Water Column

WINTER 2019

A Summer on the Water: The 2019 Lake Sampling Season

~ *Cory Sauve*

As we enter 2020, it's a perfect time to look back upon the 2019 sampling season. Our field crew spent 17 days on the water this summer, sampling 80 lakes across 26 counties. They spent most of their time in the northeast corner of Indiana where a majority of Indiana's natural lakes are found. In fact, 51 of the 80 lakes we sampled this summer were natural lakes! Reservoirs and surface mine lakes comprised the rest of the lake types we came across, with most located in southern Indiana (Figure 1).

Since we randomly select lakes to sample, many of the lakes we sampled varied considerably in depth and size. Oliver Lake – in LaGrange County – was the deepest lake we sampled at nearly 28 meters. As far as big lakes go, Patoka Reservoir was the biggest we sampled at nearly 3,593 hectares (Figure 2)!

This summer we also collected data to determine how productive the lakes were. Since

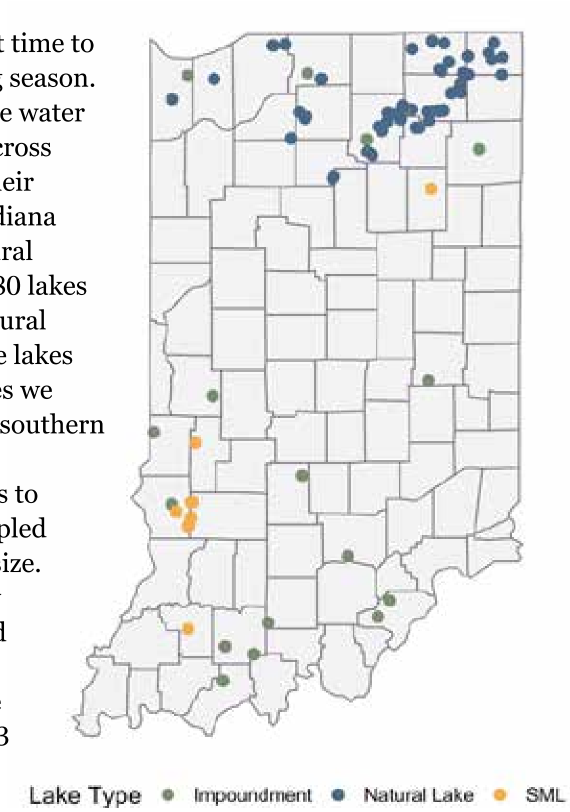


Figure 1. Lakes surveyed during the 2019 sampling season.

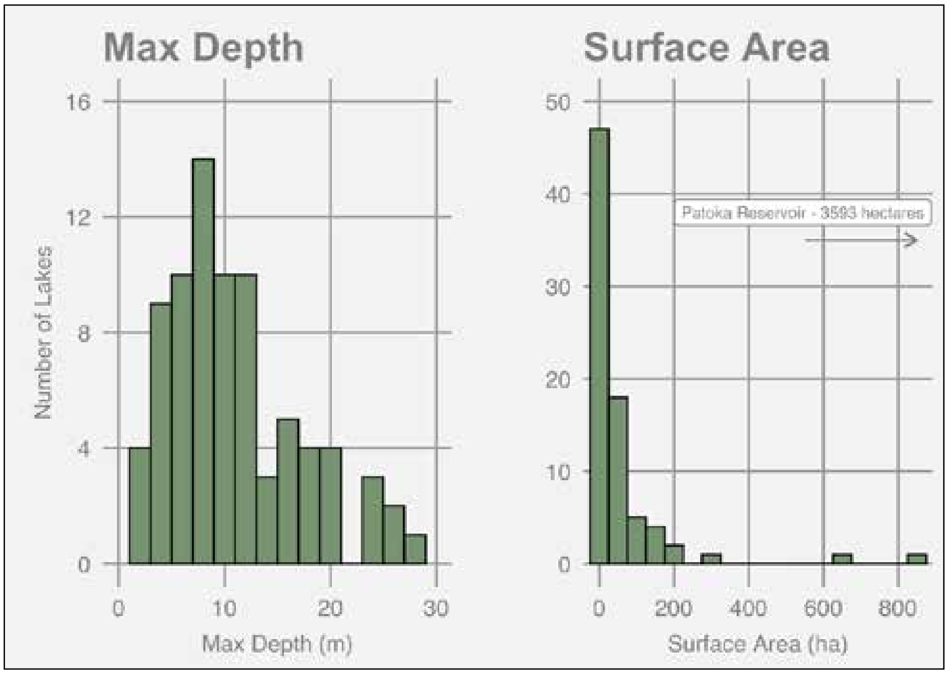


Figure 2. Variability of lake morphology for the 2019 surveyed lakes.

there was a heightened focus on blue-green algae and harmful algal blooms this summer, we were very curious to see how productive lakes were across Indiana. Mesotrophic and eutrophic lakes were the most common, each comprising 39% of all sampled lakes. We also sampled 18 lakes that were considered to be hypereutrophic, or highly productive (Figure 3).

We also sampled for chlorophyll-a, which is a primary pigment found in algae. Because it is a primary pigment, we can use chlorophyll-a as a surrogate for algal biomass in lakes. Chlorophyll-a concentrations varied widely across the lakes we sampled, from 0.59 to 285 ug/L (Figure 4). Some of the lakes with concentrations above 100 ug/L were likely experiencing an algal bloom at the time of sampling.

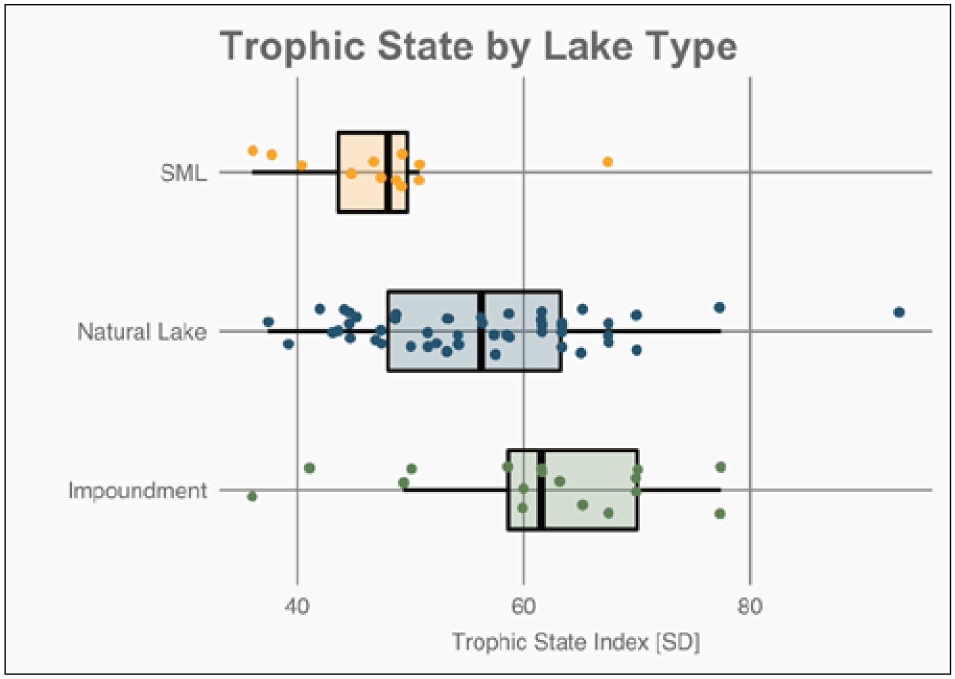
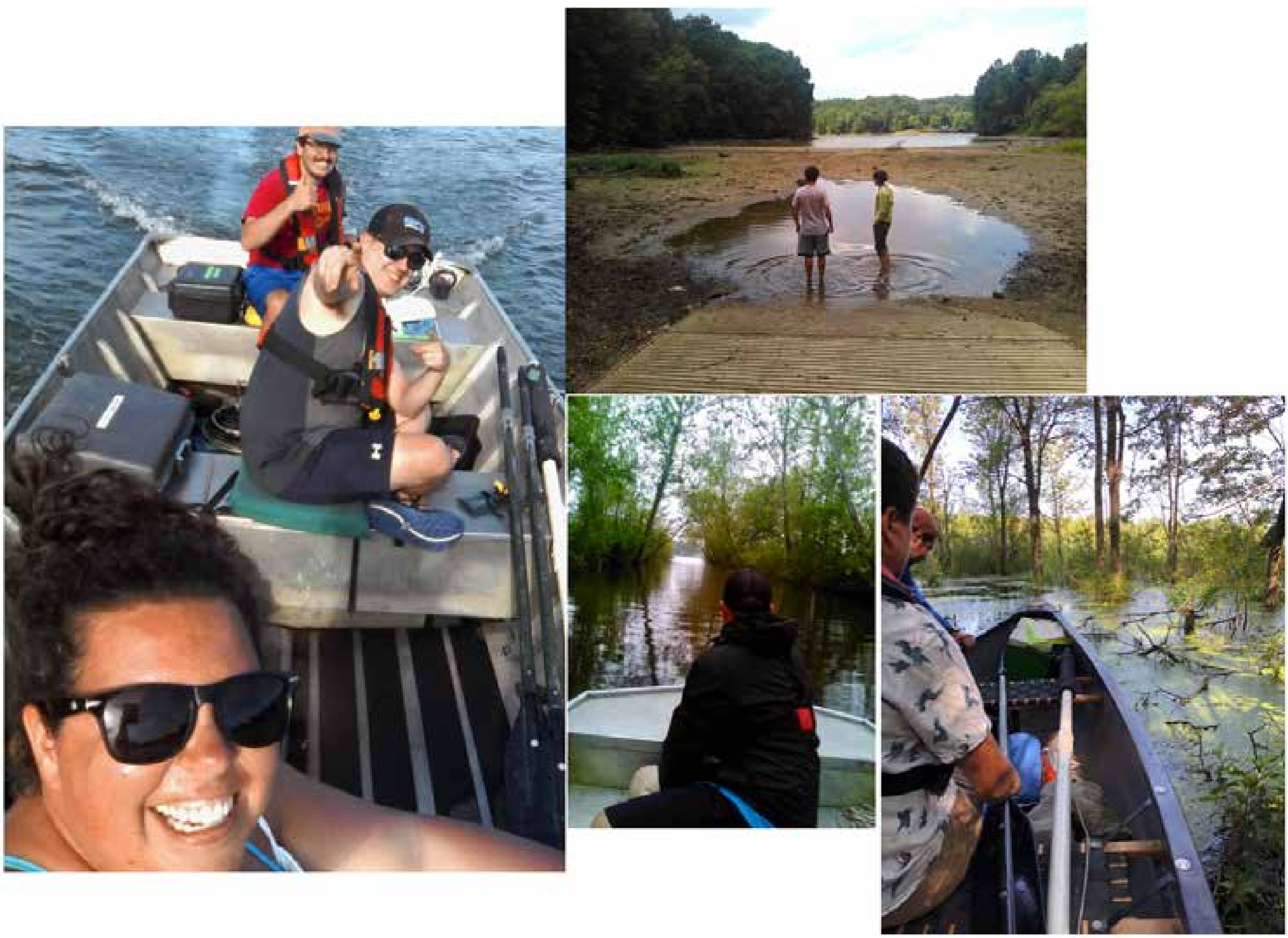


Figure 3. Trophic status of lakes surveyed during the 2019 sampling season, based on Secchi disk (SD) transparency.



A special thanks to our wonderful field crew that collected all of these data: Heather Bearnes-Loza, Megan Gokey, Elias Hanna, Tomas Fuentes-Rohwer, and Cory Sauve.

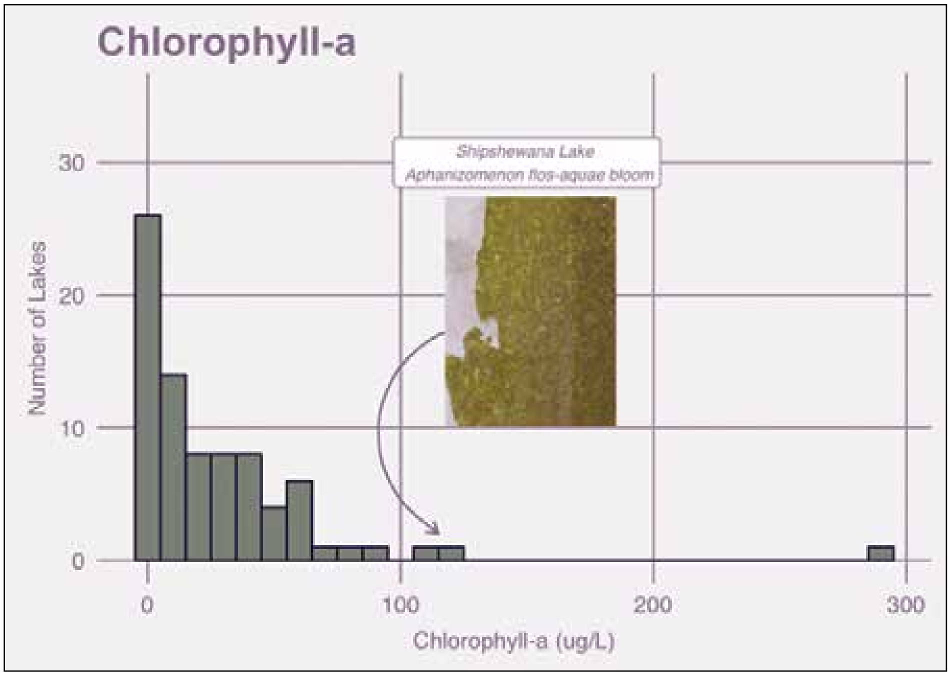


Figure 4. Chlorophyll-a concentrations for 2019 surveyed lakes.

For example, Shipshewana Lake (LaGrange Co.) had a notable *Aphanizomenon flos-aquae* bloom, a common blue-green algae found across Indiana.

That was a quick snapshot of some of the data we collected in 2019!

If you would like to find out more about our yearly sampling and to find more information about Indiana lake water quality, please visit our website at clp.indiana.edu.

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!

Invasive Common Carp in Indiana's Lakes, and What Can Be Done about Them

~ Tomas Fuentes-Rohwer

The Common Carp as an Invasive Species

The impacts and disruptions caused by invasive species are a prevalent issue in ecosystems throughout the world, and aquatic systems like lakes are no exception to this. It is often the case that invasive species will be introduced to a susceptible habitat or location by individuals with innocuous intentions, who only see the potential benefits to the species' introduction and overlook or do not consider the potential costs or damages to the ecosystem that the introduced species may cause, realizing the detrimental consequences only once the ecosystem has been negatively impacted.

A textbook example of an invasive species, introduced with beneficial intention was the common carp (*Cyprinus carpio*) (Figure 5). These fish are members of the minnow family Cyprinidae, and are native to lake and river habitats in Eurasia. The first common carp brought to North America were introduced in the late 19th century. These fish were stocked in lakes and ponds as a food source, due to their rapid growth and reproduction rates, as well as their hardiness to harsh environmental conditions. In the absence of natural predators, the common carp were

Figure 5. The common carp Cyprinus carpio *(photo: Virginia Living Museum)*

able to reproduce and grow unchecked, and quickly dominated the ecosystems they were introduced to (Figure 6). And in the present day, common carp can be found in every one of the continental United States, including Indiana. They were also introduced to aquatic systems in Australia, where they have posed an equally prevalent threat to native aquatic species and ecosystems.

The common carp are omnivorous and opportunistic fish, feeding at the bottom of lakes, streams, and wetlands. They preferentially eat insects and other invertebrates in the sediments, but will also feed on any vegetation they encounter in their habitat. Interestingly, the carps' feeding on plants and invertebrates is not what renders them such a threatening invader, but rather the *method* by which they feed. While searching for their prey in the sediment, common carp will root around with their snouts to dig out invertebrates and anything else they find edible. This rooting behavior causes the sediments to loosen and become disturbed. This disturbance also uproots and kills many aquatic plants, and negatively impacts other fish, invertebrates, and waterfowl that rely on aquatic vegetation for food (and in the fish and invertebrate case, cover from predators). The rooting also causes the otherwise clear lake and river water to become cloudy and turbid with suspended sediment, and because of this the carp-caused murkiness of the water is referred to as *bioturbation*. The bioturbation of lake water detrimentally impacts predatory fish that rely on sight to hunt invertebrates and smaller fish in their aquatic habitat (Figure 7).

By reducing the number of certain aquatic organisms in their invaded lake ecosystem, common carp can conversely promote the growth and abundance of other organisms that would normally be checked in a carp-free lake. Research has shown that common carp bioturbation and feeding behavior causes decreases in the overall numbers and biomass of aquatic submerged plants, as well as zooplankton. Because of the decrease in zooplankton numbers, phytoplankton and algae (which are normally eaten by zooplankton) are no longer limited by predation. Additionally, the carp's rooting behaviors and excretions both can cause the release of nutrients (such as total phosphorus (TP) and nitrate)

Figure 6. An infestation of common carp, attempting to migrate into Delta Marsh off of Lake Manitoba.

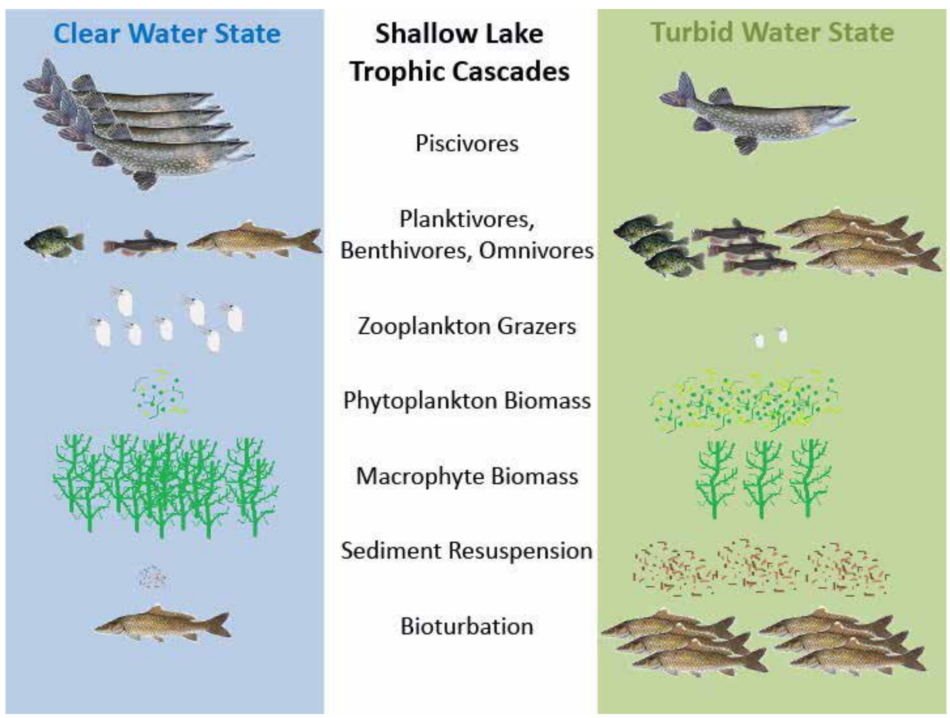


Figure 7. A comparison of conditions in turbid vs. clear water lakes. Common carp are often the cause of a shift toward the turbid conditions and organism assemblages seen on the right of the figure.

many of which were otherwise trapped in the lake sediments. These nutrients can further promote the growth of phytoplankton, including potentially toxin-producing blue-green algae, and exacerbate conditions that lead to harmful algal blooms at the lakes' surface. The process of carp population increases leading to plant and zooplankton removal, which in turn results in phytoplankton population increases, is known as a *trophic cascade*. Trophic cascades are a common phenomenon in many ecosystems that have undergone some form of disturbance, be it the introduction of an invasive species, or some other form of disruption in the ecosystem's trophic structure.

Methods for Common Carp Removal

Strategies for carp management are variable, with methods ranging from chemical to physical or mechanical to biological controls. The most commonly used strategy to counteract carp population spreading is with the use of rotenone. Rotenone is a pesticide chemical that targets fish and kills by interfering with their cellular respiratory processes. This particular treatment for invasive carp will often be administered after a drawdown of the water level in a lake or wetland has previously occurred. Additionally, any lakes affected with rotenone will have to be restocked with fish after the fact, as the chemical is nonspecific in which species it targets. This method is most widely used for carp population in lakes and certain isolated wetlands, as this limits the spread of the chemical to other carp-free aquatic habitats. Restoration efforts must also account for the cost of fish restocking, as well as the chemical's impacts on other organisms, when this method is chosen for carp control.

Mechanical methods of carp control include fishways with selectively sized grates to exclude larger carp, electric barriers that generate sound waves to repel carp, and traps that exploit the carps' defensive jumping behavior to easily separate them from native fish. While physical/mechanical controls are predominantly used in riverine habitats, they have proven useful for excluding carp from wetlands and standing water habitat in the Metzger Marsh area along Lake Erie, and the Cootes Paradise site on Lake Ontario. Because of the adult carps' wider body shape, they are unable to traverse barriers with smaller spacing between their grating, while other fish are able to freely enter and exit the marsh.

Biological control of common carp largely consists of predatory fish stocking. In the case of carp, ecologists have used both pike and muskellunge to control carp populations naturally. This method is only effective at keeping carp in check before the fish become adults, as piscivorous predators are unable to hunt for full-sized adult carp. Biological control is also most effective when lake productivity is relatively low, as highly productive lakes are more likely to have lower dissolved oxygen levels. And while many native fish are susceptible to low oxygen levels, the more tolerant carp are often able to withstand these conditions.

32nd Annual Indiana Lakes Management Conference

When: 09 Apr 2020 • 9:00 AM, EDT
Where: Monroe County Convention Center

Registration: Register Online Now! or ILMS 2020 Registration Form

EVENT DETAILS:

Join the Indiana Lakes Management Society for the 32nd Annual Indiana Lakes Management Conference.

Join us Wednesday, April 8 for Exhibitor set-up between 5:00 and 7:00 pm.

Registration opens at 8 am on Thursday, April 9th with our plenary speaker, Janet McCabe, starting at 9 am.

The conference will occur on the upper level of the Monroe County Convention Center.

Join us as a presenter – view the call for abstracts!

Interested in sponsoring the 32nd Annual Indiana Lakes Management Conference – learn more about sponsorship levels!

Need OISC CCH Credits? Earn them at ILMS – Details to be added.

Contact Sara Peel at speel@arionconsultants.com or (765) 337-9100 if you have questions about registration.

If you need hotel accommodations during the conference, reserve a room at the Courtyard by Marriott Bloomington within the $99/night conference room block! https://www.marriott.com/events/start.mi?id=1572532719098&key=GRP

Note: Guest registrations are for banquet attendee additions only.

Volunteer Corner

The Indiana Clean Lakes Program is gearing up for another full summer of surveying Indiana Lakes. In addition to our volunteer efforts with wonderful and invaluable Citizen Scientists, we are participating in a large watershed management plan for Lake Monroe, the largest lake (reservoir) in Indiana. Stay tuned for more updates on this ambitious watershed sampling adventure!

We have a new crew of eager graduate students helping to orchestrate and coordinate these efforts, so we'd like to introduce you!

Lindsey Rasnake

Lindsey comes to us from Tennessee, where she attended the University of Tennessee and obtained her B.S. in Wildlife and Fisheries Science. She is currently a first-year dual MPA/MSES student here at the O'Neill School and has been working with the Clean Lakes Program since August 2019. Lindsey helps coordinate the Volunteer Monitoring Program, maintaining correspondence with current and new volunteers, and assists in the daily operations of the Limnology lab. In her free time, Lindsey enjoys camping, kayaking, and hiking with her dog, Aldo. She is passionate about the environment, and looks forward to improving the monitoring program and eventually continuing her career in natural resources conservation using the tools she is building here at the Clean Lakes Program.

Brendan Scholl

Brendan comes to us from Cape Girardeau, Missouri. He obtained his B.S. in Corporate Communications, minoring in environmental science, geoscience, and marketing. He is currently working toward his Master of Public Affairs here at the O'Neill School, where he will focus on environmental policy and sustainability. In his free time, he enjoys hiking, rock climbing, cooking, fitness, and traveling. His position as the assistant coordinator for the Volunteer Monitoring Program will provide him with ample experience managing day-to-day program operations, data collection and analysis, and sample processing and handling. Brendan looks forward to furthering his knowledge of limnology and becoming a better educator and communicator in this position.

Lynnette Murphy

Lynnette Murphy is originally from Fox Lake, Illinois, and spent much of her time in the Chicago region before coming to the O'Neill School. She has a B.S. in Environmental Science with a minor in Chemistry and is completing a dual MPA-MSES degree here at O'Neill. Lynnette enjoys exploring the outdoors with her children, knitting and crocheting, and baking. Here in the Limnology Lab she is coordinating a sampling blitz for the Lake Monroe Watershed, working closely with the Friends of Lake Monroe to identify sampling sites and recruit sampling blitz volunteers. She is excited to bring her unique skills to this project and gain more experience in project coordination and engagement with the local Bloomington community.

Aquatic Invasive Monitoring Plant Highlight

This will be the 25th 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.

Black-footed Quillwort (*Isoetes melanopoda*), NATIVE

COMMON NAMES: Prairie Quillwort, Black-footed Quillwort

DISTRIBUTION: Rare but found throughout the Midwest.

DESCRIPTION: This rare macrophyte is listed as endangered in Indiana and neighboring states. This plant is a fern ally, meaning that it reproduces by spores verses the flowers of angiosperms. So, there are no flowers.

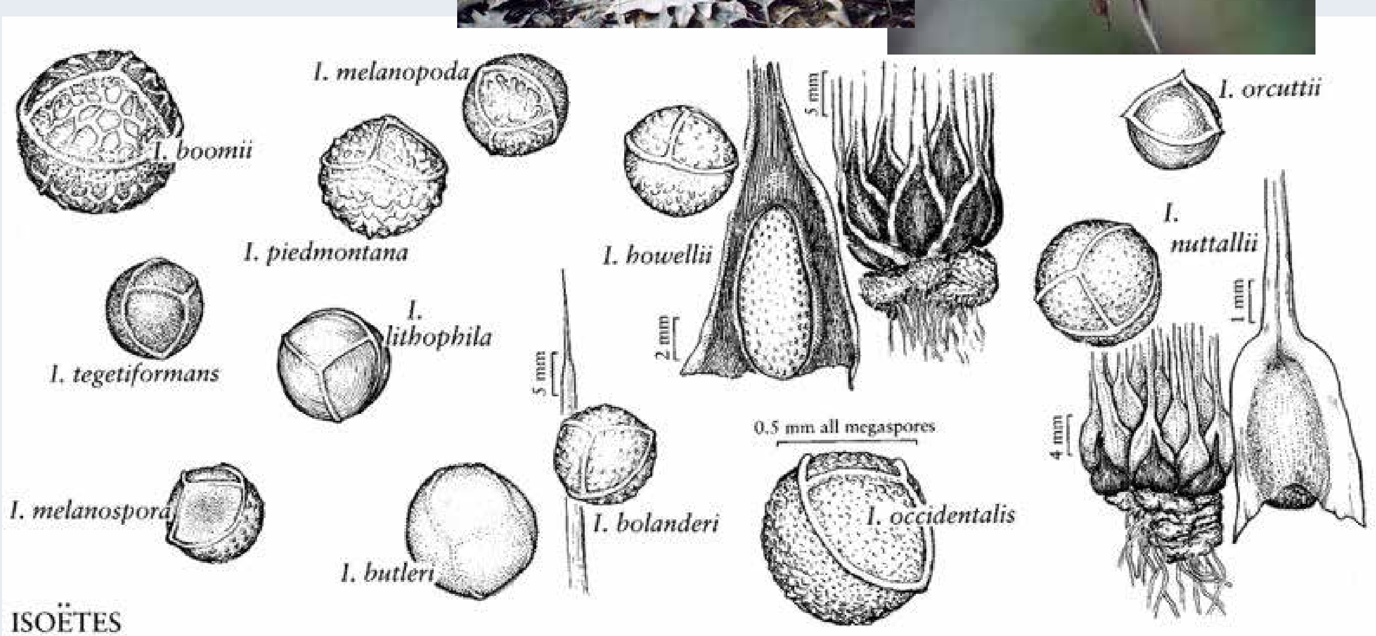
Leaves are all basal, narrowly grass-like, erect to spreading, pliant, bright green, 4 to 16 inches long, about 1 mm wide, gradually tapering to a pointed tip, and arise from a fleshy, nearly round rootstock.

The leaf base is abruptly expanded and initially pale, usually turning shiny black on the outer surface with maturity. Plants are at least partly submerged in spring but later may become stranded on land or in the mud when pools dry up and water recedes.

Spores are produced starting in late spring, in an oblong-elliptic sac (sporangium) on the inner face of the leaf base. Translucent tissue (velum) covers at least a portion of the tip end but less than 75% of the sac. Two types of spores are produced: megaspores (female) are visible to the naked eye, white at maturity, .28 to .44 mm diameter with an obscurely wrinkled surface; microspores (male) are gray and 1/10th the size of megaspores.

Identification tips:

- Basal, narrowly grass-like leaves
- Leaf bases turn black at maturity
- No flowers, spores instead



WATER COLUMN

Published quarterly by the Indiana Clean Lakes Program as a medium for open exchange of information regarding lake and watershed management in Indiana.

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Perspectives

"The first day of spring is one thing, and the first spring day is another. The difference between them is sometimes as great as a month."

- Henry Van Dyke, *Fisherman's Luck*