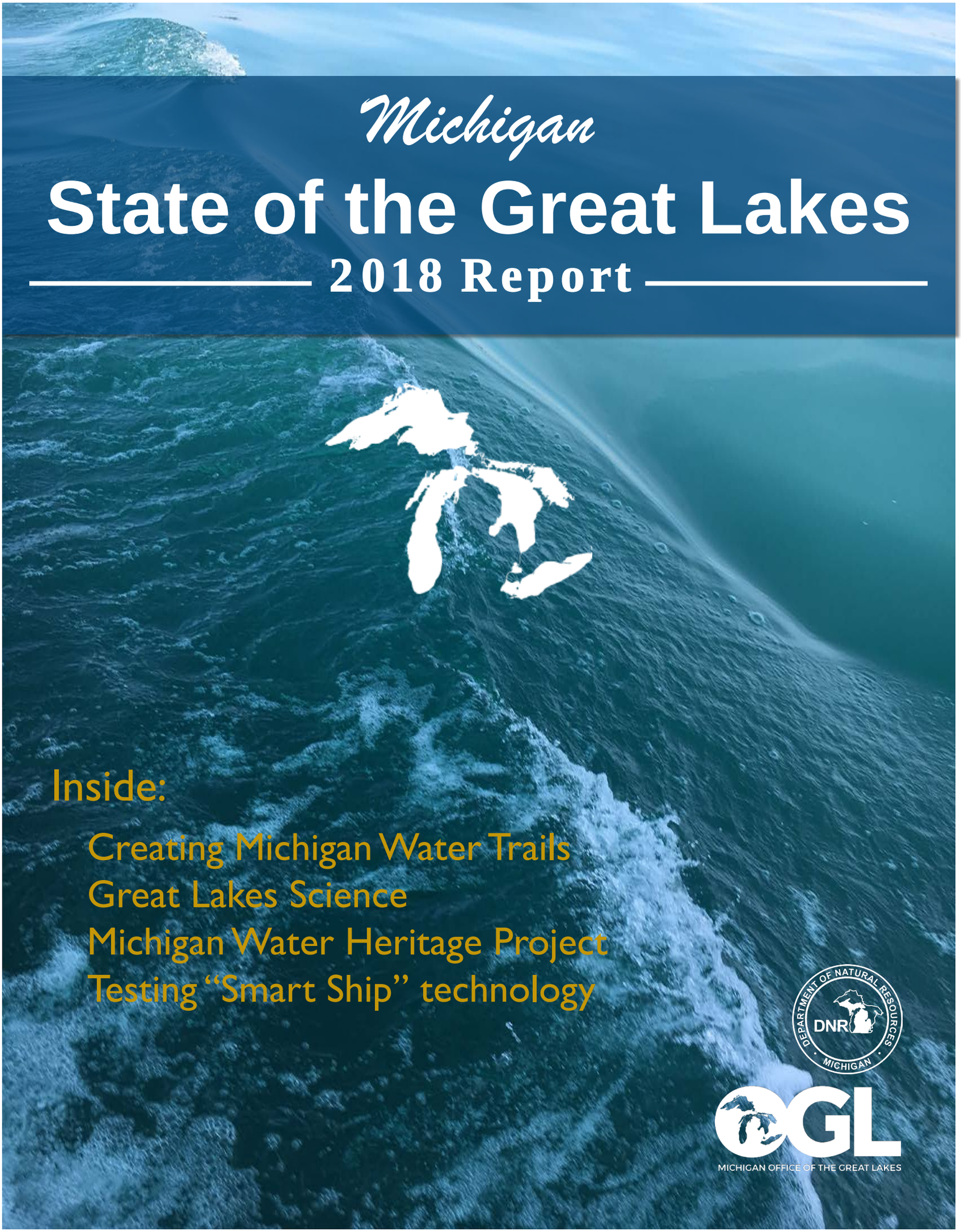


Michigan
State of the Great Lakes
2018 Report

Inside:

- Creating Michigan Water Trails
- Great Lakes Science
- Michigan Water Heritage Project
- Testing "Smart Ship" technology

DEPARTMENT OF NATURAL RESOURCES · DNR · MICHIGAN

MICHIGAN OFFICE OF THE GREAT LAKES

Contents

Cover Image: Great Lakes waters at Lake St. Clair, R. Coale, Michigan OGL

Prepared by the Michigan Office of the Great Lakes, Department of Natural Resources on behalf of the Office of the Governor

www.michigan.gov/OGL
517-284-5035
December 2018

Foreword
Leading through innovation

In 2018, Michigan's state agencies and partners have made progress in collaboratively managing water resources by launching initiatives, achieving transformative changes, and generating innovative ideas on local, state, and regional levels.

From the regional perspective, Michigan, Ohio, Pennsylvania, and Ontario have developed strategies and initiated action to support the recovery of Lake Erie. Michigan continues its leadership role in upholding the Great Lakes Water Resources Compact—recently marked by a tenth anniversary—which provides a comprehensive regional management framework for sustainable water use and resource protection. Thanks to ongoing work with the Great Lakes -St. Lawrence Governors & Premiers, the Great Lakes region has been established as a pioneer in autonomous maritime vessel research through creating solutions to short- and long-term challenges.

In Michigan, collaborative partnerships are helping communities restore and prioritize their waterfronts. We've celebrated many significant milestones, including the recovery of the contaminated former Zephyr oil refinery site in Muskegon and the removal of an impairment designation in the Menominee River. Work continues in the Twin Cities to develop a sustainable harbor vision as the St. Joseph, Benton Harbor, and St. Joseph Township communities envision the future of their shared harbor. Next year, the Saginaw Bay Reef project will have the potential to spur both economic and ecological gains through the restoration of historic reefs important for walleye, whitefish, trout, and the people who love to catch them.

While we've experienced tremendous progress and innovation in 2018, we also have encountered challenges. As our nation continues its work to understand and address the nature of PFAS chemicals, Michigan took action by initiating a $1.7 million statewide study of water supplies—the largest of its kind. We continue the battle of preventing invasive species from entering the Great Lakes, and created new methods to deter them through initiatives like the Carp Challenge. By working collaboratively with our natural resource agencies, we also are identifying ways to control existing populations of invasive species like red swamp crayfish.

To ensure ongoing progress, we're investing in resources to support water management well into the future. A pilot project in the Clinton River watershed will test new ways to monitor and manage our waters, while projects like the Michigan Water Heritage exhibit are inspiring people to become active stewards of the places they love.

Michigan's Great Lakes waters and coastal resources are an incredible asset, and as the Great Lakes State, we have a responsibility to preserve and protect them for generations to come.

Thank you,

Governor Rick Snyder

Director's Message
Reflecting on progress

I would like to reflect on how far we have come in restoring Michigan's waters. Some will not feel we have come far or fast enough, and sometimes I share that feeling. We live in a complex world made more complex by a deep history of human actions, and it should be no surprise that solutions to these problems are not simple – politically, economically or biologically.

In the past, we treated our waters and the Great Lakes as a dumping ground, and work to undo that damage will take generations of effort, not just a few years. We are in the middle of that work, but it is not finished. As we reflect today, it has already been a generation – entire careers for some people — and we should thank them for that dedication.

Our heroes who have undertaken this work did not accept the world they were handed; they chose a career of undoing inherited ecological damage. We ask no less of new employees and volunteers now as they enter the ranks of those of us who have dedicated our lives to restoring the ecological function of our waters.

In July we were visited by a high-ranking delegation from China's Guangdong Province. They are a sister province to Michigan, and, like Michigan, have nearly the same shoreline (albeit ocean coast). Discussing restoration work underway in the state and across the Great Lakes Basin provided an opportunity to reflect on our own progress and challenges.

The Guangdong delegation asked us "when in history was Great Lakes water quality the worst?" That was an easy answer — it was the 1960s, just before the Clean Water and Air Acts and many other environmental protection laws were passed. I can still recall my father's lament over "mercury perch." Looking back at that time, we have made significant progress, but there is more work to be done.

The Guangdong delegation replied that they are facing their worst water quality now. Like us, they created economic prosperity, but incurred great environmental costs. They are now seeking ways to undo this damage, as we did. In both cases, the remediation of pollutants takes time, effort and money.

Our collective work across the Great Lakes is now resonating on the world-wide stage. Our approach to restoration and the reestablishment of ecological integrity, while simultaneously enabling economic prosperity and social well-being, is being observed with interest.

Some argue that the co-important goals of economic progress and ecological integrity are fundamentally incompatible; however, I disagree. How we use our resources, the Great Lakes in particular, is critically important. How we support long-term programs for ensuring water quality and water monitoring is important. And how we manifest our deep and abiding desire for a healthy Great Lakes is key to this effort.

Today, we have strong regulatory programs for managing point-source industrial and municipal discharges. Across the region, we are inventing new mechanisms to deal with threats like invasive species, nutrient loading, and E. coli from sources such as sewage discharge, animal agriculture, and emerging contaminants.

I want to leave you with a sense of hope. We are making phenomenal progress. We have a strong regional community that will continue to see deep value in working together, being informed by science, and laboring to find harmony in shared solutions across tribal, local, state and federal governments.

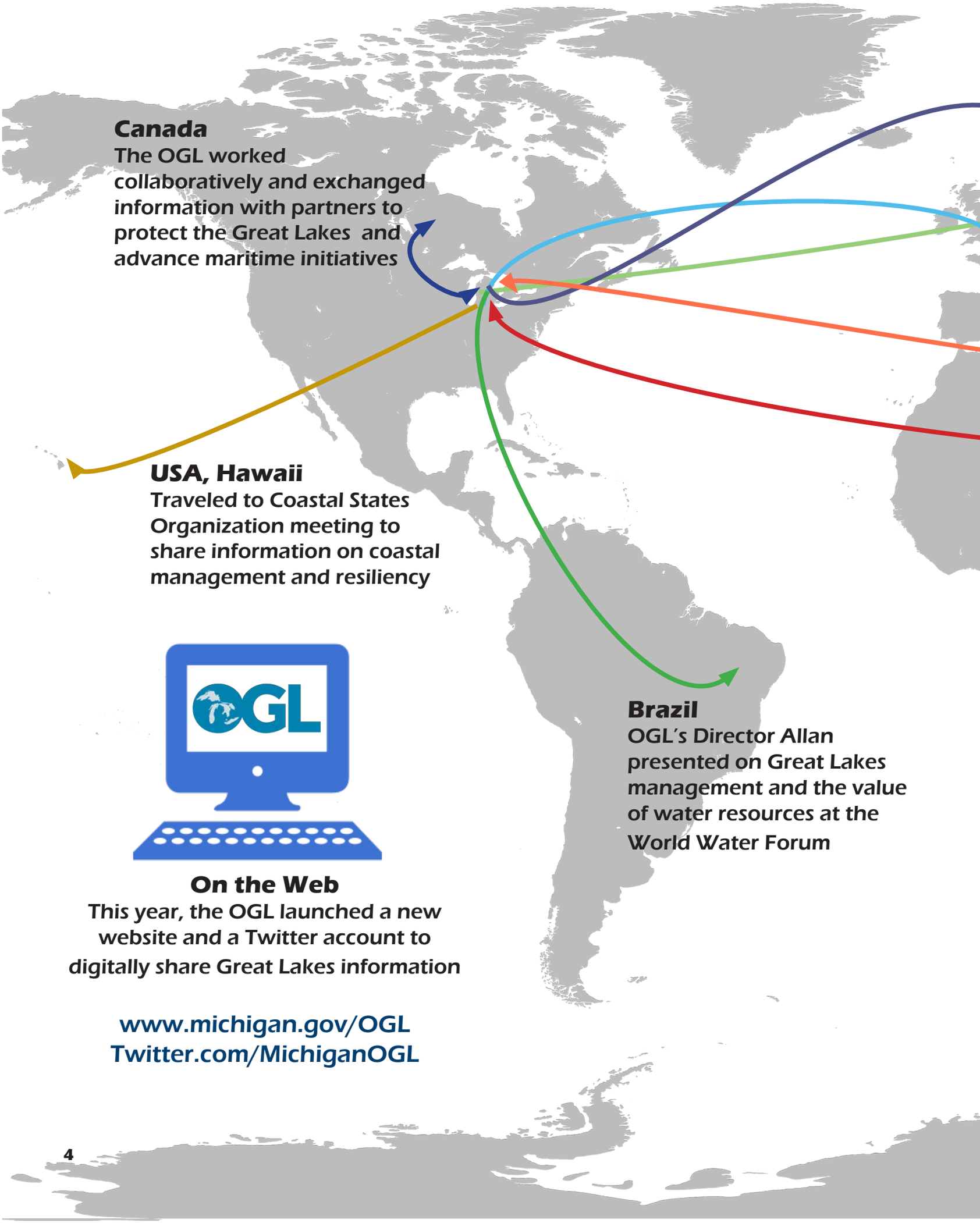
In just a short amount of time we have taken opportunities to address and fix loss of habitat; remove toxic sediment; re-establish healthy ecological function; generate resilience into our cities, harbors, shorelines and rivers; foster and support innovations in water technologies, maritime supply chain and the development of smart ships; build water-centric monitoring and sensing networks to manage watersheds; support island and rural coastal communities and their ways of life; and, connect people back to their water. If we continue this path, our region will have a sustainable future even as the world sees greater water stress.

How the Great Lakes community works together will mold the world's perception of us and how we ultimately adapt and respond to the profound demographic, climatologic, social, and economic changes that are coming to our freshwater shores. We share this responsibility and must continue to put in place the institutional mechanisms to aid in the restoration, protection, and maintenance of our region and its Great Lakes waters.

Thank you,

Jon W. Allan
Director
Michigan Office of the Great Lakes

MICHIGAN OFFICE OF THE GREAT LAKES



Canada

The OGL worked collaboratively and exchanged information with partners to protect the Great Lakes and advance maritime initiatives

USA, Hawaii

Traveled to Coastal States Organization meeting to share information on coastal management and resiliency

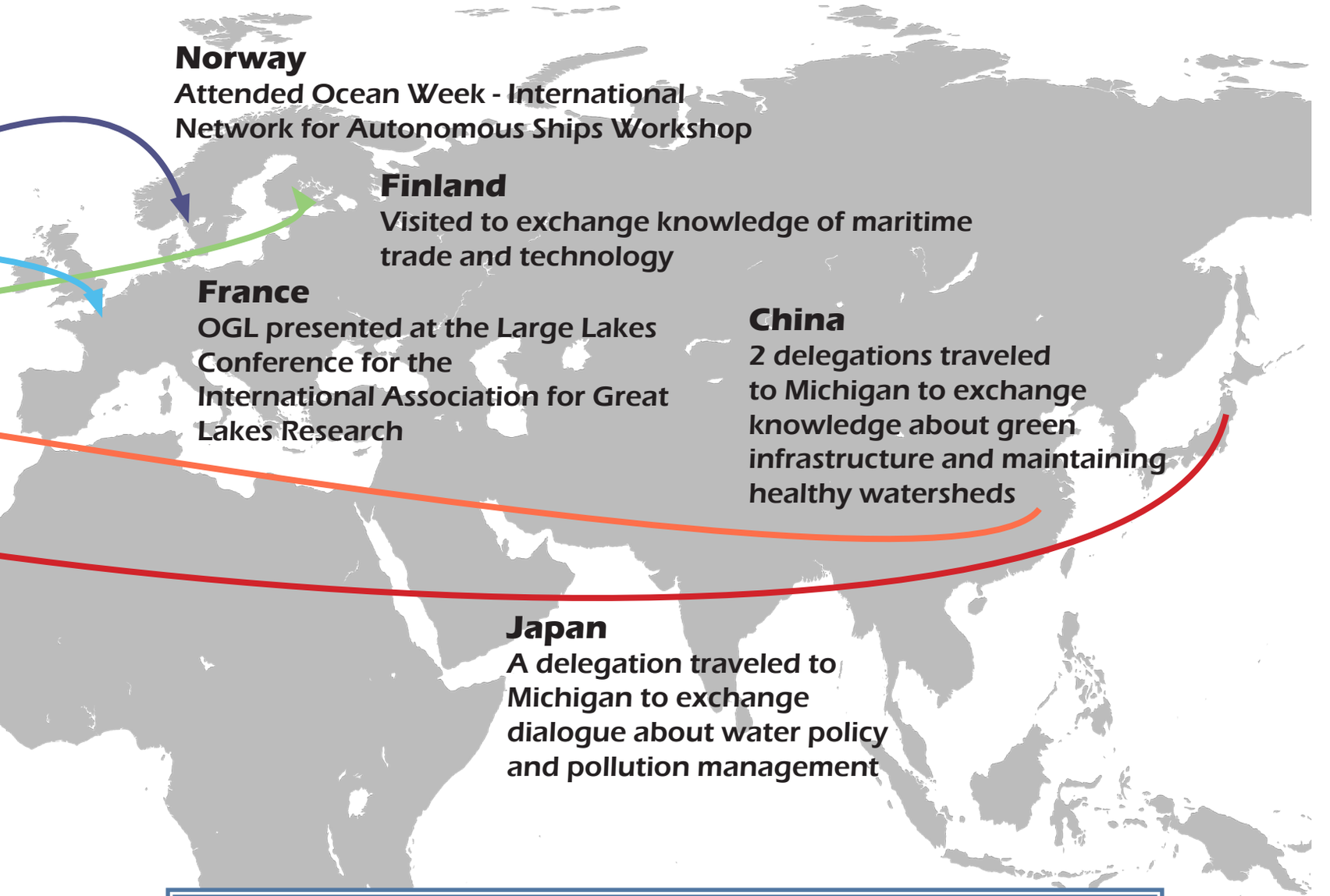
Brazil

OGL's Director Allan presented on Great Lakes management and the value of water resources at the World Water Forum

On the Web

This year, the OGL launched a new website and a Twitter account to digitally share Great Lakes information

www.michigan.gov/OGL
Twitter.com/MichiganOGL



The Great Lakes on the world stage

People of the Great Lakes region can sometimes be immune to how great the Great Lakes really are, so it's worth reminding with a few statistics: we're surrounded by more than 20% of the world's fresh water, the world's longest freshwater coastline, more than 11,000 inland lakes, and the world's largest freshwater dune system.

By sharing information about the value and management of this incredible resource, we can pass on successes and learn new strategies from others, collaboratively improving management of what is arguably the most valuable resource on our planet.

In the past calendar year, the Office of the Great Lakes connected with organizations and governments across the globe, sharing critical information and gaining new perspectives. The office also endeavored to share more information digitally, improving access, accessibility, and dialogue through an improved website and social media presence.

Rachel Coale
Outreach Coordinator, Michigan Office of the Great Lakes

Engaging waterfront communities through shared harbor visioning

The Office of the Great Lakes works collaboratively with partners across the state to support Great Lakes communities. A core tenet of this work is an emphasis on community engagement.

Sustainable Harbor Initiatives

The OGL, DNR, Michigan Sea Grant, and Michigan State Extension have worked with harbor communities across Michigan to develop long-term harbor sustainability plans through the award-winning Sustainable Small Harbor Initiative. This process involves a facilitated planning process known as a design charrette that is open to the public. Participants offer ideas and suggestions about opportunities to improve the waterfront. When community input is not intentionally sought, it makes "buy-in," or support, more challenging, so ensuring that people feel like their voices are being incorporated into decisions is key.

The Twin Cities Sustainable Harbor Project

In 2015, the Harbor Conservancy – a diverse group of community stakeholders from Benton Harbor, St. Joseph, and St. Joseph Charter Township – worked with Andrews University to develop the "Twin Cities Harbor Study," which looked at the potential of Benton Harbor and St. Joseph's shared harbor. Building on that effort, the Harbor Conservancy invited Small Harbor Sustainability partners to help the communities develop a shared waterfront vision and plan.

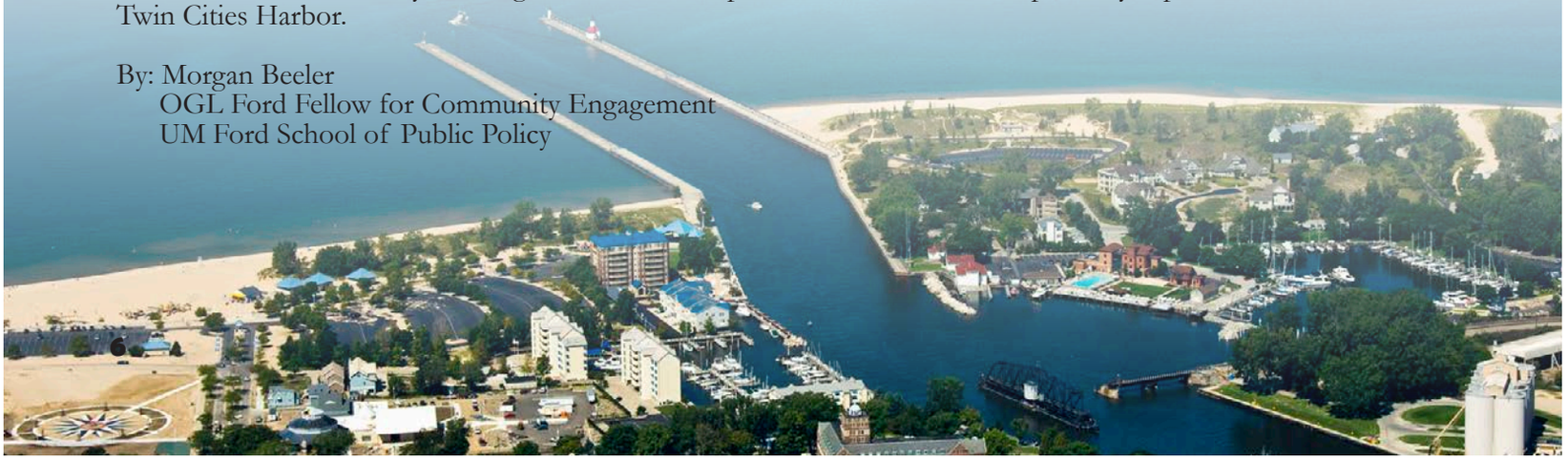
Although the Twin Cities of Benton Harbor and St. Joseph are geographically close and share a harbor, they are unique communities with individual needs. A comprehensive strategy for engagement was necessary to develop a vision that was representative of both communities.

The Twin Cities Harbor Visioning Charrette process included a design charrette planning meeting with community members; discussions with city and township officials, planning and development commissions, parks and recreation, local business and commercial interests, recreational boating and commercial shipping, as well as public safety; an initial visioning meeting where community members provided input on the opportunities they saw for their harbor; facilitation of multiple focus groups; a three-day series of public design sessions where the project team facilitated community discussion; and a final presentation to the community.

The process required an immense amount of community outreach to ensure community members were informed about the process and given the opportunity to participate. Project partners worked with the Harbor Conservancy and local leaders to develop communication strategies using their perspectives and ideas to develop plans that would be effective for engaging each community.

The Twin Cities Sustainable Harbor project is still underway. The project team has completed the three-day design charrette in the community and will take additional measures to engage the community and encourage further participation. This includes working with the local Harbor Conservancy and community leadership to conduct focus groups with faith-based organizations, sorority and fraternal groups, young professional and leadership organizations, and additional community meetings to facilitate deeper discussion and develop a truly representative vision for the Twin Cities Harbor.

By: Morgan Beeler
OGL Ford Fellow for Community Engagement
UM Ford School of Public Policy



Reconnecting to the Great Lakes

Restoring the Erie Marsh Preserve

Lush wetlands once lined the shores of Lake Erie, providing habitat for fish and wildlife, filtering our water and offering places where people could connect with nature. Of the original 307,000 acres of coastal wetlands in Lake Erie, less than five percent are left. The Nature Conservancy's Erie Marsh Preserve, encompassing over 2,200 acres near Monroe, Michigan, contains 11 percent of these remaining wetlands.

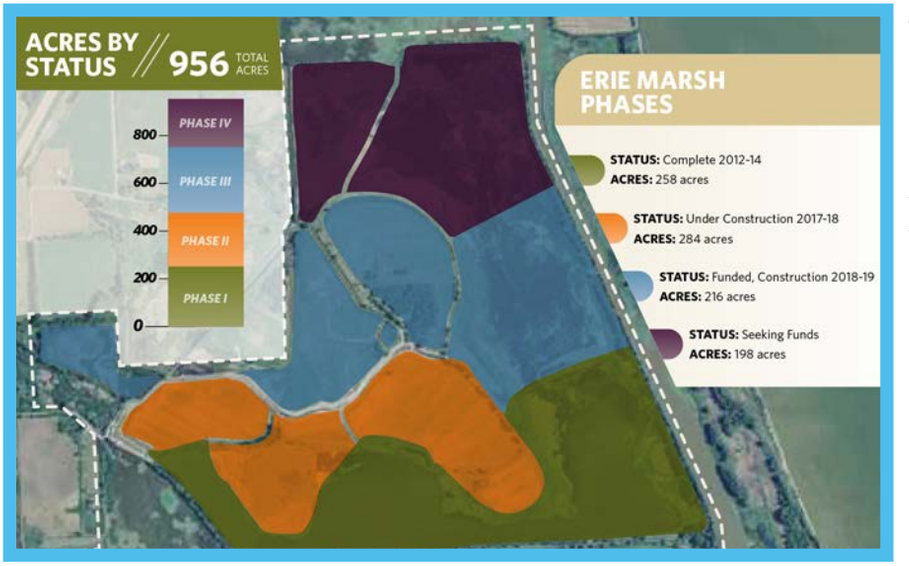
Historically, Erie Marsh was altered by levees, canals, dikes and other man-made structures, which changed the way water flowed through the wetland. Invasive species such as *phragmites* impacted native plant and wildlife communities, and perhaps most concerning of all, the preserve was cut off from Maumee Bay, which kept fish and other aquatic life from accessing the rich spawning and feeding grounds found in the marsh.

Beginning in 2011, TNC began a large-scale restoration project to reconnect 946 acres of the preserve to Lake Erie for the first time in more than 60 years and to improve wetland quality and control invasive plants. This project, the first phase of a multi-year construction effort, installed new water management structures, increasing the number of habitat types found in the preserve, managing invasive species more effectively and allowing native fish access to spawning habitat to increase populations.

In 2017, the second phase of restoration work began on nearly 200 acres of coastal wetlands.

This work made the dikes higher and sturdier, improving the water level control in three sections of the preserve and providing more control in managing fish and bird habitat.

The third phase of work began in 2018, making improvements to an additional four sections of the preserve, covering just over 300 acres. TNC continued to focus on improving the dikes, but also installed new water control structures to improve the water flow, complementing the work completed in phase one. Planning the fourth and final phase of this work is under way.



There are already signs that these efforts are having a profound impact on the ecosystem.

Shortly after the initial reconnection to Lake Erie, the number of fish species found in the wetland increased. While there is still more work to be done, the fact that these native species were able to find their way home after 60 years speaks to the incredible potential of the restoration work happening at Erie Marsh.

By: Kari Marciniak
The Nature Conservancy

Spatial mapping and outreach campaign reveal data about Michigan's coastal dunes

An 18 month project to advance understanding and awareness of the world's largest collection of freshwater coastal sand dunes is wrapping up and showing promising results.

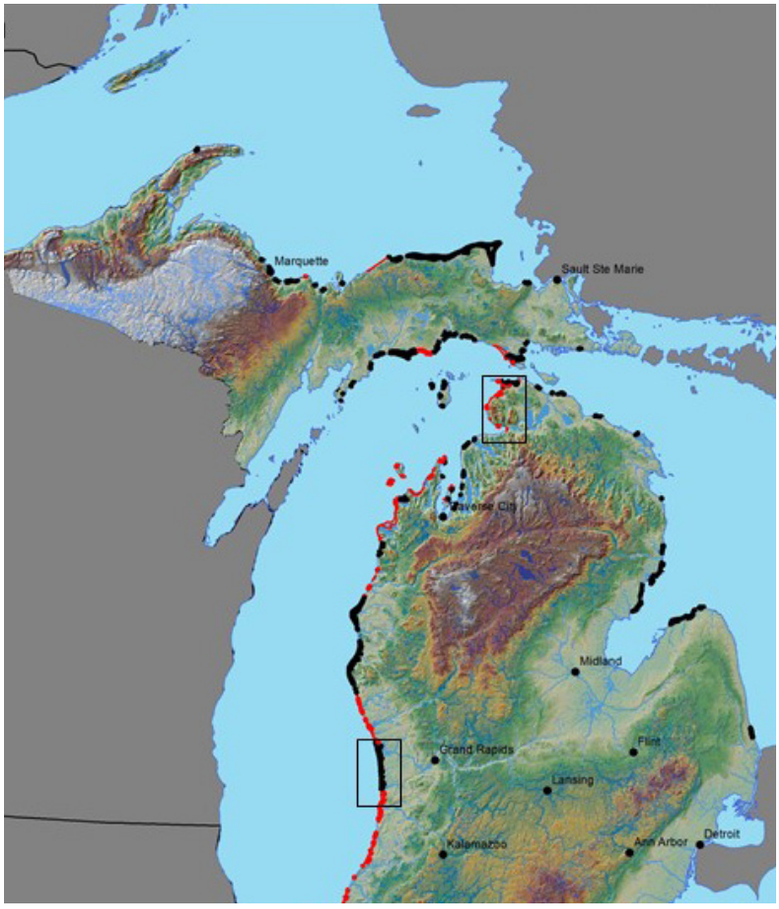
Michigan Environmental Council (MEC) coordinated with a team of academic experts, environmental organizations, citizens, and dune stakeholders to create the first complete geographic maps of Michigan's 230,423 acres (93,249 hectares) of coastal sand dunes.

The Valuing Michigan's Coastal Dunes project stemmed from a 2014 Michigan Environmental Council report outlining the history of Michigan's dune management. Both projects were supported by Michigan's Office of the Great Lakes, Coastal Zone Management Program through the National Oceanic and Atmospheric Administration.

The team had two sets of experts who worked on the project. The first, led by Michigan State University (MSU) professors, created a GIS map of Michigan's coastal dunes that established their entire spatial extent.

The map allows for a more accurate understanding of the dunes for the future, MEC said. For instance, viewers can see what percentage of dune system is in public ownership and how it is regulated by state and local laws.

Unlike previous models, this map includes several dune fields on Michigan's east coast. Some of these fields are considered "critical."



The map will be made publicly available on MEC's website.

The second part of the team, also from MSU, sought to understand the social, cultural, and economic importance of the dunes through a #HowYouDune campaign.

The campaign's core was based on an online survey, modeled on previous work done by the Surfrider Foundation and built by Duck's Unlimited, another project partner.

Participants could locate which dune sites they visited using a mapping feature. Then, they could share their activities and expenditures during their trips and rate the value they had toward Michigan's dunes.

From the campaign's Freshwater Dunes Summit kickoff in May 2017 to its end that October, over 3,600 individuals recorded over 7,000 dune visits from 2016 onward. Individuals brought an average 2.4 people with them and spent an average of $392.

Beach-going, scenic enjoyment, and camping were top reasons for visiting dunes.

More than 90 percent of participants found the dunes' scenic beauty and protection to be important to them.

West Michigan Environmental Action Council, Heart of the Lakes, and MEC led #HowYouDune's outreach. Social media posts, postcards, posters, presentations, case study interviews and email lists informed people of the survey and taught them the importance of dunes to the environment.

The outreach team presented their results at the 2018 International Association of Great Lakes Research Conference.

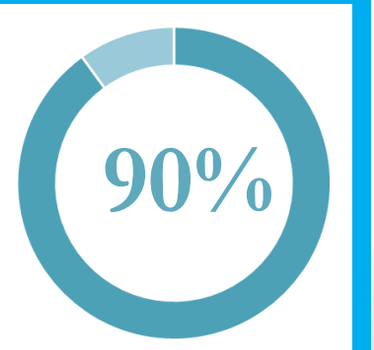
"Michigan's coastal sand dunes are truly a world-class natural resource," said Brad Garmon, Project Lead at MEC, who coordinated the presentations. "We want to build the base of knowledge and understanding of these resources and begin to measure their impact on people and the economy. That way, as a region, we can be smart about how we protect, use and enjoy them."

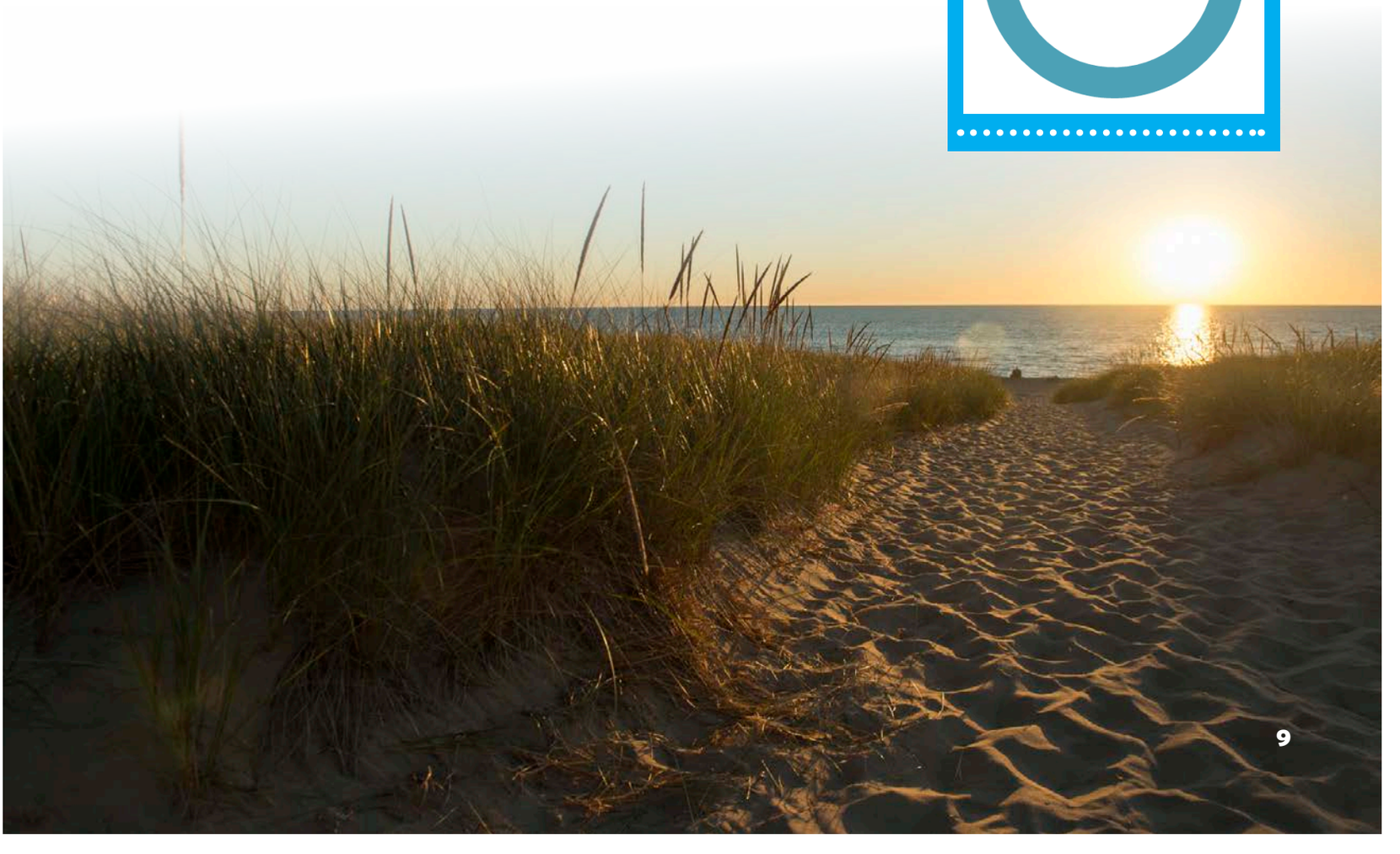
By: Beau Brocket, Jr.
West Michigan Environmental Action Council
Eco-Journalism and Blogging Intern

Dune Tourism

Average dollar amount spent: **$392**

More than **90 percent** of people surveyed reported that dune protection is important to them.





Mapping reveals shoreline changes on the Lake Michigan coast.

Sustaining Great Lakes Beaches

By: Matthew Warner, Coastal Hazards Specialist, Michigan Office of the Great Lakes

For many, a Michigan summer is not complete without visiting a favorite Great Lakes beach. We expect these beaches to stand the test of time so we may continue to wiggle our toes in the sand while watching sunsets, building sandcastles, and taking evening strolls along the beach. However, beachgoers have been surprised over the past few years as many of Michigan's favorite beaches have become narrower and, in some cases, disappeared altogether.

Concerns are mounting amongst both beach visitors and those who own or manage coastal property. **Where did the sand go? Will the beach come back?**

Like the ocean, Great Lakes water levels can go up and down dramatically. Unlike the ocean, this process is irregular, unlike tides, and can take years to change.

Michigan's Coastal Management Program is partnering with a team of researchers and planners to help coastal communities prepare for coastal erosion challenges. The team, which includes the University of Michigan, Michigan Technological University and Traverse City-based LIAA, is providing data and information communities can use to better understand how the coast changes over time. This can help inform a community's land use plan and zoning ordinances.

Increased Great Lakes water levels, combined with an overall reduction in the amount of sand in our nearshore coastal systems, play primary roles in our shrinking beaches. Water levels are largely beyond our control, but people's actions have had significant impacts on the volume of sand that reaches our beaches. Unlike many ocean coasts where rivers carry and supply sediment to the ocean systems, relatively little sand from rivers is able to find its way to the Great Lakes. Most of the sand on Great Lakes beaches comes from erosion of shoreline dunes and bluffs.

Coastal erosion often carries a negative connotation, but this erosion is essential to the building and sustaining of our beaches. As dunes are impacted by erosional waves, the sand becomes available to the beach and nearshore sand bars.

Beaches provide the best form of shore protection. Unlike engineered seawalls or revetments, beaches react to changing conditions. During large storm waves the sand bars in front of the beach actually move slightly further away from the shoreline. These bars trip the waves away from the beach causing lower waves with less energy to impact the shoreline.

Where seawalls have been built, beaches and nearshore bars are often small or non-existent because the sand needed to build these bars is trapped behind the structure. High-energy storm waves are then able to crash directly into the structure without being slowed by sand bars or having the energy dissipated by running up the beach. Almost ironically, when coastal investments are threatened by erosion, thoughts on protecting them typically turn first towards engineered shore protection such as seawalls. It is not well understood that a seawall can actually eliminate any beach that exists on a property.

Michigan's coastal communities are increasingly recognizing the importance of beaches towards their economic and social well-being. Furthermore, they are realizing that sustaining beaches benefits from a shared management approach. The City of St. Joseph on the southeastern Lake Michigan coast serves as an example of a local government taking action to work with citizens to protect beaches. The City instilled a zoning ordinance for a section of shoreline within its jurisdiction, mapping a setback line on the beach. Prohibiting buildings and shore protection structures will help maintain a naturally-functioning beach.

Healthy beaches require long-term vision. Most of Michigan's beaches are still natural and opportunities exist to sustain them into the future. Doing so will require actions of coastal property owners and land management officials at all levels of government that consider how today's action will impact the future.

Improving Lake Erie with Best Management Practices

By: Meredith D. Smith, Environmental Stewardship Division, Michigan Department of Agriculture and Rural Development

The Great Lakes are a source of water for millions of residents in United States and Canada. Lately, emphasis has been placed on collaborating to protect water quality in Lake Erie, especially in the Western Lake Erie Basin. Algal blooms are taking over parts of the lake, giving it a greenish hue and sometimes producing toxins that can be harmful to humans and animals. Scientists have discovered that a form of phosphorus, Dissolved Reactive Phosphorus, is one of the factors contributing to the algae growth.

To reduce the amount of phosphorus and nitrogen from entering Lake Erie and the growth of the algal blooms, Michigan developed a Domestic Action Plan for Lake Erie. The plan, available at michigan.gov/LakeErieDAP, discusses how the state will improve water quality for the lake. Implementation includes a research project using drainage water management practices to reduce amounts of Dissolved Reactive Phosphorus and other nutrients from leaving farm fields.

The Michigan Department of Agriculture and Rural Development, the Michigan Department of Environmental Quality, and the Lenawee Conservation District partnered with Michigan State University to conduct a five-year edge-of-field water quality monitoring project. It investigates the benefits of drainage conservation practices in reducing phosphorus, such as Dissolved Reactive Phosphorus loss from agricultural fields in the Western Lake Erie Basin.

Dr. Ehsan Ghane, Assistant Professor and Extension Specialist in the Department of Biosystems and Agricultural Engineering at Michigan State University is the lead researcher on the project.

"We are trying to find methods and ways to address the water quality issues in Michigan water bodies, especially in the Western Lake Erie Basin in terms of the algal bloom and the toxin production from the harmful algae," said Dr. Ghane. "Our overall goal is to address that issue. Specifically, we are working on subsurface drainage conservation practices to help reduce the loss of phosphorus that feeds the algae."

Farmers use subsurface or tile drainage to remove excess water from their farm, to allow for field operations and plant growth. Nutrients, such as Dissolved Reactive Phosphorus, can still pass through the tile drainage and enter the waterways. MSU will evaluate drainage conservation practices in removing nutrients in water leaving fields.

"We are trying to see how well controlled drainage and saturated buffers perform in Michigan, quantify their performance, and also come up with better management guidelines for those conservation practices," said Dr. Ghane.

Measurements and water samples will be collected year-round at three sites over several years to determine the effectiveness of these conservation practices in preventing nutrient loss and potentially improving yields. So far, only baseline data on water quantity and quality have been collected at each site.

The edge-of-field project will help researchers understand the impact of controlled drainage in improving crop yields and reducing the amount of phosphorus loss on agricultural fields. The project is set to end September 2022.

Staging a Comeback

Healing Michigan's waters

The waters of the Great Lakes support our region's economy and create prosperity, but we didn't always treat them with care. Historic practices harmed many waterways, causing environmental impacts. Fourteen of those places in Michigan, labeled "Areas of Concern," are now being restored through the collaboration of federal, state, and local partners.

In the trench(es)

Digging out 70 years of petroleum contamination at the former Zephyr gas plant

In the early 1900s, Muskegon County became the center of a mini Michigan oil boom. The Zephyr Oil Refinery was built on a bluff overlooking the Muskegon River to refine the oil into gasoline and naphtha. The refinery operated until the 1990s when it went bankrupt.

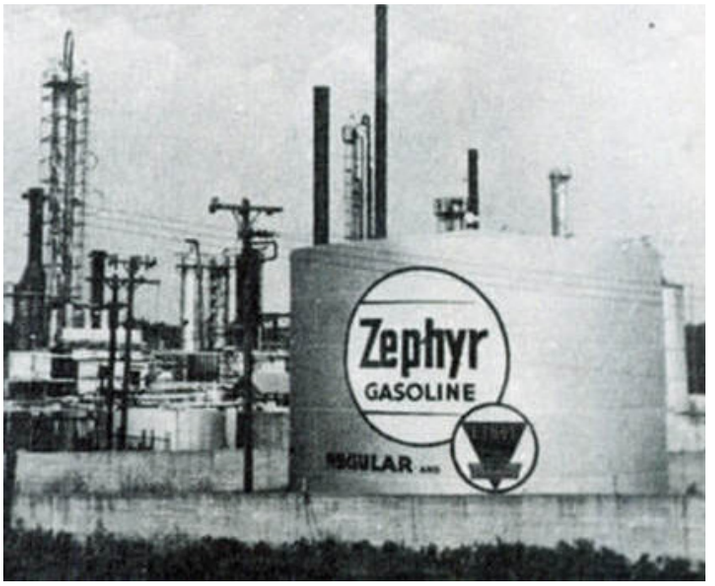


Photo: Former Zephyr Site - Lakeshore Museum Center

Over its lifetime, the company spilled more than 700,000 gallons of oil around the site. It also built a ditch from the wetlands below the bluff to bring water closer for putting out fires. The wetlands were contaminated with heavy metals and petroleum products after decades of improper refining and storage practices.

This damage, along with other environmental impacts from historic pollution, earned Muskegon Lake and connecting waters an Area of Concern designation. The site impacts area fish and wildlife habitat and populations. Today, a large-scale restoration project including the cleanup of the fire suppression ditch and surrounding wetlands at the former Zephyr property is underway. Removal of 48,880 cubic yards of contaminated sediment was finished in fall of 2018. After the contaminated sediments are removed, the restoration will include emergent marsh, submergent marsh, deep marsh, a channel and all-native wetland plantings.

The removal of the contaminated sediments and restoration of wetland function will improve hydrologic connection to the Muskegon River and provide habitat for many species of native fish and wildlife. The project is supported by the Great Lakes Restoration Initiative and federal, state, local, and NGO partners.

By: Stephanie Swart, AOC Coordinator, Michigan OGL

Nature returns to the city

Detroit River habitat restoration projects welcome sturgeon, eagles, mudpuppies, and more back to the Motor City

A hundred years ago, major environmental impacts to the Detroit River were incurred by dredging and development of industrial, residential, and urban areas. These activities drastically modified the shoreline, removed valuable fish spawning and nursery habitat, and destroyed nearly all the coastal wetlands along the river.

All native species of the Detroit River area suffered; whitefish and sturgeon became rare, migratory birds lost essential flyover stops, resident birds lost nesting areas, and turtles, frogs, and snakes no longer had access to coastal wetlands for feeding and nesting.

The state of the river and its future was grim; however, with the 1987 designation of the Detroit River as one of 43 regional Great Lakes Areas of Concern and the start of the Great Lakes Restoration Initiative, the Detroit River has seen extensive work to plan and implement habitat restoration projects. Native species have responded.

For example, reefs comprised of rock substrate have been installed in several areas of the river and have been tremendously successful. Monitoring shows that multiple species of fish now use the reefs for spawning including sturgeon, walleye, and whitefish.

On Belle Isle, habitat improvements are being made to provide hydrologic connections from the Detroit River to inland lakes called the Blue Heron Lagoon and Lake Okonoka. These habitat improvements will provide an inland oasis for fish, reptiles and amphibians. In addition, there is a 200-acre woodland on Belle Isle in need of restoration. This woodland is an important area for native birds including the bald eagles that have returned in the past year. A plan developed in 2018 to restore this woodland is expected to start within the next few years.

In the lower river, partners are restoring massive shoals to protect and enhance coastal wetland areas on Stony, Celeron, and Sugar islands. These projects include unique structures to create homes and nesting areas for rare species such as the mudpuppy, an aquatic salamander, and the Common Tern, both considered threatened in Michigan.

Other smaller habitat restoration projects have been completed along the shorelines at Milliken State Park in downtown Detroit, on property owned by private partner U.S. Steel and at the Wayne County Gateway of the Detroit River International Wildlife Refuge. Birds, pollinators, snakes, and turtles have all found homes at these newly created habitats.

In the fall of 2018, work began on the very last of the 14 projects at Hennepin Marsh on Grosse Ile. Planning for the restoration of the marsh will continue into 2019, and implementation over the next several years. As these 14 areas are restored and monitored for success, we come one step closer to our goal of restoring the Detroit River.

By: Melanie Foose, AOC Coordinator, Michigan OGL

Photo: A young girl participates in a sturgeon release - Michigan Sea Grant

Checking our work

Measuring success in the restored Little Rapids habitat

Habitat loss is one of the most common unintended impacts of development. As cities, farms, and homes are constructed, the plants and animals who lived there before are often displaced. One goal of the AOC program is to restore some of those degraded areas through smart building techniques and other strategies.

The program recently supported the Little Rapids Restoration Project completed in spring of 2017. With GLRI funding, partners removed a causeway that had blocked the flow of the Upper Peninsula's St. Marys River through an area that once had a thriving river rapids ecosystem.

High-quality, fast-flowing rapids with a stony river bottom is ideal spawning habitat for several highly-valued fish species like salmon, trout, whitefish, walleye and sturgeon.

Photo: A scientist samples fish to collect data

The replacement structure is a bridge that allows for flow across a 600-foot span, freeing the river and allowing it to flow once again over the lost rapids. The new bridge connects Sugar Island to a ferry dock that runs to the mainland at Sault Ste. Marie, Michigan.

Almost immediately following completion of the project, passersby reported seeing many species of fish exploring the newly restored rapids, exciting local sportfishers and ecologists.

To determine the long-term impact of the project, scientists are looking at several indicators of success: river depth profiles and flow rates, bottom-dwelling insect communities, larval fish production, and adult fish populations in the area.

Monitoring work is planned to continue for the next several years to document project results. Data gathered will help scientists conduct similar work to restore Great Lakes ecosystems.

By: John Riley, AOC Coordinator, Michigan OGL

Bringing the Grayling Home

Returning an iconic fish to Michigan waters

Many years ago, Arctic Grayling swam freely through streams in Michigan's Lower Peninsula, flashing through the water with their sail-like dorsal fins and gorgeous coloring.

Flash forward to today and there's not an Arctic Grayling to be found in Michigan after statewide logging efforts of the 1800s, overfishing, and habitat destruction caused their die-off nearly a century ago.

Despite their absence, the species' iconic stature lives on (as evidenced by the town of Grayling being named in their honor), and over the years several entities have tried in vain to bring the historical fish back home.

The latest effort, Michigan's Arctic Grayling Initiative, comes 30 years after the most recent reintroduction effort, but is taking an entirely different approach than any other previously tried.

This initiative, spearheaded by the Michigan Department of Natural Resources and the Little River Band of Ottawa Indians, has the support of more than 45 partners consisting of non-profits, businesses and universities.

This renewed effort is drawing upon the lessons learned from previous reintroduction attempts, as well as new approaches, new dedicated partnerships, and technologies not available in the past to achieve success.

Hundreds of streams in Michigan may have historically held Arctic Grayling and they could potentially support them once again. Michigan's Arctic Grayling Initiative is focusing their efforts on streams and watersheds that provide the most suitable habitat.

Great stream habitat is one piece of this puzzle. Another is how to effectively rear these fish. Effectively rearing Arctic Grayling and keeping them safe during vulnerable time periods is critical for their restoration and will be accomplished by using in-stream incubation for the eggs and fry (as successfully developed by the state of Montana). Coupling ideal stream habitat with a strategic rearing environment will hopefully mean Michigan's Arctic Grayling Initiative is well on its way to success.

There is still much work to be done, with many more partnerships to be cultivated and knowledge to be gained. Follow the progress at **www.migrayling.org.**

By: Elyse Walter, Michigan DNR Fisheries Communication Specialist

Photos:
Two grayling swimming, U.S. Fish and Wildlife Service
A staffer working on in-stream research, Michigan DNR

Reducing Plastic Pollution in the Great Lakes Region Together

The Great Lakes region is home to more than 3,500 species of plants and animals. With bald eagles soaring overhead, gray wolves roaming forests, and white suckers migrating through waterways, our home is rich with life.

While abundant and diverse, the wildlife in our region is not immune to threats, especially those brought on by human influence, like pollution. According to scientists from the Rochester Institute of Technology, about 22 million pounds of plastic materials end up in the Great Lakes each year, whether by escaping recycling and trash receptacles, being rinsed down our drains as microplastics, or other means. Lake Michigan alone receives half of that plastic pollution, a substantial 11 million pounds per year.

As plastic makes its way into the environment, it can be detrimental to wildlife when entangled in it or ingested. For example, scientists estimate that 90 percent of seabirds eat plastic, many feeding it to their chicks, which may die from lack of nutrition despite a full stomach.

To protect animals and other forms of wildlife, organizations across the Great Lakes region, including our team at Shedd Aquarium in Chicago, work collectively to remove pollution from the environment. As part of the Alliance for the Great Lakes' Adopt-A-Beach program, Shedd coordinates groups of volunteers to do beach cleanups. In 2017 alone, we picked up 5,000 pounds of litter off Chicago's shorelines to keep it out of Lake Michigan.

While removing marine debris from our beaches and waterways is critical, it is perhaps even more important to seek ways to stop pollution from entering lakes and rivers in the first place – to turn off the tap, so to speak, of plastic flowing into our waterways.

This is what inspired Shedd Aquarium to launch an awareness campaign called Shedd the Straw.

As it sounds, the Shedd the Straw campaign asks people to say "no thanks" to straws when possible and encourages restaurants and other businesses to only provide compostable straws upon request.

Plastic straws are one of the few single-use plastic items that cannot be recycled and that many of us can do without.

Last year at Shedd's beach cleanups, volunteers collected 2,300 plastic straws or stirrer sticks off local beaches. Straws are also among the top 10 litter items collected at beach cleanups around the Great Lakes and other coastlines around the country.

By encouraging people to rethink single-use plastics like straws as well as plastic bags, bottles and cutlery, the Shedd Aquarium hopes to address plastic pollution at its source.

To date, over 300 restaurants and businesses have opted to Shedd the Straw with Shedd Aquarium, only serving straws upon request or only serving compostable alternatives. As baseball teams like the Chicago White Sox, major events like the Bank of America Chicago Marathon, restaurant groups like Lettuce Entertain You Enterprises and individual people made their own commitments to Shedd the Straw, we learned that there is something everyone can to do prevent plastic pollution.

While 22 million pounds of plastic is a daunting amount, collective commitments and actions add up to big changes that help prevent pollution from impacting wildlife. Whether it's pledging to Shedd the Straw or cutting back on using other single-use plastics, everyone has the ability to take action. Our region's wildlife is counting on it.

The Shedd Aquarium invites people to visit *(The link provided was broken and has been removed)* or email sheddthestraw@sheddaquarium.org to learn more.

By: Jaclyn Wegner, Director of Conservation Action at Shedd Aquarium

Breaking Ground on Michigan Water Trails

By: Michael Morrison, State Water Trails Coordinator, Michigan DNR

Michigan is crisscrossed by networks of trails for hikers and bikers, off-road vehicles, snowmobilers, and horseback riders. For each of these pursuits, the Michigan Department of Natural Resources (DNR) plays a role in providing support and management for people to enjoy these outdoor activities. Michigan also has trails for boaters and paddlers, known as water trails.

Belle Isle Park, Michigan DNR

While Michigan is becoming nationally recognized as the Trails State, until recently, there has been no statewide program for water trails. With hundreds of thousands of registered boats, and paddle sports taking the lead as the fastest-growing form of outdoor recreation, the time for Michigan to stand up is now.

The DNR is preparing for the launch of the Michigan Water Trails Program, an effort aimed at acknowledging Michigan's position as The Trails State, showcasing quality water trails and recognizing the collaboration of state and local governments, nonprofits, foundations, and volunteers that develop and maintain these trails.

The use of waterways for transportation in Michigan is not new; Native Americans first used them for sustenance and trade; early European settlers used the waterways to transport goods and timber; and water resources were the foundation of Michigan's earliest manufacturing and shipping industries. This latest effort works to establish a formal framework for recreational trails systems.

What is a water trail? A water trail is a designated route on a navigable waterway such as a lake, river, canal, or bay that is designed and managed to foster a quality user experience. The trails, sometimes called "blueways," are the aquatic equivalent of a hiking trail (or "greenway"). Water trails feature well-developed access and launch points; are near significant historical, environmental, or cultural points of interest; and often include nearby amenities such as restaurants, hotels, and campgrounds.

Michigan's more than 12,500 miles of state-designated trails and pathways make our state home to one of the largest interconnected trail systems in the country. This inviting network – and associated quality of life, health, and economic benefits it offers – is contributing to the Michigan trail experience.

To receive a state water trail designation, the water trail must:

- **Provide a quality trail experience**
- **Provide clear information for users**
- **Demonstrate broad community support**
- **Demonstrate a sustainable business, maintenance and marketing plan**

2002

The Michigan Legislature created the Michigan Heritage Water Trail Program to help advocates create water trails celebrating local history, culture and environment. Nine heritage water trails have since been established.

2012

The Michigan Coastal Management Program supported a statewide water trail development project. Partner LIAA created a website, michiganwatertrails.org, and a manual for water trails. They also held a 2016 water trail summit.

2014

The Michigan Legislature passed Public Act 210, allowing communities to apply for Pure Michigan Trail or Trail Town designation. To get it, a community must demonstrate criteria on accessibility, support, accountability, education and responsibility.

2016

The Governor declared the development of recreational water trails and a Michigan water trails program as a priority measure for the Michigan Water Strategy.

2016

The DNR drafted a framework for a State Water Trail Program. The program will help establish a sustainable system of water trails that are locally supported and offer a diversity of experiences. The program will provide promotional opportunities.

2018

The DNR, OGL, Waterways Commission and community members developed a trail planning workgroup to finalize the requirements and application for the Michigan Water Trails Program. In October, the DNR invited Michigan water trail managers to apply for designation.

2019+

The first group of State Designated Water Trails will be announced. The DNR will continue to encourage communities to apply for state designation. Ultimately, the State Water Trails System will be a network of water trails for people to explore and enjoy.

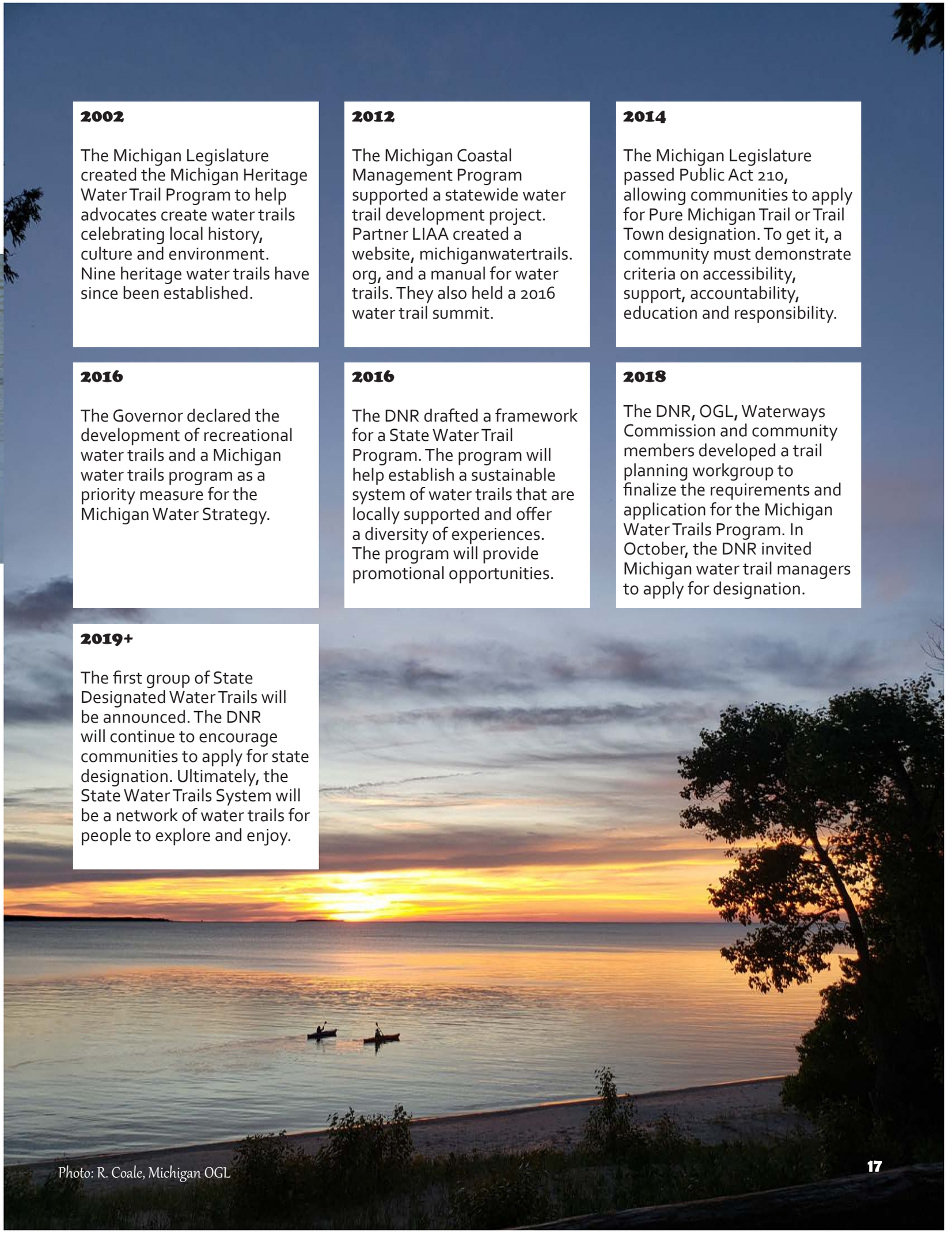


Photo: R. Coale, Michigan OGL

Exploring Fresh Water in Michigan Communities

By: Erin Dixon, Student Assistant and Rachel Coale, Outreach Coordinator, Michigan OGL

A collaborative effort to bring two water-themed, educational exhibits to Michigan, advanced by a partnership of the Michigan Office of the Great Lakes, Michigan Humanities Council, Cranbrook Institute of Science, and Michigan State University, launched this summer.

The first, the Smithsonian Institution's Water/Ways exhibit, features ways water intersects with our world's environment, history, economy ,and culture.

Paired with Water/Ways is the Michigan Water Heritage Project, which adds Great Lakes focus and aims to spark conversations with communities about why healthy local waters matter. The exhibit is generously funded by a grant from the Fred A. and Barbara M. Erb Family Foundation.

The exhibits began their Michigan journey in June with a premiere on Beaver Island. They have visited the communities of East Jordan, Big Rapids, and Harrisville and will continue on to Niles and Owosso. The Smithsonian's Museum on Main Street Program made it possible to bring the sophisticated, national-level exhibits to these rural communities.

The interactive exhibits feature envrionmental, cultural and economic aspects of water

In addition to the content provided by each exhibit, each community scheduled activities, local speakers, and events to enrich the offering and provide place-based context.

Community volunteers set up the exhibits

OGL summer intern and Beaver Island native Erin Dixon, who assisted with the exhibit, said:

> "The Water Heritage Project was greeted warmly by the Beaver Island community and enjoyed by many residents and visitors. The powerful images and information in the exhibits provoked personal stories of connection with water. People shared their triumphs and happiest memories with water, and also their fears of degradation of water quality in the Great Lakes. Many visitors voiced their opinions about pollution and invasive species in the Great Lakes and talked about how important it is to educate others about these issues."

Partners hope to encourage discussion and stewardship for water resources, and will use data collected at the exhibits to inform outreach and community engagement activities around water protection and restoration.

Michigan tribes and state collaborate on initiative to co-manage wild rice

By: Sally Kniffen, Environmental Specialist, and Taylor Brook, Watershed Outreach Coordinator
Saginaw Chippewa Indian Tribe of Michigan

Recognizing historical and cultural practices of the tribes and the ecological significance of Michigan's native wild rice species, a large group of State, tribal, and individual partners are developing a plan to sustain the health of *manoomin/mnomen* (wild rice) for the next seven generations. *Manoomin/mnomen* is a traditional food for many native communities in the Great Lakes region, and also plays an important role as an indicator species of ecosystem health and sustainability in wetlands.

The Michigan Wild Rice Initiative was created when State of Michigan resource managers worked with tribal representatives to elevate the significance of *manoomin/mnomen* as a culturally-significant species in the Michigan Water Strategy (michigan.gov/waterstrategy).

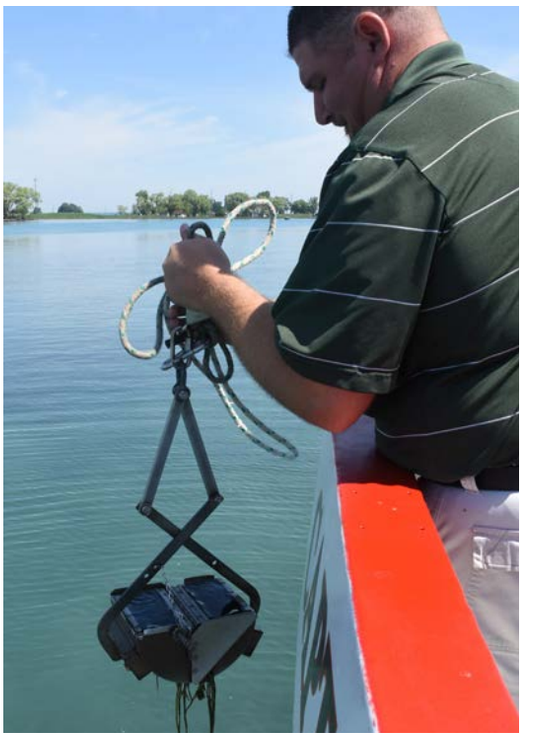
One of the first actions of the Michigan Wild Rice Initiative team in January 2017 was a joint effort to develop a co-management plan for manoomin/mnomen throughout the state. A Wild Rice Charter is now under development and, once finalized, the tribes and state will work together to co-manage the resource.

Some key operating principles for the group include acknowledging the sacredness of protecting, honoring, and sustaining the *manoomin/mnomen*.

"The Michigan Wild Rice Initiative was designed as a long-term, ongoing collaboration that would build off previous planning and priority-setting efforts." -*Draft Michigan Wild Rice Initiative Charter*

It is the intent that this will be a working model for co-management of other culturally significant resources.

Photo: Barbara Barton, Michigan Department of Transportation



Great Lakes Science

Clinton River Watershed and Lake St. Clair Smart Stormwater Systems Project

By: Michelle Selzer, Lake Erie and Lake St. Clair Coordinator, Michigan OGL
Brandon Wong, PhD Candidate, University of Michigan

Sensor Technology

The Office of the Great Lakes is working in partnership with the Oakland and Macomb Water Resources Commissioner Offices, the University of Michigan, Michigan State University, and other watershed partners to utilize innovative, open-source and real-time data, innovative analytical tools, and local knowledge to develop and achieve social and ecosystem water quality-related outcomes for the Clinton River Watershed and U.S. portion of Lake St. Clair basin.

The goal of the project is to assess and effectively manage stormwater by developing the first fully integrated and interactive model of the Clinton River Watershed and Lake St. Clair lake hydrology.

This model and associated decision support tools will help stakeholders better understand the human uses of the land-water interface at a watershed-level scale. This unprecedented water information system approach will use real-time sensor measurements that will deliver actionable insights and enable data-driven decision making.

During this first phase of the project, the University of Michigan team is deploying a wireless network of 50 water quality sensors that will make the Clinton River Watershed the most monitored watershed in the state of Michigan. Specifically, the wireless sensor nodes are being deployed across the entire watershed in urban and rural areas to obtain high-resolution measurements that can be used to track the response of the watershed under storm events, which will be used to establish baseline conditions and enable a system-level understanding of the flow of water through the watershed.

The data will also be shared with the modeling teams to improve the hydrological models for long-term analyses. Specifically, a coupled hydrological model will be used to develop a planning support toolkit that will enable local, county, and state agencies to investigate various management action scenarios in the watershed and lake to inform potential near-term and future management actions.

This technology and integrated approach has been successfully deployed across parts of Michigan and other states, and the Office of the Great Lakes is excited to be working with partners to pilot this innovative project to help improve water quality in the Clinton River Watershed and Lake St. Clair.

Helping shoreline communities live with changing Great Lakes water levels

University of Michigan Great Lakes Water Levels Integrated Assessment

By: Maggie Allan, Emerging Opportunities Program Manager, Graham Sustainability Institute

After more than a decade of declines, water levels on Lakes Michigan and Huron reached historic lows in 2013. However, during the final months of 2013 through 2014, the lakes experienced one of the largest two-year gains in water levels in recorded history, thus underscoring the dynamic nature of the Great Lakes system.

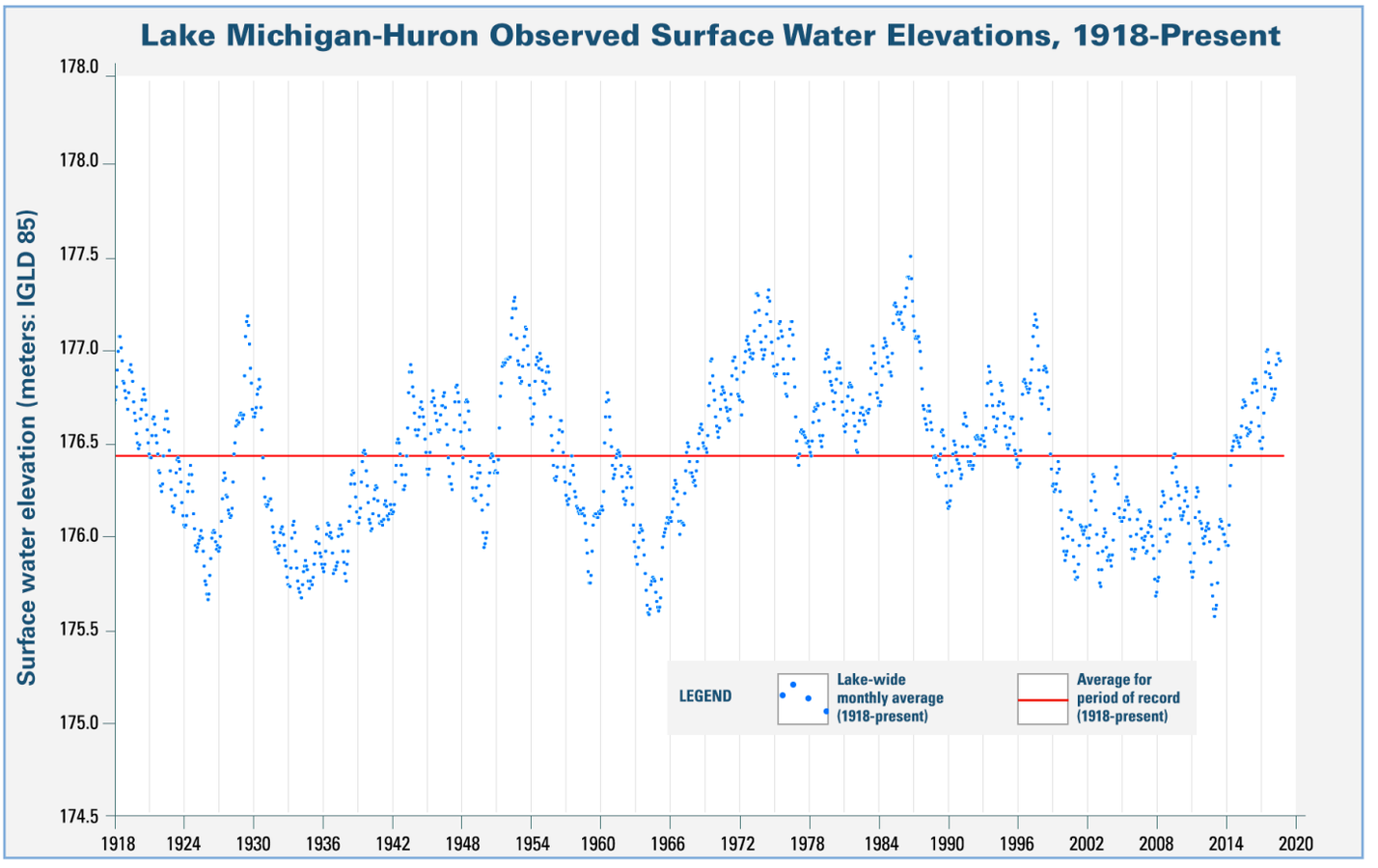
Great Lakes water levels significantly affect the region's economy, ecology, and communities. Changes in water levels drive many critical natural functions, but they also present challenges along the shoreline. Differences in fluctuations across the lakes, debate over potential engineering options, uncertainty about climate change impacts, and the wide range of affected stakeholders make the issue of Great Lakes water levels increasingly complex.

To help decision makers address the challenges and opportunities posed by Great Lakes water level variability, the University of Michigan's Graham Sustainability Institute, with additional support from the Michigan Office of the Great Lakes, initiated a collaborative research project that asked:

What environmentally, socially, politically, and economically feasible policy options and management actions can be implemented in order to adapt to current and future variability in Great Lakes water levels?

With a focus on Lakes Michigan and Huron, the project's main goal was to transform extensive existing research about water levels, flows, and impacts into practical, adaptive strategies to address issues facing shoreline property owners and managers.

Four multidisciplinary U.S. and Canadian research teams worked with specific Great Lakes shoreline communities and received input from a binational advisory committee reflecting the views of key stakeholder groups. Results of the project included a synthesis of findings to identify opportunities for the region and webinars to share updates with the public.



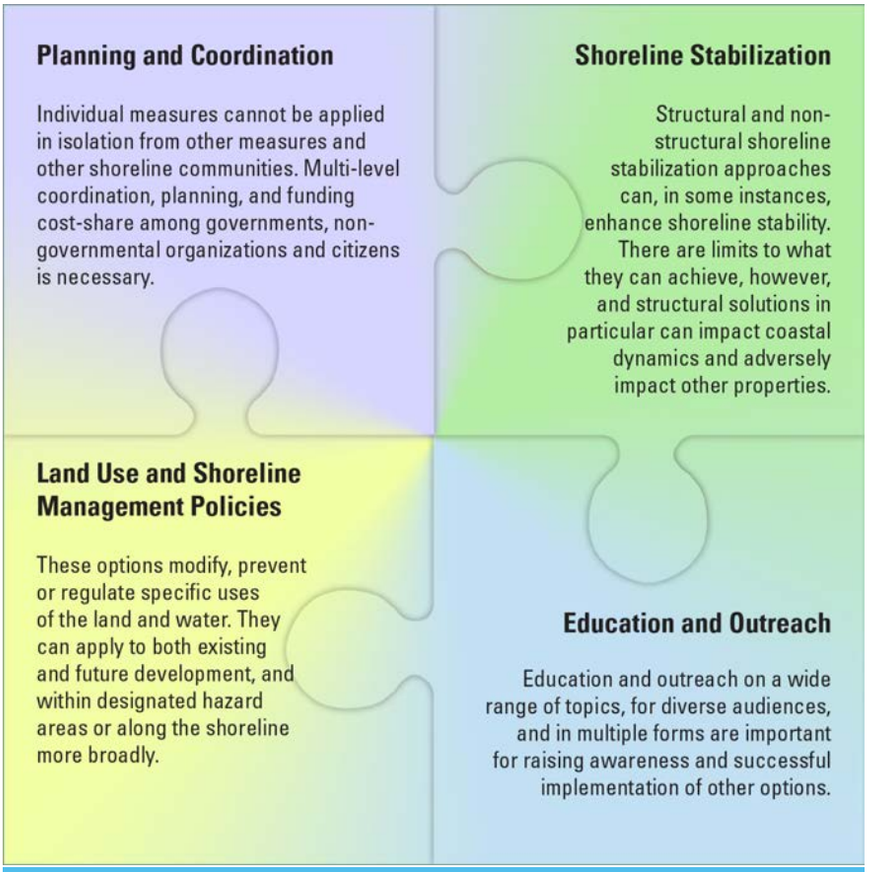
Findings for local communities

The four teams worked with community partners to assess impacts from and adaptive options for water level variability.

- Resilient shorelines – One team assisted the City of Grand Haven and Grand Haven Township, Michigan, with a deliberative process to analyze and develop local land use regulation options that advance community resilience. With additional support from the Michigan Coastal Zone Management Program, the city has adopted, and the township is working toward, recommended zoning code revisions including science-based setbacks from water features and low impact development standards that address flooding and improve water quality and natural habitat.

- Tribal collaboration – Working with the Little Traverse Bay Bands of Odawa Indians and the Grand Traverse Band of Ottawa and Chippewa Indians, one team assessed the impact of climate change on lake levels to inform Tribal fisheries management and protection of culturally important sites.

- Bluff erosion – Two other teams engaged directly with residents and state, provincial, and regional organizations to identify adaptive actions and policies to address the coastal bluff erosion impacting shoreline properties around Milwaukee, Wisconsin and in Huron County, Ontario.



Responding to variable water levels will require a suite of measures that consider the characteristics of the shoreline, natural systems, built environment, interest groups, and political and legal factors. The categories of response option illustrated here are often interrelated. This list is not exhaustive, but represents the most common options identified by the place-based teams.

Findings for the basin

The final report integrates and builds upon the work of the local projects, highlighting variation and similarities among communities' needs and identifying insights for the basin more broadly.

It discusses options for responding to water level variability with a focus on four key approaches: Planning and Coordination; Shoreline Stabilization and Protection; Land Use and Shoreline Management Policies; and Education and Outreach.

The report also summarizes the science on the factors affecting water levels and observed changes over different time scales. Factsheets and webinars serve as additional resources.

Even though the project has concluded, Graham Institute staff continue to connect researchers to communities considering water level fluctuations, including member communities of the Great Lakes Islands Alliance.

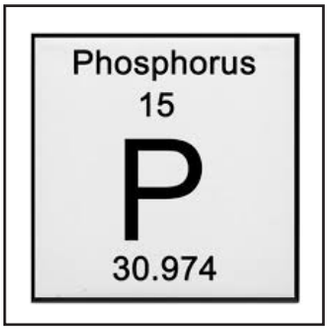
To access the project report and learn more, visit graham.umich.edu/emopps/water-levels.

Maintaining Balance in Rapidly-Changing Ecosystems

By: Jay Wesley, Michigan DNR Lake Michigan Basin Coordinator

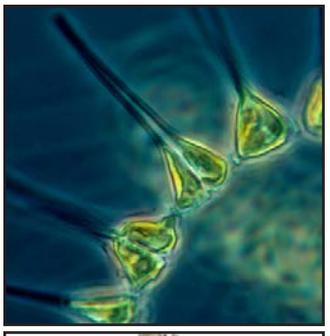
In life, there can be too much or too little of a good thing, and nutrients in the Great Lakes can be thought of in the same way. Runaway algae growth in Lake Erie caused by excessive phosphorus, a nutrient, has prompted collaborative efforts to reduce nutrient inputs to the lake. Conversely, low nutrient loads have diminished algae growth in Lakes Michigan and Huron, leading to excessively clear water. Although clear water may not seem like a problem, it can have negative impacts on fish populations. Namely, Lake Michigan fisheries managers are struggling to maintain balance, especially in salmon and trout fisheries.

The problem fisheries managers face in maintaining healthy fish populations is not new. Since the 1990s, over predation of small prey fish, such as the alewife, by salmon populations has caused an imbalance in the health of both fish populations. Even after fisheries managers significantly reduced salmon stocking, the prey fish population continued to decline.



To help understand this imbalance issue, the Lake Michigan Committee – comprised of senior state and tribal fishery managers operating under the guidance of the Great Lakes Fishery Commission – created a Lower Trophic Level Task Group in 2016. The Task Group published a report this year that helps to explain how decreased algae growth is impacting prey fish populations.

The Task Group observed trends of decreasing phosphorus, algae, zooplankton, and *Diporeia* spp. (a lake bottom dwelling crustacean) in offshore areas where water was deeper than 100 feet. In the nearshore where water is less than 100 feet deep, the declining trends were only evident with zooplankton and *Diporeia* spp. Phosphorus is vital for sustaining healthy algae, zooplankton, and crustacean populations, which are significant food sources for prey fish. It is likely that declining nutrients paired with over predation was a major cause of declines in Lake Michigan's prey fish populations.



There are two reasons for lower phosphorus levels in Lake Michigan: 1) loadings from rivers that feed the lake have declined because of the binational Great Lakes Water Quality Agreement signed in 1972; and 2) high populations of invasive quagga and zebra mussels sequester and filter phosphorus on the bottom of the lake. Lowering phosphorus levels was necessary in 1972 as the Great Lakes were showing signs of poor water quality from high nutrient loads and algae growth. However, in a short period of time, invasive mussels have significantly reduced phosphorus levels leading to lower productivity of the lake's natural systems, making it difficult to manage and maintain balanced fisheries.

Lake Michigan anglers report that prey fish populations are increasing in nearshore areas, likely due to declining populations of zebra and quagga mussels. Offshore, the situation is opposite. Although decreasing in nearshore areas, the offshore population of invasive mussels continue to increase. Long-term fish surveys show only a fraction of the prey fish that once populated offshore areas. The invasive mussels may keep the offshore productivity low. This situation challenges fisheries managers trying to maintain balance in the system.

While efforts are underway to decrease nutrient loads into Lake Erie, Lake Michigan researchers should continue to focus on gaining a better understanding of how nutrients and zooplankton interact and affect prey fish and the salmon and trout fisheries. These studies are important for fisheries managers who seek to find and maintain balance in these changing ecosystems.

[i]*Bunnell, D.B., Carrick, H.J, Madenjian, C.P., Rutherford, E.S, Vanderploeg, H.A., Barbiero, R.P., Hinchey-Malloy, E., Pothoven, S.A., Resing, C.M., Claramunt, R.M., and eight others. 2018. Are changes in lower trophic levels limiting prey-fish biomass and production in Lake Michigan? [online]. Available from: http://www.glfc.org/pubs/misc/2018-01.pdf.*

Photos: The relationships between nutrients, phytoplanton, mussels and fish are complex.

Investigating PFAS in Michigan

By: Dr. Tammy J. Newcomb, Senior Water Policy Advisor, Michigan Department of Natural Resources

Per- and polyfluoroalkyl substances (PFAS) are a group of manmade chemicals that include perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), Gen X, and many other similar compounds. Because of their non-stick, non-stain, and surfactant properties, these substances have been widely used for household and industrial purposes, as well as at military bases and firefighting training facilities.

Image from user DFSB DE via Flickr, Creative Commons

Two of the most widely produced and studied PFAS, PFOA and PFOS, are resistant to degradation and as a result can be found in a lot of places in the environment. When high concentrations are present and ingested in food or water, these chemicals may accumulate in fish, wildlife, and humans. Studies have shown that PFAS is a public health concern because exposure to elevated levels of PFAS is associated with adverse health conditions such as hepatic and metabolic toxicity, immunosuppressive effects, potential carcinogenic effects, etc.

Despite decades of widespread use, PFAS are considered emerging contaminants. The number of research studies related to health effects for PFAS is increasing as well as studies related to PFAS fate and transport in the environment. In 2016, the U.S. Environmental Protection Agency issued a lifetime health advisory of 70 parts per trillion for PFOA and PFOS. This drinking water advisory was extrapolated from extensive tests on laboratory animals and is believed by EPA to be protective of all life stages. The State of Michigan is examining standards for drinking water and is expected to make recommendations by the end of 2018.

The discovery of elevated concentrations of PFAS in drinking water sources and fish prompted a statewide reconnaissance effort. To facilitate this as a priority issue for the state, Governor Rick Snyder signed Executive Directive 2017-4 in November 2017, which formed the Michigan PFAS Action Response Team (MPART). Spearheaded by the Michigan Department of Environmental Quality (DEQ) and the Michigan Department of Health and Human Services (DHHS), MPART includes ten state agencies and two advisory committees charged with providing a comprehensive and efficient response to PFAS mitigation. Since the formation of MPART, the state has identified 34 sites of PFAS contamination, sampled private wells in those areas, is in the process of testing all municipal water supplies (>1,800) and schools on their own wells (>400). DEQ has sampled and analyzed fish, groundwater, surface water, and foam to identify sources of contamination, and are working with identified responsible parties to install treatment technologies in a timely manner. DHHS continues to issue fish consumption advisories as part of the Eat Safe Fish Program.

Although drinking water sources continue to be the priority, concurrent investigations into the potential for deer and waterfowl consumption advisories are also underway. The DNR and DHHS worked together to sample deer from contaminated areas and found elevated levels in one deer sufficient to issue a "Do Not Eat" restriction for a localized area. Evaluations of all potential pathways of PFAS into the environment include ongoing and proposed plans to monitor air emissions, biosolids, fire stations, airports, landfill leachate, wastewater, and more.

Because of these efforts, Michigan has been recognized as a national leader in characterizing and mitigating PFAS issues. MPART is the first multi-agency team of its kind in the United States, and other states are looking to adopt the MPART model. In January 2018, Michigan became one of the first states to establish drinking water cleanup standards for PFAS. As more is known about PFAS, MPART will continue to work diligently to ensure public health and safety, while striving to protect the state's natural resources for current and future generations. Additional information is available at **www.michigan.gov/pfasresponse.**

Taking the pulse of Great Lakes Coastal Wetlands

Why these unique ecosystems deserve attention and care

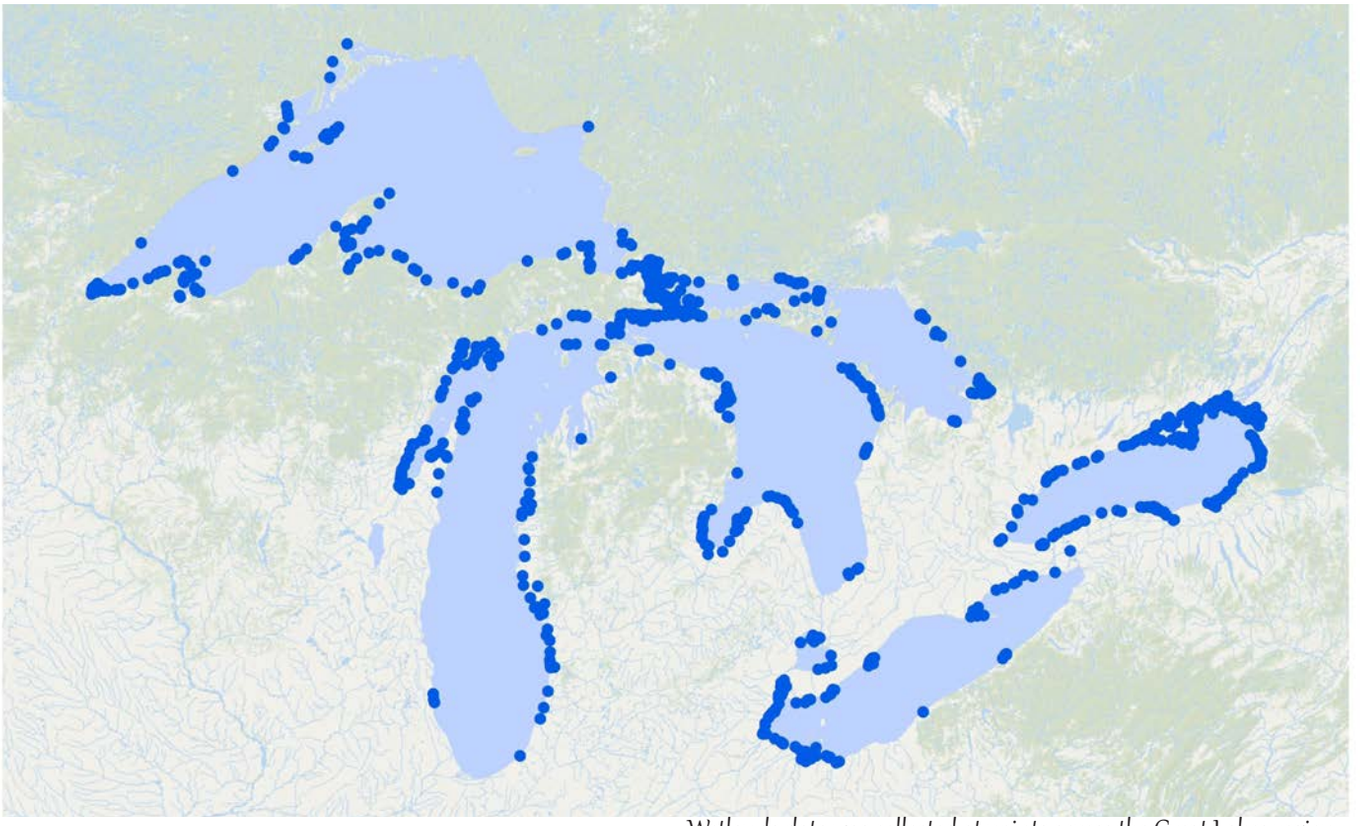
Wetlands that occur along the Great Lakes coastline, while numbering in the thousands, represent just a small fraction of the Great Lakes surface area. However, these diverse and productive ecosystems play an outsize role in supporting the fishes, birds, amphibians, insects and plants that keep our Great Lakes healthy and vibrant.

Researchers estimate that about 80 percent of Great Lakes recreational fish harvest is made up of species that use coastal wetlands at some stage in their life. Likewise, secretive marsh bird species such as the Sora rail and American bittern thrive in these productive coastal ecosystems.

Despite their importance, coastal wetlands have not always been viewed so favorably and over half of these ecosystems have been destroyed since European settlement of the region. Ensuring the remaining half are protected and managed in a way that sustains their valuable ecosystem services requires both an understanding of their current condition and a long-term commitment to monitoring conditions.

To that end, the USEPA's Great Lakes National Program Office began funding basin-wide coastal wetland monitoring in 2011. Comprised of teams of university scientists and other researchers from across the basin, the Great Lakes Coastal Wetland Monitoring Program samples all large Great Lakes coastal wetlands on a five-year rotating basis (map). This Great Lakes Restoration Initiative-supported effort just wrapped up its eighth year of sampling, visiting about 20% of the coastal wetlands in the Great Lakes each year.

Gathering such an extensive wetland dataset is not an easy task. Each year field crews fan out across the 10,000 miles of shoreline within the basin to measure human disturbance, water chemistry and water quality, conduct listening surveys for calling amphibians and birds, crews set nets to survey fish, sweep nets through the water to collect aquatic insects and other invertebrates, and identify plants along miles of transects, right down to identifications of difficult sedge and grass species. What's more, each crew must follow rigid protocols so that data collection is standardized across the many teams who are working hundreds of miles apart across the basin.



Wetlands data was collected at points across the Great Lakes region

The biological data, along with water quality and habitat information, allow researchers to determine the health of the overall wetland as well as how each biotic group is doing. Furthermore, because each biotic group experiences conditions differently—a bird experiences human produced stressors like pollution differently than a fish, for example—the multi-faceted approach to the monitoring program provides a comprehensive look at conditions in each wetland. The extensive sampling program also helps track the spread of invasive species such as the recent discovery that the invasive faucet snail, which kills waterfowl when ingested, is much more widespread than previously recognized.

Natural resource managers and other stakeholders are tapping into this standardized coastal wetland database to inform decisions on restoration priorities and other management-related questions.

Access to program data and information is managed through the project site www.greatlakeswetlands.org where the public can view general site information and managers can request access to additional data. Resource managers are also using the monitoring program's trained field crews to collect data prior to and after restoration work is completed. Such data allows those who are conducting the restoration work to quantitatively demonstrate wetland improvement based on standardized sampling procedures.

As a bonus, the monitoring program is training the next generation of aquatic scientists. Many field crews are comprised of graduate and undergraduate students and technicians who will go on to lead the research and ecosystem management of tomorrow to keep our lakes and coastal habitats healthy.

By:

Dr. Don Uzarski
Institute for Great Lakes Research
Central Michigan University

Dr. Valerie Brady
Natural Resources Research Institute
University of Minnesota Duluth

Dr. Matt Cooper
Burke Center for Freshwater Innovation
Northland College

What do fish really want?

In Saginaw Bay, scientists say the answer is a few million pounds of rocks

More than 90 fish species swim in the waters of Saginaw Bay, located in the crook of the mitten state's 'thumb.' The bay connects to 22 counties, emptying the largest watershed in the state. The walleye, whitefish, and lake trout that live there support some of Michigan's most productive sport fisheries, valued at $33 million per year.

An important ingredient of a successful fishery is spawning habitat. Historically, Saginaw Bay's fish spawned on glacially-deposited rock reefs that provided shelter for eggs and young fish. Much of this was lost during a period where historic industrial and agricultural practices buried the reefs in sediment. The loss was a contributing factor to the devastating 1940s walleye fishery collapse. Today, practices have improved, providing opportunity for change.

Now, a group of scientists from federal, state, and local agencies, including the Michigan Office of the Great Lakes and Michigan Sea Grant, are ready to restore habitat at the historic sites of the Coreyon and Saginaw River reefs. They will place 5,000 cubic yards of rock on the lakebed. The resulting 2 acres of renewed reefs will diversify spawning habitat and support a more resilient fishery.

A stronger fishery will benefit Michigan communities both ecologically and economically; stability will help fish recover, and businesses relying on them will see gains too.

The project is supported by a $980,000 Great Lakes Restoration Initiative grant from the U.S. Environmental Protection Agency, with an additional $25,000 grant from the local Saginaw Bay Watershed Initiative Network.

Construction will begin in summer of 2019 and be completed by fall.

By: Bretton Joldersma and Rachel Coale
Michigan OGL

Walleye illustration by Joseph R. Tomelleri ©

World's first freshwater test site for "smart ships" launched in Lake Superior

New technologies have potential for Great Lakes science and industry

By Rachel Coale, Michigan Office of the Great Lakes, with contributions from:
Michael Beaulac, Michigan Office of the Great Lakes, and,
Dr. Guy Meadows, Michigan Technological University

The spectacular rugged scenery, isolated Lake Superior shore, and quaint mining towns of northern Michigan's Keweenaw Peninsula can make visitors feel like they've taken a step back in time.

However, with a recent dedication at the Great Lakes Research Center in Houghton, something new is on the way – a hub for the development of futuristic, state-of-the-art 'smart ship' technologies.

The new Marine Autonomy Research Site (MARS) will serve as the world's first freshwater location for testing unmanned (autonomous) surface and underwater vessels for operation in Great Lakes and U.S. coastal waters.

The dedication drew representatives from Gov. Rick Snyder's office, the Conference of Great Lakes and St. Lawrence Governors and Premiers, Great Lakes shipping companies, legislators, the U.S. Coast Guard and Transport Canada, and local dignitaries interested in learning how the site is expected to benefit Great Lakes science, research and industry.

The Michigan Office of the Great Lakes assisted with development of the testing site.

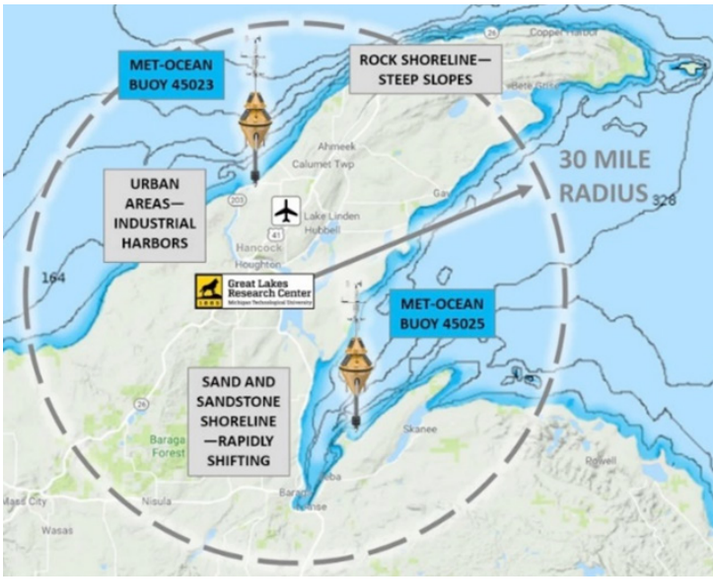
"This innovative technology will help researchers develop integrated systems to collect data and inform Great Lakes management decisions," said Jon W. Allan, director of the Michigan Office of the Great Lakes.

Technology demonstrated

The launch ceremony featured a demonstration highlighting advanced autonomous technology on the Portage Canal. A small surface vessel captured the contours of the bottom of the canal, and an autonomous buoy was demonstrated capable of maintaining position and moving itself when needed.

Additional unmanned surface and subsurface vehicles were on display.

The MARS project test site will be managed by Michigan Technological University, which plays an integral role in Great Lakes research on lake ecology, fish biology and ecosystem change.



The testing area extends within a 30-mile radius of the university's waterfront campus, where the Great Lakes Research Center is located.

"Shipping will look different in 25 years, largely because of the work done here," said David Naftzger, executive director of the Conference of Great Lakes and St. Lawrence Governors and Premiers.

The area already is served by the university's high-accuracy, real-time, GPS survey system, its fleet of crewed research vessels and a licensed mariner, along with all U.S. Coast Guard testing requirements for monitoring and verifying vehicle location and performance.

Looking to the future

University researchers envision unmanned surface and underwater vessels being used to augment manned research ships to transport remote-sensing technology, collect sonar and video imagery, deploy under frozen Great Lakes waters to gather winter samples and venture to sites unsafe for humans.

While the types of autonomous vessels to be tested at the MARS site could include larger vessels, they will initially be research- and survey-grade boats and underwater drones less than 33 feet in length overall.

Other testing could involve autonomous underwater vehicles monitoring structures such as pipeline for their

integrity, identifying shipwrecks, or mapping bottom substrate and recovering evidence when working with the Michigan State Police.

Regardless of the vessel size or type tested, much of the autonomous technology, such as anti-collision software, sensors and sensor fusion is expected to be similar and applicable to a wide spectrum of unmanned vessels and vehicles. Therefore, the lessons learned will be transferrable to others who want the knowledge.

"This center put us on the cutting edge," said U.S. Rep. Jack Bergman. "And if you're not on the cutting edge, you're behind."

In its 2017 Michigan State of the Great Lakes Report, the Office of the Great Lakes published an article noting that, "scientists in the upper Great Lakes, and Lake Superior in particular, currently lack the capabilities for real-time science observations during early- and late-winter periods, a large and critical portion of the annual thermal cycle."

Samples are collected by scientists in small watercraft, but Lake Superior's harsh winters and ice can make research difficult and dangerous. Unmanned vehicles can help close a knowledge gap and reduce the costs of human-led expeditions.

Coalition achievement

The dedication is a key victory for the newly-formed Smart Ships Coalition of the Great Lakes and St. Lawrence. The coalition, established by resolution of the governors and premiers of the Great Lakes St. Lawrence in October 2017, is the region's group for those involved in research, commercialization activities, workforce development, and regulatory matters pertaining to maritime autonomy and related automation technologies.

The coalition unites scientists, policy makers, resource managers, innovators, navigators and educators who share a common interest in the advancement and application of autonomous technologies operated in marine environments.

The organization's web page notes that "in marine applications … the state of adoption for autonomous technologies is lagging that of air and ground operations." The Smart Ships Coalition plans to bring marine technology up to speed.

Prime location

The waters near the Keweenaw Peninsula, including seasonally "arctic-like conditions," make the new Marine Autonomy Research Site an ideal testing ground for developing expertise, platforms and equipment that can withstand extreme Great Lakes and oceanic conditions.

This area also allows the technology to be tested where it will not interfere with commercial shipping or recreational boating.

Michigan's manufacturing expertise and abundance of working waterfronts also position the state for success at the forefront of this new arena. Autonomous technologies have the potential to accelerate new developments in many industries.

The Great Lakes Commission reports that the shipping industry in the Great Lakes-St. Lawrence system supports about 120,000 jobs. Science and engineering account for about 40,000 jobs, and manufacturing employs millions of people.

Autonomous vehicles and vessels have many potential applications to accelerate progress and create new jobs for Great Lakes scientific research and in shipping, manufacturing and maritime industries.

Plan for action

Coinciding with the MARS test bed launch, the region's governors and premiers released a Smart Ships Action Plan. The plan includes policy actions for the federal governments, states and provinces, and industry to help the region become a leader in this rapidly growing sector.

Smart ships represent a major leap forward in maritime technology. The regional Smart Ships Coalition will be working to implement the action plan and further establish the region as a global center of excellence for 'smart ship' technologies.

"The opening of the Marine Autonomy Research Site at Michigan Tech is another important step for our region and will help accelerate our work to create the needed policies and regulations for smart ships," Allan said.

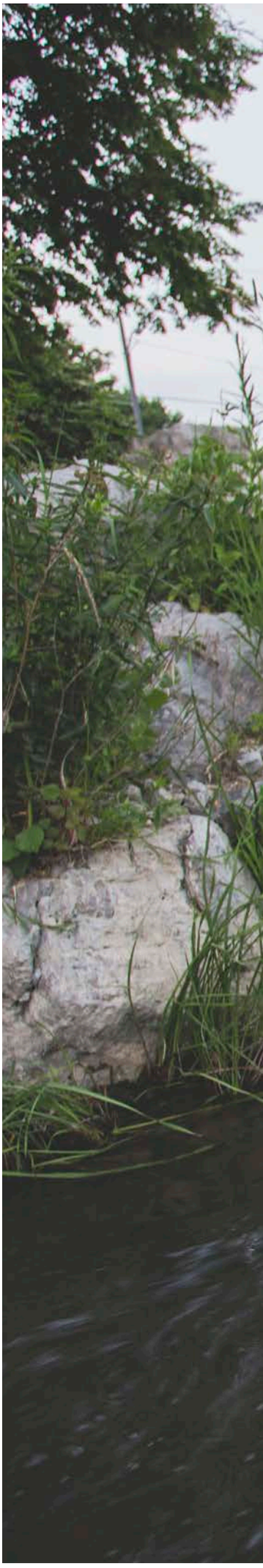
*This story was previously published in the Michigan DNR's "Showcasing the DNR" series and in the Great Lakes Seaway Review.

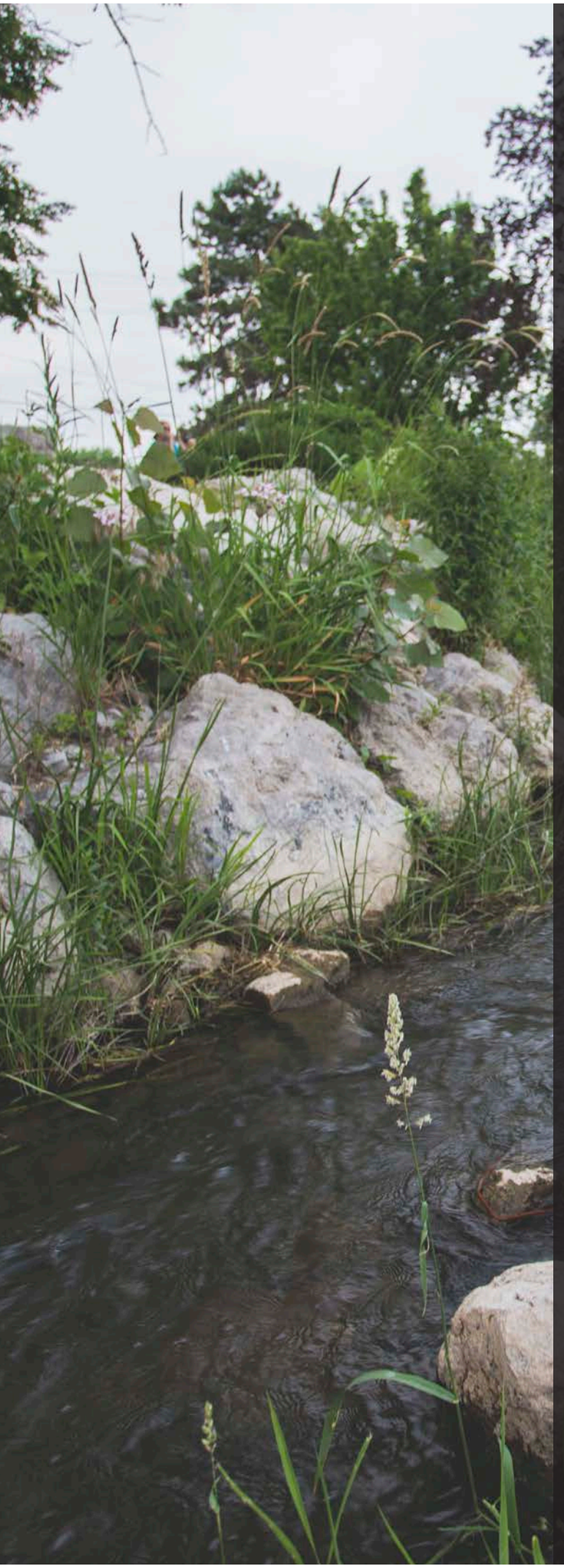
Thank you

Many thanks to the experts, contributors, partners, and editors who contributed their time and efforts to this 2018 State of the Great Lakes Report.

The stories within reflect the dedication of our region's natural resource managers and community voices of our state sharing a passion for Michigan's Great Lakes water resources.

Images in this report were sourced from the Michigan Office of the Great Lakes, Michigan Department of Natural Resources and the Michigan Department of Transportation Photo Unit unless otherwise noted.





This report is available digitally at the Michigan Office of the Great Lakes webpage, www.michigan.gov/OGL.

Rick Snyder, Governor
Jon W. Allan, Director, OGL

Design and editing by Rachel Coale for the Michigan Office of the Great Lakes.

Michigan Office of the Great Lakes
www.michigan.gov/OGL
517-284-5035

DEPARTMENT OF NATURAL RESOURCES
DNR
MICHIGAN

OGL
MICHIGAN OFFICE OF THE GREAT LAKES

MICHIGAN OFFICE OF THE GREAT LAKES

Laughing Whitefish Falls, MDOT