LES CHENEAUX WATERSHED COUNCIL

EPA/GLRI Assistance Agreement: GL-00E00809

Funding Opportunity: EPA-R5-GL-2011

FINAL TECHNICAL REPORT

For the

Eurasian Watermilfoil Strategic Biological Control Program

2011—2013

Prepared by

Mark Clymer, Project Manager

March 31, 2014

TABLE OF CONTENTS

INTRODUCTION

In order to reduce overhead and focus on quantifiable objectives, this Final Technical Report will endeavor to stay within the narrowly defined scope of the GLRI Grant Project: researching "the potential for milfoil weevils to provide sustainable and low maintenance control of Eurasian watermilfoil (EWM)". It is noted here, however, that this project and it's impact are part of a functional and ecosystem level effort in the Les Cheneaux Islands (LCI) watershed to balance native and invasive species by facilitating the natural diversity still present.

Biological control of EWM growth is part of an comprehensive and strategic weed management approach being implemented by the Les Cheneaux Watershed Council (LCWC) to improve the ecology and the economy of the Les Cheneaux Islands (LCI), through the revitalization of native vegetation and hydrological restoration. This project has also given an opportunity to demonstrate the viability of biological control of Aquatic Invasive Species (AIS) in Great Lakes waters.

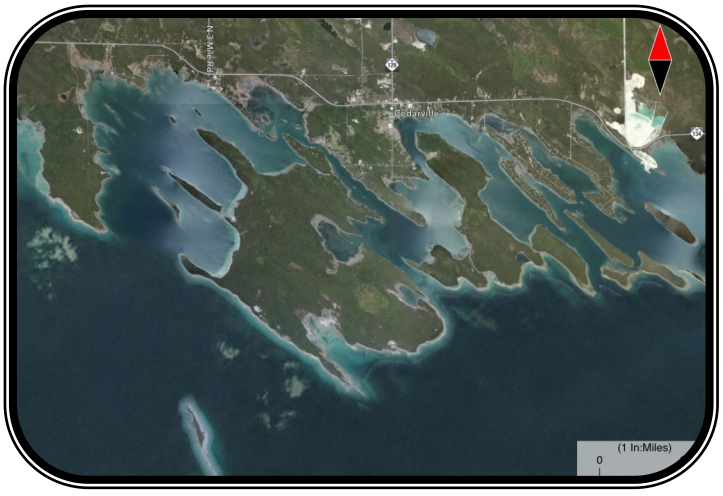
The utilization of aquatic weevils as a biological control method is both proven in documented studies, and regarded as a logical approach to EWM control. The weevils used are native to the Les Cheneaux Islands and have been shown to preferentially feed on EWM over their natural food source, Northern watermilfoil (*M. sibericum*). Aquatic weevils have been commercially produced by EnviroScience for fourteen years and many successful EWM control programs have been conducted.

Results of this project indicate that some macrophytes appear able to compete with EWM, and that EWM does not appear to be as severe an ecological threat in LCI as suggested by some in 2011-2013. This statement does not mean there is no problem, only that under favorable conditions the Pondweed Family, Chara, and Eel Grass for instance, are able to successfully cohabitate with EWM, as demonstrated in the 2013 Aquatic Vegetation Assessment Site (AVAS) survey and a Point Intercept (PI) survey findings. Favorable factors include cooler water temperatures, less available sunlight, and the presence of EWM pathogens & predators.

The presence of Milfoil Weevils decreased EWM stem density in all three project areas, but most markedly in John Smith Bay and Cedarville Bay. The exception was Sheppard Bay during the summer of 2012, an especially favorable growing year for EWM, as was reported across the entire Midwestern US.

Project Goals and Objectives have now been met and the Les Cheneaux Watershed Council wishes to express their sincere appreciation for the funding provided by the EPA's GLRI grant in 2011.

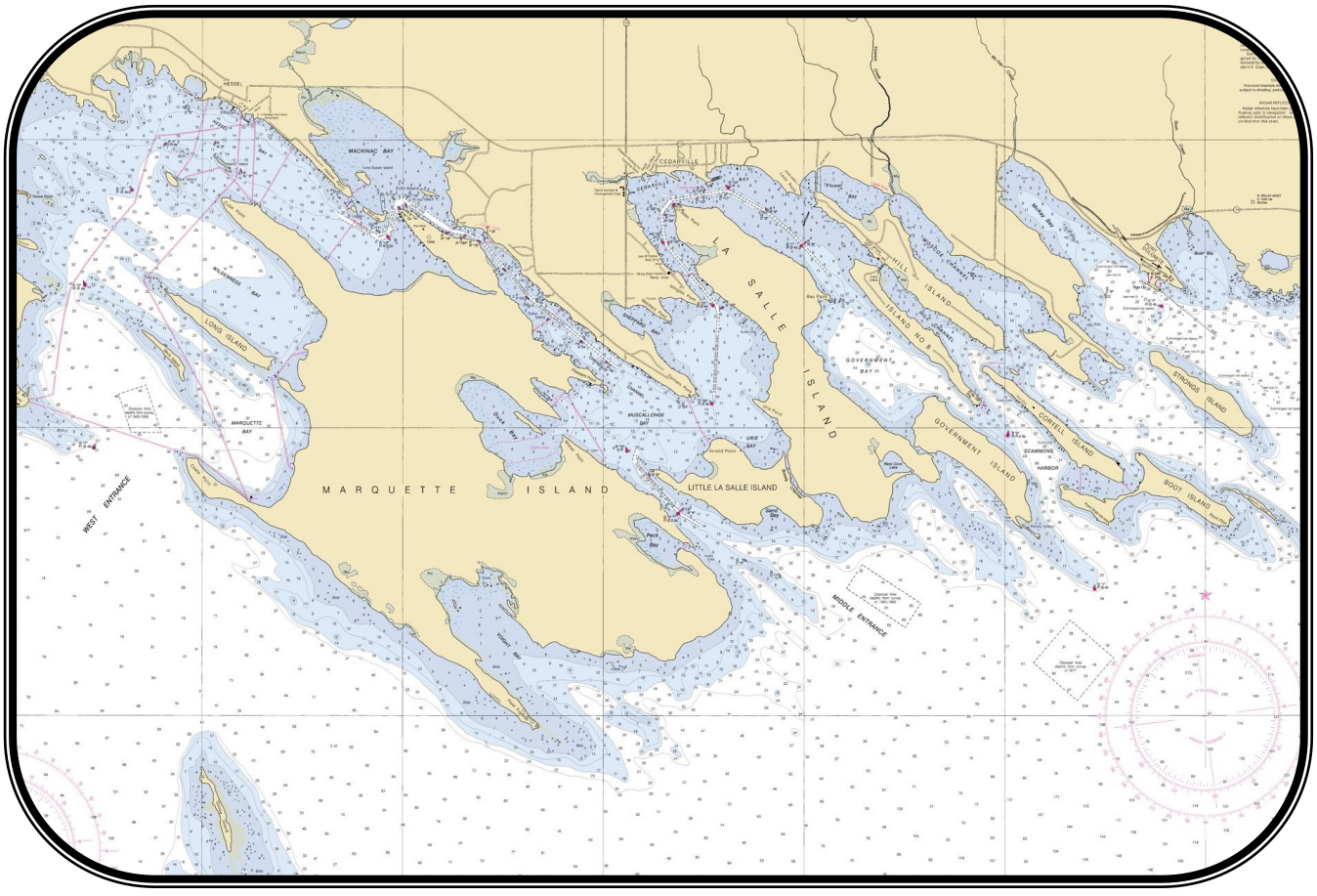
Osprey providing oversight to AVAS Project



Les Cheneaux Islands

Companion projects funded locally and being concurrently carried out by LCWC include:

- Annual Water Quality Study Project, in cooperation with Les Cheneaux Islands Association (LCIA) is in it's 13th year
- Beach Raking and Composting Project is an outreach and educational project that is promoting the cleaning up of EWM fragments from prop cuts along lake shores
- Benthic Tarping Project is providing shoreline stakeholders with a means to limit EWM in near shore areas, beaches, and around docks
- Boat Wash Project is still in the planning stage, as the local boat launches are currently limited in their ability to offer electricity, water delivery, and a way to dispose of EWM upland
- Cormorant Depredation Project, in cooperation with Islands Wildlife and LC Sportsman's Club has succeeded in reducing the local invasive cormorant population on five local rookeries
- *Dispose of your Milfoil Divots* is a Project to raise awareness on the impact of prop cuttings
- Dredge/Drag Project, in cooperation with MDNR and Islands Wildlife, is studying methodologies to uproot EWM with in the seven mile Federal Navigation Channel
- Late Season Harvesting Project is collecting evidence of weakening EWM before energy can be moved to the root system for over-wintering
- Microbial Control Agent Project in cooperation with USDA has completed first year site tests



Les Cheneaux Islands (Sheppard Bay Project Site - Lat: 45.97931 Long: -84.36195)

EPA GRANT: FINAL TECHNICAL REPORT

PROJECT OUTPUTS

1. **Resolve the problem of EWM (along with other aquatic nuisance species)**
2. **Demonstrate the potential for Weevils to control EWM and restore native plant dominance**
3. **Develop appropriate invasive species control methods**
4. **Conduct surveys to assess invasive species infestation & spread**
5. **Reduce Perch habitat impacts from invasive species and restore Perch spawning grounds**
6. **Provide local job creation for 3 part-time individuals**
7. **Public Outreach and Education**

AVAS Crew: "Lake Girls" & Walker

Les Cheneaux: "The Channels"

One of many Ospreys track field work

Summarize Nature & Extent of Project (Scope of Work - SOW)

1. Resolve the problem of EWM (along with other aquatic nuisance species)

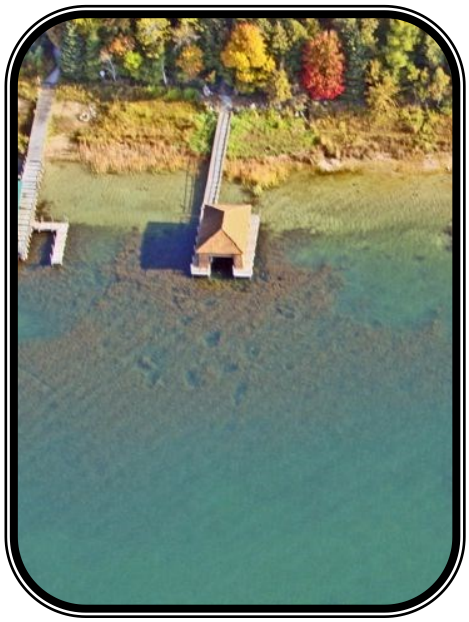
EWM is successful in many aquatic plant communities because it out-competes desirable native vegetation and tends to form dense monocultures which may contain several hundred stems per square meter. This is primarily due to its fast growth rate and canopy-forming growth habit, which allows it to shade out more desirable native vegetation. EWM does well in a wide variety of sediment conditions, can tolerate low light, and also low temperatures. Dense colonies of the plants and its ability to form thick floating mats interfere with all types of recreation - even to the extent of stopping and incapacitating motors boats with V-8 engines! Clogging water intakes has led to dozens of engine failures locally, and propellers clogged with nuisance vegetation has led to many boaters being left stranded. Dense EWM monocultures provide poor fish habitat, cause degraded water quality, and weaken ice cover - which led to the death of one very experienced local resident.

The Les Cheneaux Watershed Council has been exploring a number of ways to meet the challenge of aquatic nuisance species. The use of Weevils (I) as a biological control method is the main focus of the *Eurasian Watermilfoil Strategic Biological Control Program* and will be discussed at length in this report. Other methodologies employed by the Les Cheneaux Watershed Council are discussed in their *Aquatic Adaptive Management Plan*, and as they are not funded by this GLRI Grant, will only be touched on here. They do however constitute elements of an overall application of synergist methods that collectively are achieving the stated purpose of resolving the problem of EWM and other nuisance species.

Environmental justice is being served by supporting, both this important ecosystem, and the implications for the project methodology across the entire Great Lakes Watershed.

So we are weed-free and life without prop fouling or new weed growth is good, right? Wrong.

Whereas the milfoil did not grow as robustly this year, a number of nuisance aquatic cousins have had a very good year. Specifically, Northern watermilfoil, Richardson's Pondweed, Narrow-leaf pond weed and Elodea.



EWM infestation from prop cuttings

Pristine Island Ecosystem before EWM

EWM prop cuts around Weevil planting

2. Demonstrate the potential for Weevils to control EWM and restore native plant dominance

The Les Cheneaux Watershed Council (LCWC) retained EnviroScience Inc. (ES) to provide biological control of Eurasian Watermilfoil (hereafter referred to as EWM) in three highly infested areas within the Les Cheneaux Islands. As a subcontractor for the LCWC, ES assumed primary responsibility for supplying the biological control agent *Euhrychiopsis lecontei*, commonly known as the Milfoil Weevil. ES biologists stocked populations of the insect into the infested areas, collected baseline condition data and monitored both the weevil and aquatic plant populations after stocking. A combination Aquatic Vegetation Assessment Site Survey (AVAS) and Point Intercept Survey (PI) was added to the contracted for activities in year three, with funding provided by the Les Cheneaux Lion's Club and LCWC.

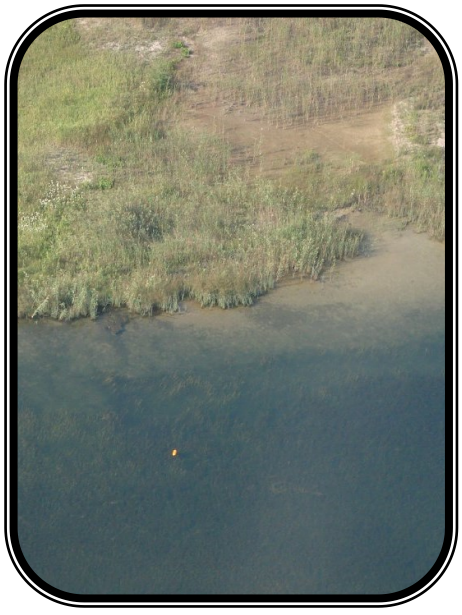
In 2007-2008, a project initiated by the Les Cheneaux Watershed Council in Cedarville Bay, Lake Huron, demonstrated the first successful implementation of Milfoil Solution® in one of the Great Lakes. Two weevil stocking sites, S1 and S2, were established on opposite ends of one long bed of EWM on the west side of the bay. Monitoring site, M1, was established along the north shore, east of the Cedarville marina. In June 2007, 13,550 weevils were planted in S1 and 2,000 in S2. The follow-up survey that year showed a decrease in EWM density by 14% in S1 and 45% in S2 and increase of 74% in M1.

By the final survey in August 2008, EWM density had reduced dramatically from June 2007 in both stocking sites by 96% in S1 and 87% in S2. A decrease in EWM was also noted in M1 along with an increase in the weevil density. As the percent EWM decreased, all sites experienced an increase in native plants, as well as the presence of bare substrate where EWM once grew. These dramatic changes in one year demonstrated that faster results can be achieved when a large number of weevils are targeted to a discrete bed of EWM in the first year of a program.

Beginning in July of 2011, a total of 85,000 aquatic weevils (*E. lecontei*) were stocked in the three project bays over a two-year period. In 2013, a follow-up monitoring survey of all program sites was completed to document the extent to which the weevils have controlled the EWM in the project areas. It was expected that EWM would transition from a dominant species to a relatively small part of the overall plant community.

EWM growing near surface

Milfoil Weevil collected from EWM



EWM Buoy at Mouth of J Smith Bay

3. Develop appropriate invasive species control methods

In order to maintain the pristine character and long term ecologic viability of the of the Les Cheneaux Islands & it's watershed, LCWC takes a "Dynamic Adaptive Management" approach, where resource stewardship policies balance management decisions with the complexity of ecosystem demands. In this way the extremes of hands off "tree-hugging" vs. large scale "silver-bullet" interventions are reconciled.

Identifying the causes allows for more preventative measures to be taken, rather than the reactionary "symptom chasing" too often witnessed when political-science is applied to systemic issues like invasive species. With at least 36 native aquatic plant species identified so far locally, LCI is a long way from requiring the "petri-dish" management techniques applied postmortem in many urban areas.

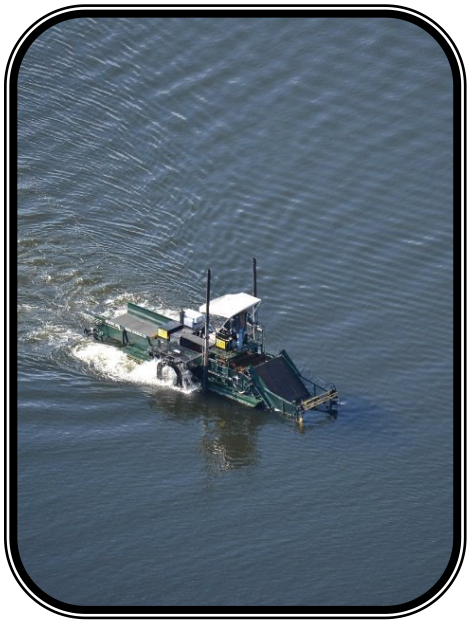
In addition to the rich local ecosystem diversity, there is also variability across the watershed. Water depths range up to 60 feet, bottom makeup spans from silt to bedrock, and the 200 linear miles of shoreline reach from large limestone rock outcroppings to wetland marshes.

There are a variety of man made stressors from both recreational and commercial usage. Climatic variability, as seen in the 6-1/2 foot water level drop between 1986 & 2012 — and this is on top of the 21" net water level drop from dredging and gravel mining in the St. Clair River between 1852 and 1962, also impacts systemic viability.

In other words, there is not a single management tool that can be applied in every instance, consequently the LCWC has been working with a number of management tools that can be applied in synergistic or additive combinations across the watershed. These intervention tools are continually being optimized for the changing conditions that are faced each season.

In the spring and early summer, Project surveys have been conducted both aerially and on the water to assess impacts from the previous year's efforts, and modified accordingly to adjust for the current year's work plan.

EWM burned by herbicide application



Harvester at work cutting EWM

Planting Milfoil Weevils

Dredge/Drag Project, in cooperation with MDNR and Islands Wildlife to Uproot EWM in the seven mile Federal Navigation Channel through the Les Cheneaux Islands

The Les Cheneaux Watershed Council (LCWC) is currently researching and developing a bottom dredging device that will remove EWM, along with dredge material, and collect milfoil for upland composting. This process aims to minimize bottom disturbance to the upper six inches of soil and is initially going to be utilized within the seven mile Federal Navigation Channel, that has been dredged multiple times over the last 100 years. Previous attempts at hand pulling EWM have demonstrated that the soil composition is such that merely pulling on plant stems results in breaking them off. This will impact the 85 acres of this channel area now threatened by EWM and other aquatic nuisance species.

The USACE undertook a maintenance dredging project in the Les Cheneaux Channels during 2009-10, sponsored in part by the LCWC. The areas dredged within the seven mile Federal Navigation Channel have remained free of EWM. The literature indicates dredged areas remain EWM free for five years or longer.

Locally, 2 heavy equipment vehicles have gone through the ice in recent years. Five years afterward, the trail they left after being drug across the bottom through EWM beds to shore is still visible from the air and has not refilled with EWM.

Unfortunately, the water level of Lake Huron has declined by approximately two feet since the USACE dredging in 2010, and some areas that met the seven foot depth requirement were not dredged at that time. Sheppard Bay is one such area and the one mile Federal Navigation Channel there is now indistinguishable from the adjacent waters and filled with Eurasian watermilfoil. Boating is hazardous and has resulted in numerous boat engines overheating from clogged water intakes and props becoming entangled. A typical inboard or inboard-outboard will cut and accumulate around 1 cubic yard of EWM in the propeller, that then will re-root where ever the EWM cutting are cleared from the propeller. Many boats were immobilized during 2012 and had to be towed into marine repair facilities.

As there is no longer any identifiable channel or clear path to get across Sheppard Bay, and other infested areas, boaters are inadvertently spreading EWM cuttings throughout the Les Cheneaux Islands, where they re-root and start new EWM beds. The Sheppard Bay stretch of the Federal navigation Channel constitutes phase I of this study.

EWM Drag Device

EWM Drag Device in Tow

LCWC Drag/Dredge Project

LCWC PROJECT NAME (Objective/How)

ACTION STRATEGY (Means): ***Navigation Channel Drag/Dredge Demonstration***

ASSOCIATED MISSION (Outcome) : *1. Limit Adverse Impact of Nuisance Aquatic Weeds*

ASSOCIATED GOAL (What): *3. Control/Manage/Restore* **Or** Enter Goal.

NEED: This project will remove nuisance weeds from the roots in primary navigation channels, limiting the growth of nuisance weeds and allowing boaters clear passage.

Priority: 5 - High **Success Probability:** 3 - Medium

Cost: 2 - Moderate **Time Required:** 3 - Weeks Score (High >11): **13**

ACTION STRATEGY ELEMENTS:

Budget: $7800 **Funding Source:** private donations & grants

Who: Jonas Carpenter, LCWC crew, & Islands Wildlife crew **Project Lead:** Lakeside Bob

Partners: Breezeswept, Bob Dunn

Resources: Barge, drag device, GPS

Where: 7. Sheppard Bay **Sub-Zone:** Federal Navigation Channel

When: 5/26/2014 10/31/2014 **Duration:** 2 days, weather dependent

CONTEXT: ☐ **Is this Project dependent on another project?**

☒ **Does this Project require land owner &/or regulatory permission/s?**

Owner/Agency: MDEQ

☒ **Does the Project provide community connections/connectivity?**

☒ **Is this Project visible to the community?**

NOTES: *This project is part of a larger research effort on weakening nuisance plants.

PROJECT IMPACT: ☒ **Ecosystem/Habitat** ☐**Pollution/Runoff** ☒ **Water Quality**

☒ **Ed./Stewardship** ☒ **Recreation** ☐ **Other:** Enter Impact.

* Extracted Project Form from LCWC's Dynamic Aquatic Adaptive Management Plan—Draft of 031814

Late Season Harvesting Project is collecting evidence of weakening EWM before energy can be moved to the root system for over-wintering

A EWM harvester was acquired by Flotation Docking Systems a few years ago, with encouragement from LCWC, and is available to harvest EWM from the seven and one half miles of local secondary navigation lanes to provide access for boaters and fish to go through EWM beds.

A critical annual stage for EWM is the shift of moving energy to the meristem for flowering, followed by shifting energies to the stem and root system for winter survival. Late season cutting weakens EWM at this critical juncture, and many of these still rooted stems will fall over (as happens when weevils chew through EWM stems). "Pruning" earlier in the season can give EWM a chance to regrow if these cuttings are not collected and composted or disposed of at an upland location. This mechanical approach will leave weevils planted in the three project areas undisturbed.

Benthic Tarping Project is providing shoreline stakeholders with a means to limit EWM in near shore areas, beaches, and around docks

Bottom barriers are sheets of synthetic material, anchored to the bottom in shallow areas to obstruct sunlight, which controls the growth of aquatic plants. The concept is comparable to using landscape fabric to control weed growth around ornamental bushes and plants in residential yards. Bottom-barrier treatments are intended for small areas, and are most commonly installed in high use areas such as near beaches, docks, and boat ramps.

These barriers can also be installed to create edge habitat for fish such as perch, pike, & bass, and may increase angler success. There is a variety of bottom barrier or screen products available that aim to suppress aquatic plant growth by reducing or blocking light. Ideally, bottom barriers should be heavier than water but porous enough to allow gas bubbles produced by bottom sediments and decomposing plant material to pass through the barrier without ballooning the material off the bottom. Geotextile fabric products are superior to burlap or plastic sheet liners as they are rot-, tear-, and puncture-resistant, but not always permeable enough to allow gas evacuation, which can lead to ballooning.

LCWC is initiated a testing program in 2012 with the help of the Higgins Lake Association, followed by an educational program on Benthic Tarping in 2014, and plans are in motion to make the purchase Benthic Tarps available to local shoreline residents and stakeholders.

EWM Harvester in Action, cutting & collecting

EWM Harvest Project in front of Boathouse

LCWC Harvester Project

LCWC PROJECT NAME (Objective/How)

ACTION STRATEGY (Means): ***Cut Secondary Navigation Lanes***

ASSOCIATED MISSION (Outcome) : ***1. Limit Adverse Impact of Nuisance Aquatic Weeds***

ASSOCIATED GOAL (What): ***3. Control/Manage/Restore*** **Or** Enter Goal.

NEED: This project will remove nuisance weeds from the path of boaters, limiting the spread of nuisance weeds and allowing boaters greater access to their cottages and recreational pursuits.

Priority: 3 - Medium **Success Probability:** 5 - High

Cost: 2 - Moderate **Time Required:** 3 - Weeks Score (High >11): **13**

ACTION STRATEGY ELEMENTS:

Budget: $11,000 **Funding Source:** grant from Mackinac County

Who: Boat Captain **Project Lead:** Lakeside Bob

Partners: FDS, Joni Burger

Resources: harvester, GPS, buoys

Where: 7. Sheppard Bay **Sub-Zone:** north & west of weevil plantings

When: 6/23/2014 8/9/2014 **Duration:** 2 days, weather dependent

CONTEXT: ☐ **Is this Project dependent on another project?**

☒ **Does this Project require land owner &/or regulatory permission/s?**

Owner/Agency: MDEQ

☒ **Does the Project provide community connections/connectivity?**

☒ **Is this Project visible to the community?**

NOTES: *This project is part of a larger research project on both weakening nuisance plants, and utilizing biological treatments after plants have been weakened by cutting. (Budget figure includes all 2014 activity)

PROJECT IMPACT: ☒ **Ecosystem/Habitat** ☐**Pollution/Runoff** ☒ **Water Quality**

☒ **Ed./Stewardship** ☒ **Recreation** ☐ **Other:** Enter Impact.

* Extracted Project Form from LCWC's Dynamic Aquatic Adaptive Management Plan—Draft of 031814

LCWC Benthic Tarping Project

LCWC PROJECT NAME (Objective/How)

ACTION STRATEGY (Means): ***Make Benthic Tarps Available to Residents***

ASSOCIATED MISSION (Outcome) : *1. Limit Adverse Impact of Nuisance Aquatic Weeds*

ASSOCIATED GOAL (What): *3. Control/Manage/Restore* **Or** Enter Goal.

NEED: This project will stop nuisance weeds from growing in shallow littoral areas, limiting the spread of nuisance weeds and allowing greater recreational opportunities. The goal is to have residents purchase benthic tarps from a link on our website, and the supplier will then make donations on a per purchase basis to LCWC.

Priority: 5 - High **Success Probability:** 5 - High

Cost: 3 - Bargain **Time Required:** 3 - Weeks Score (High >11): **16**

ACTION STRATEGY ELEMENTS:

Budget: $0 **Funding Source:** private purchases

Who: Mark Clymer **Project Lead:** Lakeside Bob

Partners: Benthic Tarp wholesalers

Resources: website link

Where: 0. Entire LC Watershed **Sub-Zone:** near shore areas

When: 5/1/2014 9/30/2014 **Duration:** 30-45 days

CONTEXT: ☐ **Is this Project dependent on another project?**

☐ **Does this Project require land owner &/or regulatory permission/s?**

Owner/Agency: Enter Name of Owner or Agency.

☒ **Does the Project provide community connections/connectivity?**

☒ **Is this Project visible to the community?**

NOTES:

PROJECT IMPACT: ☒ **Ecosystem/Habitat** ☐**Pollution/Runoff** ☒ **Water Quality**

☒ **Ed./Stewardship** ☒ **Recreation** ☐ **Other:** Enter Impact.

* Extracted Project Form from LCWC's Dynamic Aquatic Adaptive Management Plan—Draft of 031814

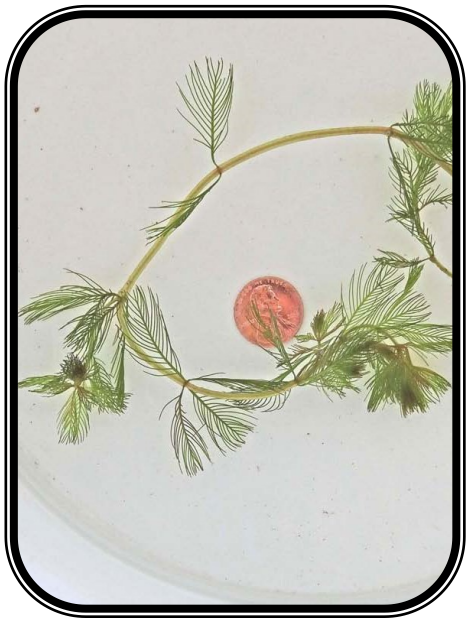
Microbial Control Agent Project in cooperation with USDA after year one site tests

Initial testing of a water-borne fungus showed lethal infectivity against Eurasian watermilfoil in Les Cheneaux waters. Although a positive outcome, significantly more testing needs to be conducted before this organism will be considered appropriate for large scale use in Les Cheneaux.

The first experiment was to inoculated with four concentrations of *Mycoleptodiscus terrestris (*Mt) based on a nominal concentration that was successfully used against EWM and Hydrilla in southern waters. Ranges were used based on the volume of Mt provided and the desire to test a concentration span that would provide unequivocal results. An untreated control (UTC) block was also used as previously described in our plot layout. Follow-up monitoring was conducted 28 days later, and EWM in the entire treated area was obviously impacted by Mt introduction. The level of plant attack appeared more severe as a function of Mt concentration applied.

Both the EWM density and macrophyte mix were different during 2013. In 2012 the entire area in which our treatment block was located appeared as a monoculture of EWM. At the time this trial was inoculated it also appeared that EWM was the primary plant growing. However, 28 DAT a considerable distance between EMW plants was obvious, where plants could be found. At areas of 6x and 9x the nominal level almost no EWM was visible. Moreover, a mixture of macrophytes was observed, to include: *Vallisneria americana* (Eelgrass or Wild Celery) was in bloom, *Elodea canadensis* (Elodea) and *Potamogeton richardsonii* (Richardson's pondweed) were all present with Vallisneria being predominant among the three. EWM remained about 16" below the surface at this time.

The experiment demonstrated the efficacy of *Mycoleptodiscus terrestris* against *Myriophyllum spicatum* (Eurasian watermilfoil). Further tests are planned for the 2014 season.



EWM from untreated area

Preparing to Apply Microbial

EWM 28 Days After Treatment

LCWC Microbiological Project

LCWC PROJECT NAME (Objective/How)

ACTION STRATEGY (Means): ***Mt Demonstration Test in Sheppard Bay***

ASSOCIATED MISSION (Outcome) : *1. Limit Adverse Impact of Nuisance Aquatic Weeds*

ASSOCIATED GOAL (What): *3. Control/Manage/Restore* **Or** Enter Goal.

NEED: This project will test the efficacy of a microbiological control agent on Eurasian watermilfoil (Myriophyllum spicatum) .

Priority: 5 - High **Success Probability:** 5 - High

Cost: 2 - Moderate **Time Required:** 3 - Weeks Score (High >11): **15**

ACTION STRATEGY ELEMENTS:

Budget: $25,930 **Funding Source:** private donations

Who: Bob & LCWC Crew **Project Lead:** Lakeside Bob

Partners: USDA

Resources: Mt from USDA, GPS, buoys, boat, sprayer

Where: 7. Sheppard Bay **Sub-Zone:** north end of bay

When: 7/7/2014 9/30/2014 **Duration:** 1 day, weather dependent

CONTEXT: ☐ **Is this Project dependent on another project?**

☒ **Does this Project require land owner &/or regulatory permission/s?**

Owner/Agency: APHIS

☒ **Does the Project provide community connections/connectivity?**

☒ **Is this Project visible to the community?**

NOTES: *This project is part of a larger research effort on weakening nuisance plants. (Budget figure includes all 2014 activity).

PROJECT IMPACT: ☒ **Ecosystem/Habitat** ☐**Pollution/Runoff** ☒ **Water Quality**

☒ **Ed./Stewardship** ☒ **Recreation** ☐ **Other:** Enter Impact.

* Extracted Project Form from LCWC's Dynamic Aquatic Adaptive Management Plan—Draft of 031814

4. Conduct surveys to assess invasive species infestation & spread

A vegetation survey was conducted throughout 24 bays of the Les Cheneaux Chain of Islands (LCI) from July 31 to August 6, 2013 (Enviroscience report included in section E, Compilation and Analysis of Data Collected). Two vegetation survey methods were implemented throughout these twenty-four areas: an Aquatic Vegetation Assessment Site (AVAS) survey and a Point Intercept (PI) survey.

The purpose of this survey was to compile an inventory of all aquatic vegetation species, identify locations of Eurasian watermilfoil (*Myriophyllum spicatum*) (EWM) infestation, and identify additional invasive/nuisance species to provide a baseline for future management practices.

A milfoil weevil (*Euhrychiopsis lecontei*) population survey was also conducted in the three Project Bays of Cedarville, Sheppard's, and John Smith's Bays to document the extent to which the weevils have controlled the EWM in the project areas, per the 2013 requirements of the stocking contract provided for in the EPA/GLRI Grant Work Plan.

A total of 43 species were identified in all survey areas. EWM was identified to varying extent in 22 of the 24 survey areas. Milfoil distribution maps and plant species tables are included in the Enviroscience report.

Both survey methods were implemented in areas of Cedarville Bay to accommodate the large area. The point intercept survey was conducted at 146 points within Cedarville Bay. Twenty-five species were identified in these points, of which EWM was found in 51% of the points (73 of 146) at varying densities.

Low growing native species found to occur in high abundance included Chara (59%), Naiad (30%) and Robbins' Pondweed (25%). Eelgrass was also relatively high at 52% occurrence. This native species is not often considered problematic, but in shallow areas it can grow to the surface and foul boat propellers. The native sedge (Juncus spp.) was observed on shore. Three invasive shoreline species were observed: Phragmites, reed canary grass, and purple loosestrife at the Cedarville boat launch.

EWM Sampling

EWM Rake Toss

EWM Rake Toss Skipped Here

A Point Intercept survey at Sheppard Bay was implemented at 147 grid points. EWM was identified in 75% of the points (111 of 147). It was most dense near the center of both major basins. The remaining 36 points or rake tows only contained native species. Twenty-two species were identified, including reed canary grass on shore.

Of the 21 species identified in John Smith Bay, EWM was most dominant at 41%. It was primarily recorded at densities of C and D, but further in to the bay, where milfoil weevils were planted in 2011 and 2012, it was sparse and distributed with dense eelgrass. A weevil population survey was conducted in the inner (eastern) end of this bay. Invasive Phragmites and reed canary grass were seen on shore.

During the GLRI Project period, it was hoped at the start of the 2011 weevil pilot study that the weevils would gain control of the milfoil as quickly as was observed during the initial 2007 program in Cedarville Bay (sponsored by the Les Cheneaux Watershed Council with local funding). Unfortunately, grant constraints pushed the first stocking event to early August, much later than the preferred stocking time of early June to mid-July. By September, milfoil densities at both Cedarville Bay and Sheppard Bay, had more than doubled over a five week period.

Additionally, a very early spring and unusually warm temperatures during the first half of 2012 resulted in EWM flowering very early and heavily throughout the Midwest. Once milfoil flowers, it is generally unsuitable for egg laying by female weevils. As a result, dramatic declines in weevil populations were noted across the region during the summer, and this trend also held true for the Les Cheneaux Islands region.

More typical weather patterns returned in 2013, weevil populations rebounded, and a more typical EWM-weevil relationship was observed, particularly in the original Cedarville sites and in the John Smith Bay stocking location. One of the largest changes noted was the decrease in density and size of milfoil beds in Sheppard Bay. Additionally, a more desirable native plant community continues to increase and thrive in all the project areas.

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, as natives are often able to outcompete EWM for light and space under favorable conditions.

When working with a biocontrol agent such as the milfoil weevil, it is important to remember that the rate in which “control” is achieved can vary greatly from bay to bay. Many factors play an important role including the size of the bay, shoreline habitat, amount and health of the EWM, amount of weevils stocked, and how much recreation occurs near the EWM beds planted with Milfoil Weevils. Most EWM control programs entail stocking weevils over multiple years (3-5) to gain effective control.

Augmenting the indigenous weevil population in Cedarville Bay in 2007 yielded abnormally quick results within one season. Although the same results were not achieved during this Project, positive attributes were still observed including: reduction of milfoil at the stocking locations, increase in desirable native plant community and finding weevils in various locations proving they are surviving, successfully overwintering and returning to the lake.

Despite variation in weevil numbers and milfoil density, overall the Les Cheneaux Islands weevil stocking program made steady, positive progress given the two years of stocking.

5. Reduce perch habitat impacts from invasive species and restore Perch spawning grounds

By reducing the biomass and range of EWM utilizing Milfoil Weevils, in conjunction with previous & ongoing synergistic measures, this project is designed to create a mix of open areas, less aquatic vegetative density, and an increase in native plant diversity in the three project areas once dominated by EWM.

Starting with a trophic state that has been classified by limnologists as excellent, with only limited potential of nutrients to support algal or plankton biomass, has made the introduction of Eurasian watermilfoil (EWM) a very visible invasive species in the Les Cheneaux Islands (LCI). Shifts in EWM density during the 3 Project years (2011-2013) were noteworthy, as a combination of factors both challenged and assisted the sustainability of the Weevil population in the 3 Project Bays, along with EWM beds in other areas of the LCI.

During the 2013 summer season, local native submerged plant species were able to compete more affectively and the impact of weevils in the project areas was more in keeping with predicted outcomes. Perch data from MDNR Fisheries will not be presented until April, 2014, but early indications are that 2013 produced a very good year class of perch and other local fish species.

The Les Cheneaux Watershed Council (LCWC) is also participating in the US Fish and Wildlife Double -Crested Cormorant Control Program in the Les Cheneaux Islands. This program has been instrumental in several recent successful spawning years for Yellow Perch (*Perca flavescens*) and a rebound in recreational sport fishing. Cormorant populations have now stabilized at US Fish & Wildlife Service targeted levels. Large flocks of these non-native birds, of often over 1000 birds, once disrupted the spring spawning cycle of Yellow Perch, and resulted poor year classes from 1985 through 2000. They also each consume an average of 2.2 pounds of fish per day, reducing the biomass of the local fishery by many tons in each of those years.

Fish spawning within these bays is adversely affected and is resulting in reduced year classes. In the case of Yellow Perch (*Perca flavescens*), their eggs must be loosely suspended off the bottom and available for male spawning to fertilize them. With the density of EWM approaching 200 stems/meter (Enviroscience, 2012 Progress Report), the fish can barley swim, and are often unable to reach their historic spawning beds, and if accessed, have a poor chance of completing an effective reproduction cycle.

Predators now feast on fish again

Eagle nest on shoreline

Immature Bald Eagle watching AVAS

6. Provide local job creation for 3 part-time individuals

This project has directly effected the high local rate of unemployment by the hiring of 3 part time personnel and the local services used to implement the project. Indirectly, hundreds of recreational boaters, fishermen, tourists, and businesses have benefited from the EWM control efforts and the resulting sustainability, restoration, and protection of the local fishery.

The Les Cheneaux Community benefited from service offerings such as lodging, boat rental, restaurants, and plane rental, along with opportunities provided to interact with visiting Enviroscience biologists, and state fisheries biologists and both state and federal AIS experts.

Project Assistance from Islands Wildlife

EWM Field Work

EWM Fearless Leader

7. Public Outreach and Education

Awareness that the Les Cheneaux waters are being adversely affected by the invasive aquatic species Eurasian water milfoil is now widespread. Efforts to control the spread of aquatic nuisance species have been undertaken by the Les Cheneaux Watershed Council since 2006.

A public forum was held on 5/23/13 though which the Les Cheneaux Watershed Council (LCWC) demonstrated that a more concerted effort is required to protect our waterways resource. During the course of that meeting there was interest expressed in sending a survey out to the entire community to get feedback on both the importance and methods that the community felt should be used in managing Eurasian water milfoil.

The survey results indicated a continuing strong interest both in maintaining the pristine nature of the Les Cheneaux islands and limiting the impact of nuisance aquatic species, such as EWM.
(The results are presented in the following pages)

Outreach events were created to share project activities, such as taking local biology students out to Milfoil Weevil planting sites by kayak, and taking both Senate and Congressional Representatives, and their staff members, to view the project areas by boat.

EWM display booths were setup and provided information on the project at public meetings, Annual FrogFest event, and the Antique Wooden Boat Show in each of the project years 2011-13.

Presentations were created and brought to local organizations such as Islands Wildlife, Les Cheneaux Community Foundation, Les Cheneaux Islands Association, and the Les Cheneaux Lions Club. The Power Point presentation to the Lion's Club is representative of these, and is included in the Appendix.

Public meetings have also been held with the both the Clark Township Board and Mackinac County Board with Power Point Presentations, that were often followed by in depth discussions.

A selection of newspaper articles on the *Eurasian Watermilfoil Strategic Biological Control Program* is provided in the Appendix.

Lion's Club Presentation on EWM, March 2013

Community Forum on EWM, May 2013

Clark Twp. & Les Cheneaux Watershed Council Milfoil Management Plan Survey	**YES**	**NO**	**???**
1. Are you or your family waterfront property owners?	**313**	66	9
2. Do you lease or own bottom lands?	101	**238**	33
3a. Do you use a lake water intake system?	116	**254**	1
3b. If yes, is this a source of your potable water?	59	**124**	0
4. What water based recreational or commercial activities do you participate in?			
_Fishing - all types, winter or summer	**278**	56	2
_Boating (motorized)	**328**	29	2
_Boating (non-motorized)	**250**	79	3
_Skiing, boarding, or skating - all types, winter or summer	**176**	129	3
_Sailing, windsurfing, ice boating - all types, winter or summer	**147**	**148**	3
_Scenic enjoyment	**352**	15	1
_Snowmobile, air sleigh, ATV	141	**156**	1
_Swimming	**296**	43	1
5. Is milfoil adjacent to your property, or where you stay, & limiting your water based activities?	**176**	170	21
6. Have you undertaken measures to manage milfoil near your property, or where you stay?	60	**268**	5
_Benthic Tarping (Mechanical)	15	**146**	3
_Dredging (Mechanical)	19	**138**	2
_Milfoil fragment disposal from anchors, cutting, prop cuts, raking, etc.	64	**113**	1
_Herbicides (Chemical)	15	**150**	2
_Harvesting (Mechanical)	35	**129**	3
7. What is your preferred source of information on this topic?			
_Social Networking, Facebook, Google + conversations, etc.	**106**	91	11
_Internet search	**126**	66	6
_Les Cheneaux Watershed Council (LCWC) Website	**228**	57	6
_Newspaper	**246**	39	4
_Scholarly articles, fact sheets, brochures	**199**	50	4
_Word of Mouth	**197**	49	5

Clark Twp. & Les Cheneaux Watershed Council Milfoil Management Plan Survey	YES	NO	???
8. Concerned about the impact of milfoil on native ecosystem, fishery & fish food web?	**348**	20	3
9. Are you concerned about ecological impacts of milfoil management efforts?	**297**	49	13
10. Are you concerned about low lake levels and it's impact on milfoil growth?	**352**	20	4
11. Are you concerned about LCI water quality?	**335**	22	5
_Runoff from fertilizers, herbicides, pesticides, & pet waste?	**284**	47	9
_Septic systems	**314**	47	6
_Twp. sewer system	**279**	46	7
12. How do you think management efforts to inhibit growth of milfoil should be paid for?			
_Donations	**222**	38	12
_Government Grants or Emergency Funds	**323**	19	9
_Property Tax Millage	110	**145**	15
_Special Assessment District (like the Clark Twp. Sewer)	**133**	**132**	17
13. Are you concerned about the economic impacts of milfoil in the LCI?	**309**	29	5
_Erosion of the local Clark Twp. tax base, and the services they can provide?	**259**	50	10
_Loss of your property's resale value?	**265**	60	7
_Loss of employment opportunities?	36	4	13
_Lost business revenue?	**246**	46	15
14. Are you willing to participate in community efforts to solve the problem?	**200**	31	29
_Financial donation/pledge, or "in-kind" (like hours of labor, or a boat, or property) donation?	**192**	58	23
_Organizational involvement	**149**	89	27
_Practice management techniques on own property	**235**	34	15

Clark Twp. & Les Cheneaux Watershed Council Milfoil Management Plan Survey	YES	NO	???
15. Which management methods would you like to know more about to make informed choices?			
_Benthic Tarping (Mechanical)	**149**	35	25
_Boat washing stations (Mechanical)	**125**	53	20
_Dredging (Mechanical)	**181**	27	16
_EWM fragment disposal from anchors, cutting, prop cuts, raking, etc.	**158**	38	16
_Fungi (Biological)	**194**	31	19
_Herbicides (Chemical)	**133**	41	4
_Harvesting (Mechanical)	**197**	24	12
_Prop cut minimizing (Mechanical)	**159**	35	16
_Weevils (Biological)	**197**	27	14
16. What topics surrounding milfoil management would you like to know more about?			
_Elements required for an LCI Comprehensive Lake Management Plan?	**249**	11	9
_Impacts of management efforts on humans, pets, fish, gardens, or wildlife?	**150**	13	5
_Potable water, wells, & lake water intakes?	**214**	26	6
_Restrictions on activities, or the use of water & waterways?	**216**	27	7
_Shoreline buffers & low impact yard care?	**194**	32	7
_Other concern:_____			

Notes (Not Linked to Questions)

1. … behind idea of weevils
2. favor any: reasonable cost, that minimizes environmental & water quality impact
3. very interested in find a solution… I would like this area to stay as it has always been
4. we don't know anything about milfoil
5. bigger problem than we can correct ourselves…need big government help…will lose tourism, prop values
6. if we lose the lake, we have lost everything we love about our land
7. exploited all funding sources; organized & effective action...before unsanctioned & potential harmful meas.
8. consider all methods, with chemical options being a last resort. Adverse effects not worth risk; consensus
9. concerned with oxygen levels & effect on fish

Notes (Not Linked to Questions)

10. used some herbicide at my dock with limited success

11. use herbicides only if a safe product is found. …don't feel we have been shown a safe herbicide yet

12. concerned about any proposed chemical use

13. I support all methods to control invasives except chemicals; (chem.) will destroy our environ. & economy

14. most concerned with loss of upper lake's water; …pressure Fed to take remedial action on St Clair River

15. If herbicides can not be proved safe to those opposed to them…buy harvesters & mow, mow, mow

16. consideration of herbicides must be entertained, e.g., Houghton Lake… need to know how much danger...

17. NO HERBICIDES! …Completely against their use!!... How is survey going to offer a preferred choice?

18. concerned with quality of life, & dropping water levels… public lacks the will to address causes…

19. I am against applying any herbicides in the Les Cheneaux Waterways.

20. serious issue that needs to be addressed by DNR, EPA, Dept of Interior; GL's are a vital natural resource

21. Already feel very informed. Reluctantly pro use of herbicide as deemed effective/safe.

22. My property is plagued by phragmites. I would like that to go away & be managed.

23. contact other communities that have succeeded in eliminating this problem… consider similar treatment

24. I'm afraid non-waterfront owners don't realize how seriousness… they get the vote & it's not a concern

25. concerned with expansion of invaded areas. … need milfoil mapping to determine the extent

26. I am not an expert. I do think herbicides should be used along with other methods.

27. What about the problem with micro-fine plastic that is suspended in the Great Lakes water?

28. Much prefer the mechanical approach… The real problem with invasives is nutrient overload.

29. Info important… all methods of milfoil control will be needed based on geography… water level control

30. species specific herbicides combined with mechanical cutting/clearing methods will be …beneficial

31. Good to present management plan… understanding & voluntary participation will show results good/bad

32. better permit process -taken for granted that chemicals are safe… education on dangers of herbicides

33. Our overriding concern is low water & weed growth… unable to get even a small boat to our dock

34. Why has problem evolved to this point? … State should be main source of funding to manage plant.

35. Very much against chemical (herbicides) treatment of milfoil.

36. other concern: The ignorance of the local population about treatment.

Notes (Not Linked to Questions)

37. Use whatever management method is not lethal to us.

38. There seems to be little action taken.

39. water quality, poor septic installations, and sloppy & incompetent home builders. Economic impact…

40. problem is bigger than Twp/resident/property owners can handle. Bring in the experts.

41. Although milfoil may be a problems for boaters, it has no effect on us at all.

42. believes sewer was not done right, lagoons are not lined & leaking. Leave it to the experts… experiment…

43. Ecologically balanced solutions, dredging, harvesting, composting, sellable product. Biological solution…

44. I can't imagine how we can solve this without some use of herbicides…learn to make this happen safely

45. …chemical solution ok so long as: no impact on recreational water use, native vegetation, drinking water.

46. Help is needed on massive scale; taxed out already; local $ & private donations can't address problem

47. I believe the problem should be addressed by the states bordering the great lakes and not just LCI

48. Impact on Waterways Harbor Grant; Lake Management Plan needed; Native American role/input?

49. no shoreline buffers - didn't buy lakefront to see forest; USACE caused problem, let them pay for fixing

50. I'm opposed to the use of herbicides.

51. Where does (the State of) Michigan stand on this problem?

52. Chemicals are too dangerous for children, potable water, fish, & wildlife.

53. talk to others with this problem; work together with this problem.

54. Swimming safety vs Milfoil accumulation

55. Overall the Twp has the most to lose & tax base; gov't at all levels needs to take an active role

56. What is role of sewer? What is causing it?

57. Every town in the nation has problems… but we can't all be asked to help.

58. low water & phragmites are 2 other problems that need to be focused on.

59. we are against chemical intervention

60. Gov't agencies imposing waterfront restrictions should pay for the milfoil problem

61. Would like to know what milfoil management works?

62. Ships that brought this in should be paying for milfoil control. Tax or special assessment - HELL NO!

Notes (Not Linked to Questions)

63. Communication: info, educational links, & progress reports pasted on web page.

64. Concerned about discharge from sewer system & algae growth from "rich" discharge

65. Do not want to see the use of chemicals.

66. Both gov't & waterfront property owners need to pay, not non-waterfront land owners.

67. Please no additional taxes. Find ways to reduce property taxes.

68. If the proper tool was sold locally, property owners would clean up their own waterfront

69. Used 24D on inland lake in the 70's. Worked well for many years.

70. concerned with a "cocktail" of herbicides being used over 1 product, & about current/tidal effect

71. Sheppard Bay so bad can barely get boat in or out of bay; Kayaking is a gross, disgusting experience

72. Sort of ironic how we all become ecologically minded too late!

73. I have great concern about using a chemical method of control, as with any run off of chemicals or toxins

74. I don't trust seeking a quick chemical fix, that may cause long term effects to humans or environment

75. Need greater federal/international involvement, ...have equal resources dedicated to water levels

76. Suggest keeping all options open to control milfoil

77. Already subsidize sewer; don't want to subscribe to anything else; let those with direct benefit pay

Reading and assimilating these comments offers evidence of the diverse stakeholder interests that the Les Cheneaux Watershed Council is integrating with the systemic needs of the natural ecosystem of Les Cheneaux.

Especially spirited was the debate on the use of herbicides to combat EWM. While spot use of Glyphosate have been applied to patches of Phragmites locally, the majority consensus on wide spread aquatic use of herbicides is not to utilize this management tool at this time. A small book on this chapter of local EWM management efforts alone could easily be written. The debate on herbicide use is an ongoing one, and may never be resolved under the current process of petrochemical oversight. The complexity and long term effects from 1000's of combinations of petrochemicals in open natural systems is well beyond the current technologies of modeling and simulation available, so there may always be unknown risks in their use. A well known example is DDT. Once thought to be safe, it's use now is limited to treating areas of malaria infestation under the assumption that malaria is a greater stressor than DDT.

SIGNIFICANT EVENTS AND EXPERIENCES

The *Eurasian Watermilfoil Strategic Biological Control Program* has marked a very significant milestone in the Les Cheneaux Watershed Council's (LCWC) history. Among the Project's many positive impacts, the opportunity for a small rural Township to leverage community resources with local, state, and federal agencies in a systemic *and* successful undertaking is very noteworthy.

Data gathered from the three year project continues to produce new insights and will be utilized to update the LCWC's *Dynamic Aquatic Adaptive Management Plan* in 2014. An excerpt from a draft version is included in the Appendix.

Future Watershed management efforts will certainly rely on Project data sets, aerial photos, and a new comprehension of ecosystem viability and stressors. One example currently being implemented is the Dredge/Drag Project. Two of the photographs at the bottom of this page are aerial shots taken during the Project that captured the impact of dragging heavy equipment along the bottom after having fallen through the ice. In both of these examples, at least five years has elapsed and the adjacent EWM beds have not succeeded in re-infesting these tracks where the bottom was disturbed and compacted.

The photo at the left on the bottom of this page shows one of the samples collected in the Sheppard Bay Project site in 2012 after an unknown person or persons applied a chemical to the EWM bed from shore. Very few dead plants were found, but the chemical burns on the plants observed in the EWM bed worsened close to shore and extended at least half way across the bay, on a diminishing capacity. As this type under-application of petrochemicals (probably the herbicide 2-4D) in an unauthorized and unpermitted application commonly triggers hybridization in EWM, samples were sent in for genetic testing.

Although genetic tests did not show signs of hybridization, the thousands of EWM plants witnessed by the Project field team and characterized by this photograph, clearly show the plants were only "inconvenienced" by this vigilante applicator.

EWM with Chemical Burns

Sheppard Bay Equipment Drag Trail

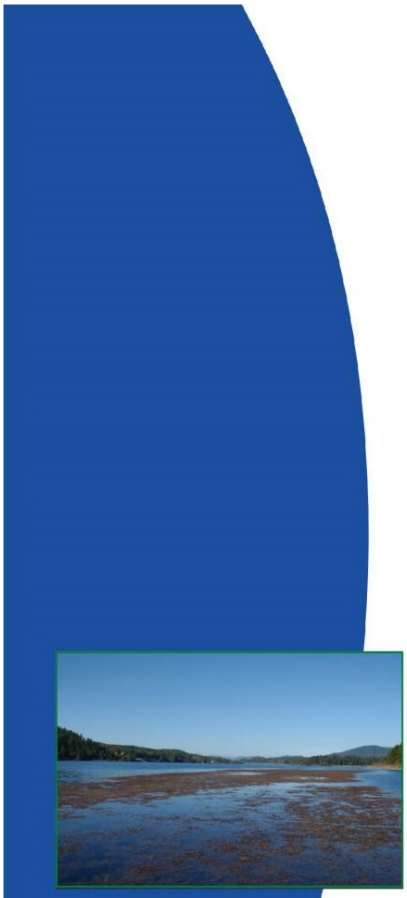
Cedarville Bay Equipment Drag Trail

METHODOLOGIES, COMPILATION OF DATA COLLECTED, AND ANALYSIS OF DATA

(This section is covered by the work of Enviroscience, and followed the approved Work Plan & QAPP)

The Appendix contains:

- 2013 Vegetation Survey and Eurasian watermilfoil Strategic Biological Control Program
  - AVAS and Point Intercept Maps and Tables
  - Aquatic Plant Guide
  - Weevil Stocking and Survey Maps



2013 Vegetation Survey and *Eurasian Watermilfoil Strategic Biological Control Program* at Les Cheneaux Islands, Lake Huron, Michigan

Prepared for:

The Les Cheneaux Watershed Council

Prepared by:

EnviroScience
Excellence In Any Environment

5070 Stow Rd.
Stow, OH 44224
800-940-4025
www.EnviroScienceInc.com

Project No. 978-4903

Date: January 2, 2014

CONCLUSIONS

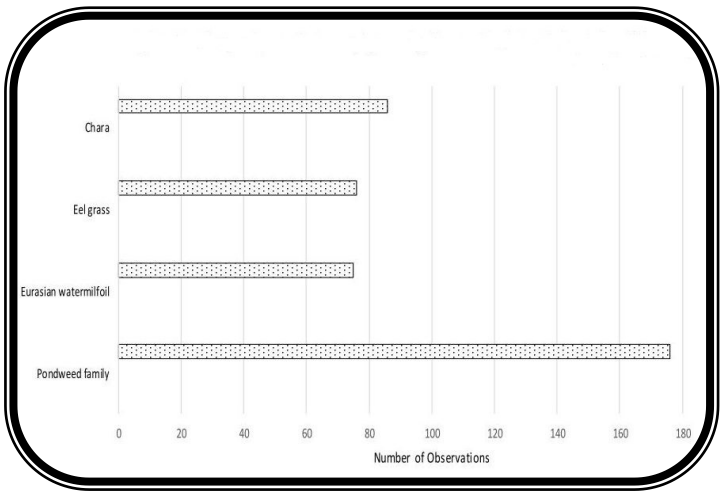
Native aquatic plants may be able to compete with Eurasian watermilfoil in LCI under favorable environmental conditions, and the presence of Milfoil Weevils is advantageous .

The perception of how an invasive aquatic weed such as Eurasian watermilfoil (Myriophyllum spicatum or EWM) impacts submerged aquatic weeds in LCI has changed since the intense, aggressive growth experienced in 2012. Data from 2013 and past records suggest that temperature is a primary factor in the ability of native aquatic plants to compete with EWM in a given season. That is to say, an early, warm spring will enable EWM to out-compete native plants whereas a longer, cool spring favors native plants being able to compete with EWM. Water level is important too, in that higher water decreases the amount of light available to plants and, therefore, growth of all plants is slower.

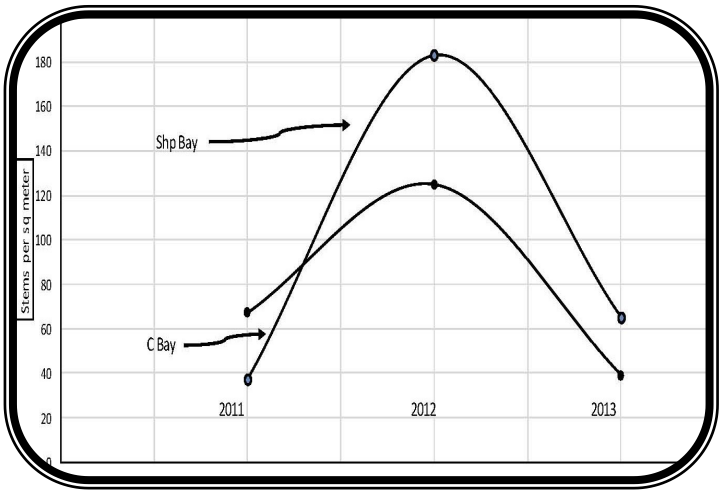
Based upon the aggressive EWM growth experienced in 2012 the expectation of many was that EWM density would be as bad, if not worse, in 2013. Such was not the case. The figure on the left below shows that Chara, an alga, and Eel grass (Wild celery) were as common as EWM in Cedarville Bay in 2013. It also shows that the Pondweed family was significantly more common than EWM suggesting that under the cooler conditions experienced in 2013 the native plants of LCI were able to compete with EWM growth. A generalization here is that some native aquatic plants appear able to compete with EWM in a given season and that EWM is less of an ecological threat than was suggested by some in 2012. The water level was approximately eight inches higher and three degrees cooler in 2013 than in 2012.

The Figure below, on the right, shows averaged EWM stem density in areas of Cedarville Bay and in Sheppard Bay where weevils were not planted. Elevated stem density in both bays during 2012 is attributed to higher average seasonal temperature with water depth as a contributing factor. It is probable that EWM began a growth spurt in 2011 in the warmer waters compared to 2010.

Data from both figures suggest that the EWM growth pattern experienced in hundreds of inland lakes may not apply to the waters of LCI that are more of an open flow than the restricted, contained waters of inland lakes.



2013 Cedarville Bay EWM Balance with other Aquatic Plants



EWM Growth Spike as a Function of Temperature (2011/60°; 2012/63°; 2013/59°) CBay- ●; Shp-○

RECOMMENDATIONS (From Enviroscience)

Two of the major concerns for the Les Cheneaux Islands are decreasing water level due to activities in the St. Clair River and the spread of the nuisance aquatic weeds, such as Eurasian watermilfoil (EWM). EWM has been increasing and spreading rapidly throughout the Les Cheneaux Watershed for more than twenty years. An example of this rapid spread can be seen in a small stand of milfoil that was found in Sheppard Bay in 2008. This stand comprised of a relatively few acres increased dramatically over the next few years to cover much of the bay by 2012, the LCWC estimated that EWM infested at least 1,400 total surface acres across the chain of islands (2012 Aerial Survey).

The worsening infestation has become more evident with the decreasing water level over the last several years, and abnormal growing seasons like the one in 2012 contribute to optimal conditions for milfoil growth and resulting nuisance conditions. Prior to the LCWC designing and implementing an Aquatic Action Plan and best management practices (BMPs), it is suggested to perform a detailed survey to document plant distribution and abundance of emergent, floating-leaved and submersed species. Although the survey methods used in the 2013 plant survey are common practice in the state of Michigan, they are somewhat limited in that they do not calculate total acreage occupied by each species. With the underlying goal of this survey in mind, these methods did successfully in identify the primary locations of the EWM infestation and other species present. They were also the most accurate and practical methods to inventory the extensive aquatic plant community throughout the Les Cheneaux Islands given the scope and budget of the project.

For future years, annual or biannual vegetation surveys are recommended to monitor the spread of invasive species and plant community changes over time. In addition to monitoring the spread of existing exotic species in Les Cheneaux islands, these surveys provide an early warning system by detecting new exotic species. Several invasive species have the potential to grow in the LCI. One invasive species common in the state is Curly-leaf pondweed (*Potamogeton crispus*) which occurs early in the growing season. Invasive Hydrilla (*Hydrilla verticillata*) has been identified in the Ohio River, Indiana and New York. A similar species, Brazilian Elodea (*Egeria densa*), has been found in southern Indiana and West Virginia. Early detection of Hydrilla and Brazilian Elodea is often difficult as they both resemble the commonly found native species elodea.

Duck Bay, Marquette Island

Cedarville Bay

RECOMMENDATIONS (From the Project Manager)

Milfoil management is a complex problem that will not be solved by following a single established routine solution. 50 plus years of attempts to control milfoil infestations across the country have clearly demonstrated this.

After the visionary work of "Lakeside Bob" Smith of introducing weevils to Cedarville Bay in 2007, with clear demonstrated success, he directed me to find a funding source to take that weevil project to the next level. A broader scope was proposed and this grant was obtained from the EPA, from Great Lakes Restoration Initiative funds, for a 3 year demonstration project across 3 diverse & environmentally unique bay systems using more weevils.

Continuing to accomplish future successes will require ingenuity on the scale of Thomas Edison (who happened to visit LCI a few times as a guest of Frank Seiberling on Long Island), rather than the "way we've always done it" robotic approach of R2D2.

Developing a broader approach, while maintaining our strategic focus on long term viable solutions, is going to require regular review and updating of the LCWC's *Dynamic Aquatic Adaptive Management Plan* that encompasses both known and presently unknown milfoil control alternatives This methodology will concurrently set the stage for both public and private funding opportunities.

Milfoil management is going to require us to discover and integrate new control methods using the best science available. Depending on funding availability, we may be challenged to prioritize certain high value areas or focus on "winnable battles" at these priority sites. In addition to the current partners we have utilized, the next phase now includes collaboration with Government laboratories and Universities to discover and implement the innovative solutions we are currently testing.

One common denominator among all plants is the need for a rich source of nutrients. Fewer available nutrients will yield slower plant growth. It is, therefore, strongly suggested that nutrient limitation be included in our area-wide weed management plans. It is also obvious that nuisance weed management plans need to address plants other than milfoil.

Continuing to carry out annual AVAS and PI surveys, and perhaps even more detailed monitoring, will be of unquestionable importance. From this ongoing work data models can be created and simulations run to test new opportunities as they unfold in near real time.

The 1st line of defense, and most viable critical path in our management approach, Prevention, has already passed us by in many ways. The option to "quarantine" infected areas and eliminate pathways of spread is going to be very difficult to carry out, as boat traffic through infested areas would have to be re-routed both day and night. Addressing entry points by installing boat cleaning stations and educating both boaters and shoreline property owners on how to properly "*Dispose of your Milfoil Divots"* is crucial to minimizing additional EWM introductions, as boat propellers are now the single biggest cause of milfoil spreading, and far outweigh lost fragments from the local harvester.

The 2nd line of defense of Early Detection and Rapid Response was instituted in 2007 with our first Weevil plantings, and followed up in 2011 & 2012 with additional plantings provided by this EPA/GLRI grant. We need to continue monitoring these sites in future years for signs of measurable success, both in weevil density and the balance of aquatic plant species present.

We are now primarily focused on the 3rd line of defense, Control, Management, and Restoration. Research is now being carried out to further develop our manual of control practices, and we plan to implement both field testing and ongoing control methods in the spring of 2014.