Water Column

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Glacially Formed Kettle Lakes in Northern Indiana

~ Mitchell Latta

About 16,000 years ago, a large region of northern Indiana was covered in great bodies of ice. Glaciers are large bodies of ice that flow similarly to rivers (Figure 1). Unlike rivers, however, these large ice bodies weigh so much that they can only move very slowly. Glaciers can flow and advance, but depending on the amount of snowfall accumulation and evaporation, glaciers can also retreat and move backwards. The sheer weight behind these slow-moving rivers of ice gives them the ability to dramatically change the landscape they move across. It may not be surprising, then, that Northern Indiana's landscape was completely redesigned by glaciers (Figure 2). A large majority of naturally occurring lakes in northern Indiana were created because of glaciers. These are called kettle lakes.

When the glaciers in Indiana started to retreat, they began reshaping the landscape as they moved. As glaciers retreat, a process called calving can occur where large chunks of ice can break off. These calved blocks of ice then cut into the ground and carve out large depressions in the earth. As the glacier continues to recede the blocks are left behind and can melt as temperatures increase. These large depressions that are filled in with water by surface or underground rivers are called kettle lakes (Figure 3). These kettle lakes are very common in northern Indiana. Glaciers can also carve out depression to form rivers, streams, and dunes. This is why the landscape in northern Indiana is so different than central and southern Indiana.

Figure 1. Glacial extent for Indiana.

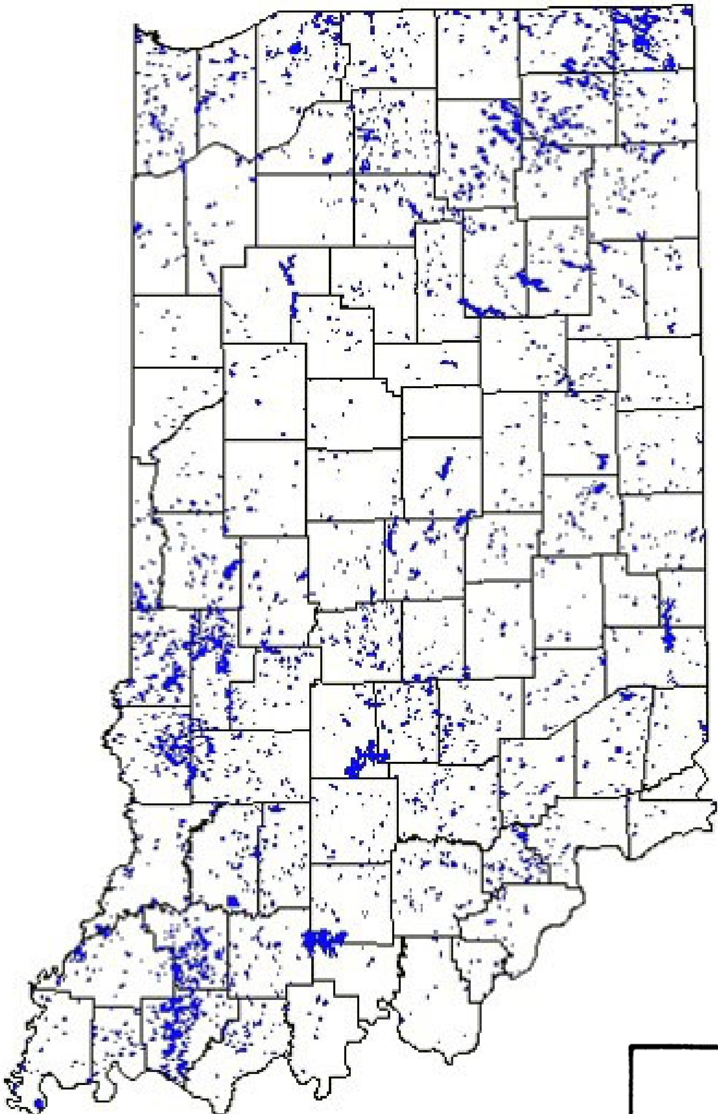

Figure 2. Kettle lakes dominate the top half of Indiana among the state distribution.

Kettle lakes can vary greatly in size; geologists explain that this can depend on many factors, including size and weight of the ice block that breaks off, rock or soil type the block cuts into, and the amount of material (such as rocks or soil) frozen in the block. While shape and size may vary from lake to lake, depth is less variable.

The difference in size and shape means that the kettle lakes can also vary in water quality and biological communities. This also means that kettle lakes face the same threats as other lakes such as sedimentation, harmful algal blooms, cultural eutrophication, etc. This also means that kettle lakes don't always require special management techniques, and problems can be solved with standard management solutions such as dredging to decrease sedimentation. Glaciers can form other types of freshwater features. Calved blocks that cut depressions that are filled by groundwater are classified as kettle ponds, and depressions that are filled in with vegetation and precipitation are classified as kettle wetlands. Kettle bogs can also form if water in the kettle becomes acidic, which can occur during decomposition of organic plant matter. These bogs, lakes, and wetlands are all very important ecosystems for various types of plants and organisms which have learned to live in these ecological niches. Glaciers were very influential in creating of lakes in Indiana and throughout the northern Midwest. They are found all over the earth and contain about 75 percent of the earth's freshwater. With climate change glaciers are at risk of melting at increased rates. This would greatly contribute to sea level rise and increase the rate of climate change even further.

The History and Consequences of Reversing the Chicago River

~ Jake Berger

To most observers, a river is as unmovable and permanent as a mountain or a valley. But for as mighty as rivers can be, mankind has been able to impose its will on them every now and again, as was the case with the Chicago River. In the late 19th century, the flow of the Chicago River was reversed via a series of locks and canals in one of the greatest civil engineering feats of all time.

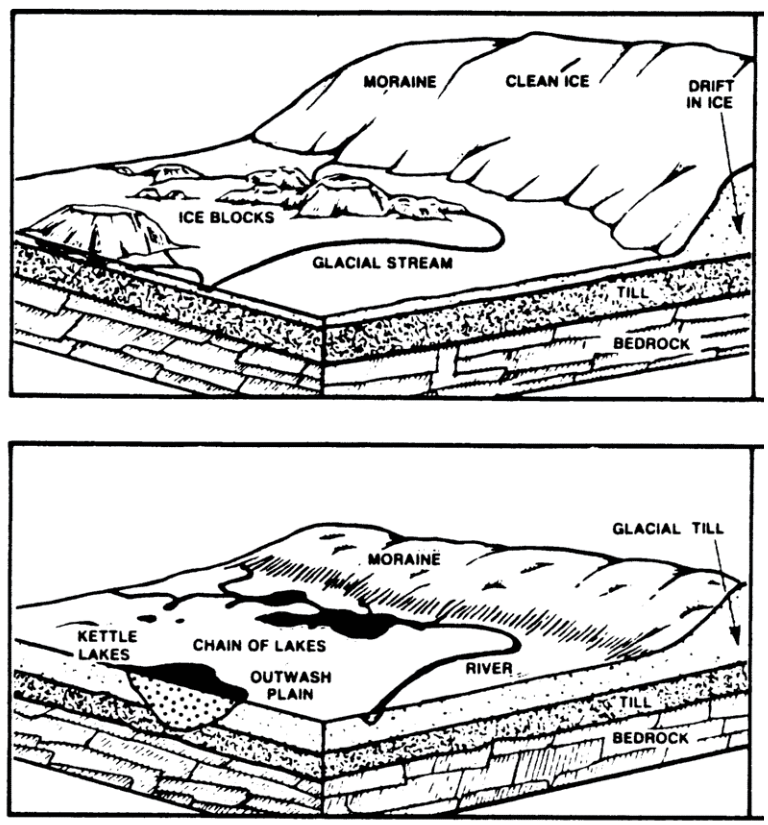

Figure 3. Isolated ice blocks due to glacial retreat result in kettle lakes.

Before the area was developed by Europeans, the Chicago River flowed from west to east into Lake Michigan, and the Great Lakes' watershed was separated from that of the Mississippi River, although only by less than 30 miles. As the city started to grow, public health issues such as typhoid and dysentery arose from the pollution and human waste that was being dumped into the Chicago River. This was then carried into Lake Michigan, which was the city's main drinking water supply. All it would take was a decent rainfall to contaminate the intake of the drinking water supply. The solution was vast in scope but simple in theory: All they had to do was dig a canal across the watershed boundary to connect the Chicago River to the Des Plaines River (a tributary of the Mississippi River) and make it deep enough so that gravity would pull the water down through the channel and away from Lake Michigan (Figure 4). The first portions of the canals were opened in 1900 and the Chicago River flowed from east to west, taking Chicago's waste in the opposite direction of the city's drinking water. At the time it was the largest-ever municipal earth-moving project.

Not only did this feat improve Chicago's drinking water quality, but it connected the Great Lakes to the Mississippi River, thus creating a navigable path from the Atlantic Ocean to the Great Lakes and down to the Gulf of Mexico, which further solidified Chicago's role as a global hub for transportation and commercial activity. However, this created its own set of environmental problems. Chicago simply put their waste downstream and made it somebody else's problem without doing much to fix the problem other than the dilutional effects. More recently, this pathway has made it more difficult to keep invasive species outbreaks quarantined. The Asian carp has quickly spread throughout the Great Lakes and Mississippi River watershed, including many freshwater bodies in Indiana. They are one of the most urgent threats to Lake Michigan's $7 billion fishing industry due to their harmful effects on native fish populations. Other invasive species whose spread has been perpetuated by this connectivity include zebra mussels, quagga mussels, and sea lamprey. Since much of Indiana is drained by the Wabash River which connects with the Mississippi River via the Ohio River, and because Illinois and Indiana, both have shoreline on Lake Michigan, the implications of this project completed in Chicago more than one hundred years ago are still affecting our state and others throughout the watershed.

Although this modern engineering marvel solved one of the most pressing issues of its time, it is important to remember that it was not completed without consequences. Management efforts will need to be collaborative between multiple states so that this connected watershed can be functional for years to come.

Perspectives

A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature.

~ Henry David Thoreau

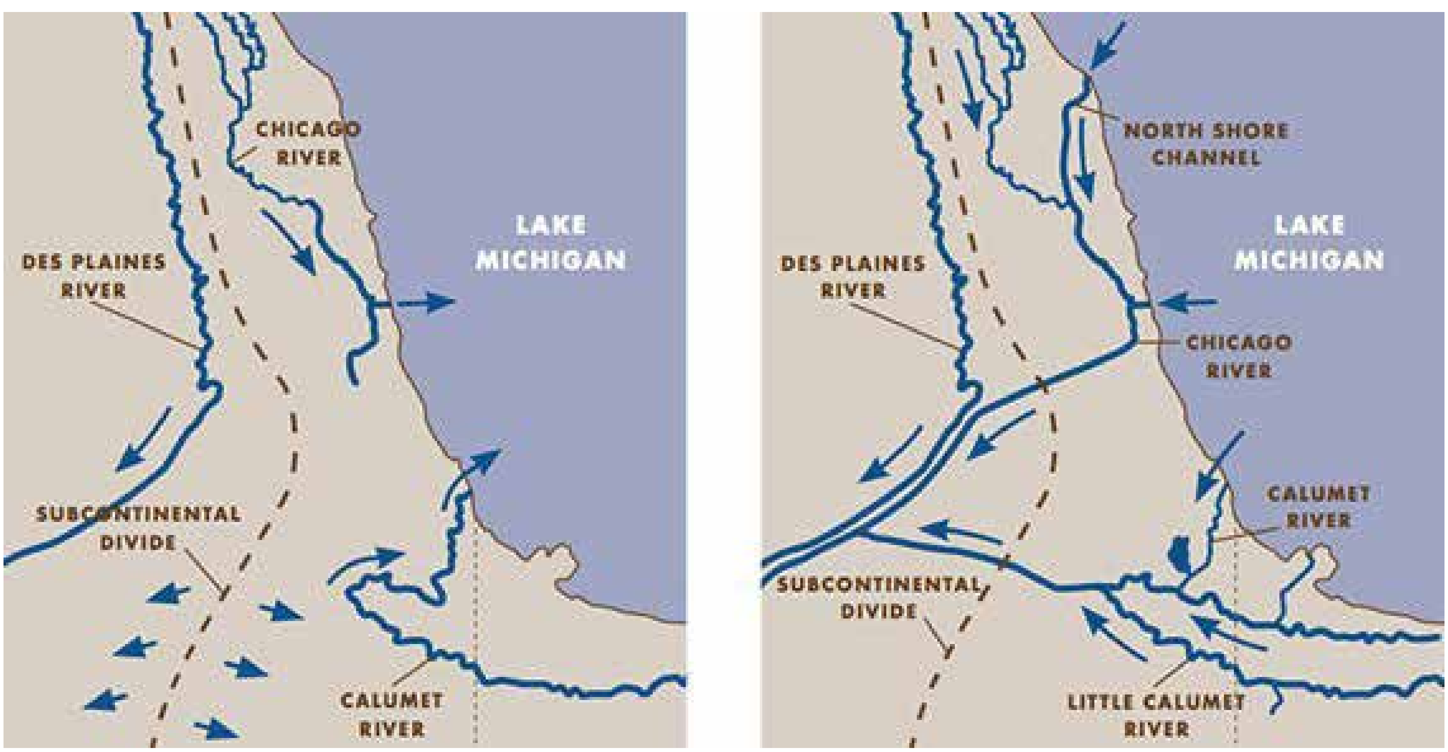

Figure 4. Flow and connectivity of the Chicago River before and after the diversion projects. Source: https://chicagoriverstories.wordpress.com

Study to answer when, why some algae turn toxic

Toxic algae blooms are becoming more frequent and destructive around the world

~ Brian Wallheimer, Purdue University

WEST LAFAYETTE, Ind. – Toxic algae blooms, such as the dramatic red tides that have swept onto beaches along the Gulf of Mexico, are becoming more frequent and destructive around the world. In Texas, one species alone, golden alga, has killed more than 34 million fish since the 1980s (Figure 5).

Current models used to predict golden alga blooms are ineffective, and the genes responsible for toxicity in the species are unknown, leaving scientists and natural resource managers unprepared for algal eruptions. But with a nearly $2 million National Science Foundation grant, Purdue biologist Jennifer Wisecaver hopes to change that.

Wisecaver, an assistant professor in Purdue's Department of Biochemistry, is leading a project with colleagues from the University of Arizona and Penn State Harrisburg, accepting algae samples from all over the world, but mainly the Texas waters experiencing large fish kills. Scientists will isolate hundreds of single cells from bloom samples, culture them and identify different strains of algae with different characteristics to determine the genes responsible for toxicity.

Matching the genetics to conditions observed when the algae bloom will uncover the triggers for toxicity and help Wisecaver and her colleagues better predict when toxic blooms will occur.
"Many of the current models focus on physical conditions like water salinity and temperature to predict blooms. However, the genes responsible for toxicity may be responding not only to the physical environment, but also to the presence of vulnerable food sources," Wisecaver said.

Figure 4. A toxic algae bloom led to more than 5 million fish killed at Lake Granby in Texas in 2003. Purdue University's Jennifer Wisecaver's work will identify the genetic mechanisms associated with toxicity to better predict these deadly events. (Photo courtesy Gary Turner/ Brazos River Authority)

That's because many species of toxic algae are mixotrophic, meaning they get energy from a mix of sources, not just photosynthesis.

"It's often assumed that algae, like plants, get energy from the sun. But, in reality, golden algae can be voracious predators," Wisecaver said. "They'll swarm and eat other non-toxic species of algae. They'll also swarm small animals like rotifers and water fleas. And we think they're even capable of swarming fish gills, actually attacking fish.

"Our hypothesis is that toxins help golden algae be better predators. If this is true, our models need to account for that. We need to appreciate their ecology to understand when and why these algae are producing toxins."

Fourth National Climate Assessment Report

~ USEPA

On November 23, 2018, the U.S. Global Change Research Program (USGCRP) released the Fourth National Climate Assessment (NCA4) focusing on the human welfare, societal, and environmental elements of climate change and variability for 10 regions and 18 national topics, with attention paid to observed and projected risks, impacts, consideration of risk reduction, and implications under different mitigation pathways. This assessment was written to help inform decision-makers, utility and natural resource managers, public health officials, emergency planners, and other stakeholders by providing a thorough examination of the effects of climate change on the United States.

According to the report, the occurrence of conditions that contribute to harmful algal blooms, can result in

31st Annual Indiana Lakes Management Conference
March 21, 2019, 9:00 a.m., EDT, Oakwood Resort, Syracuse, Indiana

Join the Indiana Lakes Management Society for the 31st Annual Indiana Lakes Management Conference.

Join us Wednesday, March 20th for Exhibitor set-up between 5:00 and 7:00 pm.

Registration opens at 8 am on Thursday, March 21st in the Hilltop Conference Center with our plenary speaker starting at 9 am.

Plenary Speaker: Dr. Allen Hamlet, University of Notre Dame will speak on "Climate Change Impacts on Water Resources".

Friday Workshops include Plankton Identification with Ann St. Amand, PhycoTech and an Inside-Outside Tour of Wawasee Area Conservancy Foundation protection and restoration efforts.

Interested in sponsoring the 31st Annual Indiana Lakes Management Conference – learn more about sponsorship levels!

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

ILMS

Dedicated to our lakes

an increase of restrictions to water usage for drinking and recreation in the Midwest. In the northwest, razor clamming on the coast of Washington State is expected to decline due to ocean acidification, harmful algal blooms, warmer temperatures, and habitat degradation. Explore the report online or download it at [nca2018.globalchange.gov.](nca2018.globalchange.gov)

Volunteer Corner

Data is in and reports are out! If you have any more data to enter, please let us know! Once it is entered, we can make any needed revisions to your report.

It was a great season for the volunteer program this year, and we are looking forward to the progress 2019 will bring. We are making some big changes in our database and reporting process. While it is slow for the moment, we are excited for the increased the efficiency and new web tools this process will bring. Thank you for your patience and stay tuned.

We can't thank our volunteers enough. We have an outstanding group of long-standing as well as brand-new folks out there on Indiana's lakes. The program wouldn't exist without your hard work and dedication to monitoring Indiana water quality. Thank you for all you do!

CLEAN LAKES PROGRAM

WATER COLUMN

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Aquatic Invasive Monitoring Plant Highlight

This will be the 23st 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.

Yellow floating heart (*Nymphoides peltata*), INVASIVE

COMMON NAMES: Yellow floating heart, fringed water lily

The yellow floating heart is also known as Fringed water lily. The genus name comes from the Greek nympha meaning 'nymph' and oides meaning 'resembling.' Plants most likely confused with yellow floating heart are spatterdock and watershield. Nymphoides peltata prefers slow moving rivers, lakes, reservoirs, ponds and swamps 1.5 to 13 feet deep. This species reproduces by seeds and broken stems. This plant overwinters as dormant tuberous rhizomes.

DISTRIBUTION: Yellow floating heart is native to temperate and tropical Asia and Europe. This plant has been introduced to North America and New Zealand. Indiana: Yellow floating heart has been found in a few Indiana ponds.

DESCRIPTION: Yellow floating heart is "an aquatic, bottom-rooted perennial with long branched stolons extending up to one meter or more and lie just beneath the water's surface. A new shoot and roots are capable of forming at each node on a stolon. The floating heart has heart shaped or nearly circular leaves are 3-10 cm long on long stalks and they arise from creeping underwater rhizomes. The leaves are frequently purplish underneath, with slightly wavy, shallowly scalloped margins. The flowers, 3-4 cm in diameter, are bright yellow with five petals. The flower edges are distinctively fringed giving this plant one of its common names, fringed water lily. The fruit is a capsule up to 2.5 cm long containing numerous seeds. The seeds are flat, oval and about 3.5 mm long with "hairy edges."

Plants most likely confused with yellow floating heart are spatterdock and watershield. Spatterdock has a large yellow "cup-shaped" flower and leaves that can grow to 30 cm or larger. Watershield has small floating leaves, an inconspicuous purple flower, and the stem and underside of the leaves often coated in a gelatinous slime.

Identification tips:

- Showy bright yellow flowers, 3-4 cm in diameter
- Flowers with fringed edges on all 5 petals
- Floating leaves – heart shaped or nearly circular, with notch
- Floating and rooted leaves are 3-10 cm long