Mayflower Lake

Eastern Marathon County Lake Study

Final Study Results 2013

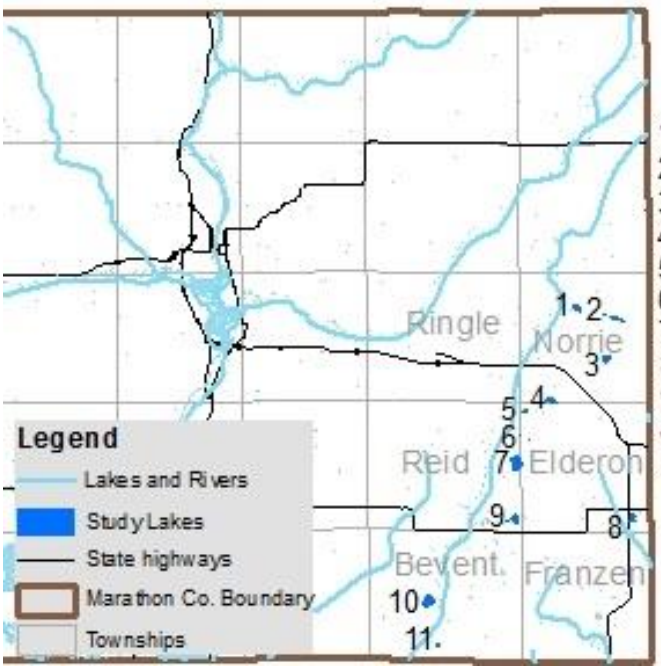
University of Wisconsin-Stevens Point
and
Marathon County Staff and Citizens

Healthy lakes add value to our communities. They provide a place to relax and recreate, and can stimulate tourism. Like any infrastructure, lakes require attention and good management practices to remain healthy in developed watersheds.

The purpose of this study is to learn about the current conditions of the fishery, habitat and aquatic ecosystems in order to help people make informed decisions to preserve what's good and correct any problems that exist.


To protect
the lake we must protect
the "watershed," the land
that drains or
sheds its water
into the
lake.

Mayflower Lake – Location



1: Mud
2: Mayflower
3: Norrie
4: Bass
5: Lost
6: Rice
7: Pike
8: Lilly
9: Mission
10: Big Bass
11: Wadley

Mayflower Lake

Township of Norrie

Co Hwy D

Surface Area: 96.4 Acres

Maximum Depth: 19.3 Feet

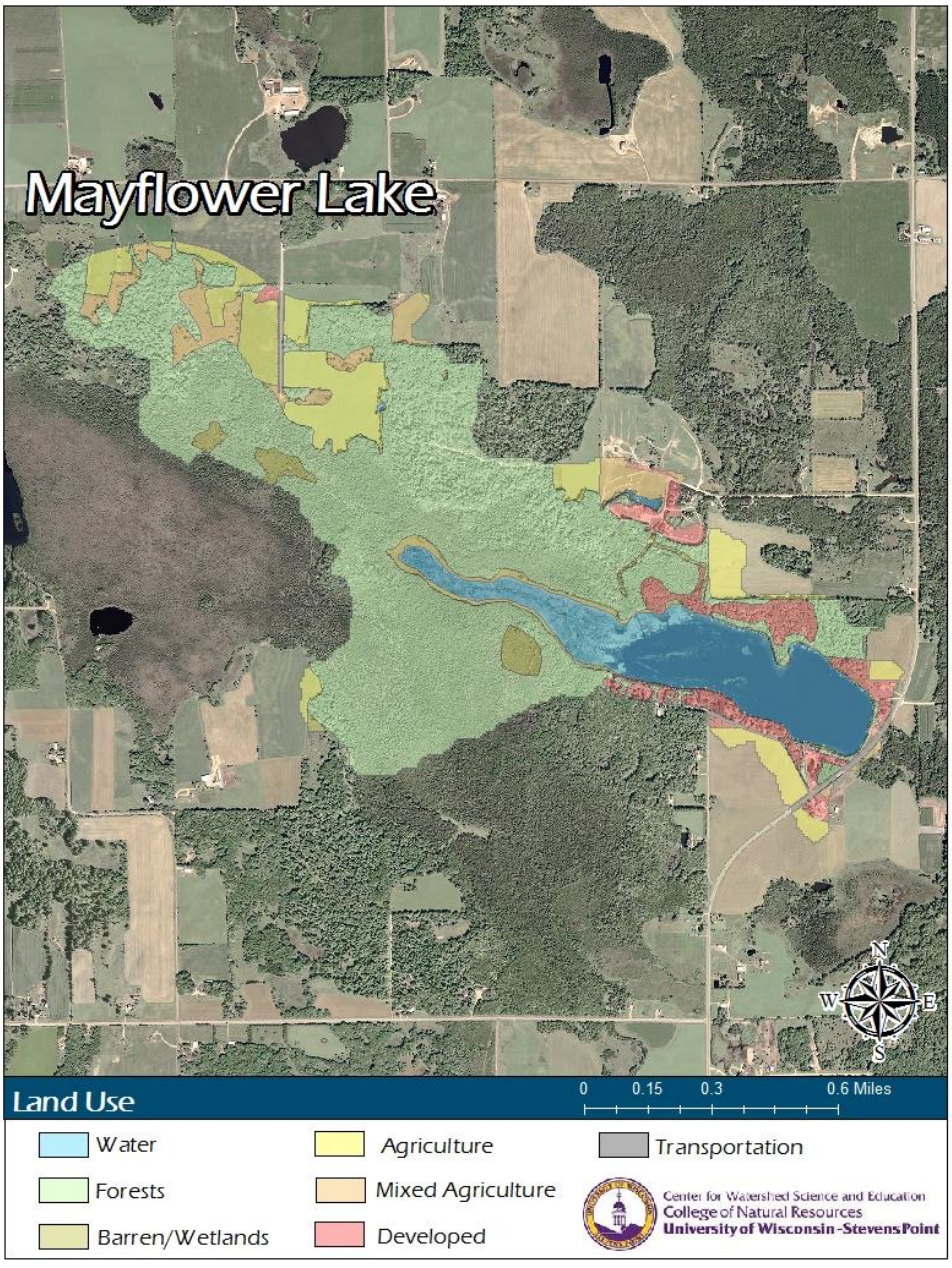
Mayflower Lake, Marathon Co.

Water Flow

- Mayflower Lake is a seepage lake with most of the water entering the lake from groundwater.
- Surface water runoff and direct precipitation also contribute water, but to lesser extents.
- Water exits Mayflower Lake through groundwater.

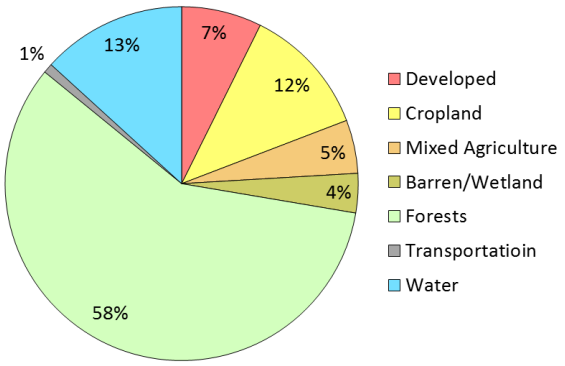
Mayflower Lake – Surface Watershed

Surface Watershed: The area where water runs off the surface of the land and drains toward the lake.



- **Land uses** and land management practices occurring in the watershed can affect the water quality in the lake.
- Land uses and land management also play major roles in how water moves across the landscape and how much water soaks into the ground (for long-term storage) or quickly runs off the land.
- The surface watershed of Mayflower Lake is 1,652 acres.
- The primary land uses in the Mayflower Lake watershed are forests and agriculture.
- Residential development is scattered throughout the watershed and is adjacent to part of the lake. Forests and wetlands are also on the lake's perimeter. In general, the land closest to the lake has the greatest immediate impact on water quality.

Land Use in the Mayflower Lake Watershed

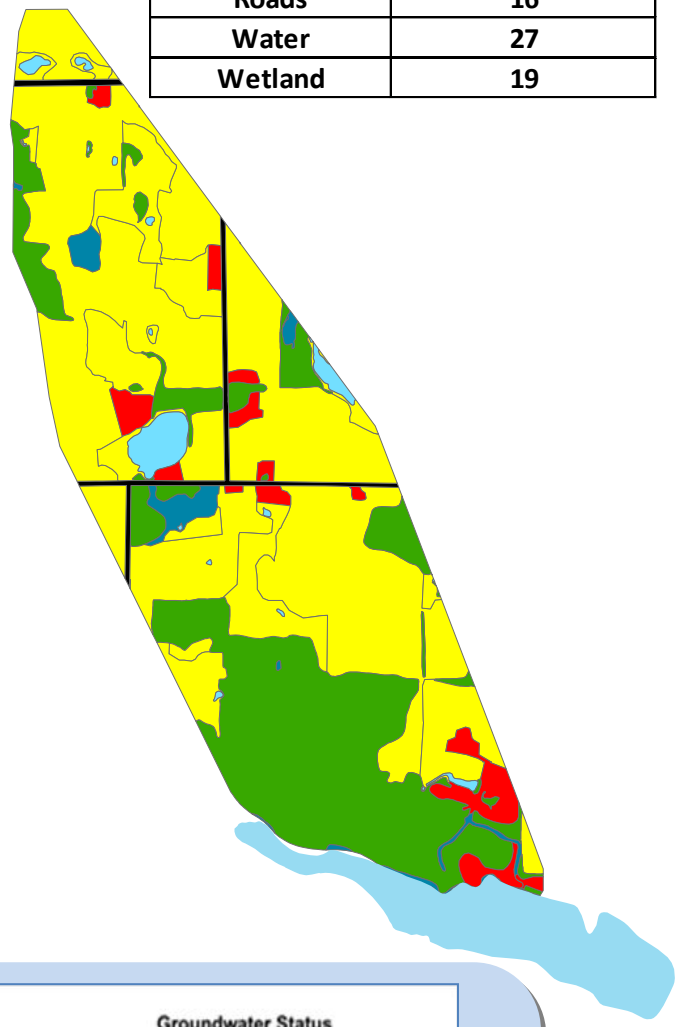


Mayflower Lake – Groundwater Watershed

Groundwater Watershed: The area where water soaks into the ground and travels underground to the lake.

- **Groundwater** slowly contributes water to our lakes throughout the year. Hard surfaces on the landscape prevent water from soaking into the ground and becoming groundwater. This results in less water flowing to the lake during the winter and between rains.
- The quality of groundwater reflects what is happening on the land surface. Precipitation falling on forested land produces clean groundwater, whereas precipitation falling on lands that have chemical use can leach contaminants to groundwater. Groundwater contamination in central Wisconsin may include nitrogen, pesticides, herbicides and other soluble chemicals originating from septic systems, crops, barnyards, road maintenance, etc. Once in the groundwater, these chemicals slowly move towards a lake or river.
- The groundwater watershed for Mayflower Lake is 905 acres.
- The primary land uses in the Mayflower Lake groundwater watershed are agriculture and forests.
- In general, the land adjacent to the lake where groundwater is flowing into the lake has the greatest immediate impact on water quality. Residential development and forests are nearest the lake where most of the groundwater enters.

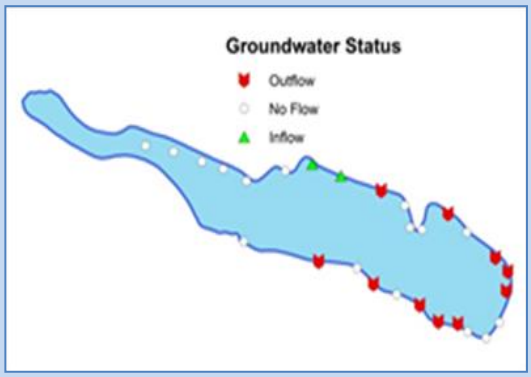
Land Use	Acres
Agriculture	551
Developed	40
Forested	249
Roads	16
Water	27
Wetland	19



Looking at Groundwater Up Close:

Groundwater enters Mayflower Lake from the northwest.

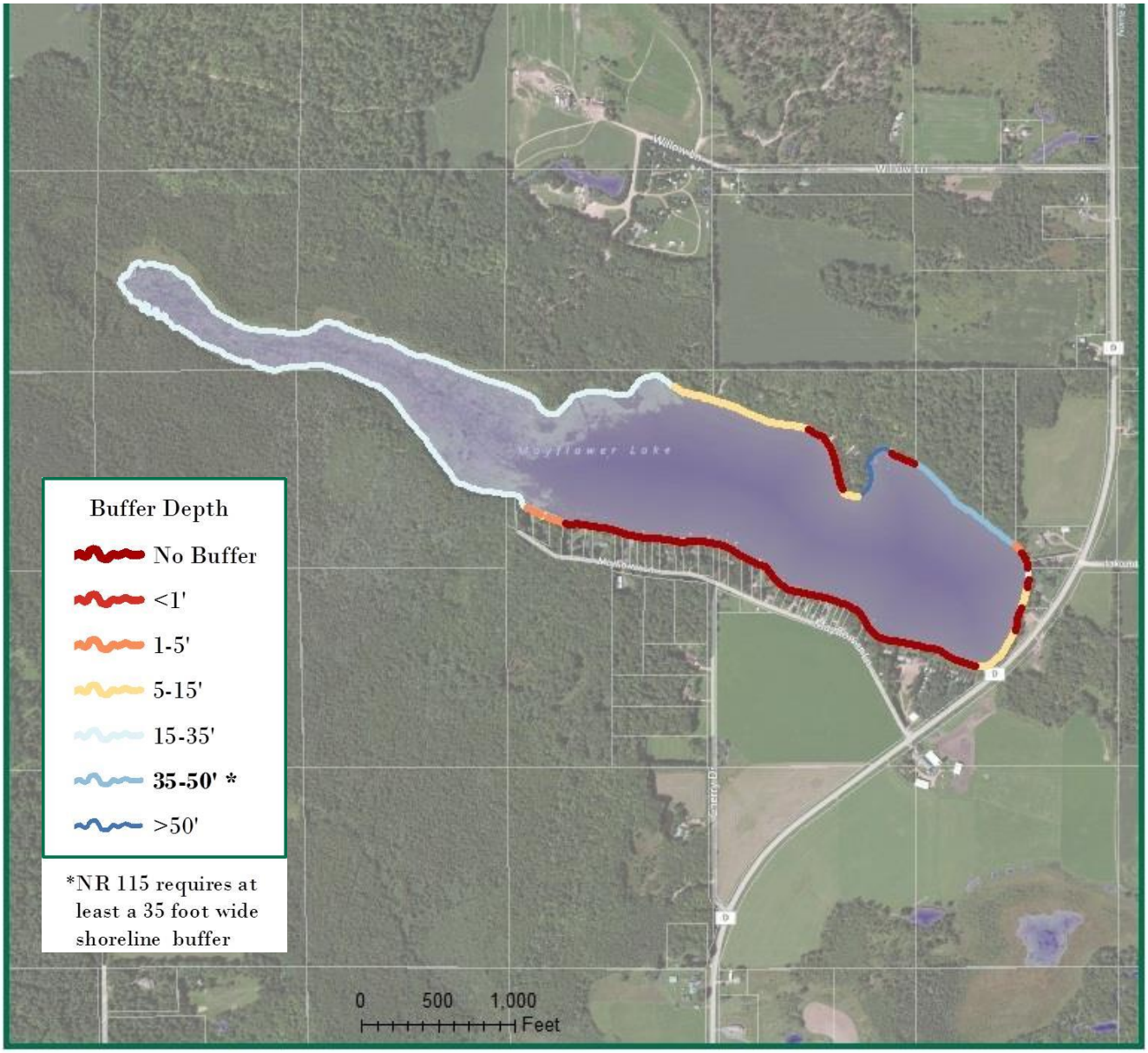
Groundwater exits on the east side of the lake.



Mayflower Lake – Shoreland Vegetation

Shoreland vegetation is critical to a healthy lake's ecosystem. It provides habitat for aquatic and terrestrial animals including birds, frogs, turtles, and many small and large mammals. It also helps to improve the quality of the runoff that is flowing across the landscape towards the lake. Healthy shoreland vegetation includes a mix of tall grasses/flowers, shrubs and trees.

The map below shows how far the 0.5 to 3 foot tall vegetation exists landward from the edge of Mayflower Lake. A greater vegetative buffer provides more habitat and better water quality.



Mayflower Lake – Lake Map

Mayflower Lake's shape and depth play major roles in determining:

- Where aquatic plants can and cannot grow
- Species of fish and where they live
- How fast water in the lake warms up and cools down
- The water quality of the lake
- Abundance of habitat for species living in the water and on the land

MARATHON COUNTY, WISCONSIN

University of Wisconsin-Stevens Point
Center for Watershed Science and Education,
College of Natural Resources, and the GIS
Center, College of Letters and Science.

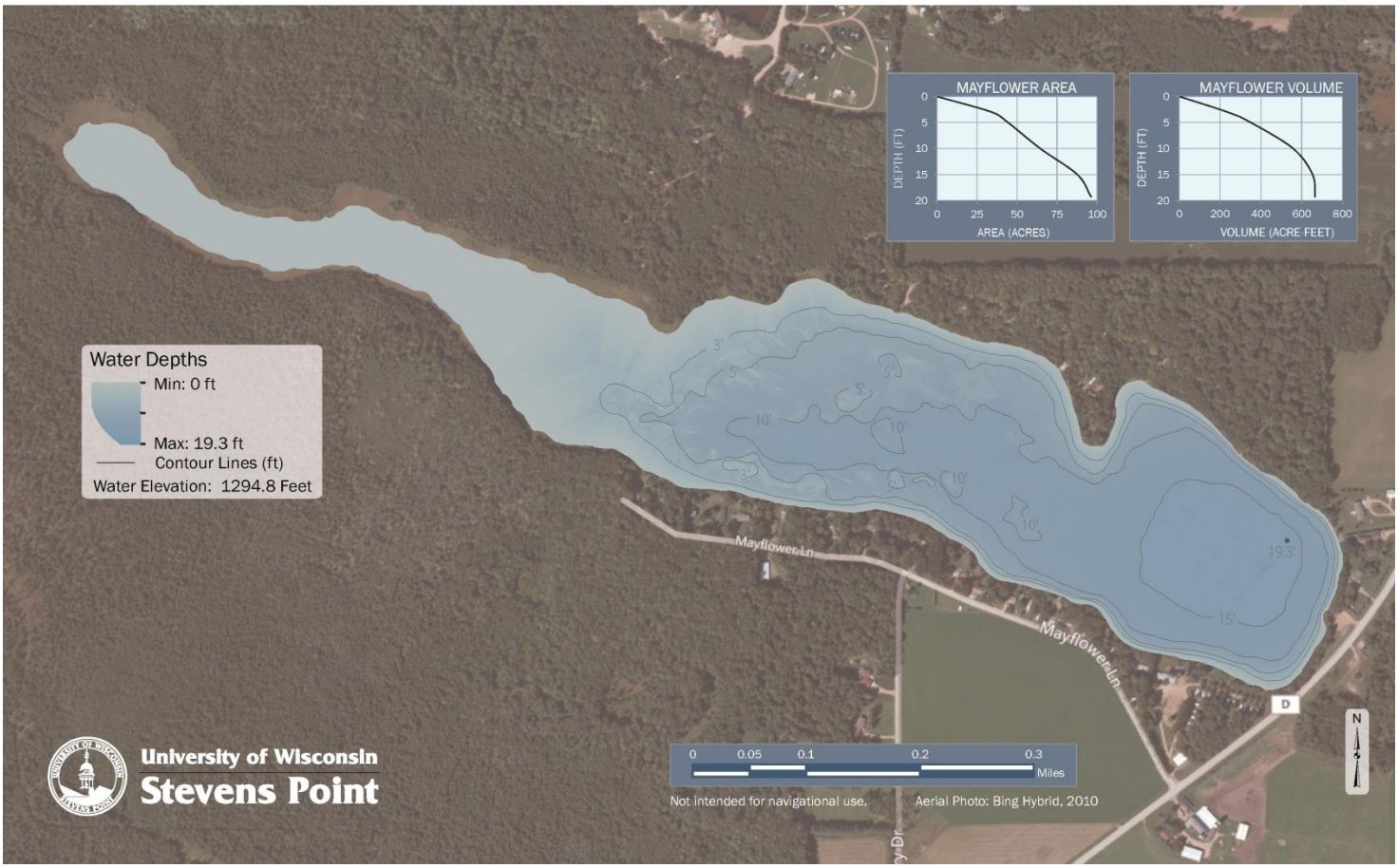
Map Cartography by Christine Koeller

MAYFLOWER LAKE
BATHYMETRIC MAP

Map funded by the Wisconsin
Department of Natural Resources Lake
Planning Grant Program, Marathon County,
Marathon County citizens, and
lake and fishing groups.

LAKE AREA	96.4 Acres	
Under 3 Feet	34.2 Acres	(35.5%)
Over 20 Feet	0 Acres	(0%)
VOLUME	665 Acre-feet	
SHORELINE	2.8 Miles	
MAX DEPTH	19.3 Feet	

GPS and Sonar Survey June, 2012



Mayflower Lake – Fishery

Many factors determine which fish species thrive in a lake. Physical factors include the lake's type, depth, surface area, lake bed materials, the amount of habitat, and availability of food. Water quality in the lake also plays a role: water clouded with sediment or algae reduces the success of visual feeders, while low levels of dissolved oxygen will limit the fish population to those that can tolerate periods with low oxygen.

Species occurrence in Mayflower Lake in the 2012 survey and from historical records of the Wisconsin Department of Natural Resources

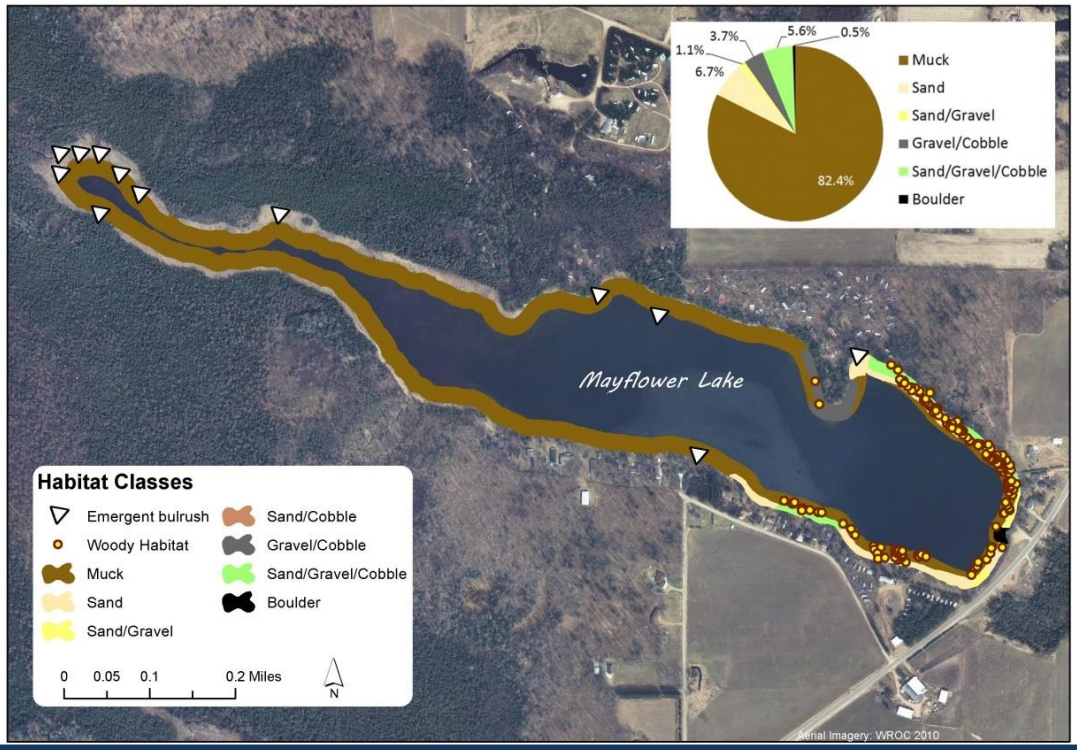
Species	1958	1962	1964	1970	1972	1983	1985	1988	1989	2000	2012
Black Bullhead											x
Black Crappie	x	x		x	x			x	x	x	x
Bluegill		x	x	x	x		x		x	x	x
Bluegill x Pumpkinseed hybrid											x
Bullhead	x	x		x	x		x	x	x		
Common Shiner								x			
Golden Shiner				x				x			
Green Sunfish										x	
Largemouth Bass				x		x	x	x	x	x	x
Central Mudminnow				x							
Northern pike				x	x	x	x	x	x		x
Pumpkinseed		x			x		x		x	x	x
Walleye	x	x	x	x	x	x	x	x	x	x	x
White Sucker	x			x			x	x		x	
Yellow Perch	x	x	x	x	x		x		x		x

- In the 2012 survey of Mayflower Lake, nine fish species were sampled and identified out of the fourteen total species that have been recorded in surveys obtained from the Wisconsin DNR dating back to 1958.
- Black bullhead and bluegill x pumpkinseed hybrid were newly documented in 2012.
- Despite sustained stocking efforts, walleye reproduction was not observed in the 2012 survey.
- The presence of young bass and abundant sunfish sampling indicates successful reproduction of these species.
- The absence of young northern pike and walleye may indicate poor natural reproduction; however, more intensive sampling efforts would be required to properly assess reproductive success of all individual fish species.

Mayflower Lake – Fishery

Habitat in and near the lake plays a large role in the composition of a fish community. Habitat is a combination of aquatic plants, woody structure and lake substrate. Near the shore is found some of the most important fishery habitat.

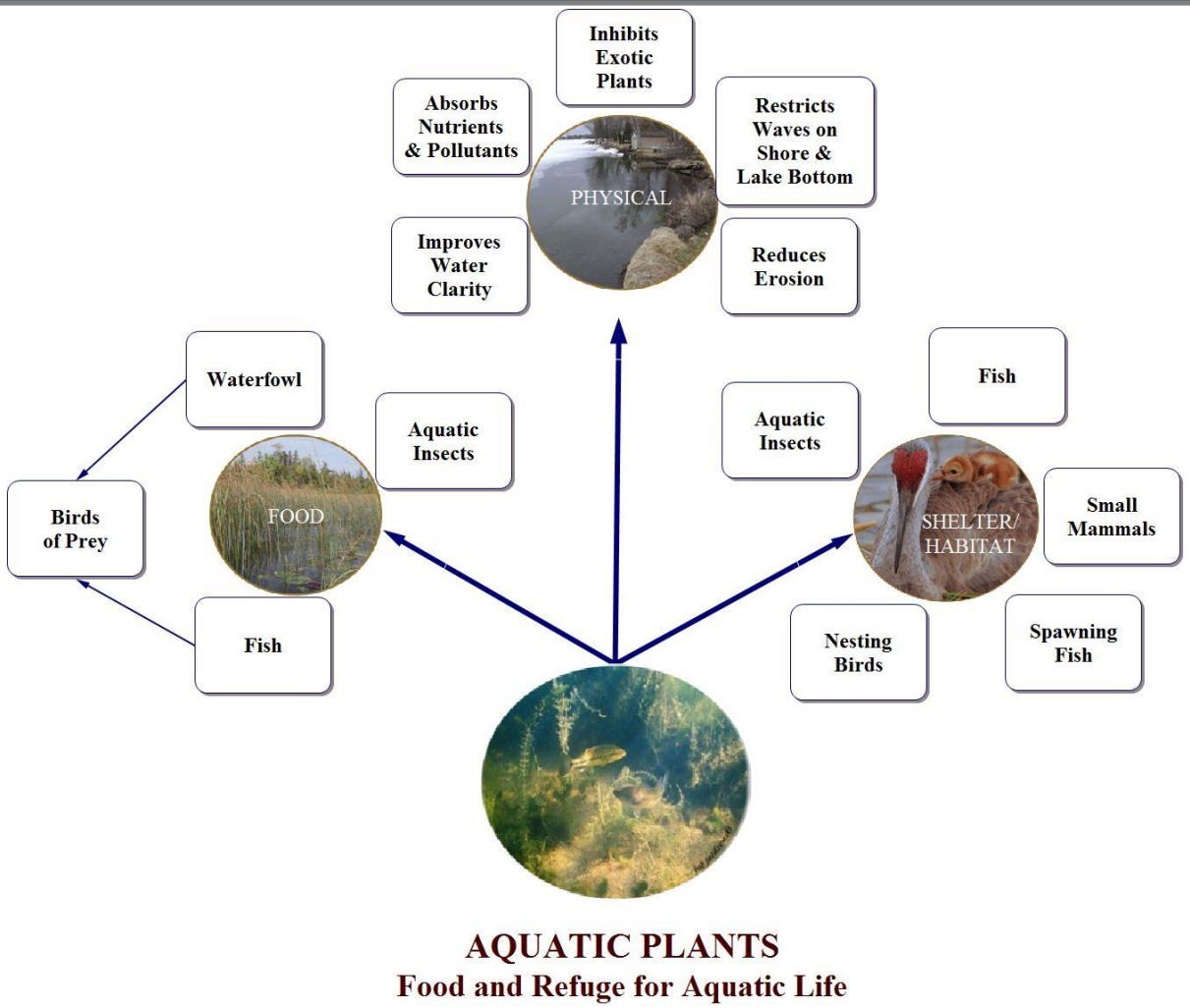
Coarse woody habitat (CWH) is an important component of a healthy and balanced fishery, playing a key role in the life histories of many fish species. Downed trees, logs and branches along with aquatic plants offer refuge from predators, a sheltered substrate for spawning, nurseries for young, and feeding grounds to forage for insects and algae. CWH is very important to other animals that live in or visit a lake including turtles, frogs, birds and mammals.



- Coarse woody habitat is abundant in portions of Mayflower Lake.
- In the southeastern portion of the lake, large areas of hard substrate are available, including boulder beds, cobble, and mixed substrates that are utilized by many fish for spawning habitat. Gravel areas are utilized as spawning habitat for many sunfish (bluegill, pumpkinseed, black bass), where males will construct nests and guard their young.
- Northern pike utilize areas with emergent and floating-leaf vegetation in shallow or flooded areas for spawning.
- Bulrush is present along areas of the western shoreline and randomly along the northern shoreline. Black crappie utilize bulrush habitat on gravel or sand substrates where they construct nests and guard young.
- Yellow perch and walleye utilize near-shore cobble in oxygen-rich environments for spawning activity. Sand can be important habitat for reproduction of non-game minnow.

Mayflower Lake – Aquatic Plants

Aquatic plants are the forest landscape within a lake. They provide food for creatures including fish, ducks, and turtles, and habitat for fish, invertebrates and other aquatic animals. They create oxygen in the water and utilize nutrients that would otherwise be used by algae. A healthy lake typically has a variety of aquatic plant species creating diversity that can help to prevent the establishment of aquatic invasive species.



AQUATIC PLANTS
Food and Refuge for Aquatic Life

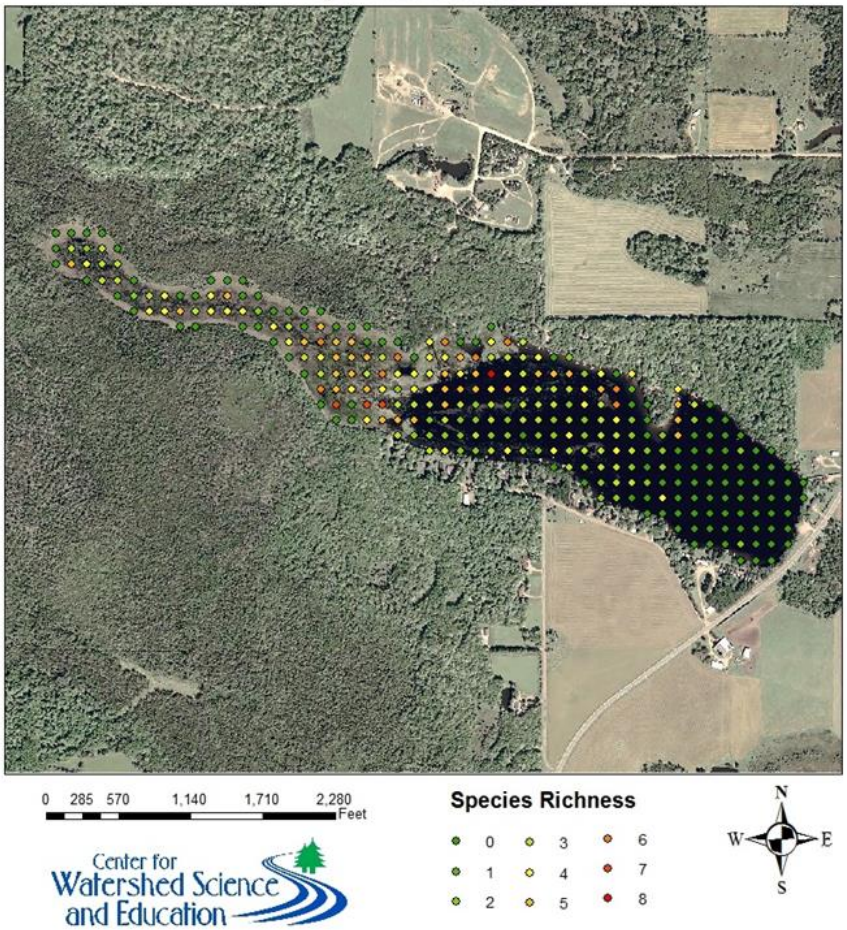
- The aquatic plant community in Mayflower Lake is characterized by an above average diversity when compared to other lakes in the Marathon County survey, with a total of twenty-three species identified.
- The bog was not inventoried; such an inventory would increase the species diversity of the lake.
- The greatest species richness was observed on the western end of the lake near the bog. The bay on the eastern side of the lake was largely devoid of aquatic plants.

Mayflower Lake – Aquatic Plants

- During the 2012 aquatic plant survey of Mayflower Lake, 69 percent of the sites sampled had aquatic plants. The maximum rooting depth of aquatic plants was 15 feet.
- No non-native plant species were found in the survey. This demonstrates diligence by lake users in cleaning watercraft before entering the lake to prevent non-native species transfer.
- The presence of aquatic plant species that are relatively intolerant of disturbance can be an indicator of quality habitat. In Mayflower Lake, these plants include creeping bladderwort, Fries' pondweed, and white-stem pondweed.

Species Richness is a count of the number of plant species found at a survey point. A greater number of species in a lake helps to make the aquatic plant community more resilient to year-to-year changes and aquatic invasive species. More plant species means more diverse habitat and food sources are available.

Mayflower Lake 2012 Aquatic Plant Survey:
Species Richness



The leaves of **white-stem pondweed** offer shade, shelter and foraging opportunities for fish. Its fruits are a valuable food for waterfowl.

The leaves, roots and seeds of the **white water lily** are a food source for wildlife including beaver, muskrat and ducks. The leaves provide shelter and habitat for fish and invertebrates, and shade that cools the water.

Mayflower Lake – Aquatic Invasive Species

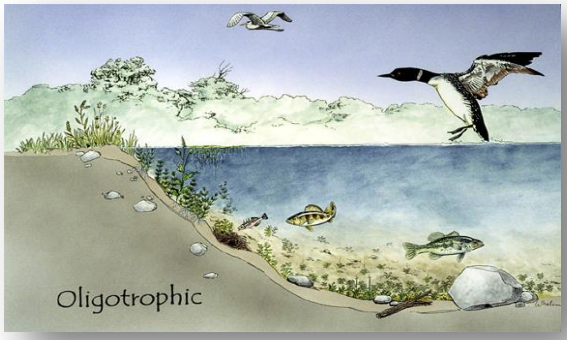
Aquatic Invasive Species are non-native plants or animals that may cause significant harm to a lake's ecosystem. Typically, they are introduced to a lake by hitching a ride on clothing, boats, trailers and other water recreation equipment. Aquatic invasive species can be introduced to a lake accidentally or intentionally. Once in a lake, they may be impossible to completely remove and can be difficult and costly to control. Prevention and early detection are the best ways to keep aquatic invasive species from establishing in a lake.

Lakes With Aquatic Invasive Species in Marathon County, 2012						
Lake Name	**Banded Mystery Snail**	**Chinese Mystery Snail**	**Rusty Crayfish**	**Curly-Leaf Pondweed**	**Eurasian Water Milfoil**	**Purple Loosestrife**
Marathon County (Shaded lakes are part of Eastern Marathon Co. Lake Study)						
Big Bass Lake	✓					
Big Rib River			✓		✓	
Eau Claire Flowage		✓			✓	
Flume Creek			✓			
Johnson Creek			✓			
Lake Wausau				✓		
Little Rib River			✓			
Little Trappe River			✓			
Lost Lake		✓				
Mayflower Lake		✓		✓		
Mission Lake	✓				✓	✓
Pike Lake	✓			✓		
Rice Lake	✓	✓		✓		
South Branch Embarrass River			✓			
Spring Brook			✓			
Trappe River			✓			
Wadley Lake	✓	✓		✓	✓	
Wausau Dam Lake					✓	
Wisconsin River			✓		✓	

Learn to identify invasive species & look for them in your lake!

Mayflower Lake – Water Quality

Lakes go through a natural aging process that results in increased aquatic plant growth, fish and wildlife over time. Within a lake's watershed, human activity on the land, in a wetland, or in the lake can dramatically accelerate this process. Depending on land management practices, changes in a lake that may have normally taken centuries to occur may take place in decades or even years. The amounts of nutrients, algal growth, and water clarity measurements help to define the age of a lake. Based on these measures, lakes can be classified for comparison to one another.



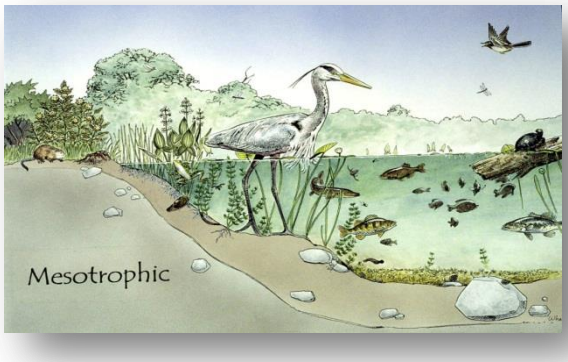
Oligotrophic Lakes

Common uses:

- ✓ Swimming
- ✓ Skiing
- ✓ Boating

Vegetation of oligotrophic lakes:

- ✓ Very little vegetation



Mesotrophic Lakes

Common uses:

- ✓ Boating
- ✓ Fishing

Vegetation of mesotrophic lakes:

- ✓ Increased vegetation
- ✓ Occasional algal blooms

Eutrophic Lakes

Common uses:

- ✓ Fishing
- ✓ Wildlife watching

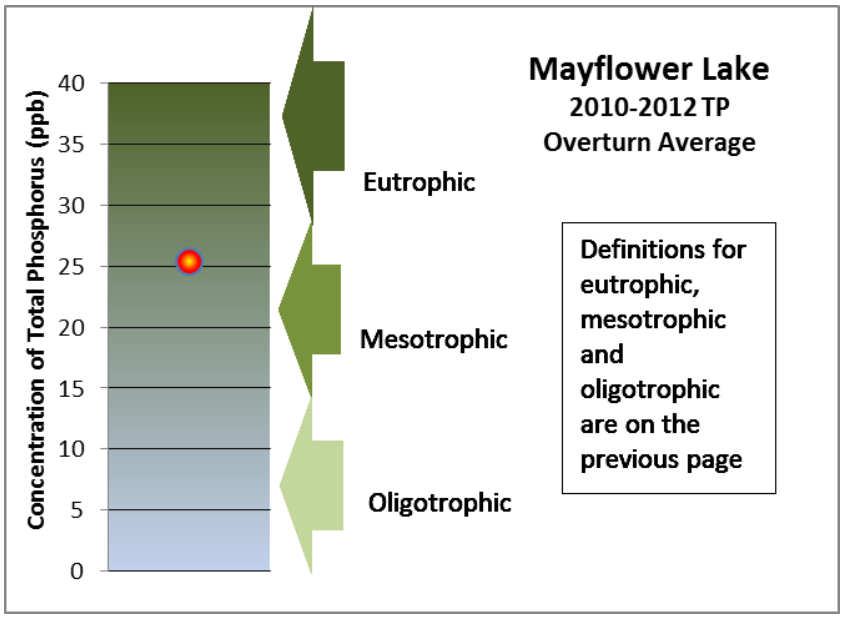
Vegetation of eutrophic lakes:

- ✓ Lots of aquatic plants
- ✓ Frequent algal blooms

Winter fish kills can occur in shallow lakes due to low oxygen levels.

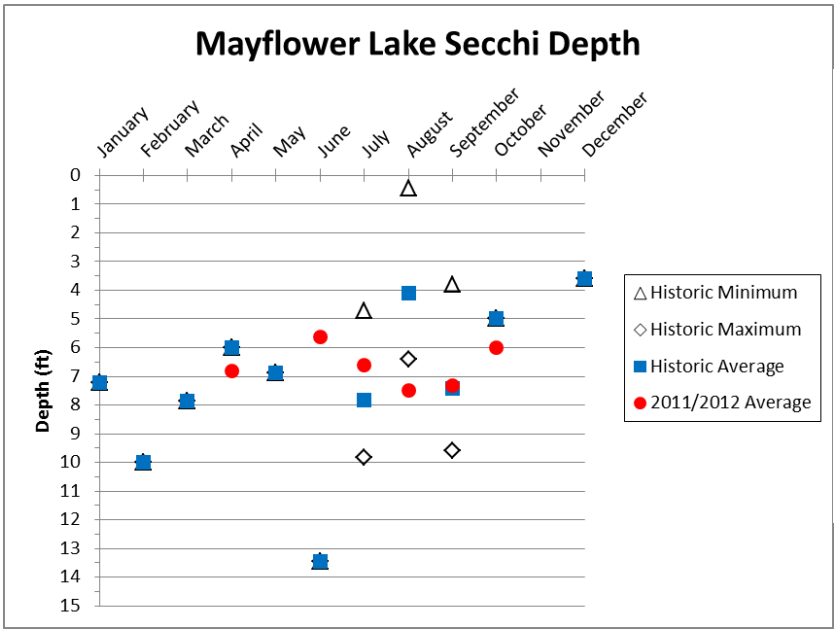
Mayflower Lake – Water Quality

Phosphorus is a major nutrient that can lead to excessive algae and rooted aquatic plant growth in lakes. In fact, one pound of phosphorus entering a lake can result 300 to 500 pounds of algal growth. All Marathon County lakes have either sufficient or excessive nutrients for aquatic plant growth, so these lakes will benefit from limiting the addition of more nutrients. Sources of phosphorus include septic systems, animal waste, storm water runoff, soil erosion, and fertilizers for lawns, gardens and agriculture.



- Total phosphorus concentrations measured when Mayflower Lake was well-mixed (overturn) are displayed in the graph to the left.
- Overturn sampling during the 2010-2012 monitoring period indicates that Mayflower Lake is a mesotrophic lake.

Water clarity is a measure of how deep light can penetrate (Secchi depth). Clarity is affected by water color, turbidity (suspended sediment), and algae. Water clarity helps determine where rooted aquatic plants can grow.



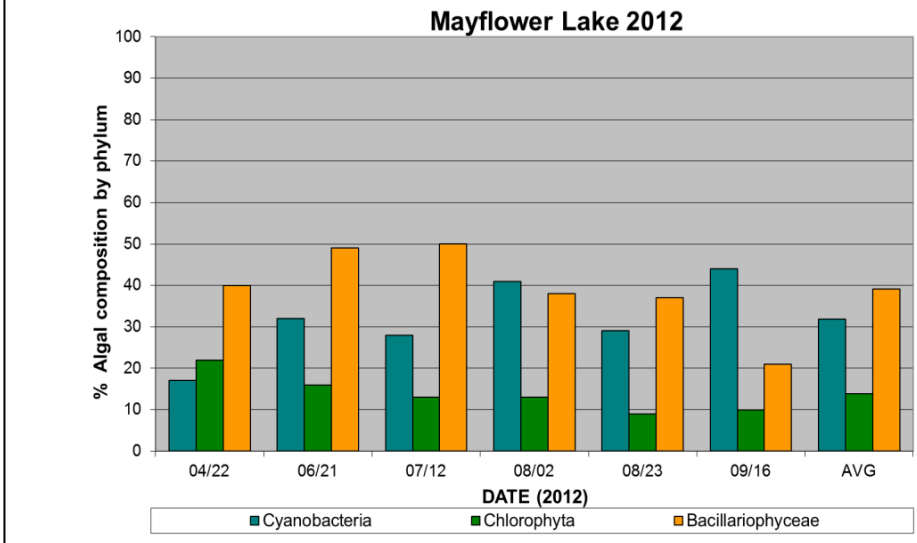
- The graph to the left shows water clarity data collected during the growing seasons in 2011 and 2012. It is typical for water clarity to vary throughout the year.
- The 2011/2012 average water clarity depths when compared with historic averages were poorer in June and July and better in August.

Mayflower Lake – Algae

Algae are microscopic, photosynthetic organisms that are important food items in all aquatic ecosystems. Different algal groups increase or decrease during the year and they can be used to analyze a lake's water quality because there are more varieties of algae than fish or aquatic plants. Conclusions can be drawn about water temperature, nutrient availability, and overall water quality of a lake using algal populations.

In Marathon County lakes, there are three dominant groups of algae: blue-green algae (Cyanobacteria), green algae (Chlorophyta), and diatoms (Bacillariophyceae).

- The algal community in Mayflower Lake displayed very similar patterns in both 2011 and 2012. In both years, the diatoms were the most common group, followed closely by the blue-green algae.
- Several species of diatoms dominated the early season while the blue-green algae dominated from August through the end of the season.
- Based on heavy midsummer algal growth, common species of the dominant groups, water clarity and nutrient loads, Mayflower Lake appears to be moderately mesotrophic.
- The large diatom populations are desirable, but increasing blue-green populations may be of concern. Lower green algae populations indicate heavy consumption by the fishery.
- Current conditions do not support the possibility of Mayflower Lake sliding into a eutrophic state.



PERCENT ALGAL COMPOSITION FOR MAYFLOWER LAKE IN 2012

Blue-green algae have the widest tolerance range for temperatures and nutrient concentrations.

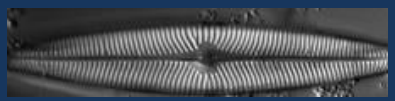
A few varieties of blue-greens can produce toxins that are potentially harmful to livestock, pets and humans. Once well-established in a lake, blue-green algae are difficult to control and remove.

Mayflower Lake – Sediment Core Analysis

Lake sediment can help to tell the history of a lake and changes that may have affected the lake related to water quality, the abundance of aquatic plants, and sedimentation or land use changes in the watershed. These changes are assessed by evaluating the content of the upper layer of the sediment versus lower layers. This information can help to guide management decisions for a lake.

- Analysis of Mayflower Lake's sediment core suggests increased disturbance in the lake basin since the time of European land clearing.
- The increase in ragweed pollen found deeper in the sediment core likely accompanied the onset of logging in the early 1880's, and peaked a decade or two later as agricultural fields replaced logged-over areas, especially around the eastern end of the lake.
- Diatom species communities as well as sediment properties reflect an increase in phosphorus and in aquatic plants and filamentous algae in the top of the sediment core.
- Changes in color and substance of upper sediment layers suggest stabilization and a slight decline in shoreline erosion and aquatic plant growth in the very recent past.

This is an example of a sediment core collected from the bottom of a Wisconsin lake. The darker layers indicate organic-rich sediments that are often due to abundant aquatic plants and/or soil erosion from the landscape. Additional analysis of these layers can help to confirm the source(s).



Diatom species found in lake sediments in Marathon County.

Diatoms are a type of algae commonly found in sediment. They are well-preserved in sediments due to silica-based cell walls which resist degradation.

Different species of diatoms are sensitive to water quality; thus, changes in the diatom community from the bottom to the top of the sediment core can reveal how water quality in the lake has changed over time.

Mayflower Lake – What can you do to help?

Lake Users:

- ✓ Run boat engines efficiently
- ✓ Observe no/low wake zones
- ✓ Refuel away from water
- ✓ Dispose of trash properly
- ✓ Remove all aquatic plants from boats and trailers
- ✓ Respect wildlife and other lake users

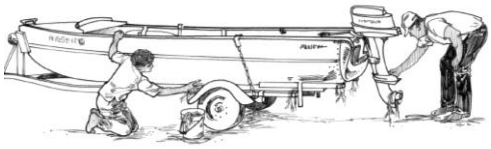
Land Owners:

- ✓ Control soil erosion
- ✓ Keep livestock out of lakes and streams
- ✓ Control manure runoff
- ✓ Carefully manage nutrients and pesticides
- ✓ Leave natural shoreland vegetation in place or restore if it has been removed
- ✓ Learn to identify and look for invasive species

Home Owners:

- ✓ Leave natural shoreland vegetation in place or restore if it has been removed
- ✓ Leave woody habitat for young fish, turtles and frogs
- ✓ Eliminate the use of fertilizer or use no phosphorus fertilizer

- ✓ Eliminate or minimize use of pesticides
- ✓ Control soil erosion
- ✓ Control runoff from rooftops and hard surfaces
- ✓ Clean up after pets
- ✓ Learn to identify and look for invasive species



Stop the Spread of Aquatic Invasive Species!

Wetlands and Shorelands:

- LEARN how to identify invasive plants and animals, and who to contact if found.
- DO NOT PURCHASE prohibited and restricted species! Whenever possible purchase native plants.
- NEVER transplant water garden plants or aquarium plants into lakes, streams, wetlands, or storm water ponds. Properly dispose of unwanted plants and animals!
- REMOVE invasive exotic plants from your landscape and replace them with native plants or non-invasive exotic plants. Scout annually for new invasive plants.
- AVOID using garden plants from other regions whose invasive potential is poorly understood.

Lakes and Rivers:

- LEARN what Wisconsin invasive plants and animals look like and who to contact if seen in a lake or river.
- INSPECT your boat, trailer and equipment when traveling to different water bodies and REMOVE any attached aquatic plants or animals (before launching, after loading, and before transporting on a public highway).
- DRAIN all water from boats, motors, and all equipment after use at a lake.
- NEVER release live fish, bait or pets into a wetland or water body.
- BUY minnows from a Wisconsin bait dealer. Only use leftover minnows at that same water body.

Mayflower Lake – Primary Researchers

Algae

Dr. Bob Bell (UW-Stevens Point)

Aquatic Plants

Jen McNelly (UW-Stevens Point)

Cultural Survey

Dr. Kristin Floress (UW-Stevens Point)

Fisheries and Lake Maps

Dr. Ron Crunkilton (UW-Stevens Point) and Dr. Justin Sipiorski (UW-Stevens Point)

Christine Koeller (UW-Stevens Point)

Sediment Core

Dr. Samantha Kaplan (UW-Stevens Point) and Paul Garrison (Wisconsin DNR)

Shoreland Assessments and Build Out

Dan McFarlane (UW-Stevens Point)

Water Quality and Watersheds

Nancy Turyk (UW-Stevens Point)

Zooplankton

Dr. Chris Hartleb (UW-Stevens Point)

UW-Stevens Point Graduate and Undergraduate Students

Project support provided by:

- *Wisconsin DNR Lake Protection grants*
- *UW-Stevens Point and UW-Stevens Point Faculty*
- *Marathon County*
- *Marathon County Citizens*

For more information about the study:

UW-Stevens Point: Nancy Turyk, 715-346-4155 Email: mclakes@uwsp.edu

Marathon County: Shawn Esser, 715-261-6010

http://www.co.marathon.wi.us/Departments/ConservationPlanningZoning/ConservationDivision/LakePrograms.aspx

Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin-Stevens Point