Pike Lake Chain of Lakes, 2009 (Google Earth)

Aquatic Invasive Species Assessment for the Pike Lake Chain of Lakes, Price County, Wisconsin

Prepared for the Pike Lake Chain of Lakes Association

Prepared by Steve McComas, Blue Water Science

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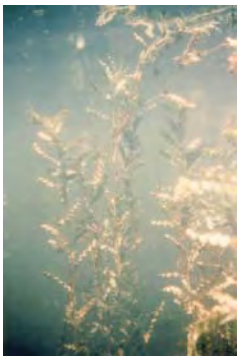
Aquatic Invasive Species Assessment for the Pike Lake Chain of Lakes, Price County, Wisconsin

Overview of seven aquatic invasive species that could impact The Pike Lake Chain are listed below. As of 2010, curlyleaf pondweed, Eurasian watermilfoil, and zebra mussels have not been observed in the Pike Lake Chain.

Species	Pike Lake Chain Status	Potential for Nuisance Colonization in the Pike Lake Chain	Management Action	
			Short Term	Long Term
Plants				
1. Curlyleaf pondweed	not in the Pike Lake Chain of Lakes	low to moderate	annual surveys by consultant or residents	selective treatment for nuisance growth conditions
2. Eurasian watermilfoil	not in the Pike Lake Chain of Lakes	low	annual surveys by consultant or residents	selective treatment for nuisance growth conditions
3. Purple loosestrife	in the area	moderate	annual surveys by residents	spot control and use of beetles for large area control
Invertebrate				
4. Zebra mussels	absent, but in Price County	moderate	mussel monitoring devices for early detection	contingency funds for aggressive rapid response
5. Rusty crayfish	present in Turner Lake	low to moderate	crayfish traps for early detection	use fish to control rusty crayfish
6. Chinese mystery snail	present in Pike Lake	moderate	no action needed	no action needed
Species to Watch				
7. VHS	absent	moderate to high	inform and educ	
8. Hydrilla	absent	low to moderate	inform and educ	



Curlyleaf Pondweed

Eurasian Watermilfoil

Zebra Mussel

Actions to Consider

Monitoring
Continue to conduct annual training sessions for lake observers to go over sampling techniques, plant identification, and delineation methods for aquatic plants and animals.

Curlyleaf scouting occurs in May and June, Eurasian watermilfoil scouting is concurrent with curlyleaf, as well as going into July. Zebra mussel inspections should occur through the growing season from June through September. Other scouting activities are less urgent and the level of effort is determined by the Pike Lake Chain with input from others.

General
The Pike Lake Chain Association should set up a policy for a treatment protocol of invasive species. For curlyleaf pondweed and Eurasian watermilfoil, does the Pike Lake Chain Association intend to conduct a rapid response or treat all areas of nuisance growth or just "open water" areas which are greater than 150 feet from shore. At this time, it might be easier to treat high growth areas, whether they are within 150 feet of shore or out farther from shore. The protocol can be adjusted as time goes on. Criteria for treatment should be established.

In the course of scouting, notes should be taken on where aquatic plants are present and where they are absent. This would make future whole lake aquatic plant surveys more efficient and save time and money.

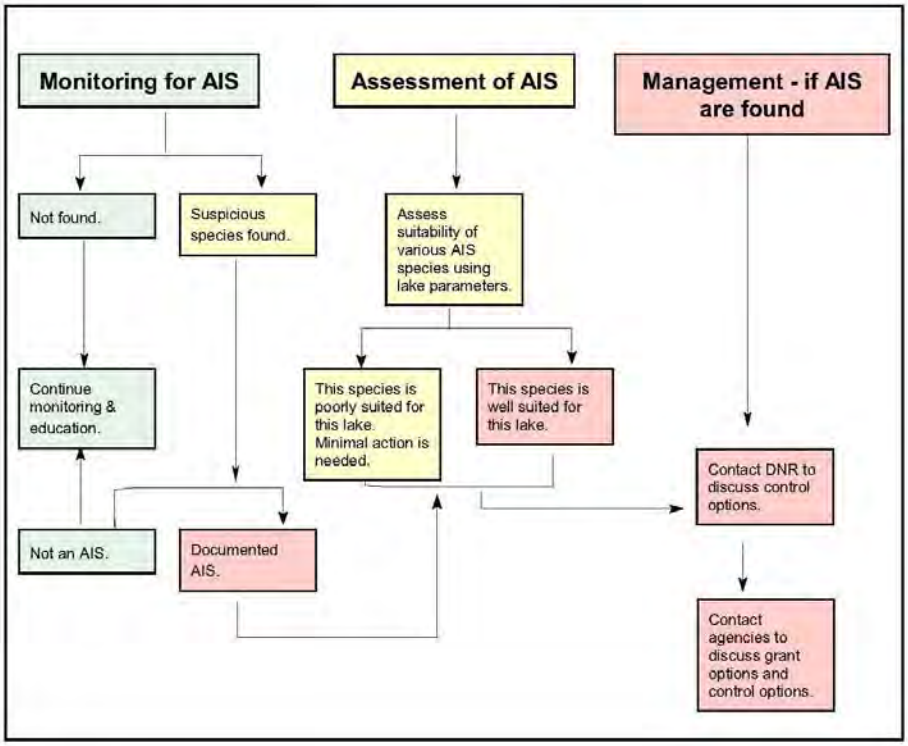


Figure S1. Flow sheet for monitoring, assessment, and management of aquatic invasive species (AIS)(adapted from Herman, L. 2009. Aquatic invasive species monitoring procedures. UW-Extension Lakes, Stevens Point, WI).

Curlyleaf Pondweed Growth Potential

Curlyleaf pondweed is not currently found in the Pike Lake Chain. Research has found curlyleaf growth is limited or enhanced based on lake sediment characteristics. Curlyleaf does best in sediments with a high pH and low iron content (McComas, unpublished). If lake sediments are conducive to curlyleaf growth, curlyleaf will sprout and grow annually. Unless the conducive sediment conditions change, curlyleaf will continue to grow on and annual basis.

It is predicted that curlyleaf can grow in the Pike Lake Chain, but will not grow to produce heavy growth. Most of the Pike lake Chain lake sediments have a low pH. If treatment is considered in the future, the latest research indicates the use of herbicides produce annual control, but long-term control (where treatments could be discontinued in the future) has not been observed (personal communication with John Skogerboe, U.S. Army Corp of Engineers).

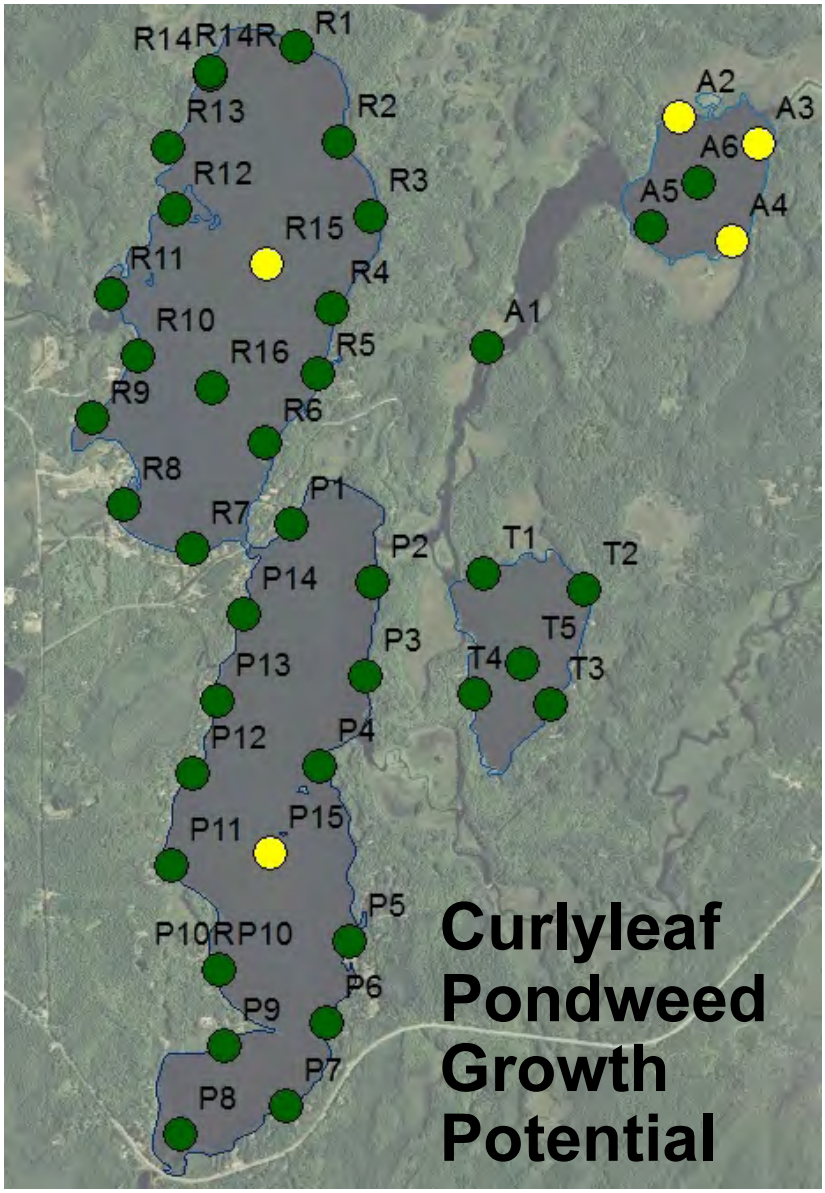


Figure S2. The circle color indicates the type of curlyleaf pondweed growth predicted to occur at that site. Key: green = light; yellow = moderate; red = heavy.

Eurasian Watermilfoil Growth Potential

Eurasian watermilfoil has not been reported in the Pike Lake Chain. However, if milfoil was to invade the Pike Chain, lake sediment analyses indicate potential milfoil growth would be light to moderate with the potential for heavy growth at only the south end of Pike Lake. Heavy milfoil growth has been correlated with high sediment nitrogen conditions and the Pike Lake Chain has mostly low to moderate nitrogen conditions.

For the Pike Lake Chain, it is estimated plants have the potential to grow down to at least 8 feet of water depth. For The Pike Lake Chain, there is the potential for Eurasian watermilfoil to cover an area of several hundred acres. However, results of the lake sediment survey show a much smaller lake area has sediment conditions conducive to heavy milfoil growth. It is estimated less than 10 acres of lake area has the potential to support heavy milfoil growth. Ongoing annual scouting activities are recommended.

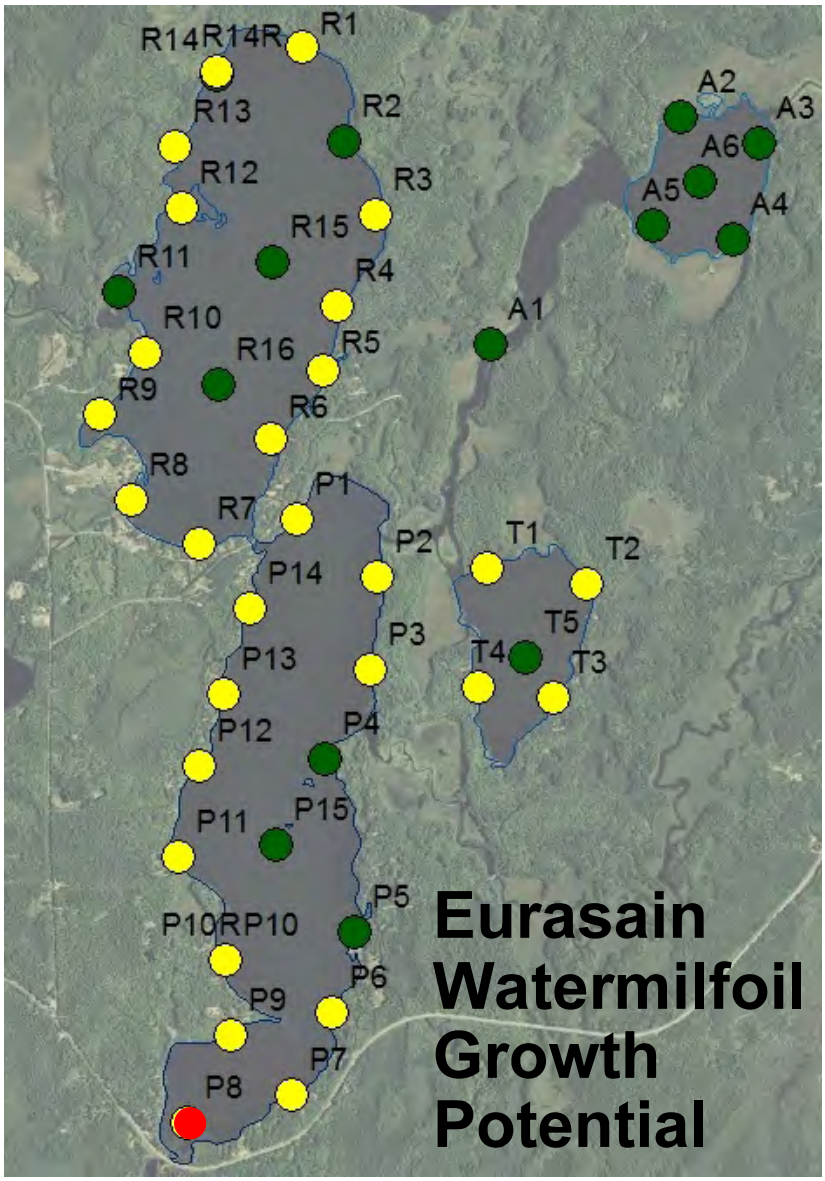


Figure S3. Indicates the type of Eurasian watermilfoil growth predicted to occur at that site. Key: green = light; yellow = moderate; red = heavy.

Zebra Mussel Growth Potential

Zebra mussels are not found in the Pike Lake Chain as of 2010. A review of water column characteristics for the Pike Chain was compared to characteristics suited for zebra mussels (blue shading) and is shown in Table S1. Low calcium concentrations in all four lakes indicate zebra mussel shell production would be limited and therefore growth would be limited. If zebra mussels invade, zebra mussel growth is expected to be light to moderate in the Pike Chain of Lakes. Ongoing scouting activities are recommended through the growing season. A zebra mussel coordinator from the Pike Lake Chain should be appointed and this person would coordinate control activities between the WDNR, the Pike Lake Chain, and contractors. An action plan should be formulated in the future with procedures outlined for actions.

Discussions with the WDNR should be held prior to zebra mussel detection in the Pike Lake Chain to outline control activities and the need for potential permits.

Table S1. Water column zebra mussel suitability criteria and the Pike Lake Chain water column conditions. Conditions for low to moderate growth seem to dominate. Heavy growth of zebra mussels would not be expected in the Pike Chain of Lakes.

		Little Potential for Adult Survival	Little Potential for Larval Development	Moderate (survivable, but will not flourish)	High (favorable for optimal growth)
Calcium (mg/l)	Pike		9.5		
	Round		9.0		
	Turner		9.2		
	Amik		12.2		
	Mackie and Claudi 2010	<8	8 - 15	15 - 30	>30
Dissolved oxygen (depth of colonization in meters)	Pike		4-6 m (water depth)	4 m	0-3 m
	Round			2-7 m	0-2 m
	Turner			1-4 m	0-1 m
	Amik		1-3 m	0-1 m	
	Mackie and Claudi 2010	<3 mg/l	3 - 7 mg/l	7 - 8 mg/l	>8 mg/l
Temperature (°C) (depth of colonization in meters)	Pike			4-5 m	0-4 m
	Round			5-6 m	0-5 m
	Turner				0-4 m
	Amik				0-3 m
	Mackie and Claudi 2010	<10 or >32 °C	26 - 32 °C	10 - 20 °C	20 - 26 °C
pH	Pike	6.7			
	Round	6.6			
	Turner		7.0		
	Amik				
	Mackie and Claudi 2010	<7.0 or >9.5	7.0 - 7.8 or 9.0 - 9.5	7.8 - 8.2 or 8.8 - 9.0	8.2 - 8.8
Alkalinity* (as mg $CaCO_3$/l)	Pike		30		
	Round	28			
	Turner		36		
	Amik		44		
	Mackie and Claudi 2010	<30	30 - 55	55 - 100	100 - 280
Conductivity* (umhos)	Pike		50		
	Round		40		
	Turner		45		
	Amik				
	Mackie and Claudi 2010	<30	30 - 60	60 - 110	>110
Secchi depth (m) (3 year avg. 2008-2010)	Pike		1.1		
	Round		1.5		
	Turner		1.5		
	Amik		1.6		
	Mackie and Claudi 2010	<1 or >8	1 - 2 or 6 - 8	4 - 6	2 - 4
Chlorophyll a (ug/l)(food source) (3 year avg. 2008-2010)	Pike			12.2	
	Round			8.2	
	Turner			11.7	
	Amik			12.0	
	Mackie and Claudi 2010	<2.5 or >25	2.0 - 2.5 or 20 - 25	8 - 20	2.5 - 8
Total phosphorus (ppb) (3 year avg. 2008-2010)	Pike		39.6		
	Round				32.5
	Turner				28.2
	Amik		36.9		
	Mackie and Claudi 2010	<5 or >50	5 - 10 or 35 - 50	10 - 25	25 - 35

* not tested at this time

Purple Loosestrife
Continue information and education programs and continue mapping purple loosestrife locations on an annual basis.

Rusty Crayfish
Annual monitoring is recommended. Rusty crayfish are in the Pike Lake Chain, they currently are in Turner Lake. If significant aquatic plant beds are disappearing, then trapping of the rusty crayfish could be considered as well.

VHS
If VHS is discovered in the Pike Lake Chain, an intensive information program should be implemented by the Pike Lake Chain. Staffing public access landings could be considered to prevent the spread of VHS by way of livewell and bilge water transport to other lakes. Costs for these actions could be partly covered by grants.

Hydrilla
It is uncertain at this time how hydrilla would react in the Pike Lake Chain. Any type of hydrilla control program in the Pike Lake Chain would be coordinated with the WDNR.

Juvenile zebra mussel from Lake Minnetonka, MN. Actual length was about 12 mm (0.5 inches).

Aquatic Invasive Species Assessment for the Pike Lake Chain of Lakes, Price County, Wisconsin

Introduction

The Pike Lake Chain is a 1,905 acre chain of lakes in Price County consisting of Amik, Pike, Round, and Turner Lakes. The objective of this report was to evaluate the potential for ecological and recreational problems to develop in the Pike Lake Chain associated with non-native aquatic invasive species. The aquatic invasive species evaluated include the following:

1. Curlyleaf pondweed (not present in the Pike Lake Chain).
2. Eurasian watermilfoil (not present in the Pike Lake Chain).
3. Purple loosestrife (present in the Pike Lake Chain).
4. Zebra mussel (not present in the Pike Lake Chain but present in Forest County).
5. Rusty crayfish (present in Turner and Round Lakes).
6. Chinese mystery snail (present in Pike Lake).
7. Viral Hemorrhagic Septicemia (VHS)(fish virus)(not present in the Pike Lake Chain but present in several Wisconsin inland lakes and all the Great Lakes).
8. Hydrilla (aquatic plant)(not present in the Pike Lake Chain with the closest known occurrence in Arkansas to the south and Maryland to the east. It has been eradicated in a single pond location in Wisconsin).

Prevention and Control Strategies

The Pike Lake Chain Association has an active prevention program with a variety of ongoing activities. These programs are well organized and will continue to evolve as experience accumulates regarding the prevention of the introduction of aquatic invasive species.

Prevention strategies consist of information and education programs combined with active monitoring for species such as zebra mussels. Since the Pike Lake Chain prevention programs are well established this report emphasizes management guidelines.

Another name for active monitoring is scouting a lake. An ongoing water quality monitoring program also serves as a scouting program for non-native species in the Pike Lake Chain.

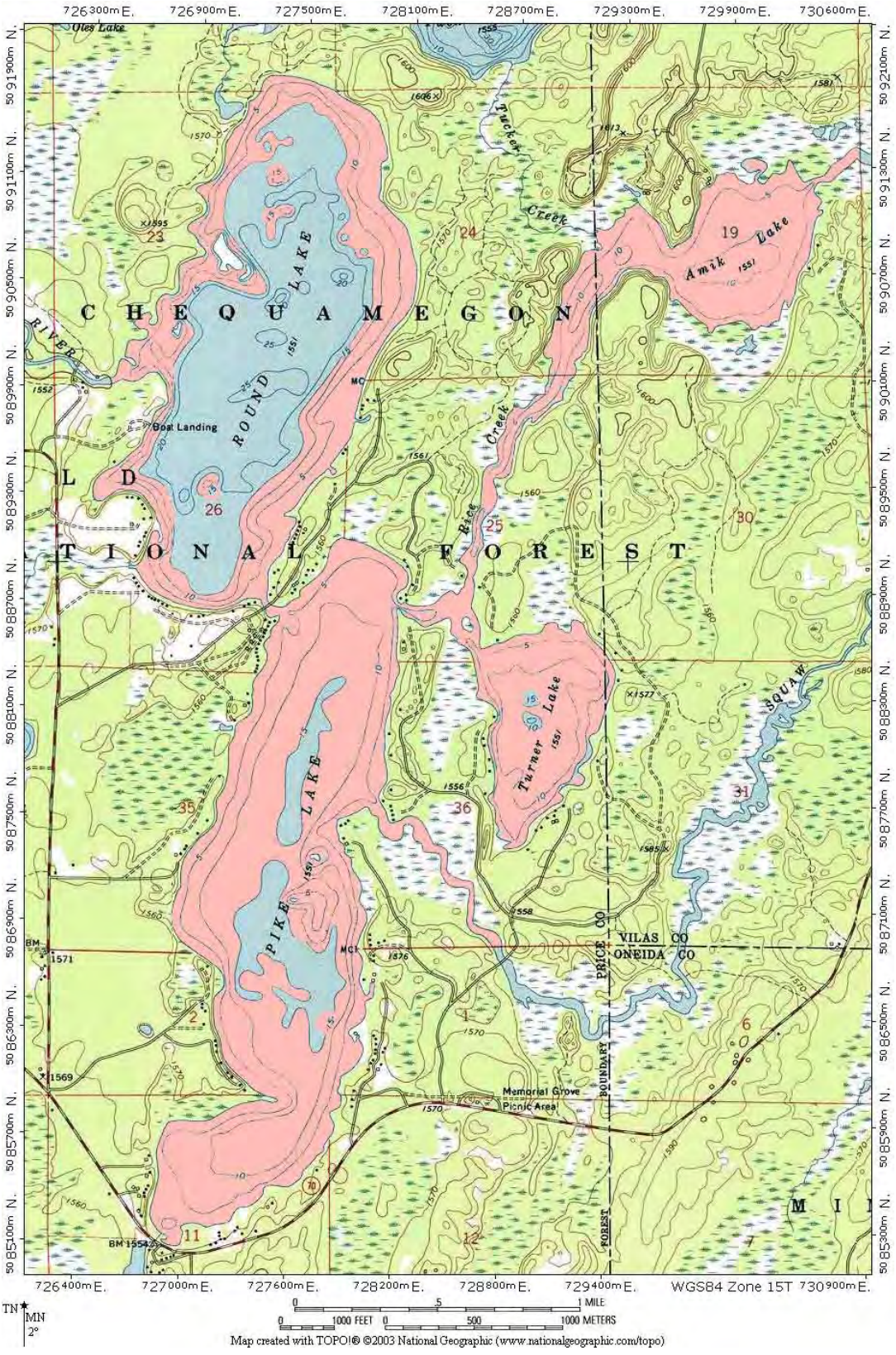


Figure 1. Scouting by volunteers occurs in the littoral zone, 15 feet for less (littoral zone is shown in pink shading).

Management Guidelines for Seven Aquatic Invasive Species That Could Impact The Pike Lake Chain

1. Curlyleaf Pondweed (aquatic plant)

Pike Lake Chain Status: Not present in the Pike Lake Chain.

Nearest Occurrence: Price County (5 lakes), Oneida County (12 lakes), Vilas County (11 lakes)

Potential for Nuisance Colonization in the Pike Lake Chain: There is a limited range of low to moderate potential for heavy growth based on lake sediment conditions.

Lake sediment sampling results from September 2010 have been used to predict lake bottom areas that have the potential to support heavy or nuisance curlyleaf pondweed plant growth. Based on the key sediment parameters of pH, sediment bulk density, organic matter, and the Fe:Mn ratio (McComas, unpublished), the predicted growth characteristics of curlyleaf pondweed are shown in Table 1 and Figure 3.

Curlyleaf pondweed growth is predicted to produce light to moderate growth (where plants occasionally top out in a solid canopy) within the Pike Lake Chain.

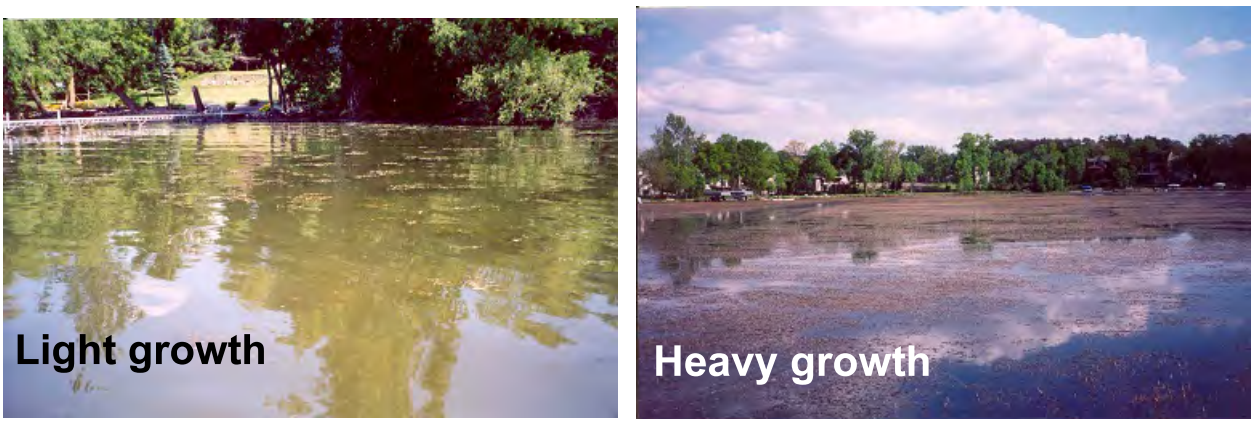


Figure 2. Light growth (left) refers to non-nuisance growth that is mostly below the surface and is not a recreational or ecological problem. Heavy growth (right) refers to nuisance matting curlyleaf pondweed. This is the kind of nuisance growth predicted by high sediment pH and a sediment bulk density less than 0.51.

Table 1. The Pike Chain of Lakes sediment data and ratings for potential heavy curlyleaf pondweed growth.

Site	Depth (ft)	pH (su)	Organic Matter (%)	Fe:Mn Ratio	Potential for Heavy Curlyleaf Pondweed Growth
Light Growth		**6.8**	**5**	**4.6**	**Light (green)**
Moderate Growth		**6.2**	**11**	**5.9**	**Moderate (yellow)**
Heavy growth		**>7.7**	**>20**	**<1.6**	**Heavy (red)**
A1	7	5.7	88.1	14.3	Light
A2	7	6.4	30.9	17.1	Moderate
A3	7.5	6.6	47.1	10.1	Moderate
A4	11	6.1	40.7	17.8	Moderate
A5	7	5.9	35.2	18.8	Light
A6	6	5.9	43.0	41.4	Light
P1	7	5.9	1.1	9.8	Light
P2	7.5	6.1	1.7	10.6	Light
P3	5	6.1	1.2	10.6	Light
P4		6.2	1.3	18.7	Light
P5	5.5	6.4	0.7	11.5	Light
P6	5	5.8	1.0	18.2	Light
P7	7	5.9	2.7	12.8	Light
P8	5	6.1	13.4	13.0	Light
P9	6	6.2	2.9	12.9	Light
P10	7	6.0	0.9	11.7	Light
P10-R	6	7.0	1.0	9.3	Light
P11	7	6.4	3.7	18.0	Light
P12		6.9	1.5	10.2	Light
P13	4	6.7	0.9	11.2	Light
P14	7	6.1	0.8	13.5	Light
P15	16	6.1	31.5	42.7	Moderate
R1	7	6.5	0.7	15.2	Light
R2	4	6.3	0.4	8.6	Light
R3	5	6.7	4.4	7.9	Light
R4	4	7.0	0.6	12.3	Light
R5	6	6.6	3.8	8.8	Light
R6	5	6.8	1.0	6.4	Light
R7	5	6.4	0.6	6.8	Light
R8	5	6.4	4.1	6.6	Light
R9	7	6.6	1.2	8.8	Light
R10	6	6.2	0.8	9.3	Light
R11	7.5	6.2	0.5	6.4	Light
R12	7	6.2	0.8	5.2	Light
R13	7.5	6.3	0.6	7.9	Light
R14	7	6.8	0.5	13.9	Light
R14R		6.8	0.6	12.1	Light
R15	25	6.2	32.4	12.6	Moderate
R16 (Deep)	22	6.0	33.3	22.7	Light
T1	7	6.9	1.5	18.6	Light
T2	7.5	6.9	1.2	17.3	Light
T3	6.5	6.5	3.5	17.8	Light
T4	8	6.3	2.0	20.1	Light
T5	13.5	6.2	38.6	33.5	Light

Curlyleaf Pondweed Growth Potential Based on Lake Sediments

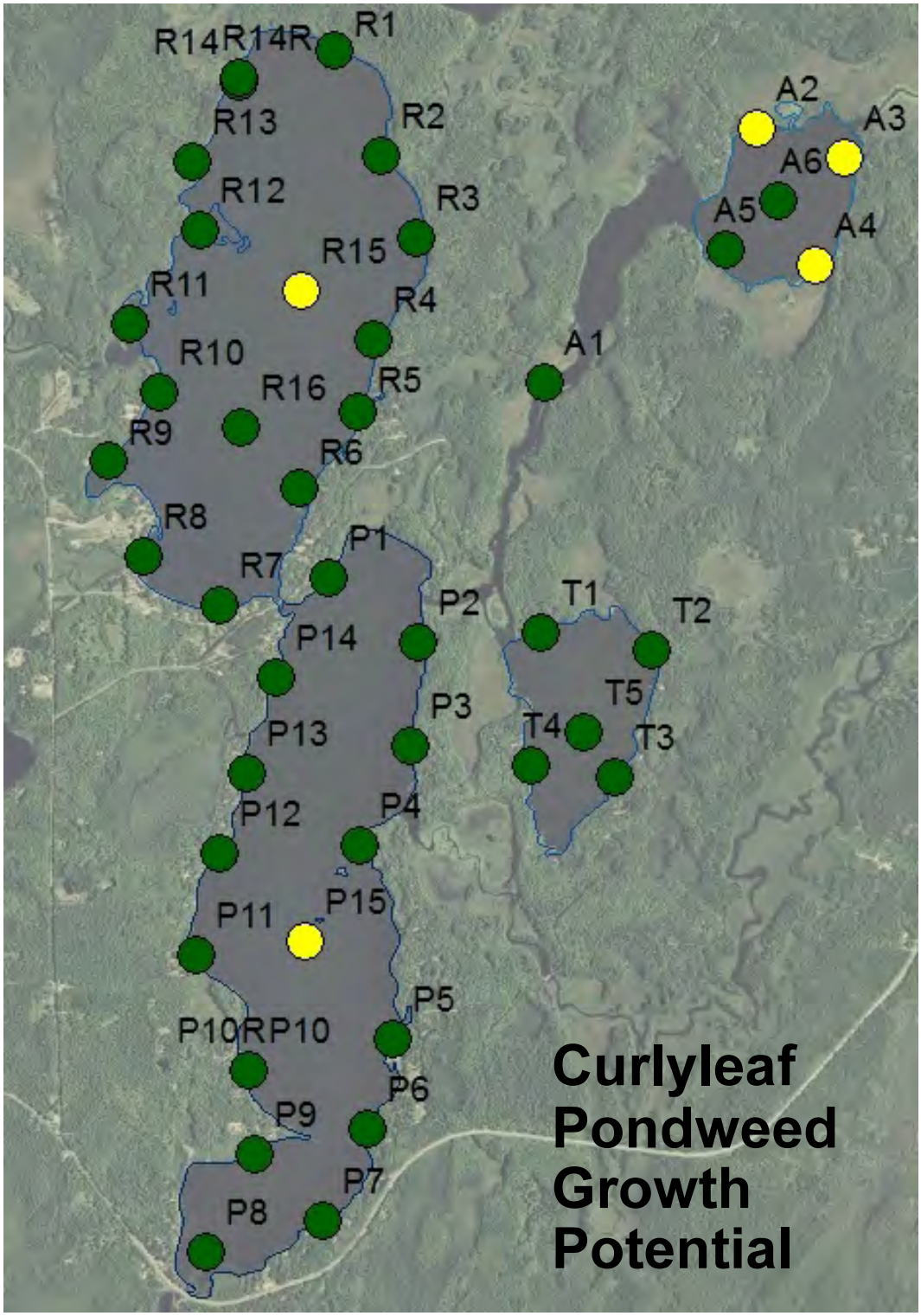


Figure 3. Curlyleaf growth potential based on lake sediment analyses. Green dots = light growth, yellow dots = moderate growth, and red dots = heavy growth.

Management Options for Curlyleaf Pondweed

Scouting Activities: Annual scouting activities could be considered to check areas where curlyleaf pondweed could be growing. Scouting should be done in May or early June. Sediment characteristics indicate there is a potential for light to moderate growth in the Pike Lake Chain. Although scouting should be conducted around the entire lake, scouting should be concentrated in areas that are conducive to growth.

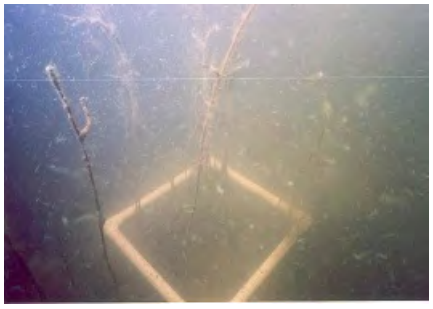
If curlyleaf is discovered in the future, it is recommended that all aquatic plants (especially the natives) should be recorded within a delineated area containing curlyleaf pondweed when scouting. A hand-held GPS should be used to outline a treatment area. A Garmin 76 series is a suitable GPS unit. Growth characteristics should be identified. A chart showing 3 classes of curlyleaf growth is shown on the next page. Areas of light growth do not need to be treated. Areas of moderate to heavy growth are candidates for treatment.

Figure 4. [left] Map shows The Pike Lake Chain littoral area for scouting purposes.
[right] Sampling plants with a garden rake attached to a telescoping pole can be used to scout for curlyleaf pondweed and sample native plants as well.

Curlyleaf Pondweed Growth Characteristics

(source: Steve McComas, Blue Water Science, unpublished)

Light Growth Conditions



Plants rarely reach the surface.

Navigation and recreational activities are not generally hindered.

Stem density: 0 - 160 stems/m^2
Biomass: 0 - 50 g-dry wt/m^2
Estimated TP loading: <1.7 lbs/ac

MnDNR rake sample density equivalent for light growth conditions: 1, 2, or 3.

Moderate Growth Conditions

Broken surface canopy conditions.

Navigation and recreational activities may be hindered.

Lake users may opt for control.

Stem density: 100 - 280 stems/m^2
Biomass: 50 - 85 g-dry wt/m^2
Estimated TP loading: 2.2 - 3.8 lbs/ac

MnDNR rake sample density equivalent for moderate growth conditions: 2, 3 or sometimes, 4.

Heavy Growth Conditions

Solid or near solid surface canopy conditions.

Navigation and recreational activities are severely limited.

Control is necessary for navigation and/or recreation.

Stem density: 400+ stems/m^2
Biomass: >300 g-dry wt/m^2
Estimated TP loading: >6.7 lbs/ac

MnDNR rake sample density has a scale from 1 to 4. For certain growth conditions where plants top out at the surface, the scale has been extended: 4.5 is equivalent to a near solid surface canopy and a 5 is equivalent to a solid surface canopy. Heavy growth conditions have rake densities of a 4 (early to mid-season with the potential to reach the surface), 4.5, or 5.

Management Options for Curlyleaf Pondweed

Control Options: After scouting activities have delineated areas to be managed, control options need to be selected. The recommended treatment option at this time would be the use of an Aquathol herbicide. Cost of herbicide applications range from about $400 to $500 per acre.

Not all curlyleaf areas have to be treated. The areas to consider are areas with moderate to heavy growth. Curlyleaf will continue to expand its distribution in the Pike Lake Chain even if it is treated. However, heavy growth should be limited by lake sediment conditions.

Three common treatment methods are shown below. In the future harvesting or cutting could be incorporated into a management program.

Herbicide applications

Boat-towed cutters

Mechanical harvesters

2. Eurasian Watermilfoil (aquatic plant)

Pike Lake Chain Status: Not found in the Pike Lake Chain (in 2010).

Nearest Occurrence: Price County (7 lakes), Oneida County (26 lakes), Vilas County (28 lakes)

Potential for Nuisance Colonization in the Pike Lake Chain: Low, with moderate potential in some bays.

Lake sediment sampling results from September 2010 have been used to predict lake areas that have the potential to support nuisance Eurasian watermilfoil growth. At this time, Eurasian watermilfoil has not been found in the Pike Lake Chain. Based on the key sediment parameters of NH_4 and organic matter (McComas, unpublished), a table and map were prepared that predict the type of growth that could be expected in the future if milfoil becomes established in the Pike Lake Chain (Table 2 and Figure 6).

The sediment nitrogen conditions in the Pike Lake Chain are relatively low. It is predicted, Eurasian watermilfoil may grow widely through the lake, but there are only a few areas where milfoil could grow from light to moderate growth conditions.

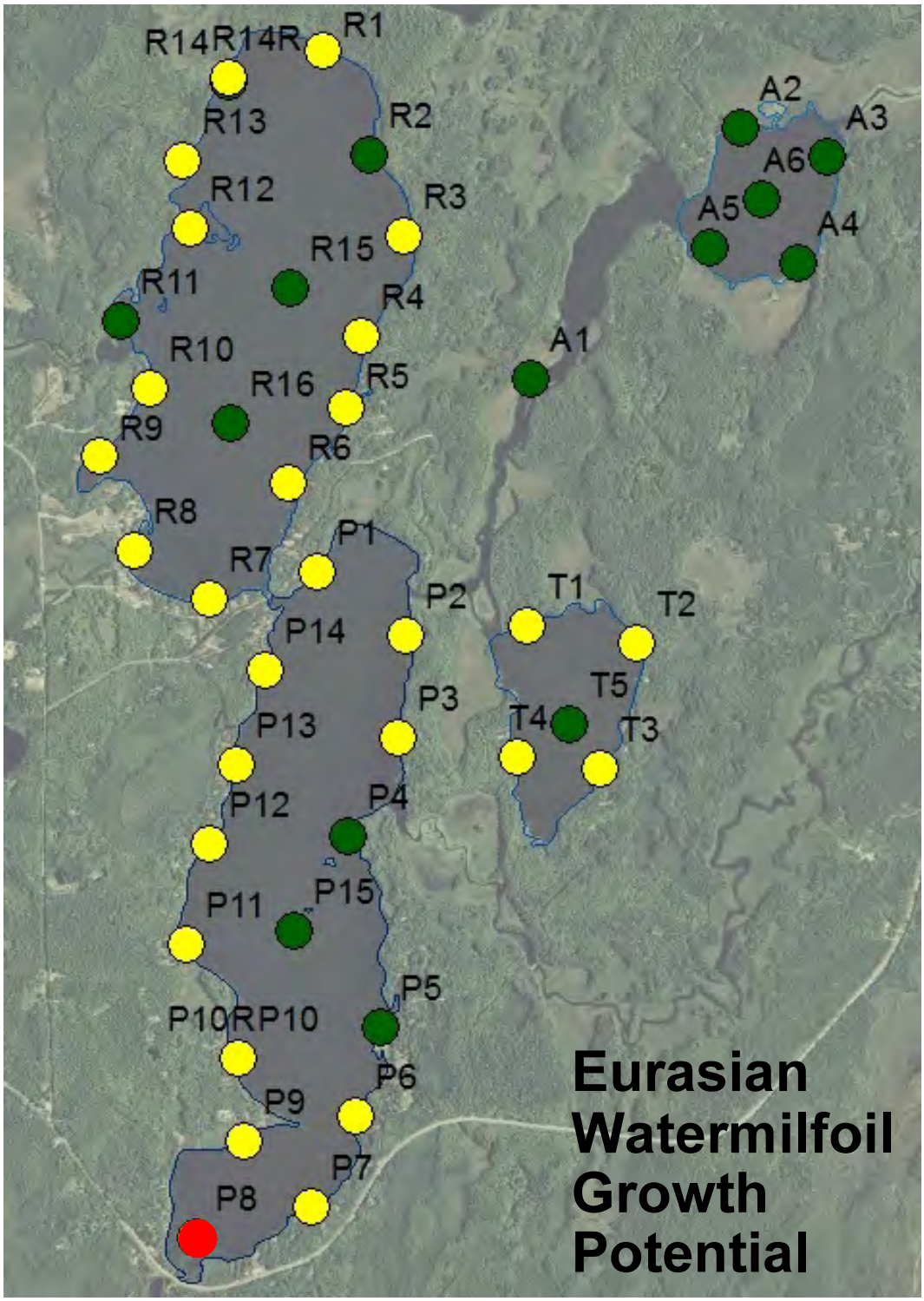
It is estimated only a few acres of lake bottom could support heavy milfoil growth. Other colonized areas would be predicted to have low to moderate growth on a long-term basis.

Figure 5. Light growth (left) refers to non-nuisance growth that is mostly below the surface and is not a recreational or ecological problem. Heavy growth (right) refers to nuisance matting Eurasian watermilfoil. This is the kind of nuisance growth predicted by high sediment nitrogen values and a sediment organic matter content less than 20%.

Table 2. Pike Chain sediment data and ratings for potential heavy EWM growth.

Site	Depth (ft)	NH_4 Conc (ppm)	Organic Matter (%)	Potential for Heavy EWM Growth
Light Growth		**<10**	**>20**	**Light (green) to Moderate (yellow)**
Heavy Growth		**>10**	**<20**	**Heavy (red)**
A1	7	15	88.1	Light
A2	7	8	30.9	Light
A3	7.5	41.1	47.1	Light
A4	11	59	40.7	Light
A5	7	25.9	35.2	Light
A6	6	17.8	43.0	Light
P1	7	5.0	1.1	Moderate
P2	7.5	6.8	1.7	Moderate
P3	5	3.7	1.2	Moderate
P4		4.1	1.3	Moderate
P5	5.5	22.4	0.7	Moderate
P6	5	5.2	1.0	Moderate
P7	7	6.1	2.7	Moderate
P8	5	10.8	13.4	Heavy
P9	6	4.5	2.9	Moderate
P10	7	6.2	0.9	Moderate
P10-R	6	4.2	1.0	Moderate
P11	7	8.9	3.7	Moderate
P12		7.2	1.5	Moderate
P13	4	4.6	0.9	Moderate
P14	7	4.6	0.8	Moderate
P15	16	6.2	31.5	Light
R1	7	4.9	0.7	Moderate
R2	4	8.5	0.4	Light
R3	5	5.4	4.4	Moderate
R4	4	6.3	0.6	Moderate
R5	6	6.9	3.8	Moderate
R6	5	7.3	1.0	Moderate
R7	5	6.4	0.6	Moderate
R8	5	6.1	4.1	Moderate
R9	7	8.3	1.2	Moderate
R10	6	5.9	0.8	Moderate
R11	7.5	9.7	0.5	Light
R12	7	5.4	0.8	Moderate
R13	7.5	6.0	0.6	Moderate
R14	7	7.0	0.5	Light
R14-R		4.4	0.6	Moderate
R15	25	27.4	32.4	Light
R16	22	29.2	33.3	Light
T1	7	5.2	1.5	Moderate
T2	7.5	4.0	1.2	Moderate
T3	6.5	7.3	3.5	Moderate
T4	8	7.2	2.0	Moderate
T5	13.5	23.1	38.6	Light

Eurasian Watermilfoil Growth Potential Based on Lake Sediments



Key: Green dots = light growth potential. Yellow dots = moderate growth potential. Red dot = heavy growth potential.

Management Options for Eurasian Watermilfoil

Scouting Activities: Observers should continue the lake milfoil evaluation to look for new milfoil infestations. This scouting activity can occur at the time of curlyleaf scouting in May and June, but additional monitoring is recommended in July. If milfoil is located, a GPS reading should be taken.

Treatment Options: Because of the large size of the Pike Lake Chain, eradication of Eurasian watermilfoil in the Pike Lake Chain is unlikely.

From the initial milfoil observation, it would take about 5 to 6 years for Eurasian watermilfoil to colonize all suitable areas in the Pike Lake Chain. Milfoil will not "take over" the lake. Lake sediment analyses indicate mostly marginal sediment conditions for milfoil growth. Lake sediments are low in nitrogen and low in organic matter. Both these conditions will inhibit growth of Eurasian watermilfoil or it's hybrid in the Pike Lake Chain.

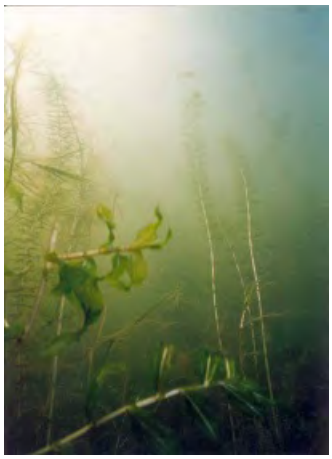
For management purposes, the chart of Eurasian watermilfoil growth characteristics can be used for classifying growth (shown on the next page). Infested areas of EWM with light to moderate growth, do not have to be treated. Areas of heavy growth are candidates for some type of treatment.

Three treatment options include herbicides, harvesting, and cutting. Herbicide applications would be the preferred initial option.

Eurasian Watermilfoil Growth Characteristics

(source: Steve McComas, Blue Water Science, unpublished)

Light Growth Conditions



Plants rarely reach the surface.

Navigation and recreational activities generally are not hindered.

Stem density: 0 - 40 stems/m^2
Biomass: 0 - 51 g-dry wt/m^2

MnDNR rake sample density equivalent for light growth conditions: 1, 2, or 3.

Moderate Growth Conditions

Broken surface canopy conditions. However, stems are usually unbranched.

Navigation and recreational activities may be hindered.

Lake users may opt for control.

Stem density: 35 - 100 stems/m^2
Biomass: 30 - 90 g-dry wt/m^2

MnDNR rake sample density equivalent for moderate growth conditions: 3 or 4.

Heavy Growth Conditions

Solid or near solid surface canopy conditions. Stems typically are branched near the surface.

Navigation and recreational activities are severely limited.

Control is necessary for navigation and/or recreation.

Stem density: 250+ stems/m^2
Biomass: >285 g-dry wt/m^2

MnDNR rake sample density has a scale from 1 to 4. For heavy growth conditions where plants top out at the surface, the scale has been extended: 4.5 is equivalent to a near solid surface canopy and a 5 is equivalent to a solid surface canopy.

3. Purple Loosestrife (aquatic and terrestrial plant)

Pike Lake Chain Status: Purple loosestrife is found in the area.

Potential for Nuisance Colonization in the Pike Lake Chain: Moderate.

Purple loosestrife can colonize a wide range of soil conditions. Because of its high seed production it has a high potential to spread. It has moderate potential to produce nuisance growth conditions on individual lake lots because residents can control small infestations. It has a higher potential to produce moderate to heavy growth in undeveloped areas around the Pike Lake Chain. However, the Pike Lake Chain has conducted successful control programs in the past and is familiar with management options.

Management Options for Purple Loosestrife

Scouting Activities: Lake observers should continue to make notes of where shoreland purple loosestrife plants are observed. If small purple loosestrife infestations are present on their property, removal is encouraged.

Control Options: The Pike Lake Chain is already familiar with information and education materials that are abundant from the WDNR and other sources describing how to control purple loosestrife found in small or large patches. For small area control, like what would be found along a shoreline area, hand pulling or treatment with a herbicide such as Rodeo is recommended.

For large-scale control efforts encompassing an acre or more, biological control using flower-eating weevils and leaf-eating beetles could be considered. Beetles have been used in the past in the Pike Lake Chain for purple loosestrife control.

Source: MnDNR

Source: MnDNR

[left] Purple loosestrife flowerhead and a purple loosestrife plant [right].

4. Zebra Mussels (invertebrate animal)

Pike Lake Chain Status: Not currently found in the Pike Lake Chain as of 2010.

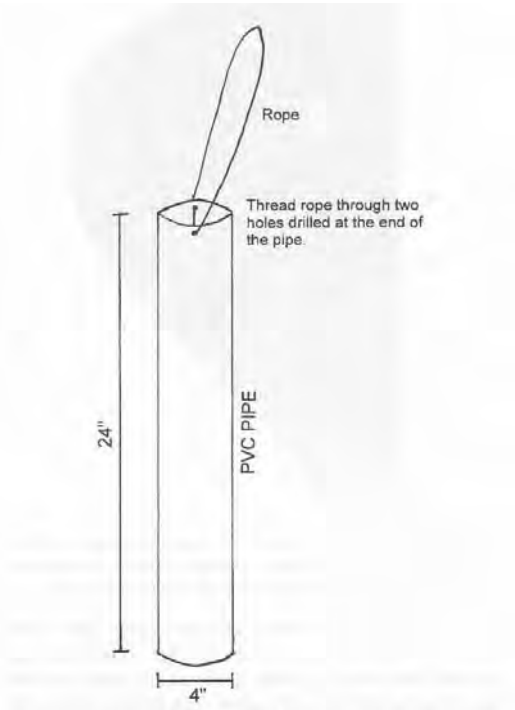
Nearest Occurrence: Lake Metonga, Forest County (first observed in 2001).

Potential for Nuisance Colonization in the Pike Lake Chain: Moderate to high.

Zebra mussels eventually can cause water quality problems in a lake. A high population density filters large volumes of lake water and uses the filtered algae for food. Eventually the build-up of excreted fecal material will fertilize the lake bottom and in some cases, generate nuisance growth of filamentous algae. Zebra mussels prefer hard substrates to attach to but will grow on sand and silt as well. The Pike Lake Chain has extensive areas of hard bottom as well as extensive areas of sandy sediments. However, because of the low calcium concentration in the water, shell production would be limited and it appears there is a low to moderate potential for zebra mussel colonization in the Pike Lake Chain. A chart of water column parameters indicates calcium would be a limiting growth factor for zebra mussels (shown on the next page).

Management Options for Zebra Mussels

Scouting Activities: The zebra mussel is a high priority aquatic invasive species to scout in the Pike Lake Chain. An active scouting program is recommended, with volunteers using pvc pipe or ceramic tiles hung from docks to monitor the appearance of juveniles. Also docks and boats lifts should be inspected as they are removed at the end of each summer.



Does your lake have zebra mussels? You can make your own zebra mussel monitoring device by hanging a 2-foot long, 4-inch diameter white PVC pipe vertically under a shady spot of your dock. Keep it about 1 foot off the lake bottom. Check it periodically through October for zebra mussels. They will be about $^1/_4$ to $^1/_2$ inch long. Report any sightings to your natural resource agency.

(From McComas 2003. Lake and Pond Management Guidebook.)

Ceramic tiles and pvc pipes should be checked weekly over the summer months. In addition, the Pike Lake Chain newsletter should have a "Zebra Mussel Column" in every issue discussing identification, ecology, and related subjects to keep the topic fresh to lake residents. Zebra mussel invasion prevention is a priority for the Pike Lake Chain.

Source: MnDNR

Figure 7. [top] Zebra mussel.
[left] Ceramic tiles make for good monitoring surfaces and so do pvc pipes which are another monitoring option.

Table 3. Water column zebra mussel suitability criteria and the Pike Lake Chain water column conditions. Conditions for moderate growth seem to dominate.

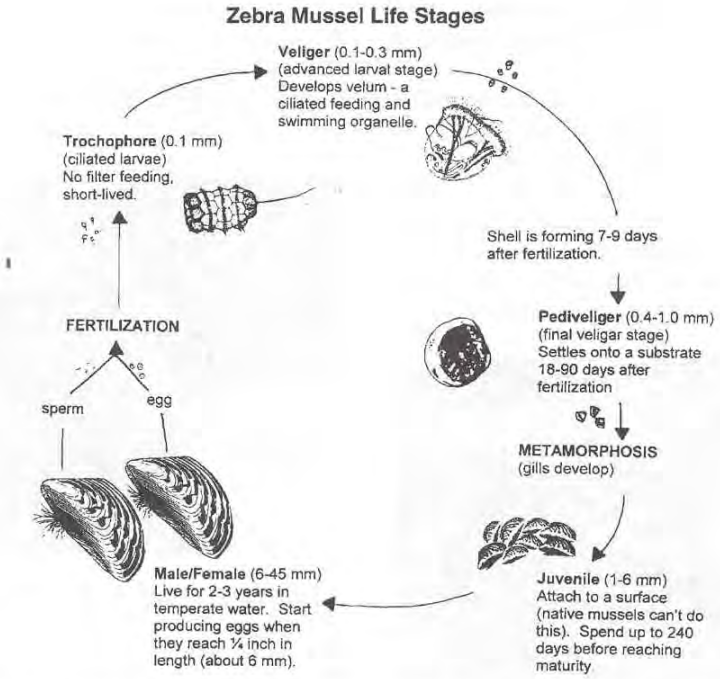
		Little Potential for Adult Survival	Little Potential for Larval Development	Moderate (survivable, but will not flourish)	High (favorable for optimal growth)
Calcium (mg/l)	Pike		9.54		
	Round		8.99		
	Turner		9.2		
	Amik		12.2		
	Mackie and Claudi 2010	<8	8 - 15	15 - 30	>30
Dissolved oxygen (mg/l)	Pike		4-6m	4m	0-3m
	Round			2-7m	0-2m
	Turner			1-4m	0-1m
	Amik		1-3m	0-1m	
	Mackie and Claudi 2010	<3	3 - 7	7 - 8	>8
Temperature (°C)	Pike			4-5m	0-4m
	Round			5-6m	0-5m
	Turner				0-4m
	Amik				0-3m
	Mackie and Claudi 2010	<10 or >32	26 - 32	10 - 20	20 - 26
pH	Pike	6.7			
	Round	6.6			
	Turner		7.0		
	Amik				
	Mackie and Claudi 2010	<7.0 or >9.5	7.0 - 7.8 or 9.0 - 9.5	7.8 - 8.2 or 8.8 - 9.0	8.2 - 8.8
Alkalinity* (as mg $CaCO_3$/l)	Pike		30		
	Round	28			
	Turner		36		
	Amik		44		
	Mackie and Claudi 2010	<30	30 - 55	55 - 100	100 - 280
Conductivity* (umhos)	Pike		50		
	Round		40		
	Turner		45		
	Amik				
	Mackie and Claudi 2010	<30	30 - 60	60 - 110	>110
Secchi depth (m) (3 year avg. 2008-2010)	Pike		1.1		
	Round		1.5		
	Turner		1.5		
	Amik		1.6		
	Mackie and Claudi 2010	<1 or >8	1 - 2 or 6 - 8	4 - 6	2 - 4
Chlorophyll a (ug/l)(food source) (3 year avg. 2008-2010)	Pike			12.2	
	Round			8.2	
	Turner			11.7	
	Amik			12.0	
	Mackie and Claudi 2010	<2.5 or >25	2.0 - 2.5 or 20 - 25	8 - 20	2.5 - 8
Total phosphorus (ppb) (3 year avg. 2008-2010)	Pike		39.6		
	Round				32.5
	Turner				28.2
	Amik		36.9		
	Mackie and Claudi 2010	<5 or >50	5 - 10 or 35 - 50	10 - 25	25 - 35

* not tested at this time

Control Options: If zebra mussels are found in the Pike Lake Chain, several management actions should be considered. At the first site of infestation all mussels should be removed from the lake, either by removing the rock substrate that they are attached to or by scrapping them off. Spot treatments could also be considered for small areas. One approach is to cover the site with a tarp and inject chlorine beach under the tarp which is weighted down on the bottom. The tarp can be removed after 2 weeks. Special permits from the WDNR would be needed for efforts like these. Intense scouting is necessary in an area of infestation in order to locate zebra mussel colonies.

Because it takes male and female gametes combining to make trochophore (larvae) which turn into adults, it takes a critical number of mussels to establish a thriving colony.

In some cases, it may be worth the effort to attempt to keep the mussels from reaching a threshold number. However, these efforts are expensive and rarely successful. For the Pike Lake Chain, zebra mussel control by way of a rapid response and aggressive treatment is not a high priority. Therefore, prevention approaches are the preferred strategies.



Zebra mussel life stages: Zebra mussels can be detected at the veliger stage using modified zooplankton nets, but this is usually performed by experts. The PVC pipe detection device will pick up mussels starting at the pediveliger stage. (Adapted from U.S. Army Corps of Engineers, WES.) **(From: McComas, 2003. Lake and Pond Management Guidebook.)**

5. Rusty Crayfish (invertebrate animal)

Pike Lake Chain Status: Presently found in the Pike Lake Chain in Turner and Round Lakes.

Nearest Occurrence: They are also found in a number of lakes in Vilas and Oneida Counties.

Potential for Nuisance Colonization in the Pike Lake Chain: low to moderate.

Rusty crayfish are regional non-native species. They are native to the Ohio River drainage, but once they get into a new area, rusty crayfish population controls are not in place and their population can increase dramatically. They feed heavily on vegetation and can devastate aquatic plant beds. If rusty crayfish populations increase significantly in the Pike Lake Chain they have the potential to reduce the aquatic plants found in the bays. However, at this time it appears rusty crayfish have minimal effects on aquatic plants in the Pike Lake Chain lakes.

Management Options for Rusty Crayfish

Scouting Activities: Over the course of the summer, modified minnow traps can be set to check for the presence of rusty crayfish. Several traps should be set around the Pike Lake Chain and checked weekly to monitor crayfish populations.

Figure 8. [top] Rusty crayfish in breeding colors (Plum Lake, Wisconsin). They can be identified by a reddish dot on their carapace (side of their body). Native crayfish do not have this marking. [bottom] Rusty crayfish graze down aquatic plant beds and eventually eliminate them.

Rusty crayfish traps are basically a standard minnow trap with a slightly enlarged opening to allow crayfish entry. It is often baited with fish parts. Rusty crayfish traps should be deployed and monitored over the summer for the presence of rusty crayfish, although any native crayfish appearances should be noted as well.

Examples of three types of rusty crayfish traps. The trap on the right is a modified minnow trap.

Control Options: At this time, the rusty crayfish abundance levels in the Pike Lake Chain are low. If they increase dramatically in the future, control programs could be considered. Lake groups implement a trapping program to remove large crayfish and then rely on fish predation to control the smaller crayfish. Crayfish trapping would be concentrated in the bays that have aquatic plants. A total of 30 to 50 traps would be set in an initial control effort. If crayfish abundance was high, trapping would probably occur for 5 to 10 years. If crayfish abundance is low, trapping could be discontinued after a year or two and natural fish predation would be the main control.

The Pike Lake Chain has several predator fish species that would prey on rusty crayfish. The fish species are largemouth bass, walleye, and yellow perch. Because rusty crayfish are more aggressive defenders than native crayfish, it takes several years for the predator fish to "learn" how to capture rusty crayfish. Once this behavior is learned, it seems fish could be a long-term control.

Big Bearskin Lake, Oneida County, Wisconsin has an active rusty crayfish control program. Volunteers run the rusty crayfish traps. Crayfish are collected and brought to a central site for sorting (shown above) at a central point and sorted. Small crayfish are taken into the woods for bear and raccoon food and the large crayfish are taken to a restaurant in Green Bay.

6. Viral Hemorrhagic Septicemia (VHS)(fish virus)

Pike Lake Chain Status: Not present in the Pike Lake Chain as of 2010.

Nearest occurrence: Several inland lakes in Wisconsin and all the Great Lakes.

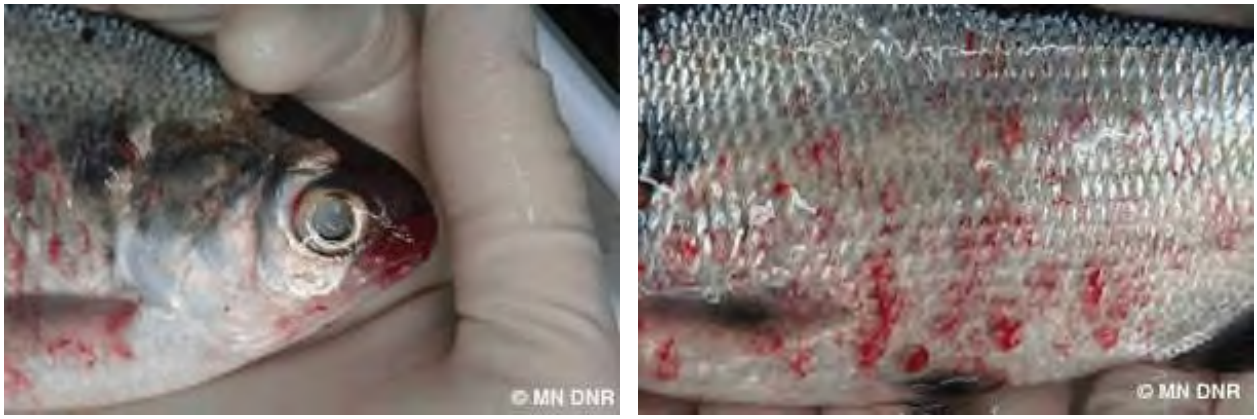
Potential for Nuisance Colonization in the Pike Lake Chain: Moderate.

Prevention is the key to minimize the impact of VHS. This fish virus will kill a variety of fish species, but does not eliminate the entire fish population in a lake. If it were to be introduced to The Pike Lake Chain, it has a high probability of becoming established.

Management Options for VHS

Scouting Activities: The basic strategy is to make anglers aware that they should report any fish with signs of hemorraging, to the WDNR. If they have caught a fish with hemorraging they should bring the fish to the WDNR. If a fish kill is observed involving hemorraging fish don't collect the fish, but call the WDNR immediately.

Control Options: At the present time, there is no known way to reduce or inactivate the virus in the open water. The best approach is to remove infected fish as soon as feasible. The virus can be passed from one infected fish to another.



Examples of hemorraging in fish with the VHS virus.

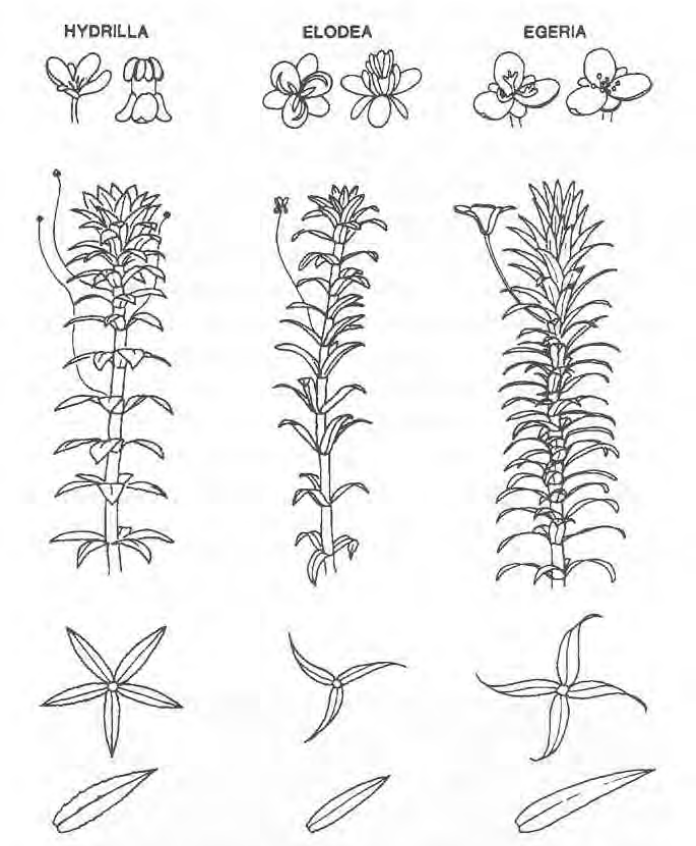
7. Hydrilla (aquatic plant)

Pike Lake Chain Status: Not present in the Pike Lake Chain (not in Wisconsin) as of 2010.

Nearest occurrence: Arkansas to the south and Maryland to the east. Hydrilla was reported in a pond in Wisconsin and a lake in Indiana. The infestation in Wisconsin was considered to be eradicated.

Potential for Nuisance Colonization in the Pike Lake Chain: Low to moderate.

Hydrilla is an aquatic plant in the same family as Elodea, a native aquatic plant. Based on the ecology of hydrilla, studies have found it could survive in Wisconsin. In the right settings hydrilla has the potential to produce more significant nuisance growth then curlyleaf pondweed or Eurasian watermilfoil. However, the correlation of hydrilla growth characteristics to sediment characteristics is not as well established compared to what is know for curlyleaf pondweed and Eurasian watermilfoil so it is difficult to predict what it would do in the Pike Lake Chain.



Hydrilla is closely related to Egeria (an exotic plant in the U.S.) and elodea (a native). All three can produce nuisance growth conditions, but hydrilla takes the prize. (Line drawings from University of Florida, IFAS, Center for Aquatic Plants, Gainesville. With permission.)

From McComas 2003. Lake and Pond Management Guidebook.

Management Options for Hydrilla

Scouting Activities: The picture of hydrilla should be copied and laminated and taken along with observers when they are scouting for curlyleaf pondweed and Eurasian watermilfoil. Any suspicious looking plant should be bagged and brought into the WDNR for an identification confirmation. The probability is low that the first sighting of hydrilla in Wisconsin would occur in the Pike Lake Chain, but observers should be aware of the possibility.

Control Options: If hydrilla was confirmed in the Pike Lake Chain, the WDNR would more than likely handle the initial control or eradication tasks. Because hydrilla has the potential to be worse than curlyleaf pondweed or milfoil in the State of Wisconsin, aggressive eradication efforts would likely be taken. Herbicides would be used immediately with follow-up inspections and treatments continuing for a year or more.