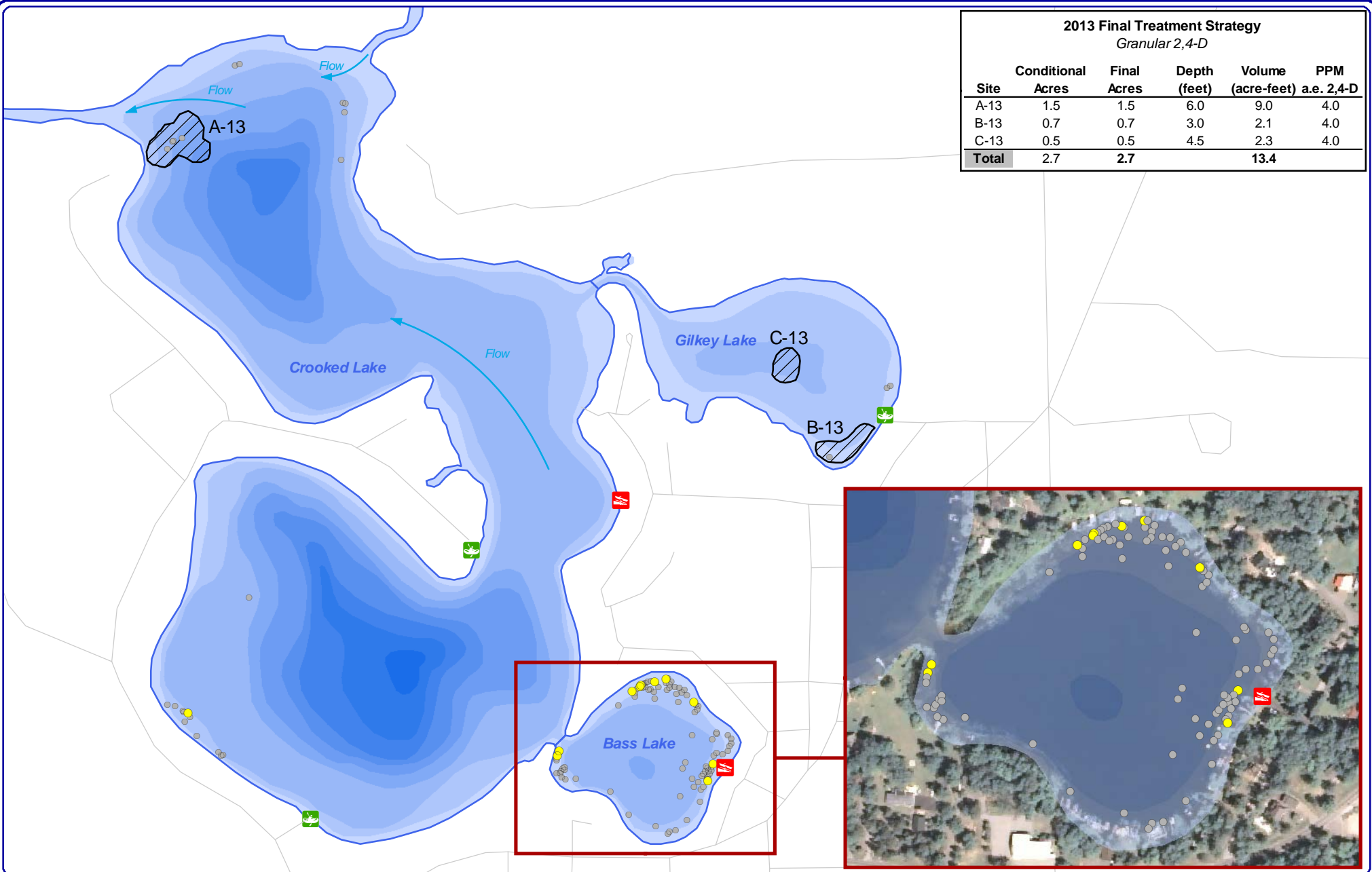
Albeit higher than in previous years, the EWM population within Bass Lake is still at a relatively low level. The EWM is widely dispersed and is not forming dense colonies in any locations; likely not having an acute impact on the ecosystem or causing recreational interference to lake users. It may be appropriate to postpone conducting a whole-lake treatment in Bass Lake and see if increasing the intensity of the hand-harvesting program in 2014 can effectively reduce or maintain the level of EWM within the lake.

The flaw of many hand-harvesting programs is not due to a faulty technique; rather an insufficient amount of effort is conducted to achieve the desired goals. Now that a core group of volunteers has been established, additional volunteers may emerge and increase the intensity of effort in 2014. In an effort to augment low volunteerism, some lake groups have even turned to hiring private firms to conduct hand-removal efforts on their system. This may be another option to be considered by the CLPRD.

Since an herbicide treatment is not planned to occur in 2014 under this scenario, it is proposed to shift the typical May pretreatment survey to a June Early Season AIS (ESAIS) Survey. The June survey would help guide volunteer-based hand-harvesting efforts in 2014, and the results of the Late-summer EWM Peak-biomass survey would be used to setup a potential control strategy for the following year (2015). If the EWM population continues to grow faster than the hand-harvesting efforts can keep it suppressed, a whole-lake treatment strategy could be planned for 2015. This would allow for a pretreatment point-intercept survey to be completed during the late-summer of 2014, to be compared with a point-intercept survey conducted following the treatment during the summer of 2015. As discussed above, this is the ideal comparison for understanding the native and non-native impacts of a whole-lake treatment.

2013 Final Treatment Strategy
Granular 2,4-D

Site	Conditional Acres	Final Acres	Depth (feet)	Volume (acre-feet)	PPM a.e. 2,4-D
A-13	1.5	1.5	6.0	9.0	4.0
B-13	0.7	0.7	3.0	2.1	4.0
C-13	0.5	0.5	4.5	2.3	4.0
Total	2.7	2.7		13.4	



Onterra LLC
Lake Management Planning
815 Prosper Road
De Pere, WI 54115
920.338.8860
www.onterra-eco.com

Sources:
Roads and Hydro: WDNR
Aquatic Plants: Onterra, 2013
Bathymetry: WDNR 1968 - digitized by Onterra
Orthophotography: NAIP, 2010
Map Date: October 10, 2013
File Name: Map1_Crooked_EWMPB_Sep13.mxd



Project Location in Wisconsin

Legend

- Highly Scattered (none found)
- Scattered (none found)
- Dominant (none found)
- Highly Dominant (none found)
- Surface Matting (none found)
- Single or Few Plants
- Clump of Plants
- Small Plant Colony (none found)
- 2013 Final Treatment Area

Map 1

Crooked Lake
Oconto County, Wisconsin

**September 2013 EWM
Survey Results**