

# Distribution and Abundance of Milfoil Weevils (*Euhrychiopsis lecontei*) in Lake Minnetonka

by William Inglis 2004-05

## Introduction:

Eurasian milfoil, *Myriophyllum spicatum*, is an invasive species that has taken over the natural vegetation of many Minnesota lakes. Eurasian milfoil was originally introduced as a popular aquarium plant and eventually was dumped into lakes (1). This plant spreads very quickly in a body of water through the formation of plant fragments (2). Eurasian milfoil has drastically changed the ecology of many bodies of water by forming dense mats of vegetation. These mats of vegetation interfere with water flow and recreational activities, such as swimming (1). Indigenous milfoil weevils, *Euhrychiopsis lecontei*, have been shown to be an effective biological control for Eurasian milfoil. A study by Newman *et al.* showed that Eurasian milfoil can be effectively controlled when there is a population density greater than 0.5 weevils per milfoil stem. However, methods of control of Eurasian milfoil in many lakes have been limited to herbicides and harvesters (2). For my study, I surveyed indigenous milfoil weevils at nine different bays on Lake Minnetonka, MN, to compare population densities and determine what factors affect weevil abundance in bays that had been harvested of Eurasian milfoil and those that had not.

The milfoil weevil is found across the northern region of the United States and along the southern border of Canada (2). It summers in water on milfoil plants and in fall migrates to shore to over-winter in soil. During the summer, female weevils lay an average of two to four eggs per day, each taking four to five days to hatch into larvae (3). Weevil larvae burrow through the vascular tissue of the milfoil meristem for nourishment. The larvae create a chamber in the stem of the milfoil where they pupate. Once the pupae evolve into adults, they exit the stem into the water (2). Studies by Newman *et al.* have shown that weevils are effective in limiting Eurasian milfoil because their development cycle disrupts the nutrient supply to the milfoil roots (2).

There are many factors that may limit weevil population densities, including water temperature, water depth, predation, plant quality, shoreline habitat, and mechanical harvesting. Weevils develop faster in warm water temperatures, ranging from a development time of 32 days at 17 °C to a development time of 17 days at 27 °C. Weevils will not develop in temperatures cooler than 10 °C (2). Research has shown weevil activity to be highest from 12:00 to 3:00 P.M. (4). Higher weevil densities have been found in shallow bays. Predators such as sunfish feed on weevils, reducing their population density (2). Plant quality also is a variable in weevil population densities since poor plant quality results in a loss of important nutrients needed for development. A natural shoreline is very important for weevil development since it provides coverage for over-wintering (2). Mechanical harvesting cuts and removes the top meristem of Eurasian milfoil where weevils develop (3).

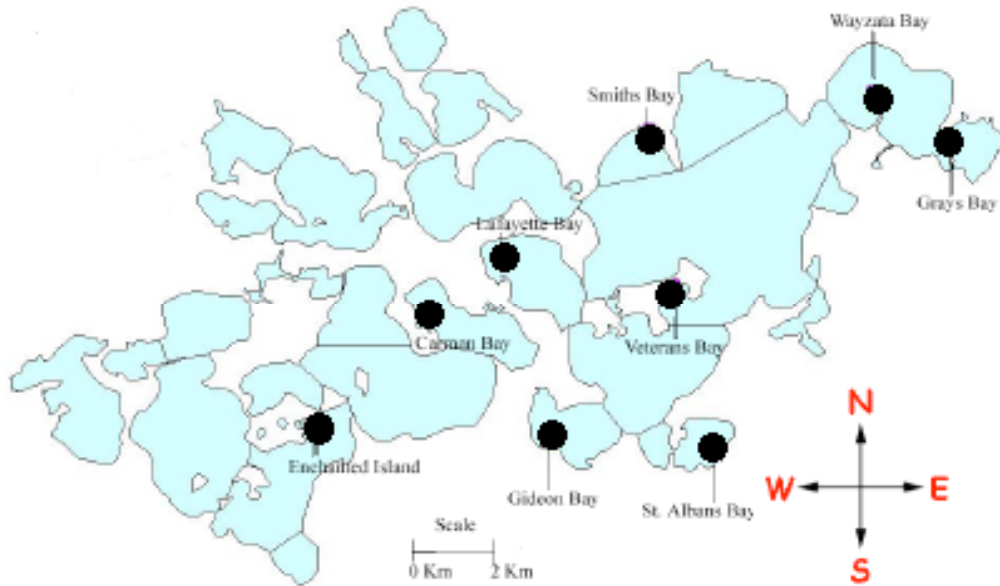
Milfoil weevils originally thrived on indigenous Northern milfoil, *Myriophyllum sibiricum*, but when exotic Eurasian milfoil was introduced to North American lakes, weevils were more attracted to the Eurasian variety. A study by Newman *et al.* showed that Eurasian milfoil produce water-soluble chemicals in the meristems, which enable weevils to differentiate the two varieties (2). A study by Marko *et al.* demonstrated that uracil is the key compound in Eurasian milfoil that serves to attract weevils (4). Midway

into my study, I decided to design and build a trap that would diffuse uracil into the surrounding water, luring the weevils up a milfoil stem and into a confined compartment. Designing and building this trap became the final goal of my study as a means of redistributing weevils into lakes with low population densities.

**Methods:**

Weevil Survey:

*Figure 1: Lake Minnetonka Sampling Sites*



I chose nine sites on Lake Minnetonka, as seen in Figure 1. Once I established the sites, I contacted the Lake Minnetonka Conservation District (LMCD), which agreed not to harvest the sites for Eurasian milfoil during the course of my study. The LMCD continued harvesting in surrounding bays for all sites except Smith’s Bay, which has not been harvested for the last year per agreement with the University of Minnesota. (The site at Enchanted Island was accidentally partially harvested midway through my study.) Table 1 shows the percent acres harvested from 2000-2003 in each site.

*Table 1: Percent acres harvested from nine sites*

<b>Sites on Lake Minnetonka</b>	<b>2000-2003 Average percent harvested</b>
Enchanted Island	9.90%
Carman’s Bay	36.70%
Lafayette Bay	18.70%
Smith’s Bay	2.80%
Wayzata Bay	24.10%
Grays Bay	31.10%
St. Alban’s Bay	27.00%
Gideon’s Bay	21.50%
Veteran’s Bay	12.20%

I sampled Eurasian milfoil from each site three times during the summer between June 24 and August 13, 2004. To locate the borders of each sampling site, I used GPS to set up a grid of five transects spaced 30 meters apart along the shoreline with three stations positioned at the beginning, middle, and outer edge of the milfoil bed. Following the GPS grid, I snorkeled to each station, collected ten Eurasian milfoil stems, and placed them in labeled zip lock bags. I repeated this process of sampling in the other transects, using GPS to locate the sample coordinate. I placed the milfoil samples in an iced cooler and processed them within 24 hours.

In the lab, I placed the stems from each Eurasian milfoil sample in a tray under a lighted magnifying glass and counted acentria, weevil eggs, larvae, pupae, and adults. Then, I preserved all insects in vials with 80 % ethanol, labeled by sampling date, site, and station. I compiled the data on Microsoft Excel<sup>®</sup> and determined average weevil density for each site. I obtained dates and coordinate estimates of each bay harvested from the LMCD, as seen in Appendix A. I averaged the mean percentage of each bay harvested from 2000-2003 and compared those averages to weevil density levels at the sampled sites. To determine if there was a significant relationship between weevil density and area harvested, I ran a linear regression.

#### *Weevil Trap:*

As seen in Appendix B, I built a weevil trap from a hermetic 13 x 13 x 4 cm plastic container. On the bottom of the container, I cut out four evenly spaced 1.5 cm holes through which I pushed 1.5 cm diameter x 13 cm long plastic tubes that served as points for weevils to enter the trap. Once all the tubes were in place, I cut blocks of Styrofoam and wrapped them around the container for buoyancy. I tied strings to all four corners of the trap and attached a brick to serve as an anchor.

Once the trap was complete, I prepared bait. I added 10 mL of dH<sub>2</sub>O to 0.10 g of agar in a 50 mL beaker. Using tongs, I gently swirled the beaker in a bath of boiling water until bubbles formed. I then added 0.01 g of uracil and continued swirling the beaker in the boiling water bath until the uracil dissolved. I poured the agar/uracil solution into a pitri dish where it cooled. The agar solidified and became gel-like. I cut the agar into thin strips, placed them in a 13 cm long dialysis bag, tied off the ends of the bag, and placed them in the trap. I tested the trap at the lab in a tank of Eurasian milfoil with weevils.

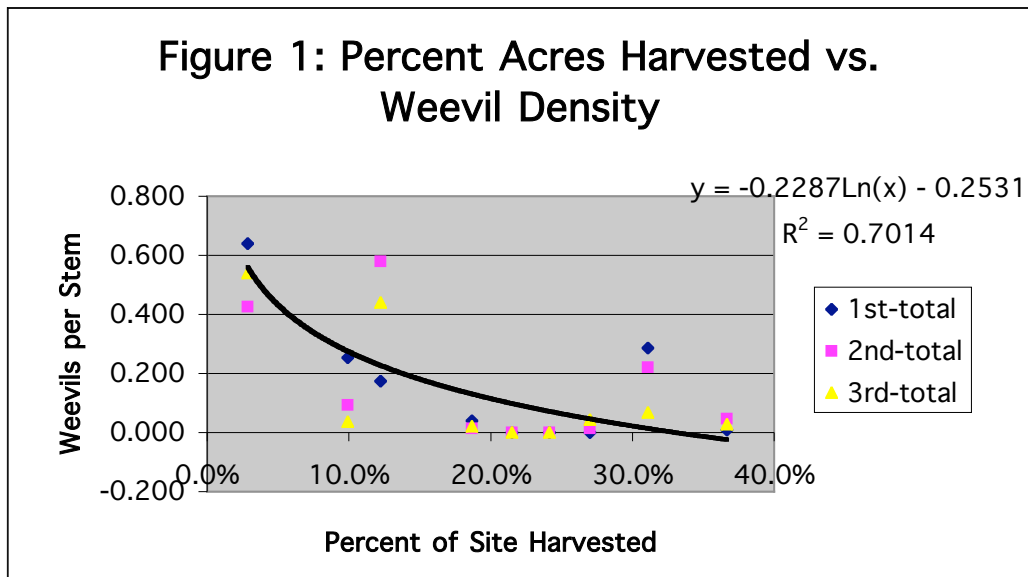
At Smith's Bay on Lake Minnetonka, the site with the most weevils, I positioned the trap in a bed of milfoil and anchored the trap so the uracil would diffuse out of the dialysis bag into the water surrounding the trap. I pulled four milfoil stems through the tubes of the trap to enable weevils to get inside. I let the trap sit in the water from 11 A.M. to 6 P.M., which was within the optimal period for weevil activity.

#### **Results:**

##### *Weevil Survey:*

As seen in Figure 1, I found an inverse relationship between the percentage of harvested acres and weevil density levels at the nine sample sites. The line of best fit gave an R<sup>2</sup>-value of 0.701, showing that the weevil density was inversely related to percent of bay harvested. Using the Bonferroni test, I was able to determine that there

was a significant inverse relation between weevils per stem and percentage of acres harvested.



Weevil density ranged from 0.536 weevils per stem in Smith’s Bay to zero weevils per stem in Wayzata and Gideon’s Bay, as seen in Table 2.

*Table 2: Average Weevils Per Stem From Sample Sites on Lake Minnetonka*

Sites on Lake Minnetonka	2000-2003 Average percent harvested	Summer average weevils/stem
Enchanted Island	9.90%	0.127
Carman’s Bay	36.70%	0.027
Lafayette Bay	18.70%	0.024
Smith’s Bay	2.80%	0.536
Wayzata Bay	24.10%	0.000
Gray’s Bay	31.10%	0.191
St. Alban’s Bay	27.00%	0.019
Gideon’s Bay	21.50%	0.000
Veteran’s Bay	12.20%	0.398

*Weevil Trap:*

*Table 3: Weevils Caught in Trap*

Trial Site	Number weevils caught	Uracil concentration
Lab Eurasian milfoil tank	1	0.015 g
Smith’s Bay trial 1	0	0.010 g
Smith’s Bay trial 2	1	0.015 g

As seen in Table 3, the laboratory trial of the weevil trap in the Eurasian milfoil tanks resulted in one weevil caught. The weevil trap was tested twice in Smith’s Bay for two six-hour trials, catching one weevil in the first trial and no weevils in the second trial.

## **Conclusion:**

The data show a clear inverse relationship between number of acres harvested and weevil population density. These correlations in the data show that mechanical harvesting extracts weevils from milfoil beds, which affects density levels of sections harvested. This presents a strong reason for discontinuing mechanical harvesting.

LMCD continued to harvest milfoil in the bays surrounding the study sites in all but Smith's Bay. While eight out of the nine sampling sites were not directly harvested during the course of my study, Enchanted Island was mistakenly harvested midway through my study. Data from the eight sampling sites compared to Smith's bay show that harvesting milfoil in the surrounding bays had a significant affect on the entire weevil population density even when sampling areas were not directly harvested. Sites such as Smith's Bay had very high weevil densities with little or no harvesting, Table 2. This shows the negative effects that harvesting plays on weevil population densities throughout bays that are harvested.

The weevil trap that I developed did not display the results for which I was looking. I only caught two weevils in two six-hour periods. In order to make the trap more effective, further trials should be done using different concentrations of uracil, to find a concentration that best attracts weevils to the trap. If the trap proves successful, further studies should include a control trap. In addition, increasing the diameter of the entry tubes might increase the chance of capturing weevils. Future development of this weevil trap could serve in eradicating Eurasian milfoil by redistributing weevils into lower density regions.

The results from my study will hopefully persuade the LMCD to stop harvesting so that weevil densities will rise and naturally control Eurasian milfoil.

## **Sources Cited:**

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## **Appendix**

Appendix A. Complete LMCD record of acres harvested from each site

Site	Littoral Acres Harvested	2002	2003	All avg.	2000-2003 avg.
S. Upper Lake	320	8.4%	6.3%	9.6%	9.9%
Carman's	187	40.6%	20.6%	36.3%	36.7%
Lafayette	195	16.2%	8.8%	23.0%	18.7%
Smith's	244	1.5%	0.0%	9.9%	2.8%
Wayzata	198	30.8%	7.1%	17.2%	24.1%
Gray's	127	42.1%	19.9%	22.6%	31.1%
St. Alban's	102	31.9%	13.6%	22.8%	27.0%
Gideon's	150	16.7%	14.9%	21.8%	21.5%
Veteran's	310	16.3%	4.6%	10.2%	12.2%

Appendix B. Weevil Trap

