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Summary

Little Sturgeon Bay is a 1,150 acre bay off of Green Bay (a bay of Lake Michigan) near Door County, Wisconsin. Little Sturgeon Bay is very important in the larger Green Bay and Lake Michigan systems in that it provides critical and sensitive habitat for fish, wildlife, and waterfowl. **Recent low water levels, increased presence of exotic species, and increased recreational use have magnified the conflict between nuisance and exotic aquatic plant growth and recreational use of this important resource.**

The Little Sturgeon Area Property Owners Association (LSAPOA), the main steward for the resource, has recently become concerned because of increasing nuisance aquatic plant growth in the bay. Their previous management activities have been related to water quality sampling, aquatic plant control, and fishery concerns. Concerns about nuisance aquatic plant growth led to this study and production of this Aquatic Plant Management Plan.

Aquatic plants were sampled on June 22nd, August 5th, and August 16th, 2005. Transects in a previous study were resurveyed (June 22nd and August 5th) and additional sample points were added (August 16th) to produce a more thorough survey. **Twenty species of aquatic plants were observed in 2005** and included (in order of abundance) Muskgrass (*Chara* sp.), Water Celery (*Vallisneria americana*), and Eurasian Watermilfoil (EWM, *Myriophyllum spicatum*). Plants were most abundant in areas less than 10 feet.

Overall, a diverse and healthy combination of plants was observed. **Plants contributing to reduced recreational access were observed to be EWM, Elodea (*Elodea canadensis*), Coontail (*Ceratophyllum demersum*), and Water Celery.**

Management recommendations target **maintaining a healthy native aquatic plant community while allowing recreational access to the bay**; continuation of water quality monitoring; and fishery improvement activities.

- **Nuisance aquatic plants (those impeding navigation) should be managed to provide reasonable recreational access throughout the bay.** Management should allow for year to year flexibility, incorporate continuing public input, and management review. In the near future, herbicide treatment of access channels in both the east and west bays is recommended. Treatment would take place in May to July period depending on local weather conditions. A post-treatment survey should take place 30 – 45 days after treatment to determine efficacy and the need for retreatment.

- In order to maintain abundance and diversity of native plants in Little Sturgeon Bay, the method of **managing aquatic plants in access channels should be continued**. Herbicide treatment in past years was cost effective and successful in creating recreational access while affecting only 0.5% of the acreage in the bay. **Channels permitted should include those that provide access from piers to navigational channels**. Based on year to year observations, channel treatment areas may be varied. Channel widths of 30 feet appeared inadequate in 2006 and should be increased to 60 feet in 2007 as conditions warrant. Harvesting can also be considered for this project.
- **Regular water quality monitoring (Secchi clarity, total phosphorus, dissolved oxygen, and Chlorophyll a) should be continued** as well as monitoring for other exotic species that might further impact the system. Further testing of phosphates and additional testing of Chlorophyll a should be conducted with the cooperation and sampling design from Door County Soil and Water and DNR. Door County is instituting nutrient management guidelines, LSPOA should support this effort and any other efforts to reduce nutrient and / or sediment to Little Sturgeon Bay.
- **Protection of undeveloped lands around the bay should be pursued to limit riparian impacts. The creation and/or enhancement of buffer strips for already developed areas should be encouraged.**
- **Fisheries management personnel should be included in ongoing management discussions to determine actions that can be taken to further enhance the fishery.**

Introduction

Description of Study Area

Little Sturgeon Bay is a bay of approximately 1,150 acres off of Green Bay, Lake Michigan, and located in Door County, Wisconsin. Little Sturgeon Bay is very important in the larger Green Bay and Lake Michigan systems in that it provides critical, undeveloped habitat for many fish, wildlife, and waterfowl. Little Sturgeon Bay is also recreationally popular. **A new county boat landing / park with parking for over 50 vehicles was completed in 2005 and further increased local recreational use of the resource.**

Partners in this study included the Little Sturgeon Property Owners Association, Wisconsin Department of Natural Resources (lake management and fisheries), Door County Soil and Water Department, and Lake and Pond Solutions LLC,.

Previous Study

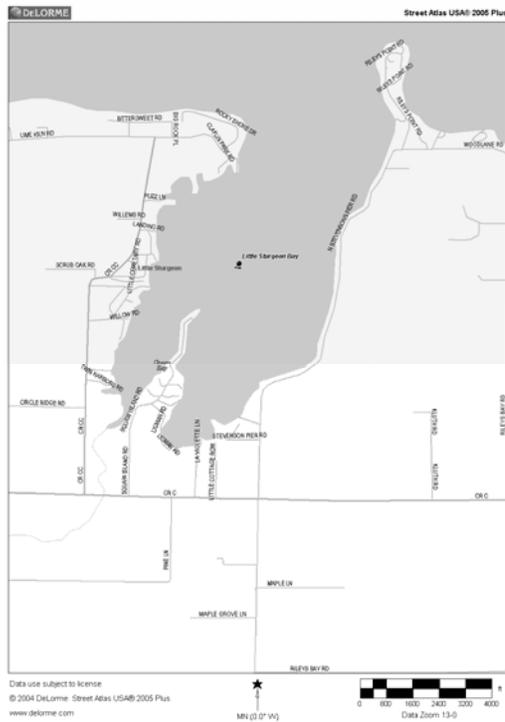
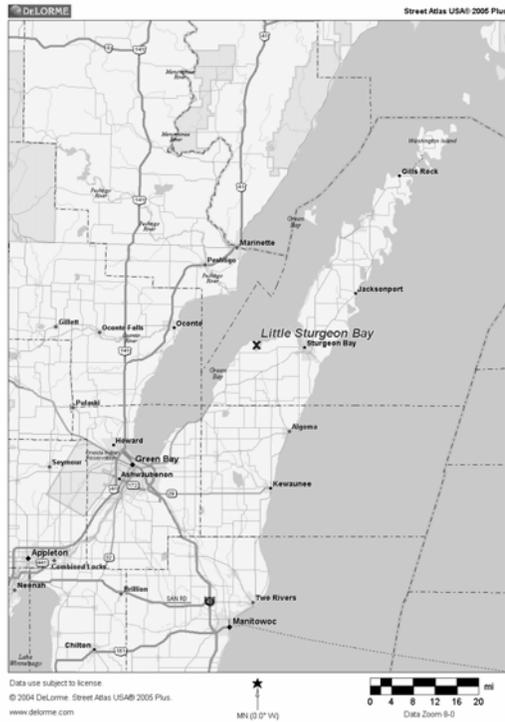
The Door County Soil and Water Conservation Department prepared an *Inventory and Analysis of Little Sturgeon Bay, Door County* in 2002 which further outlined some of the specific details of this project. Some elements of that report were based on the *Surface Water Inventory of Door County*, which was prepared in 2000. Aquatic plant sampling was performed by the Door County Soil and Water Conservation Department in 2001. The *Inventory and Analysis of Little Sturgeon Bay, Door County* (1) included watershed delineation, historic data review, public involvement activities, water chemistry sampling, and aquatic plant surveys.

Watershed Characteristics

Little Sturgeon Bay has a relatively large watershed (approximately 15,000 acres or 23.5 square miles) and consists of four stream sub watersheds and interspersed closed depressions. Land uses in the watershed include row crops, pasture/grass, wetlands, forest, barren, and other.

Water Quality Characteristics

While there is potential for some runoff to the bay from the four small creeks, on average 170 tons of sediment finds its way to the streams but only 68 tons end up in the bay. At each of the three sample sites chlorophyll a, total phosphorus, and dissolved oxygen were at mesotrophic to eutrophic levels (1).



Figures 1 and 2. Map of Project Location and Boundaries, Little Sturgeon Bay, Door County, Wisconsin.

Aquatic Plant Characteristics

Since Little Sturgeon Bay is a large and relatively shallow area, aquatic plants are abundant with numerous species present (1). Curly-leaf pondweed and EWM were two exotics present. Past surveys showed water celery to be dominant in the shallow areas with firm, often sandy or rocky, sediment. EWM, Elodea, and Coontail become more present with deeper water and softer sediment.

Historical Management

Historic management of Little Sturgeon Bay has mainly included aquatic plant management and water quality testing.

Areas of Little Sturgeon Bay have been treated with herbicides in 1987, 1990 – 2002 and again in 2005, and most recently in 2006 (Figure 3). Generally herbicide treatments have been effective in creating channels to allow navigation through both the east and west bays of Little Sturgeon Bay. Control of plants through herbicide use has been seasonal with very little year to year control.

The LSPOA also performs water quality analysis through the DNR Self-Help Volunteer Monitoring Program. Samples are analyzed mainly for Nitrogen and Phosphorus levels.

The LSPOA has also been involved in public education through meetings and newsletters.

Project Goals

It is the goal of this project to develop an Aquatic Plant Management Plan to guide the Little Sturgeon Area Property Owners Association in future aquatic plant and resource management decisions..

The goal is to provide nuisance aquatic plant management decisions based on science, current research, and past success and failure of management options. Further, the Plan should be distributed to all interested parties to provide the means for the community at large to make appropriate management decisions.

Methods

Aquatic Plant Survey

Aquatic plants in Little Sturgeon Bay were surveyed on June 22, August 5, and August 16, 2005 using the line transect method recommended by WDNR. In this method, transects (lines of observation) are selected around the perimeter of the bay from various physical locations, differing habitats, and areas of interest. Several GPS locations were established in previous studies and then duplicated for the summer 2005 survey along with an additional ten transects that were added.

Shore locations and transect distance and bearing were determined using GPS (Figure 4). From shore locations, transects were broken up into several depth ranges: 0 to 1.5 feet in lake depth; 1.6 to 5.0; 5.1 to 10.0; and beyond 10 feet in lake depth. For each depth range the substrate, aquatic plant species present, and abundance ranking (0 - 5) was recorded for each species. Plants were observed with rake sampling and *in situ* with the use of an Aqua-vu underwater camera.

Property Owner Survey

A survey of the LSPOA was conducted in October of 2006 to determine the general consensus regarding aquatic plants and their management on Little Sturgeon Bay. Survey questions were determined by DNR, Lake and Pond Solutions LLC, and the Little Sturgeon Property Owners Association Board of Directors. A comment section was also included to provide further input.

Survey forms were mailed and hand delivered to property owners. Respondents were given 2 weeks to return the survey. 112 survey forms were mailed and 10 forms handed out; 64 forms were returned.

Public meetings were also held to receive input from the general public in developing this plan.

Table 1. Aquatic Plant Survey Transect Locations, Little Sturgeon Bay, Door County, Wisconsin.

<u>Transect</u>	<u>Latitude / Longitude</u>
A	N44° 50.109' W87° 32.438'
B	N44° 49.661' W87° 33.006'
C	N44° 49.601' W87° 33.221'
D	N44° 49.634' W87° 33.500'
E	N44° 49.984' W87° 33.409'
F	N44° 50.078' W87° 33.434'
G	N44° 49.819' W87° 33.580'
H	N44° 49.871' W87° 33.903'
I	N44° 50.229' W87° 33.715'
J	N44° 50.451' W87° 33.617'

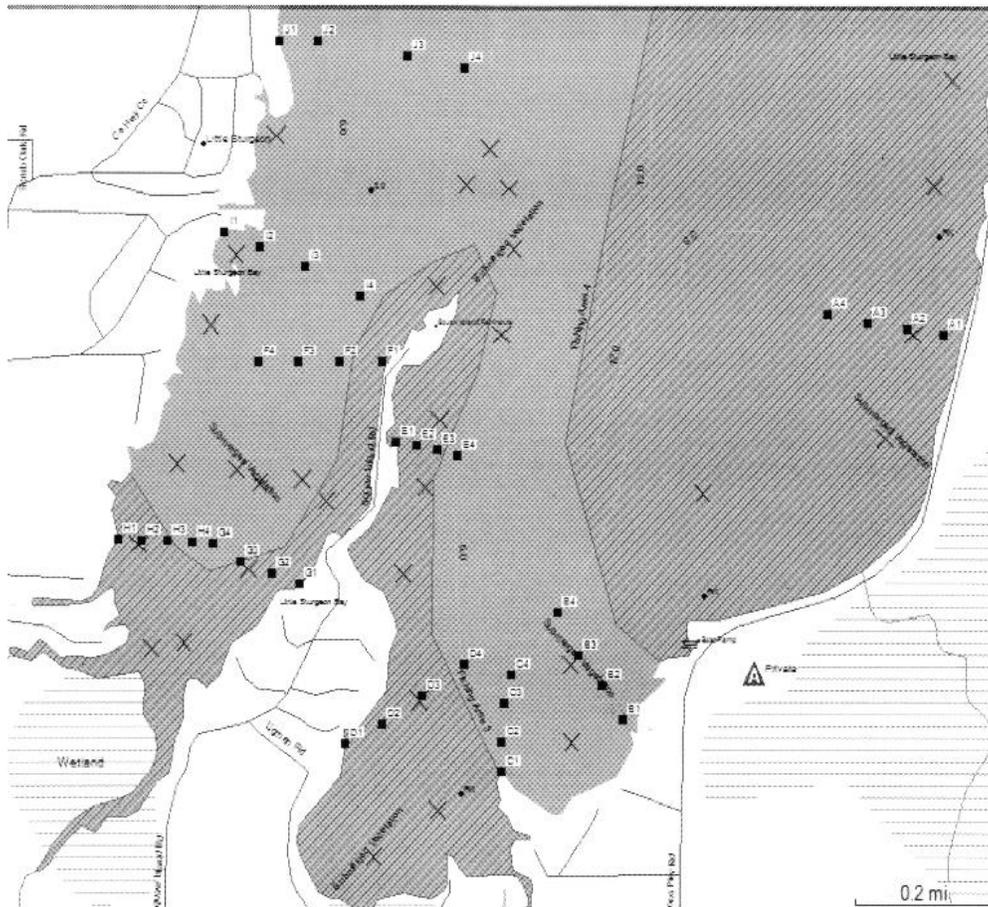


Figure 4. Aquatic Plant Transect Locations, Little Sturgeon Bay, Door County, Wisconsin.

Results and Discussion

Aquatic Plants Present

The August 2005 surveys indicated 20 species of aquatic plants were present in Little Sturgeon Bay. Species present and relative abundance varied slightly between surveys, but was consistent for the most part.

The most common species were Muskgrass (*Chara* sp.), followed by Water Celery (*Vallisneria americana*), EWM (*Myriophyllum spicatum*), Naiad (*Najas* sp.), and Richardson's Pondweed (*Potamogeton richardsonii*). EWM populations are significant, but overall there are good species diversity and high levels of native and beneficial aquatic plants.

Aquatic plant species and populations were similar to those found in the 2001 survey. There were 20 species observed in 2005 versus 24 species in 2001 (1) (Table 4). The species that appeared in the 2001 survey and not in the 2005 survey were observed in the bay, but not in the sampled transects.

Table 2. Aquatic Plant Species Observed, Little Sturgeon Bay, Door County, Wisconsin, August 2005

<u>Taxa</u>	<u>Code</u>
Arrowhead Plant	SAGCU
(<i>Sagittaria cuneata</i>)	
Bushy pondweed.....	NAJFL
(<i>Najas</i> sp.)	
Clasping-leaf Pondweed.....	POTRI
(<i>Potamogeton richardsonii</i>)	
Common waterweed.....	ELOCA
(<i>Elodea canadensis</i>)	
Coontail.....	CERDE
(<i>Ceratophyllum demersum</i>)	
Curly-leaf Pondweed.....	POTCR
(<i>Potamogeton crispus</i>)	
Eel Grass (water celery).....	VALAM
(<i>Vallisneria americana</i>)	
Eurasian watermilfoil.....	EWM
(<i>Myriophyllum spicatum</i>)	
Fern-leaf pondweed.....	POTRO
(<i>Potamogeton robinsii</i>)	
Flat-stem pondweed.....	POTZO
(<i>Potamogeton zosteriformis</i>)	
Hybrid milfoil (unconfirmed).....	MYRHY
(<i>Myriophyllum</i> sp.)	
Large-leaf pondweed.....	POTAM
(<i>Potamogeton amplifolious</i>)	
Muskgrass.....	CHASP
(<i>Chara</i> sp.)	
Sago pondweed.....	POTPE
(<i>Potamogeton pectinatus</i>)	
Small pondweed.....	POTPU
(<i>Potamogeton pusillus</i>)	
Water milfoil (various milfoils other than Eurasian Water Milfoil).....	MYRSP
(<i>Myriophyllum</i> sp.)	
Water naiad	NIASP
(<i>Nias</i> sp.)	
Water stargrass	ZOSDU
(<i>Zosterella dubia</i>)	
White water crowfoot.....	RANAC
(<i>Ranunculus acris</i>)	
White water lily.....	NYMSP
(<i>Nymphaea</i> sp.)	

Table 3. Aquatic Plant Survey Results (Percent Coverage) August 16, 2005, Little Sturgeon Bay, Door County, Wisconsin.

Transect	Substrate	Species Code				
		CHASP	ELOCA	EWM	MYRSP	VALAM
A1	Silt/rock	15	0	5	0	60
A2	Silt/rock/sand	85	0	0	0	0
A3	Silt/rock/sand	0	0	10	0	15
A4	Silt/sand	0	0	10	0	65
B1	Silt/rock	70	0	0	0	5
B2	Silt/rock/sand	50	0	0	0	0
B3	Silt/rock/sand	55	0	5	0	10
B4	Silt/sand	10	0	20	0	10
C1	Silt/sand	55	0	0	10	0
C2	Sand	25	10	0	10	0
C3	Sand	20	0	0	5	45
C4	Silt/sand	0	40	35	0	0
D1	Silt/rock	75	0	5	0	0
D2	Silt/rock	0	5	10	0	10
D3	Silt/rock	10	0	30	0	25
D4	Silt/sand	0	10	5	10	55
E1	Silt/rock/sand	80	5	0	5	0
E2	Silt/sand	0	0	20	10	65
E3	Silt/sand	0	0	5	0	95
E4	Silt/sand	0	10	10	0	55
E5	Silt	0	0	0	0	0
F1	Rock/sand	20	10	5	5	25
F2	Silt/rock/sand	0	5	5	5	60
F3	Silt/rock/sand	0	0	10	10	45
F4	Silt/sand	0	0	20	10	40
G1	Silt/sand	20	0	0	0	20
G2	Silt/sand	0	0	5	5	45
G3	Silt/sand	0	0	0	0	80
H1	Silt/rock/sand	50	0	10	10	0
H2	Silt/rock/sand	15	0	0	20	25
H3	Silt/sand	0	0	15	15	50
I1	Rock/gravel	75	0	10	0	10
I2	Silt/sand/gravel	0	0	15	5	75
I3	Silt/sand	0	0	20	0	50
I4	Silt/sand	5	10	25	0	50
J1	Rock	40	0	5	0	5
J2	Silt/rock/sand	20	0	20	0	10
J3	Silt/sand	0	0	10	0	80
J4	Sand	10	30	35	0	10
J5	Sand	0	25	0	0	0

Table 4. Occurrence and Abundance (In Order) August 1, 2001; June 22, 2005; and August 5, 2005, Little Sturgeon Bay, Door County, Wisconsin.

<u>CODE</u>	<u>1 (4 Sites)</u>			<u>2 (3 Sites)</u>			<u>3 (5 Sites)</u>			<u>4 (5 Sites)</u>			<u>5 (5 Sites)</u>		
	<u>8/01</u>	<u>6/05</u>	<u>8/05</u>												
CHASP	41	55	40	26	12	8	8	11	5	1	2	1	1	0	0
ELOCA	2	2	2	3	2	2	22	21	20	67	11	13	44	24	21
EWM	1	1	0	33	30	10	12	25	19	25	23	17	7	6	6
MYRSP	0	0	2	2	3	12	0	0	2	0	0	0	0	0	0
NYMSP	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POTAM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
POTCR	1	0	0	0	2	0	0	0	0	0	4	2	1	0	0
POTPE	3	8	8	0	0	0	0	0	0	0	0	0	0	0	0
POTRI	2	4	4	2	3	0	1	1	1	1	1	1	0	0	0
POTZO	0	0	0	3	3	0	0	0	0	2	2	2	6	6	6
POTRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
VALAM	7	4	5	19	5	27	21	7	21	8	7	10	0	1	2
CERDE	2	1	3	5	17	20	7	7	6	15	15	13	24	6	10
POTPU	4	3	3	0	0	0	1	1	0	0	0	2	0	0	1
RANAC	1	1	1	0	0	3	3	3	1	3	2	2	0	0	0
NIASP	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
ZOSDU	0	0	0	12	3	3	3	0	2	3	1	4	1	0	0
MYRHY	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0
NAJSP	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAGCU	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Important Native Species

A healthy population of native plants is an important component of a healthy aquatic ecosystem. Native aquatic plants provide shoreline stabilization and erosion control, fish habitat for feeding, spawning, and refuge, as well as important habitat for terrestrial and amphibious species. A few species particularly important to Little Sturgeon Bay are outlined below.

Chara

Because of its size and complex structure, Chara or muskgrass (named for its strong odor) may look like a higher plant, however, it is actually a genus of algae. Muskgrass grows attached usually in firm sediment in hard water ponds, lakes, and rivers. Lakes with a significant amount of Chara tend to have very clear water. This macro-alga has no true “leaves”, only branches and branchlets. Muskgrass is relatively rough to the touch. During times of reproduction, dark, ball-like sporangia appear seed-like along the branchlets.

Water Celery

Water celery is a submersed plant that spreads by runners and can form tall underwater meadows. It is common in still and fast-flowing water. Its leaves grow in clusters from their roots. The average about one inch wide and can be several feet long, depending on water conditions.

Large-Leaf Pondweed

Large-leaf pondweed has a large thick stem with wavy, re-curved, oblong, submersed leaves, which taper to the stem. There is a solid, tightly packed spike of nutlets at the tip of the plant, which poke out of the water. Into the growing season the leaves often develop a brown color from mineral deposits. It is common in hard water throughout the northern half of the U.S. Reproduction is by way of seeds. .

Water Lilies

Water lilies have floating leaves and are found throughout the U.S. Water lily leaves are either circular (white water lily) or oblong (yellow water lily) and are notched to the center. The leaves arise on stalks from long rhizomes and grow best in soft sediment. Water lilies are perennial reproduce mainly by root growth.

Exotic Species

Exotic species are those that have been introduced to a new area. They often are harmful to the new ecosystem because they lack the predation present in their native habitats. Exotic species often can then increase in numbers and thus alter the native community. Just a few of the exotic species of concern to Little Sturgeon Bay are outlined below.

Eurasian Watermilfoil

Eurasian water milfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. EWM has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. EWM grows best in fertile, fine-textured, inorganic sediments. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, and/ or bait buckets, and can stay alive for weeks if kept moist.

Dense stands of EWM also inhibit recreational uses like swimming, boating, and fishing. Cycling of nutrients from sediments to the water column by Eurasian water milfoil may lead to deteriorating water quality and algae blooms of infested lakes (2).

Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) was not observed as part of the aquatic plant surveys in 2003. Purple Loosestrife is a perennial plant native to Europe. It arrived in the U.S. from immigrants who valued its striking purple flowers. Seeds were also unintentionally transported to the shores of North America in the ballast water of ships. Since then, purple loosestrife has expanded its range. It is now a serious pest of wetlands and pastures.

Once purple loosestrife enters a wetland, it takes over. Common native wetland plants, such as cattails and sedges, cannot compete with purple loosestrife. Once these native plants are choked out, the wildlife that depends on them for food and shelter are also eliminated. Purple loosestrife has little value as food for animals, and populations of the plant become so thick that they cannot serve as cover for wildlife. Purple loosestrife also invades the shallow waters used for northern pike spawning, ruining these areas as spawning grounds.

Purple loosestrife reproduces prolifically -- one plant can produce several million seeds in a single summer. In addition, root or stem fragments can take root and form new plants. River water and floods are the primary ways that seeds and plant fragments are transported to new areas.

Over 100 insect species feed on purple loosestrife in Europe and Asia. These insects, along with disease, keep purple loosestrife growth under control in its natural habitat. None of these natural enemies are native to North America.

Curly-Leaf Pondweed

Curly-leaf pondweed (*Potamogeton crispus*) is an exotic plant that forms surface mats that interfere with aquatic recreation. The plant usually drops to the lake bottom by early July. Curly-leaf pondweed was the most severe nuisance aquatic plant in the Midwest until EWM appeared. It was accidentally introduced along with the common carp.

Zebra Mussels

The zebra mussel (*Dreissenia polymorpha*) is a tiny (1/8-inch to 2-inch) bottom-dwelling clam native to Europe. The mussel takes its name from its striped shell. Zebra mussels were introduced into the Great Lakes system in 1985 or 1986 and first turned up in Lake St. Clair. They have spread throughout the Great Lakes and are now found in Green Bay, Sheboygan and Kenosha counties. Zebra mussels were first found in Wisconsin waters of Lake Michigan in 1989. Zebra mussels are also negatively impacting native mussel populations in the Mississippi River. Native mussels are being smothered by high concentrations of

mussels that attach themselves to their shells. Ecological studies have recently been completed on two inland Wisconsin lakes where zebra mussels first invaded in 1994. The results of these studies should provide more information on the ecological impacts.

Methods of Controlling Nuisance Aquatic Plants

Physical Controls

Manual Cutting / Raking

Mechanical cutters and rakes are commonly used for controlling nuisance aquatic plant growth. They work best inshore, where they complement hand pulling and bottom screening. The cost of this option can be the cost only of the cutter or rake (about \$100 - \$200). A permit is now required if more than 30 feet of frontage is manually harvested. Additional information is outlined in Table 6. Hand cutting and raking is non-selective and should be coupled with native aquatic planting (see below).

Table 5. Comparison of Aquatic Plant Control Techniques, Little Sturgeon Bay, Door County, Wisconsin (3,4).

<u>Method</u>	<u>Species Selective</u>	<u>Permit Required</u>	<u>Native Plantings also Required</u>	<u>Labor Intensive</u>	<u>Cost per Acre</u>	<u>Labor per Acre</u>	<u>Notes</u>
Manual Cutting/Raking	No	YES	Yes	Yes	\$125	\$0	PERMIT REQUIRED FOR NATIVE AQUATIC PLANT SPECIES
Harvester	No	Yes	Yes	Yes	\$200	Included	Large scale applications only Use of Sturgeon Bay's rig?
SCUBA / Hand Pulling	Yes	No	No	Yes	\$0	\$0	Small scale applications No cost if done by landowner
Bottom Barrier	No	Yes	Yes	Yes	\$1,740	\$300	Must be removed annually
Dredging	No	Yes	Yes	Yes	Varies	Varies	Radical habitat alteration
Drawdown	Yes/No	Yes	Yes/No	No	Permit	\$0	Not practical for this project
Milfoil Weevils	Yes	No	No	Yes	\$500?	\$250?	Not effective on EWM EWM is not the only nuisance
Herbicide	Yes	Yes	No	No	\$350	\$100	May have water use restrictions
Native Plantings	Yes	No	n/a	Yes	\$400	\$200	Must accompany other methods

Harvesters

Most aquatic plant harvesters consist of a paddle wheel propelled barge with an adjustable sickle cutter (up to 6 feet in depth maximum) and a conveyor/storage area. Cut plants are picked up on the conveyor and when the storage area is full, the harvester off loads the plants to a transport barge or to a conveyor on shore. Plants are then taken to a compost area or farmers field. Harvesting operations usually cost about \$200 per hour and are able to cover 1 – 3 acres per hour in open water.

While harvesting may clear out beaches and boat landings by breaking up the canopy, the method is not selective, removing beneficial aquatic vegetation as well as forage fish and invertebrates. Harvesters create shoot fragments, which contributes to EWM dispersal. Harvesting may be useful for Little Sturgeon as EWM colonies are widely dispersed and easily able to be brought into the system. There is also the possibility that the City of Sturgeon Bay equipment might be utilized for Little Sturgeon Bay. Harvester costs should be explored and costs / benefits examined.

Hand Pulling

Hand pulling is a preferred control method for localized nuisance growth. A SCUBA diver or snorkeler selectively removes the problem plants and places them on shore or in a floating net. When done properly, the plant and the root can be removed on a plant by plant basis. This method can be at no cost but is labor intensive.

The process can be thorough and selective; special care must be taken to collect all roots and plant fragments during removal. In areas where more than 50% of the plants are removed in an area, this method should be coupled with native plantings (see below).

Bottom Barriers

Bottom screening can be used for localized infestations that are remote from boat traffic. Screens weighted to the lake bed prevent plants from getting sunlight and/or growing up from the lake bottom. The cost of sediment covers is \$400 – \$500 per 1000 square feet plus anchoring and labor.

Bottom screening is very labor intensive and non-selective. They must be placed, anchored, monitored for gas bubbling, removed, and cleaned annually. After bottom screening, the screened area should be replanted with native aquatic plants (see below).

Dredging

Dredging is a radical form of habitat manipulation. In order for dredging to be successful for aquatic plant control, the depth of the lake must be increased to a depth at which sunlight no longer reaches the lake bottom.

Dredging costs can run anywhere from \$1.75 to \$7.50 per cubic yard of sediment removed. The permitting process is also a lengthy and expensive one. Dredging should also be accompanied by native aquatic planting (see below).

Drawdown

By modifying lake levels (usually by lowering levels in the fall), some plants can be encouraged to grow while retarding the growth of others.

The cost of drawdown would be only the cost of any permits needed and native aquatic plantings (see below). However, EWM is not always negatively affected by drawdown and is very effective at taking over disturbed areas. Drawdown should also be accompanied by native aquatic plantings.

Native Aquatic Plantings

Most physical control of aquatic plants where EWM is present should be accompanied with replanting altered areas. Because EWM is so effective at repopulating disturbed areas, any areas disturbed should be immediately planted with healthy native plants. Native plants should include those that have grown well in the past. Typical native stock for Little Sturgeon Bay would include Chara sp., Water Celery, Naiad, Richardson's Pondweed, and Big Leaf Pondweed. The cost for native aquatic plantings can be up to \$400 per acre per species planted plus labor.

Biological Controls

Milfoil Weevils

Eurhychiopsis lecontei, an herbivorous weevil native to North America, has been found to feed on Eurasian water milfoil. Adult weevils feed on the stems and leaves, and females lay their eggs on the apical meristem (top-growing tip); larvae bore into stems and cause extensive damage to plant tissue before pupating and emerging from the stem. Three generations of weevils hatch each summer, with females laying up to two eggs per day. It is believed that these insects are causing substantial decline in some milfoil populations. Because this weevil prefers Eurasian Watermilfoil, other native aquatic plant species, including northern water milfoil, are not at risk from the weevil's introduction.

A study on the effectiveness of the weevil in Loon and Lulu Lakes, Shawano County showed poor control of EWM (5). Herbicide controls have since been employed on both. Twelve Wisconsin lakes are currently part of a two-year DNR

project studying the weevil's effectiveness in curbing Eurasian water milfoil populations. (4).

Herbicide Controls

Reward and Cutrine Plus Combination

Nuisance aquatic plants can be effectively controlled with the use of a combination of the liquid herbicides Reward (active ingredient diquat dibromide) and Cutrine Plus (active ingredient chelated copper). The typical application rate is 1.5 to 2.0 gallons per acre Reward and 1.0 gallons per acre foot Cutrine Plus. A weighting agent is usually added in open applications to aid in getting the herbicide to plants on the bottom and help control dispersal and drift.

Aquathol K and Weedar 64

Another possible option is just emerging. The combination treatment of Aquathol K (active ingredient Endothall) and Weedar 64 (active ingredient 2,4-D) has been shown to reduce the most common nuisances EWM, CLP, and Coontail. When treatments are timed at or near 55 degrees F (before beneficial native plants are out of the sediment) control can be achieved without disrupting native plants, fish spawning, etc.

Drawbacks to herbicide application include water use restrictions and the inherent effects of adding a foreign agent to a lake. There are no swimming or fish consumption restrictions for areas treated with Reward, Cutrine Plus, Aquathol K or Weedar 64. The irrigation restriction indicates water treated with Reward should not be used for potable (drinking) water for three days; water treated with Weedar 64 should not be used for potable purposes until an assay indicates the concentration to be less than 70 parts per million (ppm). Also, water from the treatment area should not be used to irrigate food or ornamental crops for five days for Reward; until an assay determines the level to be less than 100 ppm for Weedar 64.

Property Owners Survey

A complete copy of the property owner's survey and the comments returned are outlined in Appendix 1. There were 64 surveys returned. The general results are indicated below.

1. Demographics: Members of LSPOA 83.7% Boater 44.2%

	Local Resident	32.6%	Fisherperson	41.6%
	Non-Resident	53.5%	Vacationer	20.9%
2. Use of the Bay:	Daily	11.6%	Monthly	4.7%
	Weekly	55.8%	A few X per month	23.3%
			Never	4.0%
3. Weeds are:	Out of Control	88.4%	Just Right	2.0%
	No Concern	9.3%		
4. Concerns:	Along Shore	44.2%	Harbor / Ramp	37.2%
	Channels	48.8%	Total Bay:	83.7%
	No Concern	9.3%		
5. Interfere w/ Use:	Most of the Time	60.5%	Some of the Time	6.9%
	Never	6.9%		
6. Control Effort:	Too Much	0%	Just Right	6.9%
	Not Enough	83.7%	No Effort Needed	2.0%
7. Weed Mgt.:	Strongly Agree	67.4%	Agree	18.6%
	Disagree	4.7%	No Opinion	4.7%
8. Manage By:	Herbicide	58.1%	Harvest	20.9%
	By Hand	16.3%	By the DNR	46.5%
	Town of Gardner	46.5%	LSPOA	48.8%

Conclusion and Recommendations

Little Sturgeon Bay is currently in relatively good condition. The bay is negatively affected by overland runoff; very high phosphorus readings are typical during summer sampling and may be attributing to algae (*Cladophora sp.*) growth along shorelines during the open water season. Sampling is ongoing to track changes. The fishery is variable but healthy and the bay is an important nursery area for many species. Aquatic plant growth is diverse and healthy with localized nuisance native and exotic plant growth. Recreational use of Little Sturgeon Bay is high and is recently increased with the completion of a new boat landing and park.

Management recommendations for the Little Sturgeon Bay include preservation of healthy native aquatic plant populations, creation of recreational access lanes, and continued water quality monitoring. Successful future management for Little Sturgeon Bay would include a flexible approach. Annual reviews will help to evaluate the goals of the public, as well as year to year aquatic plant populations.

With regard to aquatic plant management, an herbicide program appears to have the most cost effective potential for Little Sturgeon Bay. Species targeted would most likely include Eurasian Water Milfoil, Coontail, and Elodea. Treatment should be limited to recreational access lanes in the east and west lobes of Little Sturgeon Bay. These lanes would be located to provide recreational access to the most landowners, in similar areas year to year, and be adjusted annually as conditions change. In 2007, a combination of Reward (diquat dibromide) and Cutrine Plus (chelated copper) will likely be used. With further research, a combination treatment of Aquathol K (Endothall) and Weedar (liquid 2,4-D) may be considered as an earlier season option.

Harvesting may be practical, and could be further evaluated as an option. Major drawbacks of aquatic plant harvest are that it is non-selective (removes all plant species as well as fish and invertebrates) and can be more expensive than an herbicide control program. There may be an opportunity to utilize the City of Sturgeon Bay harvest equipment to create access lanes in Little Sturgeon Bay cost effectively.

Given the variable nature of species present and bed location, a pre-treatment survey should be conducted on the day of treatment in 2007 to track changes that may be occurring in treatment areas. Survey and treatment should include the use of GPS to accurately determine survey and treatment areas.

A post-treatment aquatic plant survey should be conducted at least one month after treatment to determine the effectiveness of the treatment and to retreat missed or unaffected areas.

Water quality monitoring should be continued by the LSAPOA to help track changes in the resource of time. Chlorophyll a, and phosphorus sampling should be undertaken also. Further testing of phosphates should be conducted with the cooperation and sampling design from Door County Soil and Water and DNR.

Undeveloped lands (most of which are sensitive areas) should be protected and/or purchased to minimize future impacts on the lakes, but also to provide fish and wildlife refuge and wild shorelines.

Developed shoreline owners should be educated on the benefits of buffer strips and other land use practices that can positively impact the lakes. Some information/education steps would be inclusion of tips/methods in their newsletter, a presentation at the annual meeting, a field day at properties with and without buffer strips, and getting the LSAPOA a membership on the "Lake Tides" mailing list.

References

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4. Wisconsin Department of Natural Resources. 1991. *Wisconsin Lakes*. PUBL-FM-800 91. Bureau of Water Resources Management (Lakes Section) and Bureau of Fisheries Management (Aquatic Education). Madison, Wisconsin.
5. Aquatic Biologists, Inc. 2003. *Loon Lake Comprehensive Survey Results and Management Plan*. Fond du Lac, Wisconsin.

**Action Steps
Little Sturgeon Bay
Door County, WI**

December, 2006

1. The LSAPOA should pursue the acceptance of the Aquatic Plant Management Plan Draft. Upon acceptance, a request can be made to the DNR for the final grant payment of \$750.

January / February / March, 2007

1. Copies of the Aquatic Plant Management Plan should be distributed to the appropriate parties.
2. A Summary of the Aquatic Plant Management Plan should be shared in the LSAPOA newsletter.
3. Lake and Pond Solutions LLC should submit the *Permit Application for Chemical Aquatic Plant Chemical Control* to DNR-Green Bay. Property owners requesting treatment should have requests in no later than March 1, 2007.

May / June, 2007

1. A pre-treatment survey should be done to determine which areas are to be treated.
2. Treatment should proceed upon permitting from DNR and notification of landowners. Water temperature should be at or near 60 degrees F. Treatment is usually scheduled early in the week to avoid traffic and recreational conflicts. Includes posting of affected and adjacent properties.

July / August, 2007

1. Post treatment survey should be conducted to determine the success of treatment. Decisions should be made regarding re-treating or resurvey.

Winter 2007 / 2008

1. Treatment results and efficacy should be evaluated to determine appropriate actions for 2008.

Appendix 1
Sample Weed Control Survey for the Bay of Little Sturgeon,
Little Sturgeon Bay, Door County, Wisconsin

WEED CONTROL SURVEY FOR THE BAY OF LITTLE STURGEON

Please complete this survey and mail it to LSPO, P.O. Box 421, Sturgeon Bay Wi. 54235, or place it in our CONCERNS BOX at Stevenson Pier Mini Mart. by November 5, 2006. Results will be tabulated and presented at the Nov. 9th Public Forum.

Circle all responses that apply to you.

1.) I (we) are: A.) Members of LSPOA B.) Local Resident C.) Non-resident property owner D.) Boater/water sports D.) Fisherpersion E.) Vacationer

2.) How often do you use the Bay of Little Sturgeon? A.) Daily B.) Weekly C.) Monthly D.) A few times a year E.) Never

3.) Weeds in the Bay are: A.) Too many-Out of control B.) Just the right amount C.) No concern or opinion

4.) I am concerned with weeds A.) Along the Shore B.) In the Harbor/Boat launch C.) In the Channels D.) In the total Bay E.) No concern
 Comments please:

5.) Weeds interfere with my use of the bay A.) Most of the time, B.) Some of the time C.) Never
 Comments Please:

6.) Our efforts to control weeds by herbicide are: A.) Too much effort B. Just right C.) Not enough effort D. No effort should be undertaken
 Comments Please:

7.) Aquatic weeds should be managed in order to provide for increased use of Little Sturgeon Bay: A.) Strongly agree B.) Agree C.) Disagree D.) Strongly Disagree E.) No opinion
 Comments Please:

8.) Aquatic Weeds should be managed by: A.) Herbicide treatment B.) Harvesting C.) Hand removal D.) The DNR E.) Town of Gardner F.) LSPOA & residents
 Comments:

9.) Please elaborate any specific problems you have had as a result of excessive weed growth in the bay or any specific concerns regarding our efforts for weed control.

PLEASE USE REVERSE SIDE FOR ADDITIONAL COMMENTS...

Appendix 2
Comments Submitted on Weed Control Survey,
Little Sturgeon Bay, Door County, Wisconsin

1. Weeds have progressively gotten worse. We can't even leave our dock without problems. We need to be more aggressive to control weeds. They are a nuisance.
2. Boat motor clogs up with weeds.
3. Can't get a boat out.
4. Manage weeds by whatever works the best.
5. Weeds are too thick and my motor overheats.
6. Poor control of spraying..No sign of improvement
7. The inner Bay has turned into a useless clogged swamp.
8. We have spent a lot of money on our harbor but are unable to use it. The inner bay is useless for fishing.
9. Get rid of all foreign growth and replant with native grasses, lily pads and water celery.
10. We pay high taxes on water frontage and all we have because of paths is a swamp.
11. Riley's Point channels should be included in any weed control program.
12. The DNR should pay for Navigation Channels
13. I cannot get in and out of my property with all the weeds
14. Do whatever it takes to get rid of them
15. I see neighbors spraying herbicides in the water and mowing the weeds below the high water mark. I think the DNR rules regarding weed and water control should apply to everyone. I wonder what damage we are doing to the ecosystem in our ignorance?
16. We must be realistic about goals for weed control in the Bay of Little Sturgeon.
17. We need to educate every member in regards to maintaining the best water quality. This is a shallow bay and should be considered a lane lake. Roaring fast motors creates floating weed problems.
18. The DNR should post at our Park-boat ramp lower speeds until the big bay.
19. It's hard to fish...Kids don't want to swim ...It's hard on the motor
20. We should begin the spraying process earlier .
21. We need to control weeds by any and all methods available
22. Take charge of the problem.
23. Not able to fish in areas because of weeds...Boat can't get through.
24. Weeds are too thick in the Squaw Island area. More effort must be done.
25. Weeds were never this bad. We've been here for fifty years.
26. We have cures for everything...why not this problem?
27. The weeds are a major problem My friends would rather go elsewhere to go fishing
28. We have concerns about Rileys Bay. Will this project include our bay also?
29. It's difficult to get a kayak out of the boathouse and you sure don't want to walk in this weedy mess.

30. The channel to Wavepointe seems to be the only channel to be clear of weeds. I need to row my boat from our 40' dock to avoid the heavy congestion of weeds. We pay taxes and boat registration fees to have clean and usable waterways. The DNR should clean up this mess
31. Ten years ago we could water ski and swim in this bay, now it is gross and disgusting with all of the overgrowth.
32. I have boated on L.S. bay for 40 years since I was a child. My 2 children are not forming the good memories of L.S. that I had. Large beds of weeds are floating to shore holding dead fish and bacteria making swimming and wading impractical. Floating in an inner tube isn't feasible because the weeds envelope your legs. I'm fed up with Little Sturgeon. We go to Riley's Bay every time we leave our dock
33. The inner bay has way too many weeds. I've owned property here for over 60 years and it has never been this bad
34. Something has to be done soon before the use of Little Sturgeon Bay is lost forever.
35. Payment should not come from property owners but from the DNR, the State of Wis., Town of Gardner and Door County
36. LSPO's efforts have been great. The problem has gotten out of hand....An earlier treatment would get the weeds when they are small and we would have fewer floaters
37. The water may be low but the weeds are the main reason we are not able to use the bay. The residents don't own the waterways, they are accessible to everyone. Local government should do the job for the benefit of everyone
38. Hand removal is out of the question as weeds are too thick...water is low for harvesting. The DNR should allow the township to assist in the payment for treatment of the shoreline water. This would benefit everyone who uses the bay
39. Efforts are not LSPOA's fault the DNR controls this but it is not effective to me on much help with a lot of \$ being spent
40. You can't move forward in the bay...Weeds always around the props.
41. We need HELP! HELP!
42. We have been here for 12 years and the weeds have gotten progressively worse.
43. This is a project of great magnitude and must be a cooperative effort with all parties. It has come to a point that I am looking to move out of this area of Little Sturgeon...It is disturbing to look out and see green all the way across the bay..It is impossible to fish in front of our home, swim or boat. With the small number of landowners choosing to actively back this battle, we have lost control. From the tax base from the shoreland owners isn't it in the township and counties best interest to gain control of the problem?
44. What has the DNR done to solve the problem?NOTHING!
45. Each year the problem gets worse and the weeds are filling up the entire bay. please keep trying to eliminate the weeds
46. Weeds are sprayed too late. This should be done by the end of May.
47. Please do not stop attempting to control the weeds. If we stop, the weeds will take over.

48. The DNR doesn't have the \$, The town should contribute.
49. The DNR program is forcing each person to take weed control into their own hands-Picking, Poisoning or whatever.....
50. Very poor weed control. This should be LSPOA's #1 priority. I'm dropping out of LSPOA until we make it #1...I'm very dissatisfied with all our efforts. We need to reassign our priorities.

51. The inner bay can't be used for anything and weeds are just beginning to fill the total bay. I will sell but how can you sell property in a mess of weeds. With high taxes (I'm non-resident), we get nothing in return for these taxes. The DNR, Town and County needs to take charge of a problem that will be a major loss to the L/S area.