2014 Milfoil Weevil Stocking and Survey at Dewart Lake, Kosciusko County, Indiana

Prepared for:

The Dewart Lake Protective Association

Prepared by:

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1.0 Introduction

Since its widespread introduction, the exotic-invasive Eurasian watermilfoil (*Myriophyllum spicatum*, herein referred to as milfoil) has become one of the most problematic plants in North American lakes. Rapid growth and reproduction by seed, stolon and fragment allows this plant to create dense, monotypic stands that displace native species. In turn, these dense beds can reduce biodiversity, cause detrimental changes to water quality and impact the aesthetics and recreational use of the water. In 2012, EnviroScience implemented the **Milfoil Solution®** process at Dewart Lake, a 551 acre lake in Kosciusko County, Indiana to combat nuisance populations of milfoil using the milfoil weevil (*Euhrychiopsis lecontei)*.

The milfoil weevil is a native insect to North America that began feeding on Eurasian watermilfoil once it was introduced. This milfoil-specialist completes its entire life cycle on the plant (egg-larvae-pupae-adult) and is capable of producing multiple generations in one growing season. Throughout the fall months, weevils move to shore to overwinter in dry, loose soils and return to the water as the ice recedes in the spring to continue the process. The most significant impacts to milfoil occur during the larval life stage of the insect. During the larval stage, weevils feed on the meristem (growing tip) of the plant and burrow through the stem. This disrupts nutrient flow within the plant and causes the stem to lose buoyancy from air escaping through the damaged plant tissue causing the plant to collapse. This process also leaves the weakened plant susceptible to secondary infection. Over time, milfoil stands become weakened diminishing their ability to compete with native species and prepare for winter months.

Although milfoil weevils are present throughout the northern U.S. states, they are often in populations unable to cause significant declines. Milfoil Solution® is employed to increase weevil populations to aid in reducing nuisance stands of milfoil. This form of biological control is based on a gradual process with significant declines to nuisance populations typically occurring over a 3-5 year program. This year marked the third stocking season at Dewart Lake. This report was prepared on behalf of Dewart Lake Protective Association and outlines the progress of the program to date at Dewart Lake.

The table below outlines the milfoil weevil stocking program for Dewart Lake thus far, including site establishment and number of weevils stocked:

Year	Sites Stocked	Total Weevils
2012	S1, S2, S3	25,000
2013	S1, S3, S4, S5	23,500 *(3,500 extra)*
2014	S6	11,000 *(1,000 extra)*

2.0 Survey Methods

An initial survey is performed prior to weevil stocking and a follow-up survey is conducted at the end of the summer season at least six to eight weeks later. These surveys are integral in monitoring changes that occur in both the augmented weevil population and the health of the milfoil over the course of the program in order to make informed management decisions. Qualitative observations in these surveys include the overall density and health of milfoil, identification of native plant species present, and the presence of weevils and weevil-induced damage. Quantitative measurements include milfoil density and weevil population density. Milfoil density is determined by randomly collecting stems throughout the milfoil bed using a $0.09m^2$ quadrat. This sample is then converted to the number of stems per square meter (stems/m^2). Weevil population density (number of weevils per stem) is determined through lab analysis of 30 stems sampled from three transect lines at each site.

3.0 2012 and 2013 Summary

The program was started on June 8, 2012 in which 25,000 weevil eggs and larvae were heavily stocked among three beds of milfoil, S1, S2 and S3 (Figure 1). It was noted that approximately 75% of the milfoil was growing at the surface and flowering. This growing condition, typical for late season, was observed in lakes all across the Midwest and as early as May. The severity of the infestation throughout the lake also gave ES biologists reason to assume that a natural population of milfoil weevils either did not exist or was at a low density in the lake. Surprisingly, they were identified at site two (S2) (Table 1). By August of that season, the only major change observed was a dramatic decrease in milfoil density at site one (S1) (Table 2).

The winter/spring season of 2013 was one would consider a 'more normal' start to the growing season. EnviroScience biologists returned to the lake on June 20, 2013 with an additional 23,500 weevil eggs and larvae which were split among two new sites (S4 and S5) and two existing sites (S1 and S3). Positive findings from that initial survey included identifying weevil life stages, damage indicative of weevils at all five stocking locations and decrease in milfoil density. This also confirms that the weevil population in Dewart Lake was larger than originally anticipated. Milfoil density decreased at all sites from June to August (except for new site S4 where little change occurred), a pattern which does not follow the typical trend as the summer progresses and milfoil reaches peak growth. Data collected to this point are encouraging since initial survey sites from 2012 to 2013 have all experienced reduction in stem density by approximately 40 to 50%. Additionally, the increase in native aquatic vegetation as observed from 2012 to 2013 is highly preferred over the contiguous growth of one species. However, some native species such as Coontail (*Ceratophyllum demersum*) can grow to nuisance levels as observed in the southeast bay of the lake in 2013.

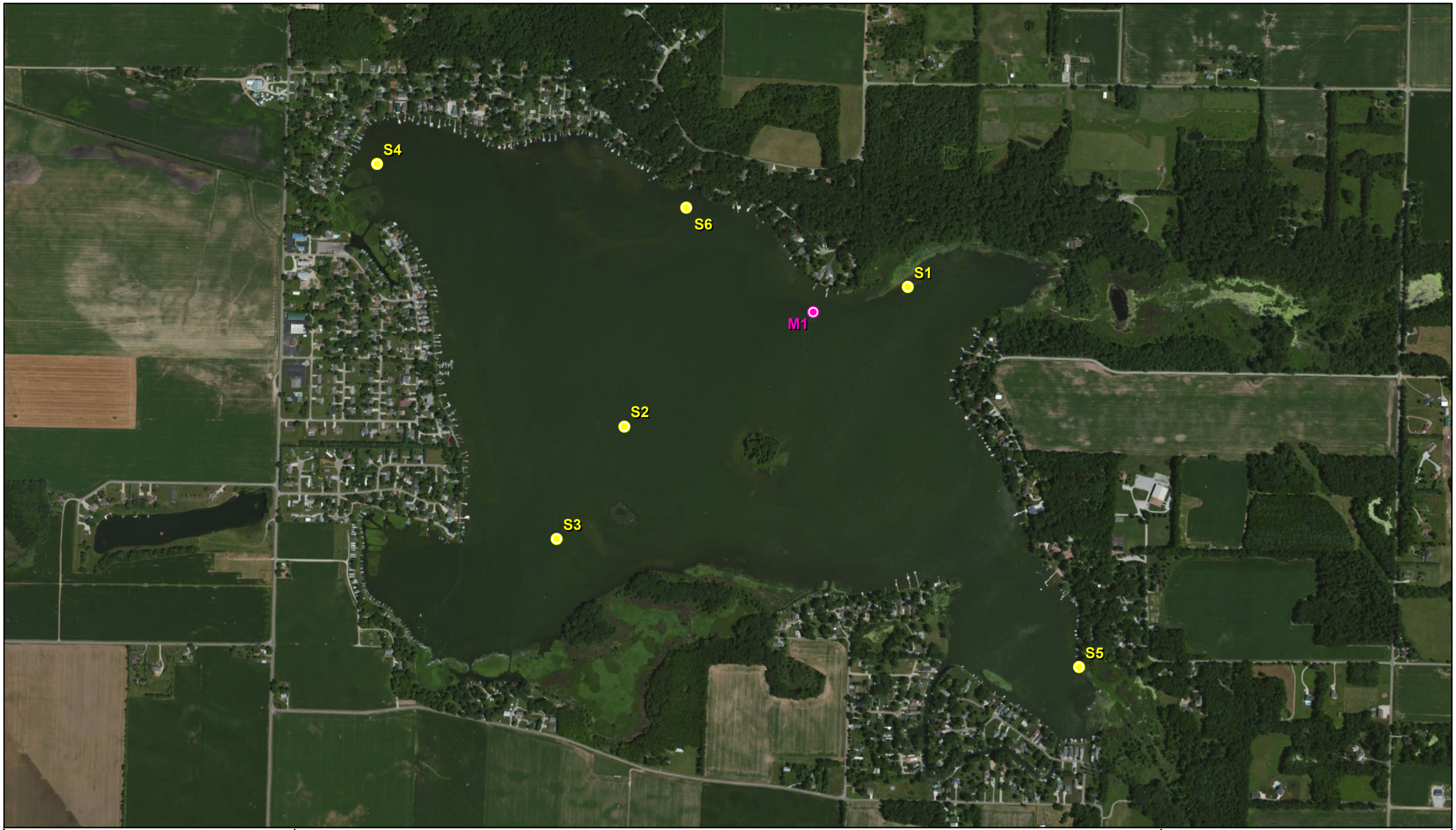

Figure 1. Dewart Lake
Kosciusko County, Indiana

Monitoring Location
Stocking Location

0 500 1,000 2,000 Feet
0 150 300 600 Meters

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Date: 10/14/2014 Path: P:\Milfoil Solution\Data & Reports\Indiana\Dewart Lake\2014\GIS\DewartLake_IN_2014.mxd

Basemap courtesy of Esri.

4.0 2014 Results

Initial Survey – June 3rd, 2014

Despite the harsh winter, the milfoil came back with a vengeance in 2014 with densities reaching close to measurements recorded in June of 2012. Milfoil compromised 75-100% of the overall plant community at each site with the exception of site 5 (S5) which was measured at only 50%. As a result of the increased milfoil, only six native species were identified. A total of 11,000 weevils were stocked in one large, dense milfoil bed along the northern shore of the lake, S6. This area exhibited favorable, life-sustaining factors necessary for weevil survival. Lab analysis revealed weevil life stages and damage indicative of weevils on stems collected from site 4 (S4) (Table 1).

Follow-up Survey – August 13, 2014

By August, the milfoil at all the stocking locations had decreased in stem density and exhibited extensive larval damage. Little to no change was observed in the monitoring site. Microscopic analysis revealed weevil life stages on the stems collected from sites 1, 4 and 6.

Other field observations during the survey include:

- **Flowering**, a natural late season occurrence, was found in 25% of the milfoil at the new site (S6) and the monitoring site.
- **Senescence**, the dying back of the plant which is dependent on the growing season but can be accelerated by weevils, was observed in S1, S4 and S5.
- **Native vegetation** had increased from June to August with a total of fourteen species identified.

5.0 Discussion and Conclusion

Milfoil densities were high at the beginning of the season but had decreased by mid-August; close to the measurements recorded the prior year. Due to the aggressive nature of milfoil, the native species were out competed early in the season. EnviroScience biologists observed six species in June which increased to fourteen by August. The presence of a healthy and diverse native plant community has been shown to be an important factor in maintaining long-term control of Eurasian watermilfoil. In project after project, we have observed that if the milfoil population can be decreased enough to allow for re-establishment of desirable native species, the natives are often able to out-compete milfoil for light and space. However given the shallow nature of Dewart Lake, aquatic vegetation (native and/or exotic) will continue to be problematic and will vary from season to season. Controlling invasive species (as eradication is typically not possible) is a gradual process that will require ongoing effort and support from the residents of Dewart Lake.

When working with a biocontrol such as the milfoil weevil, it is important to remember that the rate in which “control” is achieved can vary greatly from lake to lake. Many factors play an important role including the size of the lake, shoreline habitat, amount and health of the EWM,

amount of weevils stocked, and how much recreation occurs on the lake. Additionally, the use of herbicides could have an indirect impact on the weevil population by limiting their growth with depleting their food source. However, positive attributes were still observed in the summer of 2014 including: reduction of milfoil at the stocking locations, increase in desirable native plant community and finding weevils in various locations including the newly established site. This supports that the weevils are surviving, successfully overwintering and returning to the lake year after year. Despite variation in weevil numbers and milfoil density, overall the weevil stocking program continues to make steady, positive progress given the three years of stocking.

The Milfoil Solution® program at Dewart Lake continues to make steady progress. Although the program will be discontinued, EnviroScience will gladly perform a final follow-up survey in July/ August, 2015 and generate a report of those findings at no cost to the association. In order to perform this survey we ask the association to supply a boat for the survey, and secondly, to leave weevil stocking areas free of herbicide use (1,000 ft) for the season. Giving the weevils another full season could result in further milfoil reductions. We are aware that milfoil growth can be very troublesome (for example, the 2012 growing season) and can lead to changes in management approach. We ask for open communication from the association about any increase in herbicide management within proximity to the stocking sites. If this were to occur, we would not be able to perform the survey.

Table 1. Weevil population analysis (weevils/stem), 2012-2014.

Site	Parameter measured	6/8/12	8/8/12	6/20/13	8/1/13	6/3/14	8/13/14
S1	Total weevils	0.00	0.00	5.00	0.00	0.00	5.00
	Total stems	30.00	30.00	30.00	30.00	30.00	30.00
	Avg. weevils/stem	0.00	0.00	**0.17**	0.00	0.00	**0.17**
S2	Total weevils	7.00	8.00	3.00	0.00	0.00	0.00
	Total stems	27.00	29.00	30.00	30.00	30.00	30.00
	Avg. weevils/stem	**0.26**	**0.28**	**0.10**	0.00	0.00	0.00
S3	Total weevils	0.00	0.00	11.00	0.00	0.00	0.00
	Total stems	29.00	29.00	30.00	30.00	30.00	30.00
	Avg. weevils/stem	0.00	0.00	**0.33**	0.00	0.00	0.00
S4	Total weevils			2.00	0.00	1.00	3.00
	Total stems	***	***	30.00	30.00	30.00	28.00
	Avg. weevils/stem			**0.07**	0.00	**0.03**	**0.11**
S5	Total weevils			1.00	0.00	0.00	0.00
	Total stems	***	***	25.00	30.00	30.00	30.00
	Avg. weevils/stem			**0.03**	0.00	0.00	0.00
S6	Total weevils					0.00	1.00
	Total stems	***	***	***	***	30.00	30.00
	Avg. weevils/stem					0.00	**0.03**
M1	Total weevils			0.00	0.00	0.00	0.00
	Total stems	***	***	30.00	30.00	30.00	30.00
	Avg. weevils/stem			0.00	0.00	0.00	0.00

****Site not established*

Table 2. Average Eurasian watermilfoil density (stems/m^2), 2012-2014

Site	6/8/12	8/8/12	6/20/13	8/1/13	6/3/14	8/13/14
S1	161.11	38.89	83.33	40.74	85.18	55.56
S2	158.33	172.22	61.11	35.19	92.59	53.70
S3	94.44	80.56	42.59	38.89	120.37	57.41
S4	***	***	38.89	40.74	177.78	53.71
S5	***	***	25.93	25.93	55.56	55.56
S6	***	***	***	***	116.67	57.41
M1	***	***	59.26	24.07	101.85	109.26

****Site not established*