2013 Milfoil Weevil Stocking and Survey at Dewart Lake, Kosciusko County, Indiana

Prepared for:

The Dewart Lake Protective Association

Prepared by:

EnviroScience
Excellence In Any Environment
5070 Stow Rd.
Stow, OH 44224
800-940-4025
www.EnviroScienceInc.com

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1.0 Introduction

Eurasian watermilfoil (*Myriophyllum spicatum*)(hereafter referred to as milfoil) is an exotic aquatic species that tolerates a wide range of growing conditions and out-competes native vegetation (Figure 1). Monocultures of milfoil limit recreational use, reduce biodiversity, and can contribute to detrimental changes to water quality in severe infestations. Dewart Lake is a 551-acre lake in Kosciusko County, Indiana infested with this invasive plant. To manage portions of this milfoil infestation, EnviroScience implemented the **Milfoil Solution®** process in 2012 using the native milfoil weevil as a biological control (Figure 2).

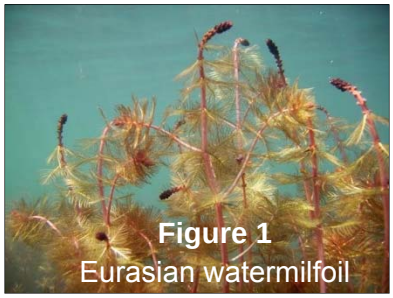

Figure 1
Eurasian watermilfoil

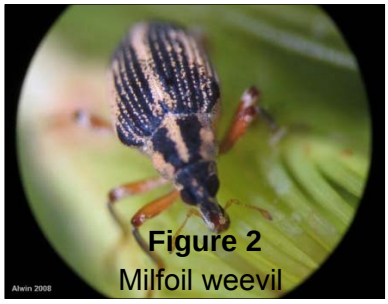

Figure 2
Milfoil weevil

This weevil is native to North America and is a specialist herbivore of milfoil. It inhibits the plant in multiple ways, the most significant impacts caused by weevil larvae as they damage the meristem, or growing tip, and burrow through the stem. Nutrient flow in the plant is disrupted and the stem loses buoyancy and collapses in the water column. A cascading effect pulls neighboring plants lower into the water column and the rate of photosynthesis is significantly reduced in these stems (Figure 3).

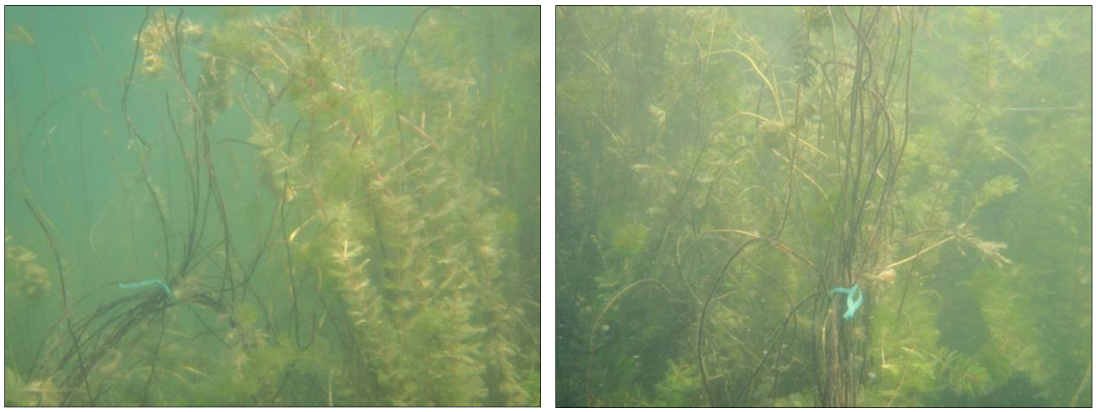

Figure 3. Weevil-induced damage to stocked milfoil stems.

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)*

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 2013 Weevil Stocking and Surveys

The initial survey occurred at all sites on June 20, 2013 with a total of 23,500 weevils stocked between S1 (5,000), S3 (5,000), and newly-established S4 (8,500) and S5 (5,000). Weevil densities (Table 1) and milfoil densities (Table 2) were recorded at each site and the follow-up survey was conducted on August 1. Initial microscope analysis of stem samples revealed weevils at all sites (except for the Monitoring site) as well as plant damage specific to a weevil population. Damage was observed *in situ* at all sites except new site S5 and very minimal damage was seen at M1. No weevils were found on stems from the follow-up survey.

Milfoil density decreased at all sites from May 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 at this point is encouraging since initial survey sites from 2012 to 2013 have all experienced decreases of approximately 40 to 50%. With only two years

of data to compare at this point, stem density trends will become more definitive once the 2014 and 2015 measurements are available.

Milfoil in the survey sites accounted for approximately 75% of the plant community in June and 50% in August at each site and was mixed with a total of sixteen native species: Bulrush (*Scirpus spp*.), Bushy pondweed/Slender Naiad (*Najas flexilis*), Chara (*Chara sp.*), Coontail (*Ceratophyllum demersum*), Eel grass/Wild celery (*Vallisneria americana*), Elodea (*Elodea canadensis*), Illinois pondweed (*P. illinoensis*), Sago pondweed (*P. pectinatus*), Slender naiad (*Najas flexilis*), Small pondweed (*P. pusillus*), Spadderdock (*Nuphar variegata*), Variable-leaf pondweed (*P. gramineus*), and White water lily (*Nymphaea odorata*).

Figure 4. Coontail growing at the surface (left) and in detail (right).

The common native plant Coontail was growing densely at the surface throughout the bay east of S5 (Figure 4). Although not considered invasive in the state of Indiana, this species can behave similarly to milfoil and become a nuisance in certain growing conditions.

4.0 Discussion

Aquatic plant growth will always occur in Dewart Lake and is a positive aspect of this natural feature. These native species compete with milfoil for space, contribute to sediment stabilization, and provide habitat for invertebrates and small fish. Studies suggest that for many lakes, optimal habitat conditions for game fish begin to deteriorate when the percentage that is covered with aquatic vegetation ranges below approximately 10% or exceeds 60% lake coverage. (Valley et. al., 2004). It appears that Dewart Lake is currently within this range based on previous vegetation maps and the amount of native species cover observed during the

weevil population surveys. Selective management techniques such as weevil stocking inhibit the growth of Eurasian watermilfoil with minimal negative impact to beneficial native species.

Weevils were found at all sites in 2013 and are expected to contribute to increased levels of damage and decreased stem density as the augmented populations grow. While the absence of weevils found on samples in August may be due to random sampling, it may also be attributed to the amount of milfoil senescing to the bottom of the lake and the measured decrease in stem density. Observing oscillations between weevil populations and milfoil density is natural as these fluctuations reflect the predator-prey nature of biological control.

The overall stem density and infestation of milfoil is expected to decrease as the augmented weevil population grows. This biological control process is most successful when introduction of the milfoil weevil occurs over multiple, successive growing seasons to ensure that the weevil population reaches high densities in the lake to maintain the milfoil to non-nuisance levels. Signs of milfoil suppression include:

- Reduction in density of the milfoil
- Maintenance of the stems below the lake surface at a non-nuisance level
- Open areas within the stocking sites

A secondary effect of the process it that native aquatic plants replace exotic milfoil as it is outcompeted and becomes a less dominant species in the plant community. Over the course of the program, areas of infestation transition into a more natural distribution of native plants, restoring a balanced lake ecology that supports a healthier fishery while improving recreational and aesthetic value. A total of fifteen native aquatic species were identified throughout the survey sites and will continue to be monitored over the course of the program to monitor positive changes in the plant community.

5.0 Recommendations

It is the recommendation of EnviroScience that 10,000 weevils are stocked in 2014 following the management plan outlined in the most recent proposal. Sites will be selected early in the season based on the level of plant damage encountered. A few additional practices can contribute to mitigating the amount of milfoil in the lake year-round:

- Limiting the amount of boat traffic in dense milfoil beds and stocked sites. Milfoil weevils typically reside in the upper 24 inches of the stem so damaged plants can negatively

impact the weevils ability to propagate. Driving through dense patches should also be limited since fragments of the plant can be dispersed throughout the lake capable of starting a new population.

- Milfoil fragments can move freely through the water body and can root to start a new plant. Once removed from the lake and relocated to areas along the shore, dried milfoil is often used as compost in gardens and flower beds.
- Leave a buffer of natural shoreline whenever possible. In the fall months, weevils move to shore to overwinter in loose soils, leaf litter, and where grasses can grow.

Suppressing this invasive species is a gradual process that will require continued support from the Dewart Lake Protective Association. Thank you for choosing our natural program to manage Eurasian watermilfoil safely and sustainably. The last year of stocking in the contract is currently 2015 and final surveys are recommended in 2016. At this time, EnviroScience is focusing on expanding our specialized range of environmental consulting services and will only offer the milfoil weevil commercially until 2016. Existing contracts will be honored to their fulfillment including stocking and surveys. Please contact EnviroScience at (800) 940-4025, or slomske@EnviroScienceInc.com with questions regarding this report.

Dewart Lake
Kosciusko County
Indiana

Weevil Stocking and Survey Sites

1000 ft
200 m

N

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6.0 References

Valley, R. D., Cross, T. K., and Radomski, P. 2004. The Role of Submersed Aquatic Vegetation as Habitat for Fish in Minnesota Lakes, Including the Implications of Non-Native Plant Invasions and Their Management. MDNR Special Publication 160.

Table 1. Weevil population analysis (weevils/stem), 2012-2013.

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

****Site not established*

Table 2. Average Eurasian watermilfoil density (stems/m^2), 2012-2013

Site	6/8/12	8/8/12	6/20/13	8/1/13
S1	161.11	38.89	83.33	40.74
S2	158.33	172.22	61.11	35.19
S3	94.44	80.56	42.59	38.89
S4	***	***	38.89	40.74
S5	***	***	25.93	25.93
M1	***	***	59.26	24.07

****Site not established*