AQUATIC VEGETATION MANAGEMENT PLAN FOR THE YEARS 2013-2017 CLEAR, ROUND, AND ANNE LAKES, STEUBEN COUNTY

Robin Scribailo & Mitchell Alix

Aquatic Restoration Systems, LLC

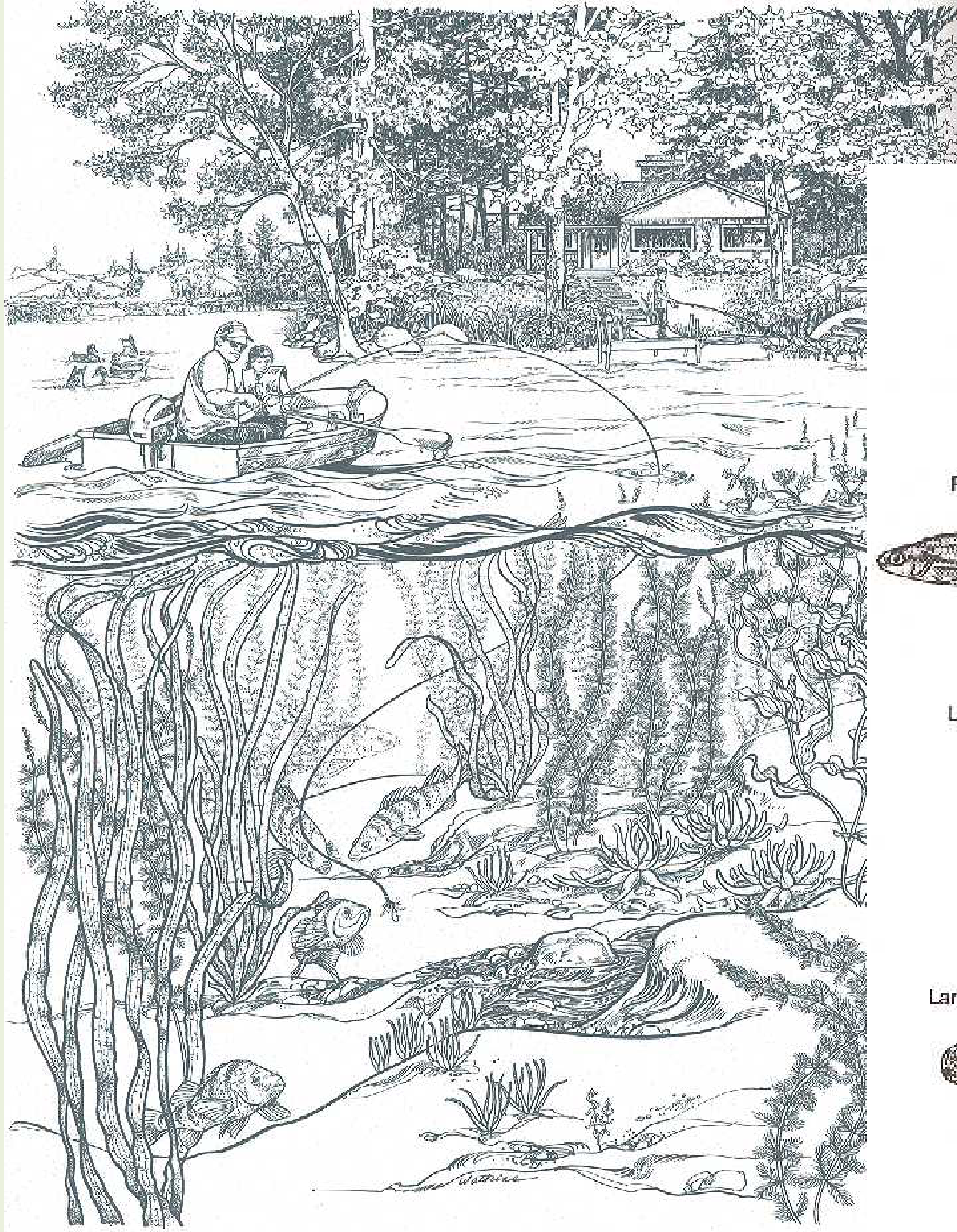
Biological Sciences

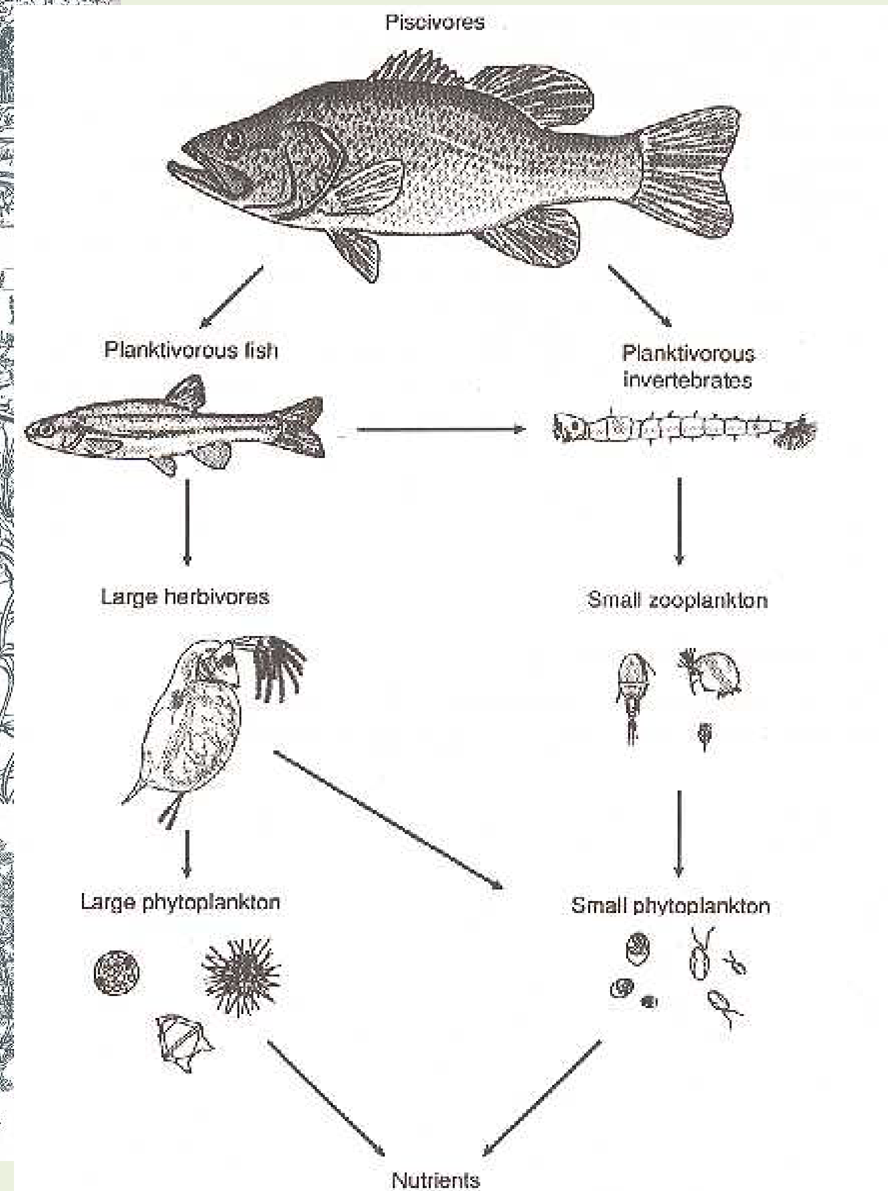
Purdue University North Central

Outline of Presentation

1. Why are aquatic plants important in the maintenance of lake health?
2. What are the elements of an IDNR aquatic plant study?
3. Herbicide application treatments to control exotic aquatic plant species.
4. Results and recommendations of the tier II aquatic plant surveys.
5. Aquatic weed control recommendations from the aquatic plant management plan.

TROPHIC CASCADE IN LAKES

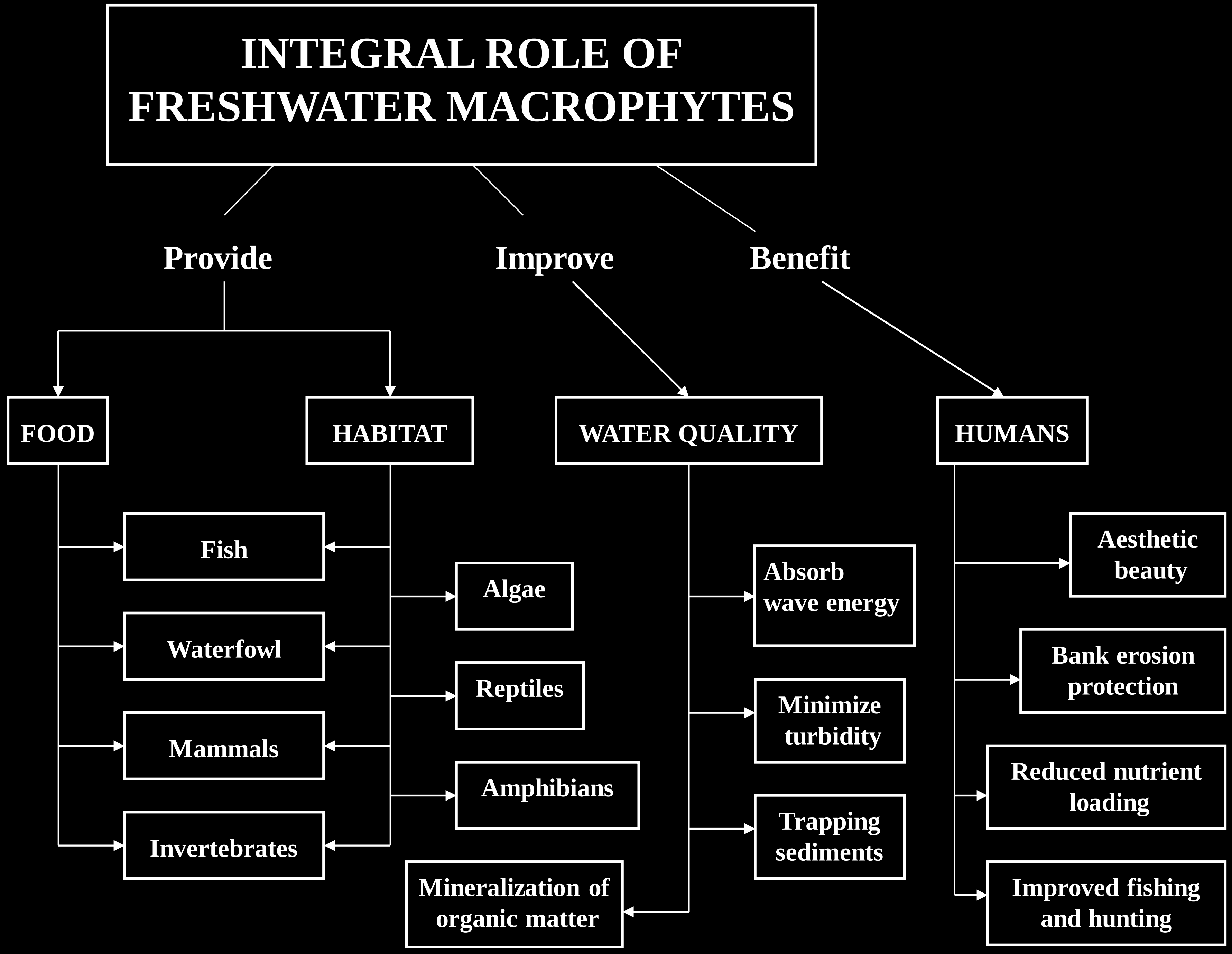




Aquatic Vascular Plants

Aquatic Vascular Plants

Charophytes Form Large Meadows on Lake Bottom


INTEGRAL ROLE OF FRESHWATER MACROPHYTES
Provide
Improve
Benefit
FOOD
HABITAT
WATER QUALITY
HUMANS
Fish
Waterfowl
Mammals
Invertebrates
Algae
Reptiles
Amphibians
Absorb wave energy
Minimize turbidity
Trapping sediments
Mineralization of organic matter
Aesthetic beauty
Bank erosion protection
Reduced nutrient loading
Improved fishing and hunting

Funding of Aquatic Vegetation Management for 2013

The Clear lake Township (HLCA) received a $16,750 grant in April, 2013from the Indiana Department of Natural Resources (IDNR), Lake and River Enhancement Program (LARE). Aquatic Restoration Systems, LLC received $4,500 to prepare an aquatic vegetation management plan for Clear and Round Lakes with a 20% match from the . Funding for treatment of invasive plant species will be allocated in the second year based on findings and recommendations for the first year.

IDNR Lake Funding

- Preparation of a lake-wide, long-term integrated aquatic plant management plan provides a valuable tool for lake protection. It also is a prerequisite to eligibility for Lake and River Enhancement program funding to control exotic or nuisance species.

- Aquatic plants play an integral role in the maintenance of lake health. A rich diversity of aquatic plants is ideal. Excessive dominance of one or a few species of aquatic plants can lead to lake decline and eutrophication over time.

Although Clear, Round, and Anne Lakes do not have a history of problems with invasive aquatic plant species such as Eurasian water-milfoil (EWM) or curly-leaf pondweed it is important to assess the extent of these species since they are readily introduced from other lakes and can rapidly spread.

Heavy growths of EWM are well known to frustrate the ability of anglers to fish without incessant line-snagging and reductions in the quality and size of fish catches, and snarl boat propellers reducing boat-related activities such as water skiing.

Reductions in the extent of EWM are correlated with overall increases in aquatic plant diversity (Carpenter, 1980; Nichols and Lathrop, 1994) as well as the diversity, abundance, and size of certain cohort of game fish (e.g., Unmuth et al., 1999).

The aquatic plant management plan for Clear, Round, and Anne Lakes Lake should meet the following goals as specified by the LARE program:

1) develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species.

2) direct efforts to preventing and/or control the negative impacts of aquatic invasive species.

3) provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

IDNR Requirements for a Lake Management Plan

- A. Problem Statement
- B. Management Goals
- C. Watershed and Water Body Characteristics
- D. Present Water Body Uses
- E. Characterize Aquatic Plant Community
- Map of Exotic and Invasive Species
- Threatened and Endangered Species Surveys
- Description of Beneficial and Problem Plant Areas
- F. Aquatic Plant Management Alternatives

An Important requirement of the LARE Aquatic Vegetation Management Plans is the mapping of invasive species.

A pre-treatment mapping of invasive species was carried out on June 12th, 2013

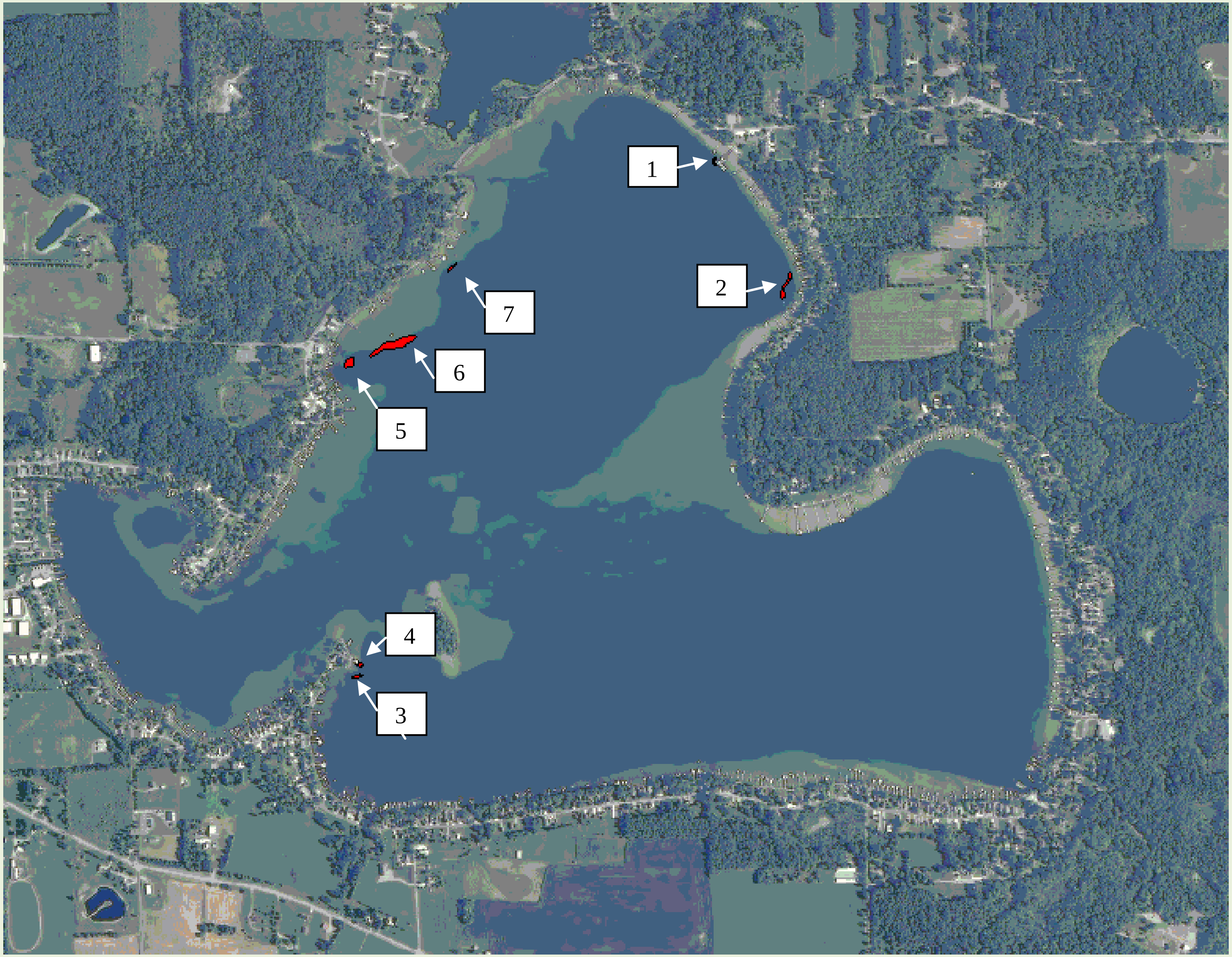
Submerged Invasive Aquatic Plant Species

Eurasian
Water-milfoil

(*Myriophyllum spicatum*)

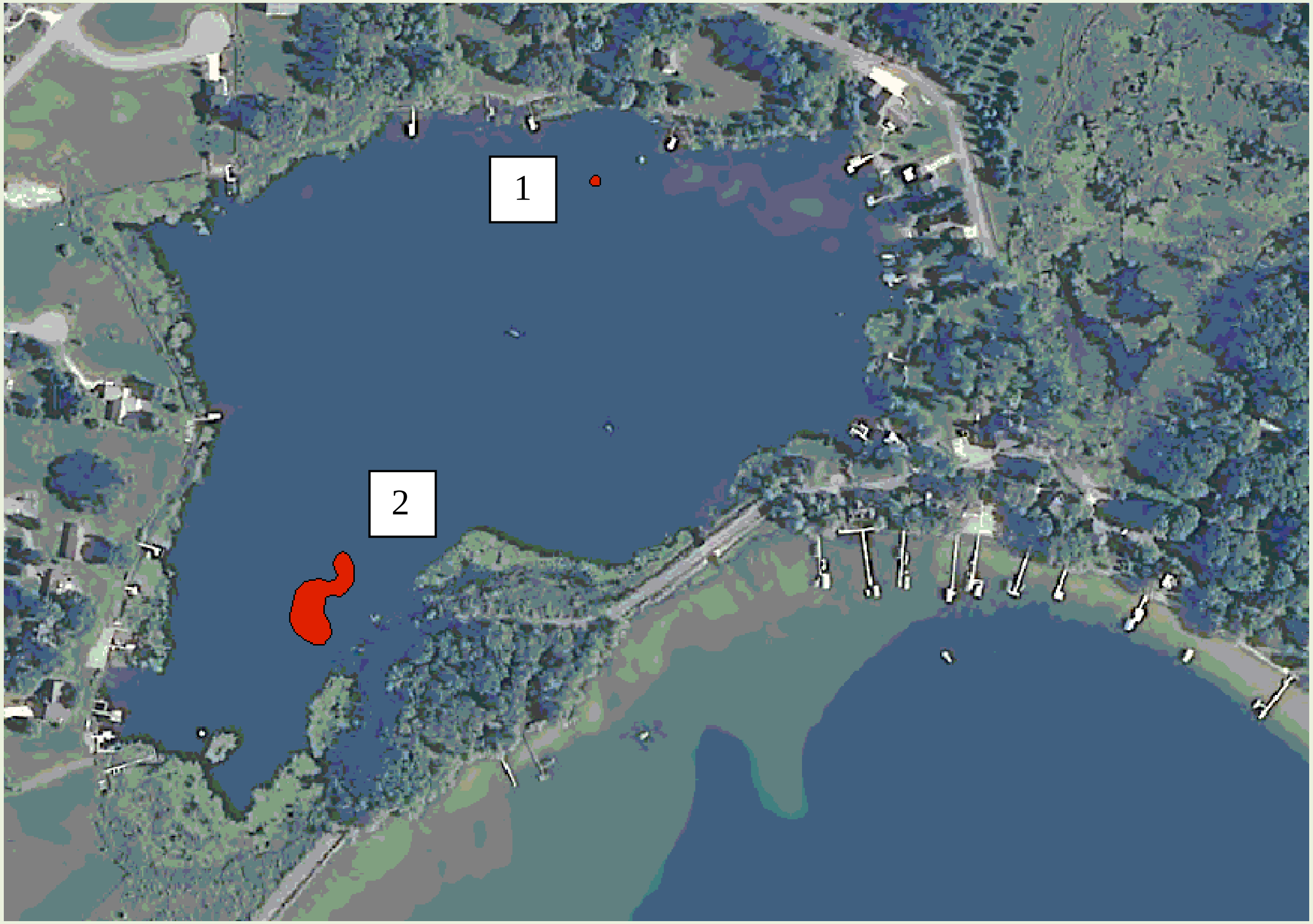
Curly-leaf pondweed (*Potamogeton crispus*)

Clear lake, Steuben County Eurasian water-milfoil beds May 2013



Polygon ID	Area	Average Depth (feet)
1	0.02	4.0
2	0.17	4.0
3	0.03	3.0
4	0.03	3.0
5	0.13	6.0
6	0.56	6.0
7	0.04	4.0
TOTAL	**0.98**	

Round Lake, Steuben County   Curly-leaf pondweed beds   May 2013



Polygon ID	Area	Average Depth
1	0.01	10.0
2	0.23	8.0

TIER II AQUATIC PLANT METHODS

1. Quantitative sampling method by lake depth.
2. Sampling is conducted twice to ensure a representative survey of the aquatic plant community.
3. The number of points sampled by depth contour is determined by trophic status of the lake and lake size.
4. Plants are sampled at each point using a double-headed rake dragged along the bottom for a distance of 10 feet.
5. Plant abundance for each species is scored by measuring the depth of material placed on one side of the rake relative to five incremental marks on the tines.

Sampling Effort by Trophic Status

Trophic State	Maximum Depth of Sampling
Hypereutrophic	10
Eutrophic	15
Mesotrophic	20
Oligotrophic	25

Table 2.0. Protocol for the number of random samples required for the determination of aquatic vegetation abundance. The number of samples is based on lake surface area and trophic state, in which samples are distributed by depth class (modified from IDNR, unpubl. data). Highlighted values correspond to sampling regime for Hudson Lake.

		Eutrophic Contours			Mesotrophic Contours				Oligotrophic Contours				
		Number of Random Samples											
Area (Acres)	Total	0-5	5-10	10-15	0-5	5-10	10-15	15-20	0-5	5-10	10-15	15-20	20-25
<10	20	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	17	13	10	10	10	10	10	10	10	10	7	3
100-199	50	23	17	10	14	14	12	10	10	10	10	10	10
200-299	60	30	20	10	18	16	16	10	14	12	12	12	10
300-399	70	37	23	10	22	20	18	10	17	15	14	14	10
400-499	80	43	27	10	25	25	22	10	**19**	**18**	**17**	**16**	**10**
500-799	90	50	30	10	29	27	24	10	22	21	19	18	10
>800	100	57	33	10	33	31	26	10	25	23	22	20	10

Sampling Rake

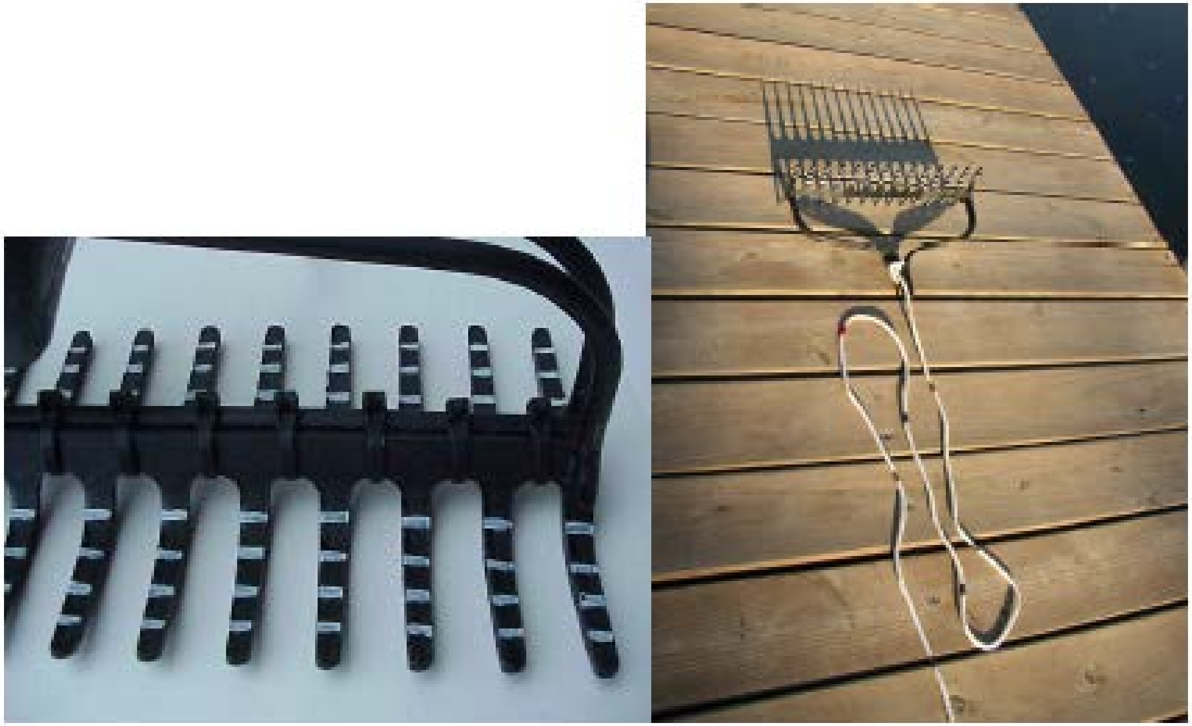


Figure 1: Double-headed rake for aquatic vegetation sampling

Vegetation Abundance Rankings

Rake teeth filled (%)	Abundance rating
100+	5
20-100	3
1-19	1
No plants retrieved	0
Ratings modified from Deppe and Lathrop (1992)	

Occurrence and Abundance of Submersed Aquatic Plants in Clear Lake

County:	Steuben	Total Sites:	100	Mean species/site:	1.21
Date:	6/11/2013	Sites with plants:	66	SE Mean species/site:	0.13
Secchi (ft):	9.8	Sites with native plants:	63	Mean native species/site:	1.08
Maximum Plant Depth (ft):	20.9	Number of species:	15	SE Mean natives/site:	0.12
Trophic Status:		Number of native species:		Species diversity:	0.83
		Maximum species/site:	6	Native species diversity:	0.79

All Depths (0 to 25 ft)	**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Species		**0**	**1**	**3**	**5**	
Chara	43.0	57.0	35.0	8.0	0.0	11.8
Illinois pondweed	14.0	86.0	14.0	0.0	0.0	2.8
Sago pondweed	14.0	86.0	12.0	2.0	0.0	3.6
Northern water-milfoil	9.0	91.0	6.0	1.0	2.0	3.8
Eel-grass	8.0	92.0	6.0	2.0	0.0	2.4
Coontaill	5.0	95.0	3.0	1.0	1.0	2.2
Eurasian water-milfoil	5.0	95.0	4.0	1.0	0.0	1.4
Canada water-weed	4.0	96.0	4.0	0.0	0.0	0.8
Common naiad	4.0	96.0	3.0	1.0	0.0	1.2
Nitella	4.0	96.0	3.0	1.0	0.0	0.0
Flatstem pondweed	3.0	97.0	2.0	0.0	1.0	1.4
Large bladderwort	2.0	98.0	2.0	0.0	0.0	0.4
Curly-leaf pondweed	1.0	99.0	1.0	0.0	0.0	0.2
Large pondweed	1.0	99.0	1.0	0.0	0.0	0.2
Tolypella	1.0	99.0	1.0	0.0	0.0	0.2

Occurrence and Abundance of Submersed Aquatic Plants in Clear Lake

County:	Steuben	Total Sites:	100	Mean species/site:	1.42
Date:	8/13/2013	Sites with plants:	57	SE Mean species/site:	0.16
Secchi (ft):	12.5	Sites with native plants:	56	Mean native species/site:	1.32
Maximum Plant Depth (ft):	19.4	Number of species:	18	SE Mean natives/site:	0.15
Trophic Status:		Number of native species:		Species diversity:	0.85
		Maximum species/site:	7	Native species diversity:	0.83

All Depths (0 to 25 ft)	**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Species		**0**	**1**	**3**	**5**	
Chara	44.0	56.0	33.0	10.0	1.0	13.6
Illinois pondweed	21.0	79.0	21.0	0.0	0.0	4.2
Sago pondweed	15.0	85.0	14.0	1.0	0.0	3.4
Northern water-milfoil	13.0	87.0	10.0	2.0	1.0	4.2
Eel-grass	12.0	88.0	11.0	1.0	0.0	2.8
Eurasian water-milfoil	9.0	91.0	7.0	2.0	0.0	2.6
Coontaill	6.0	94.0	5.0	1.0	0.0	1.6
Canada water-weed	3.0	97.0	3.0	0.0	0.0	0.6
Common naiad	3.0	97.0	3.0	0.0	0.0	0.6
Nitella	3.0	97.0	2.0	0.0	1.0	1.4
Flatstem pondweed	2.0	98.0	2.0	0.0	0.0	0.4
Large bladderwort	2.0	98.0	2.0	0.0	0.0	0.4
Large pondweed	2.0	98.0	1.0	1.0	0.0	0.8
Tolypella	2.0	98.0	2.0	0.0	0.0	0.4
White-stem pondweed	2.0	98.0	2.0	0.0	0.0	0.4
Slender pondweed	1.0	99.0	1.0	0.0	0.0	0.2
Variable-leaf water-milfoil	1.0	99.0	0.0	1.0	0.0	0.6
Curly-leaf pondweed	0.0	100.0	0.0	0.0	0.0	0.0

Chara contraria (Stoneworts)


Myriophyllum sibiricum
Northern water-milfoil

Illinois pondweed

Variable-leaved water-milfoil

Tolypella or Chara?

Occurrence and Abundance of Submersed Aquatic Plants in Round Lake

County:		Total Sites:	30	Mean species/site:	2.03
Date:	6/11/2013	Sites with plants:	26	SE Mean species/site:	0.27
Secchi (ft):	9.2	Sites with native plants:	25	Mean native species/site:	1.70
Maximum Plant Depth (ft):	18.5	Number of species:	13	SE Mean natives/site:	0.25
Trophic Status:		Number of native species:		Species diversity:	0.87
		Maximum species/site:	6	Native species diversity:	0.84

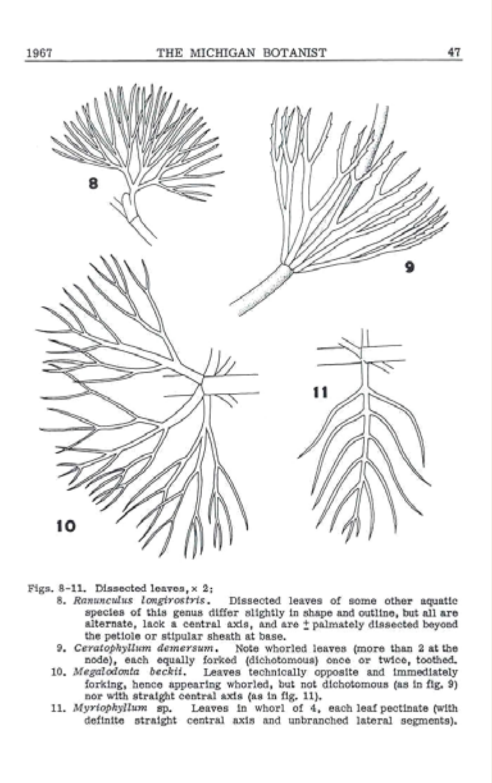
All Depths (0 to 25 ft)	**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Species		**0**	**1**	**3**	**5**	
Common bladderwort	43.3	56.7	43.3	0.0	0.0	8.7
Chara	33.3	66.7	26.7	6.7	0.0	9.3
Coontail	26.7	73.3	23.3	3.3	0.0	6.7
Curly-leaved pondweed	23.3	76.7	10.0	13.3	0.0	10.0
Illinois pondweed	23.3	76.7	23.3	0.0	0.0	4.7
Canadian water-weed	10.0	90.0	10.0	0.0	0.0	2.0
Common naiad	10.0	90.0	10.0	0.0	0.0	2.0
Nitella	10.0	90.0	10.0	0.0	0.0	2.0
Eurasian water-milfoil	6.7	93.3	6.7	0.0	0.0	1.3
Large-leaved pondweed	6.7	93.3	6.7	0.0	0.0	1.3
Eel-grass	3.3	96.7	3.3	0.0	0.0	0.7
Spiny naiad	3.3	96.7	3.3	0.0	0.0	0.7
Variable-leaved water-milfoil	3.3	96.7	3.3	0.0	0.0	0.7

Occurrence and Abundance of Submersed Aquatic Plants in Lake __________.

County:		Total Sites:	30	Mean species/site:	1.77
Date:	8/13/2013	Sites with plants:	20	SE Mean species/site:	0.31
Secchi (ft):	9.2	Sites with native plants:	20	Mean native species/site:	1.67
Maximum Plant Depth (ft):	21.0	Number of species:	13	SE Mean natives/site:	0.29
Trophic Status:		Number of native species:		Species diversity:	0.87
		Maximum species/site:	5	Native species diversity:	0.85

All Depths (0 to __ ft)	Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species		0	1	3	5	
Common bladderwort	43.3	56.7	40.0	3.3	0.0	10.0
Chara	26.7	73.3	20.0	3.3	3.3	9.3
Common naiad	20.0	80.0	20.0	0.0	0.0	4.0
Coontail	20.0	80.0	13.3	6.7	0.0	6.7
Illinois pondweed	20.0	80.0	20.0	0.0	0.0	4.0
Nitella	13.3	86.7	10.0	0.0	3.3	5.3
Variable-leaved water-milfoil	10.0	90.0	10.0	0.0	0.0	2.0
Eel-grass	6.7	93.3	6.7	0.0	0.0	1.3
Canadian water-weed	3.3	96.7	3.3	0.0	0.0	0.7
Curly-leaved pondweed	3.3	96.7	3.3	0.0	0.0	0.7
Eurasian water-milfoil	3.3	96.7	3.3	0.0	0.0	0.7
Large-leaved pondweed	3.3	96.7	3.3	0.0	0.0	0.7
Spiny naiad	3.3	96.7	3.3	0.0	0.0	0.7

Round Lake



Figs. 8-11. Dissected leaves, × 2;
8. *Ranunculus longirostris*. Dissected leaves of some other aquatic species of this genus differ slightly in shape and outline, but all are alternate, lack a central axis, and are ± palmately dissected beyond the petiole or stipular sheath at base.
9. *Ceratophyllum demersum*. Note whorled leaves (more than 2 at the node), each equally forked (dichotomous) once or twice, toothed.
10. *Megalodonta beckii*. Leaves technically opposite and immediately forking, hence appearing whorled, but not dichotomous (as in fig. 9) nor with straight central axis (as in fig. 11).
11. *Myriophyllum* sp. Leaves in whorl of 4, each leaf pectinate (with definite straight central axis and unbranched lateral segments).

Ceratophyllum demersum

Coontail

Qualitative Survey of Lake Anne

Submergent		Emergent	
Chara haitensis	Haitian stonewort	*Peltandra virginica*	Arrow arum
Ceratophyllum demersum	Coontail	*Typha angustifolia*	Narrow-leaved cat-tail
Elodea canadensis	Canadian water-weed	*Decodon verticillatus*	Swamp loosestrife
Heteranthera dubia	Water star-grass	*Lythrum salicaria*	Purple loosestrife
Myriophyllum spicatum	Eurasian water-milfoil	*Pontederia cordata*	Pickerel-weed
Potamogeton amplifolius	Broad-leaved pondweed		
Potamogeton crispus	Curly-leaved pondweed	**Floating**	
Potamogeton illinoensis	Illinois pondweed		
Potamogeton natans	Floating-leaved pondweed	*Nuphar advena* subsp. *Advena*	
Potamogeton praelongus	White-stem pondweed	Yellow pond-lily	
Potamogeton zosteriformis	Flatstem pondweed	*Nuphar variegata*	Bull-head pond-lily
Stuckenia pectinata	Sago-pondweed	*Nymphaea odorata* subsp. *tuberosa*	
Vallisneria americana	Eel-grass	White water-lily	
		Spirodela polyrrhiza	Greater duckweed
		Wolffia columbiana	Common water-meal

Major Management Issues

- Almost all pond and lake management issues in Indiana are the result of the short-term or long-term negative effects of excessive nutrient loading.

- Best management practices should stress prevention of problems rather than reaction to problems after-the-fact.

Aquatic Plant Control Options

Control method with herbicides is dependent upon whether the plants are monocots or dicots.

Eurasian water-milfoil is a dicot and is more easily controlled without collateral damage than curly-leaf pondweed.

Control of curly-leaf pondweed is typically in Spring before other plants become established.

Control of Eurasian water-milfoil

- There are a variety of chemicals used to control EWM.

- Aquatic herbicides can be divided into two broad categories;

  Contact herbicides are in pellet form and kill aquatic plants by being directly applied to the surfaces of the plant. The most commonly used contact aquatic herbicide is Reward® (diquat). Contact herbicides work more effectively on emergent or floating type species, such as water lilies, where direct contact is possible.

- Systemic herbicides are absorbed through the leaves and roots of aquatic plants where they travel through the vascular tissue to all parts of the plant body. Examples of systemic herbicides are Sonar® and Avast™ (active ingredient: fluridone); Navigate®, Aqua-Kleen®, DMA® 4 (active ingredient: 2, 4-D), and Renovate® (active ingredient: triclopyr).

Control of Curly-leaf pondweed

- Early spring treatments using contact herbicides with active ingredients of diquat or endothall have shown positive effects in reducing curlyleaf pondweed shoot and root biomass as well as suppressing turion production.
- Research has shown that a chemical application of diquat or endothall should occur when the water temperature is around 50

  to 55 degrees to greatly reduce turion production.

- Fluridone applied early in the spring has inhibited turion production. Fluridone should only be used for large scale or whole lake treatments, whereas diquat or endothall may be used over isolated beds of curlyleaf or large scale treatments.

Regulations Governing Aquatic Herbicide Usage

- Water-bodies on private land are not regulated by the state although causing damage downstream from your property can result in prosecution.
- On public water-bodies homeowners can herbicide 25 feet of shoreline to a depth of six feet without a permit.

Aquatic Plant Control Options

For Clear, Round, and Anne Lakes.

A. Treatment of Curly Leaf control with Aquathol K
early season at $160.00 per acre

B. Treatment of EWM with Navigate at $350.00/acre
(average 3.5 ft depth, dosage rate 18.9 lbs/acre)

Best Management Practices

1. Reduce the frequency and amount of fertilizer, herbicide, or pesticide used for lawn care. Make sure timing of application is appropriate and not just prior to heavy rains.
2. Use only phosphorus-free fertilizer.
3. Plant buffer strips along the lake edge and shallow littoral zone to slow-down runoff and trap sediment and nutrients. Buffer strips also discourage goose activity and nesting.
4. Place rip-rap limestone in front of seawalls to dampen wave energy.
5. Keep lawn clipping, leaves, and animal waste out of the water.
6. Properly maintain septic systems. Systems should be pumped regularly and leach fields should be properly cared for.
7. Clean all plant fragments and sediment from boats, propellers, and trailers after lake use and refrain from dumping bait buckets into the lake to prevent the spread of exotic species.
8. Exercise care in filling boat motors with gas and oil to avoid spillage into the lake.
9. Use oars or paddles to push boats out into deeper water before lowering motors to avoid damage to the bottom and the creation of excess turbidity.
10. Rake floating vegetation off the shoreline to avoid excess nutrient loading to the lake.