Water Column

Spring 2013
Vol. 25, No. 1

Life Under the Ice

~ Melissa Clark

Its official – spring is here! While many of you are confused by the recent wintery weather, some may be looking forward to the ice-capped lakes melting away and contemplating the spring fishing season. One might wonder how those fish have survived such a long time isolated below that thick layer of ice and snow because the exchange of oxygen with the atmosphere ceases. Each spring, however, there is a lake full of aquatic life. The lake ecosystem survives throughout all seasons, even the deep winter. Abundant or barely minimal amounts of oxygen concentrations for fish are dependent on the trophic status of the lake and depth.

Oligotrophic lakes are characterized by low nutrients and lower levels of biological productivity (low algal densities). Because these lakes have low levels of decomposition, the bottom layer (hypolimnion) will not become depleted of oxygen. These very oligotrophic lakes are uncommon in Indiana. More frequently observed in Indiana are those with higher nutrients and increased algal densities, eventually increasing the level of decomposition along the lake bottom. This creates a reduction of oxygen concentrations that increases with depth, particularly near the lake sediments. Figure 1 illustrates how the temperature and dissolved oxygen profiles change following fall turnover for an oligotrophic and eutrophic lake, both under ice cover.

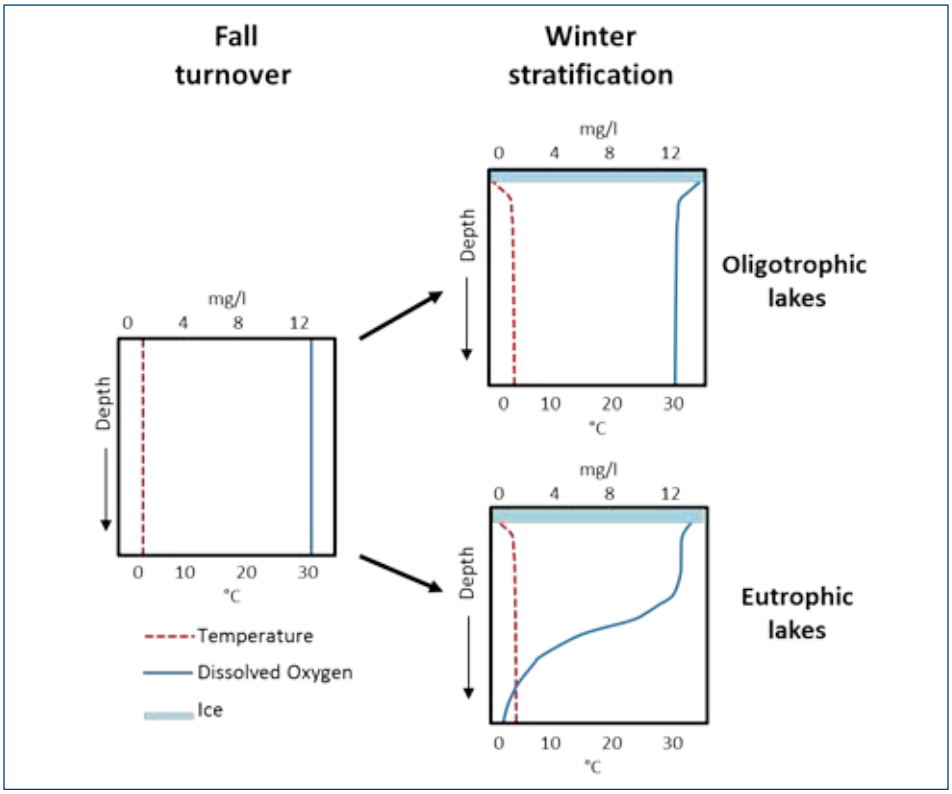


Figure 1. Vertical distribution of dissolved oxygen concentrations and temperature in a typical oligotrophic and eutrophic lake in the Midwest (modified from Wetzel, 2001).

Just below the ice layer, the water temperatures are just above freezing because of the close proximity to the ice. With increasing depth the water will warm slightly, and remain very cold through the whole vertical depth of the water column. Even under the ice, photosynthetic production continues throughout the winter, adding oxygen to the water column. In oligotrophic lakes, dissolved oxygen will remain largely at saturation throughout the water column. Eutrophic lakes, however, will decrease with depth due to respiration and decomposition similar to summer stratification. Ice thickness, snow cover, and duration of ice cover will also influence the light penetration, which will then influence algal production. Therefore, the photic zone is often limited to the upper layers. The photic (a.k.a., euphotic zone) is the depth of water that contains at least 1 percent of the surface light, essential for photosynthesis (Figure 2). Fish and other aquatic organisms often survive well because of this photosynthetic activity. They can also find oxygen trapped beneath the ice layer (Figure 3). Some fish species require higher oxygen concentrations, but as a general rule, most fish need at least 2 mg/l of dissolved oxygen. Prolonged periods of concentrations £1 mg/l is lethal.

Ice cover can last the whole winter season, prolonging separation from the oxygenated atmosphere above the lake surface. If the critical light is lacking and respiration exceeds photosynthesis due to decomposition, winter fish kills are possible. Winter fish kills, the most common type of fish kill, usually only occur in shallow eutrophic lakes with excessive amounts of macrophytes (aquatic plants) and organic matter at the bottom of the lake. Finding fish gasping for air at holes in the ice is a sign of distressed fish and of a potential fish kill (Figure 3).

While excessive macrophytes contribute to decomposition and oxygen depletion when they die back in the fall, a healthy balanced community of macrophytes is valuable for oxygen production. Some plants will continue to overwinter and photosynthesize if within the photic zone.

Since winter stratification and ice cover is a natural process, the only way to prevent or minimize fish kills is to prevent causes of eutrophication: reduce or stop using lawn fertilizers with phosphorus, maintain riparian buffers along stream banks and lake shorelines, protect and enhance shorelines with littoral vegetation or resurface sea walls with glacial stone, to list a few.

Figure 3. Fish struggling for oxygen that is trapped just below the ice layer (source: aquarius-systems.com).

As your lake ice melts, consider how the fish and other aquatic organisms are welcoming and adjusting to new inputs of oxygen. Soon, nutrients will also redistribute as lakes warm and eventually turnover. Hope you all enjoy the thawing winter ice with many jubilant thoughts of ways you plan to enjoy your upcoming fishing, canoeing, sailing, boating, bird watching – and many more ways we love to love our lakes. Happy spring!

For more info on oxygen, check out our spring 2011 *WaterColumn* found at: **http://www.indiana.edu/~clp/documents/water_column/Water_Col_V23N1.pdf**.

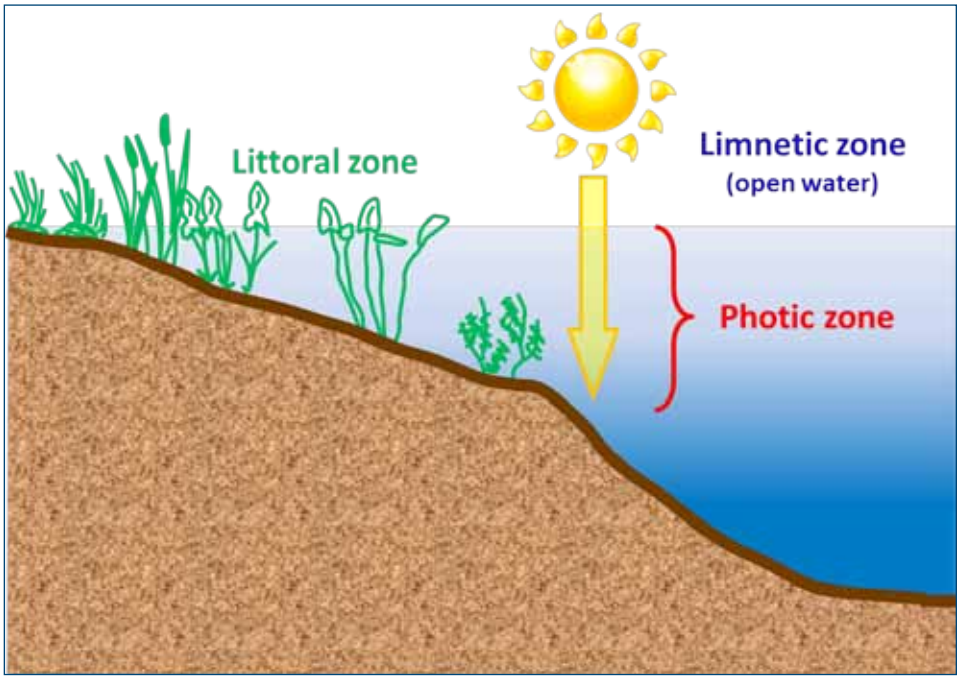


Figure 2. The photic zone is the volume of water that has enough light to support photosynthetic productivity, which is at least 1 percent of the surface light.

Have you checked out the Indiana Clean Lakes Program Web page lately? Take a look at www.indiana.edu/~clp/ and see what's new and happening with the program and with Indiana lakes!

Indiana Moving from Seawalls to Healthy Shorelines

~ Laura Barnhart

Picture your favorite Indiana lake. Now, remove the speedboats. Also, erase the lake homes with large lush green lawns extending to the seawalls. In those voids, add aquatic plants at the water's edge, shrubs to the sloping shorelines, and trees overhanging the water. How does it look?

Depending on your perception, your answers will range from pristine and healthy, to messy and no fun! Or, you might prefer the first image for swimming, but the final image for fishing. Regardless of perceptions of how a lake "should be," the fact remains that changes to shorelines eventually result in changes in water quality.

Lake residents of the Upper Tippecanoe Watershed, and their nine lake associations, have embraced this connection. They are improving their lakes in Kosciusko, Whitley, and Noble Counties by protecting their shorelines naturally. The Tippecanoe Watershed Foundation (TWF) is assisting this transition through the Healthy Shorelines Initiative.

Poor Shoreline Habitat Means Poor Lake Health

The U.S. Environmental Protection Agency (USEPA) report on the 2007 National Lake Assessment identified an association between shoreline habitat quality and lake health. Thirty-six percent of lakeshore habitat received a poor rating nationwide. The report also states that "[p]oor biological health is three times more likely in lakes with poor lakeshore habitat relative to lakes with good habitat."

Lyn Crighton, Executive Director for the TWF, notes that this connection is apparent within their watershed. Some of the upper lakes in the watershed have more natural shorelines and enjoy relatively better water quality and clarity. In contrast, the lower lakes are more heavily developed with seawalls and high speed boats (and have lower water quality and clarity).

Residents on lakes in the Tippecanoe Watershed noticed these stark differences during a recent lake tour exchange between upper and lower lakes. Crighton noted the astonishment of those on the boat when they saw that Crooked Lake has only two seawalls on the entire lakeshore, and noted Crooked Lake residents' general acceptance of plants on lakefront property. While there are additional differences among lakes in the watershed, this exercise got residents thinking about their shorelines.

Crash Course: Shoreline Erosion Causes and Solutions

Before diving into the efforts in the Tippecanoe Watershed, we need a crash course on erosion causes and options for dealing with it. For a more comprehensive lesson on shoreline stabilization, please read "Seawalls and Your Lake" by Bill Jones in the fall 2003 *Water Column* at **http://www.indiana.edu/~clp/**.

The causes of shoreline erosion may be inevitable; natural wave action is enhanced by high-speed boat traffic and can eat away at a steeply sloping unprotected shoreline. When erosion becomes a problem, shoreline property owners face two major options for shoreline stabilization: (1) structural additions including glacial stone and rigid seawalls; and (2) natural vegetation and bioengineering techniques.

Seawalls

Seawalls are rigid vertical structures generally installed on properties with steep slopes and extreme wave action. When installed properly, seawalls address one problem, but create a host of others:

- Erosion is increased in front of the seawall as wave energy deflects off the hard surface and back into soft, unanchored sediments. This action increases turbidity in the water, unlocks algal-bloom causing nutrients and discourages any organisms from taking up residence.
- Any natural barrier to lawn runoff is removed allowing nutrients from lawn fertilizer to flow directly into lake water, encouraging the growth of algal blooms.
- Lack of habitat – lack of interstitial spaces (voids between the rock and sediment) for organisms to take refuge
- The flat vertical surface becomes a barrier to wildlife that inhabit both land and water, such as frogs and turtles.

Glacial Stone and "Rip-Rap"

Glacial stone can be laid at the shoreline and extended down into the water as either an initial shoreline stabilization effort, or to counteract some of the negative effects of an existing seawall.

The Indiana Department of Natural Resources (IDNR) reports that: "Stabilizing the toe or refacing an existing vertical seawall with stone may replace some of the lost habitat value and minimize erosion due to wave reflection." Some advantages of glacial stone include:

- Presence of interstitial spaces among stones for plants to root and organisms to inhabit
- Appearance of a semi-natural shoreline
- Maintenance can be incremental, rather than replacing an entire failed seawall

Vegetation Bioengineering

Vegetation along lakeshores provides natural stabilization for moderate slopes. An additional list of benefits includes:

- Runoff control and nutrient uptake before entering the lake
- Excellent habitat for organisms, including insects that feed fish
- Shading out of dense invasive aquatic plants along the water's edge

Bioengineering refers to engineering techniques to assist

in the initial establishment of shoreline vegetation. These include professional use of techniques like "willow-stalking," "joint planting," or use of biodegradable fiber "coir logs" for initial plantings. This may be necessary when wave action prohibits vegetation from becoming established.
For a more comprehensive explanation of costs and use of shoreline stabilization methods, please read "Lakeshore Protection in Indiana," an online publication by IDNR.

The Healthy Shorelines Initiative – A Working Model

TWF is implementing their second year of shoreline improvements. In 2012, 40 applicants were funded up to $3,000 for shoreline improvement projects on their properties. Among these participants, 22 residents re-faced existing seawalls with glacial stone (Figures 4 and 5), 11 installed new glacial stone seawalls, and seven used bioengineering and vegetation techniques (Figures 6 and 7). Projects including vegetation were funded at the highest amount to incentivize and support a message that, "Plants are OK."

The Foundation partnered with the Indiana Department of Natural Resources in 2012, which shares in TWF's vision for healthy shoreline habitat. Lyn Crighton recognizes IDNR as an indispensable partner for other organizations seeking a similar track. They learned that each project must begin with a clear understanding on what is permissible on your shoreline under state regulation, and then proceed to creative implementation within the boundariess of the law.

"There were some disheartened participants who found that they could not construct their projects as planned due to permitting limitations," said Crighton. For a clear breakdown on the lakeshore zoning and permitting regime, please refer to the guidelines in the IDNR's online publication, "Lakeshore Protection in Indiana."

Figure 4. Seawall prior to re-facing with glacial stone.

Figure 5. Seawall after new glacial stone improvements.

Changing Perceptions

Crighton says that physical changes to the lake will take time, but there is anecdotal evidence that perceptions of seawalls and natural shorelines are already adjusting. Conversations about vegetation and glacial stone are commonplace at community events now.

Additionally, she is happy to see that several influential homeowners have recently installed new glacial stone seawalls or refaced their old seawalls fronting high value properties which may set some positive examples for others.

Formal evidence of these attitude changes to shoreline preferences will arrive in 2014. Monitoring assessments will include a follow-up (to TWF's) *Social Indicator Survey*, conducted in

Figure 6. Seawall, prior to shoreline stabilization using bioengineering techniques.

Figure 7. Seawall after shoreline stabilization using bioengineering techniques.

2010. The TWF leaders are excited to see the effect of their education and assistance programs appear in survey results, and eventually in the watershed.

For more information on the TWF mission, initiatives, and a helpful healthy shorelines packet, peruse the TWF website at **www.TippecanoeWatershed.org**.

Sources for this Article

U.S. EPA. 2010. The National Lakes Assessment Fact Sheet. Available online at: **http://water.epa.gov/type/lakes/upload/nla_survey_fact_sheet.pdf**

IDNR. Lakeshore Protection in Indiana. Lake and River Enhancement Program, Division of Fish and Wildlife, Indianapolis. Available online at: **http://www.in.gov/dnr/water/files/seawall.pdf**

Jones, Bill. 2003. Seawalls and Your Lake. Water Column: 15 (3) accessed at **http://www.indiana.edu/~clp/documents/fall%2003%20Water%20Column.pdf**

Laura Barnhart *is a recent graduate from the School of Public and Environmental Affairs with a dual MPA / MSES degree. Laura interned with the Indiana Clean Lakes Program during the 2011 sampling season and is continuing a career in Water Resources in the Midwest.*

Indiana Lakes Management Society Annual Conference Summary

~ Heather Buck

The Indiana Lakes Management Conference took place March 22-23, 2013 at the Potawatomi Inn at Pokagon State Park. More than 130 lake residents and enthusiasts joined the Indiana Lakes Management Society (ILMS) for its 25th annual conference. Many thanks to our sponsors, including Aquatic Control, Aquatic Enhancement and Survey, Aquatic Weed Control, Christopher B. Burke Engineering, Clarke Aquatic Services, Arion Consulting, and the Indiana Association of Soil & Water Conservation Districts.

ILMS welcomed Darby Nelson, aquatic ecologist, author, and professor emeritus to speak about our outward love for lakes as well as our participation in their

deterioration. Concurrent sessions focused on blue-green algae, legislation issues, public awareness, dam management, and local lake presentations. Saturday workshops detailed basic principles of limnology, grants and fundraising, and the beneficial amphibians and reptiles present in many of our lakes.

As part of the conference, ILMS completed its annual meeting. As part of this effort, ILMS members elected new board member Kathy Clark of Lake Maxinkuckee, and re-elected Steve Lee of Aquatic Control, Sarah Powers of the Indiana University School of Public and Environmental Affairs, and Brigette Schoner of Whippoorwill Lake. Additionally, Heather Buck of Christopher B. Burke Engineering, LLC and Leslie Raymer of McClish-Lake of the Woods were elected president and vice-president of the society, respectively. ILMS would like to thank out-going board members Chad Appleman of Davey Resource Group and Ed Spanopoulos of Lakes of the Four Seasons for all of the efforts during their time on the board.

At their annual banquet, ILMS recognized the ILMS Student Scholarship recipient, Lake/Watershed Group of the Year, the Project of the year, and the Volunteer of the Year winners.

The Student Scholarship was awarded to Bridget Borrowdale from the Indiana University School of Public and Environmental Affairs' Accelerated Master's Program (Figure 8). She received a $500 scholarship and free conference attendance.

ILMS was pleased to recognize the Wawasee Area Conservancy Foundation (WACF) for its commitment to improving conditions in the Wawasee watershed (Figure 9). Over the years, its work has included studies, constructing erosion control and stabilization projects, restoration and mitigation, educational outreach programs, and agricultural farm tours. Other efforts involve

Figure 8. Elizabeth Tompkins, ILMS Board Member, with Bridget Borrowdale, ILMS Scholarship recipient.

Figure 9. Sara Peel, ILMS Board Member, presents the Wawasee Area Conservancy Foundation with the Outstanding Lake Association Award.

Friday morning canoe trips; Saturday morning "Lake Talk and Eats"; a joint effort with the Elkhart River Restoration Association on several erosion control projects preventing of 16,000 tons of sediment from ending up in rivers and lakes downstream; planting over 7,000 trees on highly erodible soils, and efforts to control exotic plant species within their lake. The WACF has been very active working toward its main mission of good water quality through preservation and enhancement of the Wawasee watershed.

ILMS also recognized Larry Lehman of Indiana Lake (Figure

10). Larry Lehman has overseen the management and monitoring of Indiana Lake for 25 years. He has served as a Volunteer Lake Monitor for over 25 years and submitted more data as one individual than any other monitored lake. From April 1988 to November of 2012, Larry made an astounding 1,175 Secchi disk transparency measurements at Indiana Lake. He has assembled one of the most impressive records of water clarity changes of any lake in the United States. Larry puts together additional reports each year for the Indiana Lake Association. These reports analyze trends in the data and report the information to the group. His reports not only look at his lake but the comparison to other lakes, evaluating the trophic status rankings of lakes in the state of Indiana. Larry has also contacted the Indiana CLP with further questions about the lake when issues arise and collected algal samples to have identified when persistent blooms have emerged.

Additionally, ILMSW was pleased to recognize Sister Mary Baird with the Poor Handmaids of Ancilla and the MoonTree LEED project as the outstanding implementation project for 2013 (Figure 11). Sister Mary Baird championed this LEED project for Ancilla's MoonTree Studio. It features sustainable sites that have some affect on Galbraith Lake, which is part of the Ancilla property. It also covers water efficiency, energy and atmosphere impacts, green materials and resources, as well as impacting indoor environmental quality and offering pervious paving system parking areas. The primary aim of the project was to protect the natural habitat and to maximize open space. It controls stormwater both in quantity and quality. Both the studio building and the lodge itself use the best in LEED design, with heat reflective surfaces like metal roofs, hidden outside lights to reduce light pollution, water efficient landscaping using no irrigation, and a roof catchment system featuring a cistern for roof runoff to assist with water use reduction. Seven rain gardens grace the property as well as two retention basins. A wetland cell wastewater system was built next to the buildings in old pasture ground. All effluent is pumped into the wetland area where it recirculates among the roots of the plants and the bacteria there purify the water before it trickles into a drainfield.

Figure 10. Sarah Powers, ILMS Board Member, presents Larry Lehman, Indiana Lake, with the Volunteer of the Year Award.

Figure 11. Sara Peel, ILMS Board Member, presents Joe Skelton with the Outstanding Implementation Project Award for Ancilla MoonTree Studio.

The Volunteer Lake Monitoring Corner

~ Sarah Powers

Spring has finally arrived, although hard to tell, and we will quickly be moving into the summer. I hope that you are ready for your summer projects or have had the chance to lay the framework to begin them. I have worked this winter to continue to expand on our invasive monitoring program and we have decided to make a few changes. While we are still in search of other ways to expand this program we have decided to do a name change now to save confusion later. We will be calling the program "Invasive Species Monitoring." This is in hope that in the future we will be expanding the program, while also in an effort to remind and encourage us all to not think of our aquatic plants as "weeds" but rather to realize the beneficial role aquatic vegetation play in our lakes. The program will now focus on early detection of new invasive species to increase the likelihood of eradication.

We have two training workshop scheduled and will likely be scheduling more based on need. The first will be April 27th in Bloomington, IN and a second date on May 25th at the Wawasee Area Conservancy Federation. The trainings will have a class room and field component. The program allows volunteers to be as involved as they would like. If you would like to survey the aquatic plant community in front of your property, around the public boat launch, or the entire lake it is up to you. You can do as little or as much as you like.

While we are focusing some of our efforts on the invasive monitoring program I also want to remind everyone that we are always expanding on our Volunteer Lake Monitoring Program. We encourage you to become a volunteer or make sure your lake has a volunteer. I am including a list of lakes that submitted data in 2012. If your lake is not on the list I encourage you to contact me. The primary component of the program is collecting Secchi disk measurement at least every other week. It is a short test that can tell us so much about our lakes. Please take a look and consider joining our extensive network of volunteers.

I would also like to encourage all of our volunteers to take dissolved oxygen and temperature measurements on your lake. We have dissolved oxygen and temperature meters at select locations throughout the state. Many are at local soil and water conservation districts. The full list of locations is below. All volunteers are welcome to check those meters out and we are happy to provide any training you need to use them.

If you would like more information about our Volunteer Lake Monitoring Program or the Invasive Species Monitoring Program please contact me at **indianaclp@gmail.com** or go to our website at **www.indiana.edu/~clp**.

List of Currently Monitored Lakes in Indiana

Adams Lake, LaGrange
Lake Anne, Steuben
Big Lake, Noble
Big Bass Lake, Porter
Big Chapman Lake, Kosciusko
Big Long Lake, LaGrange
Big Turkey Lake, LaGrange
Brookville Reservoir, Franklin
Cedar Lake, Lake
Center Lake, Kosciusko
Clear Lake, LaPorte
Clear Lake, Steuben
Lake Clearwater, Marion
Cook Lake, Marshall
Cordry Lake, Brown
Crooked Lake, Noble
Elizabeth Lake, Kosciusko
Flat Lake, Marshall
Flint Lake, Porter
Lake Gage, Steuben
Galbraith Lake, Marshall
Lake George, Steuben
Heaton Lake, Elkhart
Heritage Lake, Putnam
Hogback Lake, Steuben
Holiday Lake, Lake
Lake Holiday, Montgomery
Indiana Lake, Elkhart
Irish Lake, Kosciusko
Lake James, Kosciusko
Lake James, Steuben
Jones Lake, Noble
Knapp Lake, Noble
Koontz Lake, Starke
Lake of the Woods, LaGrange
Lake of the Woods, Marshall
Lake Lamb, Johnson
Liberty Lake, Hancock
Little Chapman Lake, Kosciusko
Little Crooked Lake, Whitley
Long Lake, Porter
Loomis Lake, Porter
Lower Fish Lake, LaPorte
Lake Manitou, Fulton
Martin Lake, LaGrange
Lake Maxinkuckee, Marshall
Lake Millpond, Marshall
Monroe (Upper) Lake, Monroe
Lake Nyona, Fulton
Old Lake, Whitley
Ole Swimming Hole, Morgan
Olin Lake, LaGrange
Oliver Lake, LaGrange
Oswego Lake, Kosciusko
Palestine Lake, Kosciusko
Pinestone Lake, Harrison
Pretty Lake, Marshall
Rachel Lake, Kosciusko
Ridinger Lake, Kosciusko
Salamonie Reservoir, Wabash
Sechrist Lake, Kosciusko
Shriner Lake, Whitley
Silver Lake, Steuben
Skinner Lake, Noble
Snow Lake, Steuben
Steinbarger Lake, Noble
Stone Lake, LaGrange
Sweetwater Lake, Brown
Sylvan Lake, Noble
Syracuse Lake, Kosciusko
Tamarack Lake, Noble
Lake Tippecanoe, Kosciusko
Upper Long Lake, Noble
Waldron Lake, Noble
Waubee Lake, Kosciusko
Lake Wawasee, Kosciusko
Webster Lake, Kosciusko
West Otter Lake, Steuben
Whippoorwill Lake, Morgan
Winona Lake, Kosciusko
Witmer Lake, LaGrange
Yellow Creek Lake, Kosciusko

Temperature and Dissolved Oxygen Meter Locations

Elkhart County SWCD
Elkhart County 4-H Fairgrounds
17746-B County Road 34
Goshen, IN 46528
574-533-3630 ext. 3
Contact: Nancy Brown

Fulton County SWCD
1252 E. 100 S, Suite D
Rochester, IN 46975-8036
574-223-3220 ext. 3
Contact: Chris Gardner

Kosciusko County SWCD
217 E. Bell Dr.
Warsaw, IN 46582
574-267-7445 ext. 3
Contact: Darci Zolman

LaGrange County SWCD
910 S. Detroit St.
LaGrange, IN 46761-2235
260-463-3166
Contact: Donna Hunter

Marshall County SWCD
2903 Gary Dr.
Plymouth, IN 46563-1825
574-936-2024 ext. 3
Contact: Wanda Norris

Merry Lea Environmental Learning Center
2388 S 500 W
Albion, IN 46701
260-799-5869
Contact: Jane Litwiller
http://www.goshen.edu/merrylea

School of Public and Environmental Affairs (SPEA)
Indiana University
1315 E. Tenth Street
Bloomington, IN 47405
812-855-1600
Contact: Sarah Powers

Steuben County SWCD
Peachtree Plaza 200
1220 N. 200 W
Angola, IN 46703-8901
260-665-3211 ext. 3
Contact: Kayleen Hart

Aquatic Weed Watchers Plant Highlight

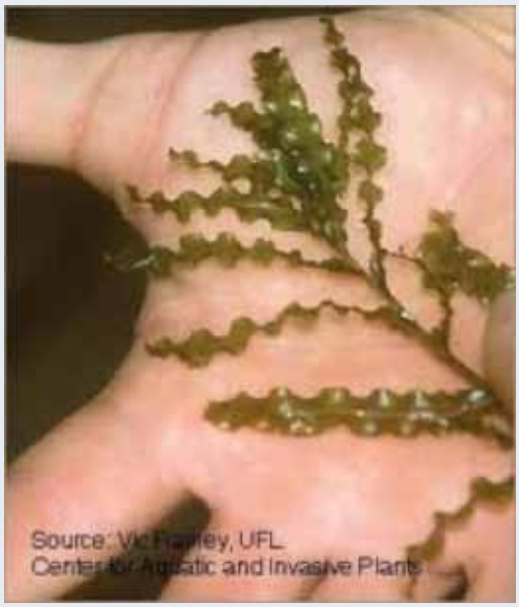
This will be the fourth plant in the plant highlight series. We will be featuring one aquatic plant in each *Water Column* issue. We will feature both native and invasive plants to improve our plant identification skills

Curly-leaf pondweed (*Potamogeton crispus*) – INVASIVE

Curly-leaf pondweed is a common invasive plant in Indiana and is known to be present in at least 43 counties in the state. Curly-leaf pondweed is native to Eurasia, Africa, and Australia. It is a cool water species that can persist through the winter and typically dies back by mid-July as water temperatures rise. It is said to have been the most common nuisance plant in Indiana before the introduction of Eurasian watermilfoil.

You can find more information about our Invasive Plant Monitoring Program and curly leaf pondweed on the Clean Lakes Program website www.indiana.edu/~clp. We will be updating the Invasive Plant Monitoring page to include links to several resources and tips on identification guides.

Identification tips
- leaves distinctly wavy and stiff
- leaf margins finely toothed
- olive green, but can appear reddish-brown under the water
- grows in deep waters up to 15-20 feet deep



An Ode to ILMS

The limnos of Indiana
flowed and pooled
accumulating in angola
Carrying with them the suspended
knowledge of their watersheds

Tumultuous excitement forever
barring these concepts
from deposition
and loss

how do we deal with the bluegreens
toxic odors and taste
brought forth from fertile waste
Nico suggested the Chihuahua test:
throw them in and observe the mess

we've got the science
now how do we sell it
Lakes are for people is the marketing cry
they are tangible goods that must be sold
their integral to humankind
our efforts to preserve them must be bold

the transition from Talks to chatter
began when bidding on bits of matter
a silent auction in name only
as the "kids table" seeked something holy
and the tension built to the last moment
when bidders raced to their prize hellbent

Fat on fact and fun
the limnos returns to their headwaters
ready to share and enact lake mgmt.
to benefit their sons and daughters.

~ Tim Clark
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WATER COLUMN

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Perspectives

"April hath put a spirit of youth in everything."

~ William Shakespeare