

STRENTHENING THE LINKS BETWEEN

SCIENCE AND **MANAGEMENT**

INFORMING REAL-WORLD DECISION-MAKING

ACROSS LAKE MICHIGAN'S ECOSYSTEMS AND COMMUNITIES

Meeting Sessions and Abstracts Guide

The State of Lake Michigan Meeting, supported in part by Illinois-Indiana Sea Grant, University of Illinois Extension, and Purdue University's Institute for Sustainable Futures, will be held November 4–6, 2026, in Michigan City, Indiana.

This meeting revives the lake specific format previously hosted by IAGLR, offering a cost effective space where researchers, resource managers, outreach professionals, and partners from across the basin can connect. The focus this year is on strengthening the links between science and management, highlighting work that informs real world decision making across Lake Michigan's ecosystems and communities.

This document serves as a guide to the sessions that will occur, and focuses on providing the abstracts, keywords, and authors that make up each presentation session for your future reference.

We hope you will enjoy the program we have developed that highlights emerging research, innovative management strategies, collaborative projects, and community-engaged approaches that advance understanding and protection of the Lake Michigan ecosystem.

It took a village to make this meeting come to life, and we want to thank Blue Chip Hotel & Casino, Visit Michigan City LaPorte, and those that participated as part of the planning team:

- **Indiana Department of Environmental Management:** Nicole Messacar, Michael Spinar
- **Illinois-Indiana Sea Grant and Purdue University:** Angie Archer, Stuart Carlton, Paris Collingsworth, Pat Charlebois, Laura Esman, Tomas Höök, Sarah Peterson, Aaron Thompson, Cary Troy, Dominique Turney, Les Warren
- **Michigan Department of Environment, Great Lakes, and Energy:** Shannon Brigss, Matt Preisser
- **University of Michigan:** Jake Downey, Jared Merchant
- **US National Park Service:** Erin Argyilan
- **Wisconsin Department of Natural Resources:** Stacy Hron
- **Wisconsin Sea Grant:** Jennifer Hauxwell

Thank you for attending this meeting. We hope you take this opportunity to share ideas, ask questions, strengthen existing partnerships, and identify new collaborations. We are all here because we value Lake Michigan and the resources it provides. Keep doing good work and enjoy the meeting!

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Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

A Binational Framework for Resilient Great Lakes Coastal Ecosystems

Promoting ecosystem resilience to climate-driven stressors is a core priority of the Great Lakes Commission's Action Plan for a Resilient Great Lakes Basin. To advance this goal, a binational advisory group of researchers and resource managers was convened to develop the Science-Based Framework for Building Resilient Coastal Ecosystems in the Great Lakes Basin. The framework synthesizes current understanding of climate-driven changes affecting coastal ecosystems to provide a shared foundation for planning. Rather than providing a prescriptive management philosophy, the framework accommodates existing decision-support approaches, placing them within an iterative adaptive management cycle that considers strategic alternatives. This structure is intended to help practitioners evaluate the viability of protection, restoration, and management strategies under rapidly changing environmental conditions, high uncertainty, and shifting ecological baselines. The framework also addresses the role of communities, stakeholders, and organizational capacity in shaping management outcomes. This presentation will describe the framework's development process, conceptual structure, and practical applications for cross-jurisdictional coastal management. Attendee feedback will inform potential applications and next steps. Ultimately, the framework supports government and community decision-making in reassessing conservation goals, addressing procedural barriers to implementation, and expanding the portfolio of strategies for fostering resilient coastal ecosystems.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Nathan Kroeze, Great Lakes Commission

Keywords:

- Coastal Ecosystems
- Adaptive Management

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

Resilient Coastal Habitat Restoration Along WI's Lake Michigan Shores

This presentation will focus on sharing lessons learned from planning and implementing water quality, restoration and protection projects along Wisconsin's Lake Michigan coastal habitats. Important considerations for working in this dynamic and ever-changing environment to produce resilient projects will be discussed. These include coastal wetlands, beach and shoreline projects from Kenosha to Kewaunee.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Resilient
- Restoration
- Protection

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

Advancing Shoreline Resilience: Helping Municipalities Address Coastal Challenges Through the Resilient Coastal Projects Initiative

Shoreline erosion, flooding, bluff failure and other impacts across the Great Lakes region, including along Lake Michigan, pose a major challenge for coastal municipalities. More frequent severe storm events and rapidly changing lake levels in recent years have exacerbated the challenge for shoreline municipalities, particularly related to threats to municipal infrastructure such as roads, parks, water/wastewater treatment facilities, as well as public and private property. In response, the Great Lakes and St. Lawrence Cities Initiative developed its Resilient Coastal Projects Initiative (RCPI) to help municipalities develop nature-based solutions to strengthen resilience along their shorelines, protect public infrastructure, and generate new community benefits, such as fish and wildlife habitat and recreational amenities. The RCPI program has supported more than 100 municipalities in some way, ranging from initial planning and concept development to final engineering designs and construction cost estimates. The program also identifies funding options for coastal projects and assists with funding applications to foundations and government programs. The presentation will discuss how the RCPI program is structured, how the Cities Initiative recruits and works with municipalities, the work conducted in each phase of project development, key technical issues addressed, how community stakeholders are engaged, and how engineering consultants support the RCPI program. The Cities Initiative will also provide project details for select sites in the Lake Michigan watershed.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Coastal resilience
- Shoreline erosion
- Nature-based solutions

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

Leveraging Physics When Engineering With Nature

This presentation will focus on sharing lessons learned from planning and implementing water quality, restoration and protection projects along Wisconsin's Lake Michigan coastal habitats. Important considerations for working in this dynamic and ever-changing environment to produce resilient projects will be discussed. These include coastal wetlands, beach and shoreline projects from Kenosha to Kewaunee.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Jack C Cox, Edgewater Resources LLC

Keywords:

- Engineering with Nature
- Shore Protection evolution
- Coastal engineering

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

The State of Beach Nourishment in Lake Michigan

Beach nourishment is a familiar process to nearly all coastal states. The strategy has been deployed successfully for many reasons, spanning from tourism and economy to disaster mitigation and resiliency. Nourishment enhances beaches and public trust shorelines which attract visitors and generate tourism. The process also provides ecological benefits, restoring shorelines and littoral drift patterns. Perhaps most importantly, nourishment restores the littoral sediment systems which naturally buffer our shorelines, correcting for man-made impacts, and absorbing the erosive forces of storms. In Lake Michigan, beach nourishment occurs primarily as a byproduct of the channel maintenance dredging. And yet the benefits of the process are far greater than the intent. Historically, Great Lakes States residents have reacted to cyclic changes in water levels, resulting in 'emergency' armoring during high water conditions and stormy years, followed by the lakeward creep of development during low water conditions and sand accretion. States are taking proactive steps to retool coastal resiliency - educating communities and shoreline property owners, encouraging soft solutions and supporting local planning/zoning efforts, and regulating how shorelines are managed. Each location may benefit from one solution or another and beach nourishment has generally not been considered an option due to funding challenges and lack of clarity regarding the implementation process. Given the successful strategies used along other coastlines and the observed benefits of beneficial use of dredged material (BUDM) in the Great Lakes, beach nourishment represents yet another tool, to be considered in locations where the needs and constraints align with the solution. This presentation will provide an overview of beach nourishment in Lake Michigan; updates regarding the process to add nourishment to the coastal resiliency toolbox; and information about a community who is pursuing such a solution.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Michael Morphey, Edgewater Resources, LLC, St. Joseph, Michigan

Keywords:

- Coastal Resilience
- Shoreline Restoration
- Proactive Solutions

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

Illinois Beach State Park Shoreline Regeneration

Illinois Beach State Park is a 6-mile-long stretch of undeveloped Lake Michigan shoreline and is regarded as an irreplaceable environmental asset. The coast has suffered shoreline retreat as high as 100 ft in one year and as such, there is urgent need to preserve the remaining coast. To find a shoreline stabilization strategy which preserves a natural setting, Edgewater Resources married innovative approaches to finesse certain littoral responses with ecological enhancement design to develop a composite, value engineered solution that naturally embeds habitat as an integral part of the solution. By locally inducing, through intentional refraction and diffraction, the transport rate to be more uniform and reduced, the shoreline would experience a balanced transport, eradicating local erosion "hot spots", and ultimately minimizing shoreline and sediment loss. Deviating from a prescribed brute force solution controls shoreline morphology changes and also allowed for the integration of natural features to enhance aesthetics and ecological value. Using an "Engineering with Nature" approach Edgewater was able to coerce a specific transport behavior utilizing strategic structures such as submerged reefs or appropriately placed and shaped near shore structures to limit and redirect the amount a of wave energy that can reach the shore. This is accomplished using "tuned" structures oriented to induce a certain desired reaction from the wave field. This locally produces a different transport rate, which in turn modifies the shoreline planform. In the extreme, even the direction of sediment movement could be reversed. The design solutions were initially developed and analyzed using numerical modeling tools and methods to initially size and configure the system. Two and three dimensional physical model testing was then employed to validate and refine the actual performance, allowing the resilience and effectiveness of the habitat enhancement to also be demonstrated.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Jack Cox, Edgewater Resources, LLC, Madison, Wisconsin

Keywords:

- Coastal Resilience
- Nearshore Habitat
- Engineering With Nature

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

Lake Michigan Coastal Shoreline Changes: Spatial Variability and Geomorphic Implications

This study presents the first basin-wide assessment of coastal change along Lake Michigan from extreme lows in 2012/2013 to the record highs in 2019/2020. Using USACE topo-bathymetric LiDAR datasets, coastal changes were quantified using two approaches – shoreline-based and elevation-based, which represent shoreline migration from inundation and actual geomorphic change (erosion, accretion), respectively. Spatial patterns of coastal change were evaluated at both state- and county-scale, and differences were examined in relation to shoreline type, armoring, and coastal orientation. Results showed a general pattern of coastal retreat along the entire Lake Michigan coast. With the shoreline-based method, Michigan exhibited the greatest average recession rates, followed by Indiana, Wisconsin, and Illinois. In contrast, the elevation-based approach documented substantially smaller rates of change and a different regional pattern, with Wisconsin experiencing the most change, followed by Indiana, Michigan, and Illinois. These spatial patterns appear to be associated with shoreline types (beach, bluff, wetland, artificial), armoring (armored vs. non-armored), and coastal orientation (northeast, southeast, northwest, southwest), all of which exhibited significant differences in recession rates among groups. In general, the highest rates of recession were found along beaches, non-armored coasts and on the southeastern shoreline of Lake Michigan. In addition, analyses also revealed a positive relationship between increases in shoreline armoring and greater recession rates. Overall, these findings demonstrate that coastal change across the Great Lakes exhibits considerable spatial heterogeneity and is governed by the interaction of multiple geomorphic and anthropogenic factors. These insights are critical for understanding coastal responses to fluctuating water levels and supporting long-term management of Great Lakes shorelines.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Coastal changes
- Water level
- Geomorphology

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

Mapping Potential Longshore Sediment Transport Pathways and Variability Across Lake Michigan

Longshore sediment transport plays an important role in shoreline change, beach stability, and sediment management along Lake Michigan, yet basin scale transport patterns remain poorly quantified. This study develops a high resolution, lake wide assessment of potential longshore sediment transport using hourly wave hindcast data from 1979 to 2023. Offshore wave conditions were transformed to breaking conditions along shoreline segments spaced approximately 5 km apart, and potential transport was estimated to characterize net and gross transport magnitude, transport direction, directional persistence, seasonal variability, and long term temporal changes. The results reveal strong spatial heterogeneity around the lake, including persistent transport reaches, frequent directional reversals, and localized zones of transport convergence and divergence. Seasonal analysis shows that transport magnitude and direction vary substantially through the year, with energetic cold season wave conditions producing much of the annual transport activity. Comparisons among alternative bulk transport formulations indicate substantial differences in predicted magnitude, while the major alongshore transport patterns remain broadly consistent. The resulting transport atlas provides a basin scale framework for identifying dominant sediment pathways, sediment imbalance zones, and shoreline sectors where harbors and coastal structures may interrupt natural sediment movement. These findings provide a basis for regional sediment management and for linking potential transport patterns with observed shoreline change.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Sediment Transport
- Coastal Processes
- Shoreline Management

Advancing Coastal Resilience in Lake Michigan: From Science to Practice

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

UAV-Based 3D Reconstruction for Visualizing and Assessing Coastal Change Along Lake Michigan

Lake Michigan coastal communities face increasing challenges from shoreline erosion, changing water levels, storm impacts, and infrastructure vulnerability. Effective coastal resilience planning requires accessible methods for documenting shoreline conditions, visualizing physical change, and communicating potential risks to researchers, managers, and local communities. This study proposes a workflow that integrates unmanned aerial vehicle imagery, photogrammetry, and three-dimensional reconstruction to create detailed digital representations of selected Lake Michigan shoreline areas. Overlapping aerial images are processed using structure-from-motion and multi-view stereo techniques to generate georeferenced point clouds, digital surface models, and three-dimensional coastal models. Repeated data collection can support the identification and visualization of changes in shoreline position, beach morphology, bluff conditions, and nearby infrastructure. The reconstructed environments may also be incorporated into virtual or mixed-reality platforms to provide an interactive tool for exploring coastal conditions and communicating resilience challenges. The proposed approach provides a relatively flexible and scalable method for coastal monitoring while connecting spatial data collection with visual decision support. Expected outcomes include a reproducible reconstruction workflow, quantitative and visual indicators of coastal change, and an interactive framework that may support communication among researchers, coastal managers, and community stakeholders. This work contributes to ongoing efforts to advance coastal resilience in Lake Michigan by improving how shoreline information is collected, interpreted, and communicated.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Wei Wu, Purdue University

Keywords:

- Coastal Resilience
- 3D Reconstruction
- Shoreline Change

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

Moderator(s):

- Moh Aboelnour, University of Notre Dame, South Bend, Indiana

Presentation Title:

Bridging Science and Implementation: The Role of Regional Watershed Governance in Connecting Decision Support Tools to Local Water Management

Illinois Beach State Park (IBSP), in southwestern Lake Michigan, contains the last remaining stretch of natural beach-ridge coastline in Illinois. The park is home to globally significant panne wetlands, a wide variety of flora and fauna, and attracts visitors each year for beach recreation, camping, hiking, and boating and is free and open to the public year-round. Nearby coastal development and shoreline armoring have disrupted natural coastal processes within IBSP, resulting in coastal geomorphological impacts. In 2024, a large-scale shoreline protection project, containing 22 emergent breakwaters, was installed along the Lake Michigan shoreline at IBSP to protect this valuable coastal habitat. Additional sub-aquatic habitat features were installed at a subset of the structures with the goal of further enhancing aquatic habitat. The Illinois Natural History Survey, in partnership with the Illinois DNR Coastal Management Program (IDNR CMP), began an intensive evaluation of these structures in 2026. Goals of the evaluation program are to 1) quantify the effect of the breakwater structures on aquatic species abundance and diversity, and 2) determine the potential increased benefit of the sub-aquatic habitat features to aquatic species. Targets for evaluation include physical conditions, aquatic vegetation, larval fish, and pelagic fish. Impressions from initial surveys conducted in the spring and summer of 2026 will be shared during this presentation, as well as how observed changes to the aquatic system resulting from the breakwaters may fit in with observations of other research groups quantifying botanical and geological systems within IBSP. The IDNR CMP's support of a robust scientific approach when evaluating these structures will put the state of Illinois on the forefront of coastal science in the Great Lakes, paving the way additional successful coastal protection projects in the future.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Watershed Governance
- Decision Support
- Conservation Incentive

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

Moderator(s):

- Moh Aboelnour, University of Notre Dame, South Bend, Indiana

Presentation Title:

Evolution of Data Driven Water Supply Predictions in Support of Binational Great Lakes Water Management

Regional hydroclimate is the primary driver of Great Lakes water levels at subseasonal to interannual timescales, yet integration of climate forecasts as direct inputs to operational seasonal water level forecasts that support binational management of the Great Lakes has historically been limited. This is in part due to computational requirements involved with propagating ensemble-based climate forecasts through physical models over this longer forecast horizon. Approaches to address this in the past have made use of simple linear regression-based models relating overbasin temperature and precipitation to water supply or weighting climatologically-based water supply scenarios to match temperature and precipitation outlooks through optimization methods. Advancements in computational power and machine learning now present an opportunity to directly incorporate operational climate forecast products into seasonal projections of water supply in efficient modeling frameworks. This presentation highlights the evolution of the application of climate forecasts into the U.S. Army Corps of Engineers' (USACE) contribution to the binationally coordinated 6-month forecast of Great Lakes water levels through increasingly sophisticated data driven modeling approaches, including the most recent advancements made through the development of the Net Basin Supply (NBS)-Predictor, which has been transitioned into operations by USACE this year through a collaboration between USACE, the National Oceanic and Atmospheric Administration, and the Cooperative Institute for Great Lakes Research.

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Keywords:

- Water level forecasts
- Machine learning
- Hydrology

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

Moderator(s):

- Moh Aboelnour, University of Notre Dame, South Bend, Indiana

Presentation Title:

Advancing Seasonal-to-Annual Streamflow Forecasting for the Great Lakes Basin Using AI

Seasonal runoff forecasting is essential for predicting Great Lakes water supplies, lake-level variability, flood risk, and ecosystem conditions, yet remains challenging because of complex hydrologic processes, strong climate variability, extensive surface-water interactions, and large ungauged regions. This study develops a Long Short-Term Memory (LSTM) deep learning model to improve seasonal runoff forecasting across the Laurentian Great Lakes basin., The LSTM model was trained using Climate Forecast System Reanalysis (CFSR) meteorological data from 1979–2023 and evaluated using archived nine-month Climate Forecast System (CFS) seasonal forecasts. Forecast skill was assessed across multiple lead times at basin and lake scales using water-balance-derived runoff estimates and standard performance metrics., Results demonstrate that the LSTM model effectively captures nonlinear watershed responses and provides skillful seasonal runoff forecasts across the Great Lakes basin. The model shows strong potential for improving seasonal prediction of basin runoff, providing valuable information for water-level forecasting and operational water management."

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Yi Hong, Cooperative Institute for Great Lakes Research (CIGLR) and University of Michigan (UMICH), Ann Arbor, MI; Lindsay Fitzpatrick, CIGLR - UMICH; Dani Jones, CIGLR - UMICH; and Lauren Fry, Great Lakes Environmental Research Laboratory - NOAA, Ann Arbor, MI

Keywords:

- Seasonal to Annual
- Watershed modeling
- Long Short Term Memory

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

Moderator(s):

- Moh Aboelnour, University of Notre Dame, South Bend, Indiana

Presentation Title:

Accelerating Watershed Decision Support Through Hydrologic Modeling, Machine Learning, and Multi-Objective Optimization

Climate change, land-use change, and increasing demands on water resources require watershed managers to evaluate increasingly complex decisions across interconnected rural and urban landscapes. While process-based hydrologic models provide robust predictions of watershed response, their computational demands often limit the rapid evaluation of numerous management scenarios needed for adaptive planning. We present an integrated framework for accelerating watershed decision support by coupling hydrologic modeling with automated workflows, parallel scenario evaluation, multi-objective optimization, and emerging machine learning techniques. Using the St. Joseph River Basin, which drains to Lake Michigan, as a demonstration watershed, we employ a calibrated Soil and Water Assessment Tool (SWAT) model to evaluate watershed responses to conservation practices and infrastructure interventions. Automated workflows streamline data preparation, model execution, and post-processing, enabling efficient parallel simulation of management scenarios. Current work focuses on identifying influential model parameters and management variables through global sensitivity analysis and exploring multi-objective optimization to balance flood mitigation, nutrient reduction, agricultural productivity, and implementation costs. This computational framework establishes the foundation for future machine learning emulators that will substantially reduce computational requirements for large-scale scenario evaluation. Preliminary results demonstrate how automated parallel simulations and global sensitivity analysis identify key hydrologic processes and management controls, reducing the dimensionality of the optimization problem while improving the exploration of trade-offs among competing watershed objectives. The proposed framework provides a scalable pathway toward AI-enabled watershed decision support to advance watershed planning and climate resilience throughout the Great Lakes region.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- St. Joseph River Basin
- Hydrologic Modeling
- Decision Support

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

Moderator(s):

- Moh Aboelnour, University of Notre Dame, South Bend, Indiana

Presentation Title:

Leveraging Machine Learning to Improve Remote Sensing and Modeling Tools for Monitoring and Prediction of Nearshore Water Quality in the Great Lakes

Satellite-based remote sensing has become a crucial tool for the monitoring of open oceans, coastal oceans, and inland waters over the last thirty years. The Color Producing Agents Algorithm (CPA-A) is a semi-analytical inversion algorithm designed to estimate concentrations of chlorophyll-a, suspended sediments, and colored dissolved organic matter (CDOM) absorption in the Great Lakes region. Prior applications of the CPA-A were generally successful in capturing these parameters in offshore waters but were more limited in nearshore environments due to sensor spatial resolution issues and the inability of a single parameterization to capture highly dynamic optical conditions. A recent Great Lakes Restoration Initiative (GLRI) grant funded an effort to improve the CPA-A's nearshore monitoring capabilities, with the ultimate goal of generating products to assist in the monitoring of nutrient loading. This work included the transition to a higher resolution satellite sensor to better resolve the nearshore region as well as the incorporation of machine learning to improve the model parameterization in order to better account for the dynamic optical nature of the lakes. Specifically, the XGBoost algorithm was utilized to select optimal processing parameters based on the satellite-measured reflectance. This updated approach resulted in a substantial improvement in the accuracy of water quality retrievals across a wide scale of measurements while also increasing processing efficiency.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Remote Sensing
- Machine Learning
- Water Quality

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

Moderator(s):

- Moh Aboelnour, University of Notre Dame, South Bend, Indiana

Presentation Title:

Improving Phosphorus Predictions in Great Lakes Watersheds: Advances in SWAT Modeling and Machine Learning-Guided Calibration

Great Lakes Embayments are susceptible to harmful algal blooms and hypoxia due to lake characteristics and concentrated phosphorus inflows from large agricultural watersheds. Agricultural conservation practices can improve water quality by reducing phosphorus inputs to the riverine system. Hydrologic models have been widely used to quantify the effect of conservation practices on water quality from field to basin scales. Our team is working to improve the simulation of phosphorus sources and transport pathways in the Soil and Water Assessment Tool (SWAT). Our modeling approach uses a machine learning-guided optimization method to jointly calibrate model parameters and assess several phosphorus cycling algorithms in the SWAT model. We are conducting this work in two Great Lakes Priority Watersheds and Areas of Concern that contain extensive measured data on phosphorus in streams and sediments: the Maumee River Watershed draining to Lake Erie and the Lower Fox River Watershed draining to Lake Michigan's Green Bay. In addition to enhancing our understanding of phosphorus lags and legacies in Priority Watersheds through model improvements and efficient optimization-based calibration and assessment of algorithms, a major outcome of the project is the incorporation of SWAT+ source code improvements into the latest publicly available source code for download, and eventually into the full National Agroecosystem Model.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Margaret Kalcic; *Lourdes Arrueta Antequera; Joel Paulson; and Anna Apostel, University of Wisconsin-Madison; Katherine Merriman, New York Water Science Center, Troy, New York; Rebecca Kreiling, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin; Tanja Williamson, Ohio-Kentucky-Indiana Water Science Center, Louisville, Kentucky

Keywords:

- Watershed modeling
- Water quality

AI-Enabled Decision Support for Watershed Management and Conservation in the Lake Michigan Basin

Moderator(s):

- Moh Aboelnour, University of Notre Dame, South Bend, Indiana

Presentation Title:

Future Changes in Surface Water and Groundwater in the Great Lakes Basin

Global temperatures have been increasing rapidly over the past 50 years. In the Midwest and Great Lakes Region temperatures are projected to increase more rapidly than the global average, with the most extreme projections increasing by as much as 10° C in summer on average. A strong consensus in the climate model simulations shows precipitation increasing in fall, winter and spring, with modest drying in late summer. Together, these changes are projected to increase streamflow and flooding in cool season in 20 Midwest basins studied, due primarily to increasing precipitation and loss of snow cover in the future projections. The St. Joseph River is a case in point, which has important impacts on Lake Michigan. Comparing pre- and post- 1975 streamflow data reveal substantial increases in monthly average streamflow, and timing shifts towards earlier spring peak flows due to loss of snowcover and increasing spring precipitation. The historical record of annual peak flows shows strong upward trends, and WY 2018 produced unprecedented flooding due to a winter rain on snow event. Future projections of flooding in the St. Joseph from hydrologic model simulations show a 45% increase in the 100-yr flood by the 2080s. Groundwater has been much less thoroughly studied than surface water, but an existing study in the Kankakee River Basin shows increasing groundwater recharge in response to climate change, largely due to projected increases in cool-season precipitation. Changes in annual average air temperature are expected to increase groundwater temperatures, resulting in higher saturated hydraulic conductivity (K), and altered baseflows. Investigating hydrologic impacts at the scale of Lake Michigan and the Great Lakes as a whole will require computationally efficient tools for simulating these diverse hydrologic effects. AI and ML tools, for example, may play an important role in developing improved hydrologic models over large spatial scales.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

[*,†]Alan F. Hamlet, University of Notre Dame, South Bend IN, USA

Keywords:

- Climate change
- Hydrologic change
- Impacts to the Great Lakes

Aquatic Invasive Species in Lake Michigan: New Approaches for Management

Aquatic Invasive Species in Lake Michigan: New Approaches for Management

Moderator(s):

- Katie O'Reilly, Illinois-Indiana Sea Grant, Champaign, Illinois

Presentation Title:

Be a Hero: New Approaches to Aquatic Invasive Species Prevention and Outreach

The prevention of aquatic invasive species (AIS) is a critical step in the management process, as preventative actions are often less costly and more likely to have successful management outcomes compared to ongoing control efforts once AIS are established. Encouraging preventative behaviors among individuals involved in AIS pathways is therefore important, but requires an understanding of different audience needs to inform the development of new and engaging forms of outreach. Here, we discuss how the "Be a Hero" outreach campaign has been successfully to encourage preventative behaviors recreational water users and aquarium hobbyists in Illinois. We also highlight how "Be a Hero" demonstrates the importance of collaboration among organizations, and the importance of program evaluation. Overall, coordinated outreach campaigns like "Be a Hero" have the potential to influence AIS prevention behaviors among audiences, but depend on innovation, understanding of audience needs, and effective communication practices.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Greg Hitzroth; Natalia Szklaruk; and Karter Burgdorf, Illinois-Indiana Sea Grant, Glencoe, Illinois

Keywords:

- Aquatic Invasive Species
- Outreach
- Science Communication

Aquatic Invasive Species in Lake Michigan: New Approaches for Management

Moderator(s):

- Katie O'Reilly, Illinois-Indiana Sea Grant, Champaign, Illinois

Presentation Title:

***Dreissena* Spatial Organization in Lake Michigan**

The ecological effects of *Dreissena* may depend not only on their abundance, but also on the spatial organization of individuals on the lake bottom. To evaluate Dreissena spatial structure in Lake Michigan, we analyzed data collected during the U.S. EPA Great Lakes National Program Office Great Lakes Biology Monitoring Program and the Coordinated Science and Monitoring Initiative benthic surveys. We quantified depth-related patterns in *Dreissena* colony size and aggregation using benthic imagery and evaluated their relationships with hydrodynamic conditions. We found that Dreissena colony size varied strongly with depth, peaking at intermediate depths near 60 m and declining at the shallowest and deepest stations in Lake Michigan. *Dreissena* remained strongly aggregated across most of the sampled depth range, although a local decline occurred near 40 m. Within-station variation in colony size decreased significantly with depth, indicating greater spatial heterogeneity nearshore and more uniformly small colonies at deeper offshore stations. Bottom shear stress declined exponentially with depth, but too few stations occurred under high-shear conditions to evaluate its influence. Low-current conditions became more common offshore and were associated with smaller colonies, whereas aggregation remained high and was not significantly related to current conditions. These findings suggest that hydrodynamic conditions may influence colony size more strongly than mussels' tendency to aggregate. To evaluate changes in *Dreissena* spatial structure, we analyzed 2015-2025 data using complementary spatial statistical and geostatistical methods. The resulting maps revealed persistent and shifting hot and cold spots, spatial clusters and local outliers, and broader changes in the distribution of *Dreissena* across Lake Michigan. We will discuss how these changes may affect other benthic taxa and the broader food-web dynamics in Lake Michigan.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Nikolai Barulin, Great Lakes Center, SUNY Buffalo State University; Allison Hrycik, Darrin Freshwater Institute and The Jefferson Project, Rensselaer Polytechnic Institute; Lyubov Burlakova, Great Lakes Center, SUNY Buffalo State University; Alexander Karatayev, Great Lakes Center, SUNY Buffalo State University; Susan Daniel, Great Lakes Center, SUNY Buffalo State University; Kaira Kamke, Great Lakes Center, SUNY Buffalo State University

Keywords:

- Dreissena
- Spatial organization
- Lake Michigan

Aquatic Invasive Species in Lake Michigan: New Approaches for Management

Moderator(s):

- Katie O'Reilly, Illinois-Indiana Sea Grant, Champaign, Illinois

Presentation Title:

Invasive Mussel Control to Restore Native Lake Whitefish Spawning Habitat: Results of the First Experimental Treatment in Northern Lake Michigan

Invasive *dreissenid* mussels have rapidly expanded throughout the Great Lakes over the past three decades and produced significant ecological impacts as voracious filter feeders and ecosystem engineers. One of the negative effects coinciding with the expansion of *dreissenids* in Lakes Michigan and Huron was a decline of economically and culturally important native lake whitefish populations. Mussels's attachment to hard surfaces on spawning reefs causes clogging of the spawning habitats and decreases oxygen and water flow for egg incubation. The objective of this project is to determine whether control of *dreissenid* mussels on a spawning reef could improve egg survival and hatching success. This presentation will provide results on initial and one-year post-treatment condition of *dreissenid* populations of treated reef sites; assessment of fish response is ongoing. Two treatment approaches were tested in Good Harbor Bay, Lake Michigan, in 2025. Three benthic mats (6 m x 18 m, each) were deployed on a reef by scuba divers for 4-5 days duration and dosed with CO2 four times per day; additionally, two larger benthic mats (12 m x 12 m, each) were deployed for 30 days duration without CO2 application. Samples were collected before treatment and immediately, 30 days, 60 days (CO2-infused mats only), and 1 year after treatment on treated and reference sites. Decrease in mussel densities on treated sites was astounding; from about 11,000 individuals per m2 pre-treatment to an average of 10 and 66 individuals per m2 under CO2-infused mats and non-CO2 mats, respectively, at 30-days post-treatment. Post-treatment assessment in Good Harbor Bay, Lake Michigan, is ongoing and additional experimental treatments in Thunder Bay, Lake Huron, and Big Bay de Noc, Lake Michigan are planned.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Kasia Przybyla-Kelly, U.S. Geological Survey, Great Lakes Science Center, Chesterton, Indiana; Diane Waller, USGS Upper Midwest Env Sciences Center, La Crosse, Wisconsin; Mary Anne Evans, USGS Great Lakes Science Center, Ann Arbor, Michigan

Keywords:

- Invasive mussels
- Restoration
- Experimental treatment

Aquatic Invasive Species in Lake Michigan: New Approaches for Management

Moderator(s):

- Katie O'Reilly, Illinois-Indiana Sea Grant, Champaign, Illinois

Presentation Title:

Mussel Puberty: Defining Size Thresholds for Quagga Mussel Reproduction Across a Depth Gradient in Lake Michigan

Understanding the reproductive success of the highly invasive quagga mussel (*Dreissena bugensis*) requires knowing the proportion of reproductively active individuals in a population. Extensive research shows that zebra mussels, *Dreissena polymorpha*, start producing mature gametes between 5 mm and 12 mm with large variations based on depth; this trend has been under-researched for quagga mussels. The goal of this study is twofold: we aim to determine when quagga mussels start producing mature gametes as well as the length at which they begin to release gametes. We studied quagga mussels collected from Lake Michigan at depths of 1, 25, 45, and 100 meters in June and July 2026. Sampled mussels ranged in length from 4 mm-19 mm. We dissected 10 mussels of each size from each depth and examined gonad squash mounts microscopically for gamete presence and to assess maturity. Analysis suggests that quagga mussels reach maturity at different lengths in nearshore and offshore locations. While all sites had mussels with mature gametes starting at lengths between 4-8 mm, 50% of nearshore mussels between 7-10 mm were mature, compared to between 14-16 mm in offshore mussels. To assess the relationship between length and spawning, we conducted a spawning assay across the same size spectrum as our dissections. We induced spawning using serotonin and examined the surrounding water for released gametes. Spawning was not significantly correlated to size for small mussels (< 20 mm); however, nearshore mussels had significantly higher spawning rates than did offshore mussels. These findings identify which portions of the quagga mussel population are the largest contributors to mussel reproduction and, in turn, recruitment. This will help inform future literature, ecosystem models, and management strategies.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Amelia Myers, University of Miami, Coral Gables, Florida; Ashley Elgin, NOAA Great Lakes Environmental Research Laboratory, Muskegon, Michigan; Rachel Pietscher, Grand Valley State University, Annis Water Resources Institute, Muskegon, Michigan

Keywords:

- AIS
- Dreissenid mussels
- Reproduction

Coastal Resilience Monitoring in the Great Lakes

Coastal Resilience Monitoring in the Great Lakes

Moderator(s):

- Shelby Brunner and Michael Sutherland, Great Lakes Observing System (GLOS), Ann Arbor, Michigan

Presentation Title:

The Great Lakes Observing System Development

The Integrated Ocean Observing System (IOOS) is a network of people and technology that work together to compile and distribute data on our coastal waters, Great Lakes, and oceans. IOOS has been a national leader in providing regionally and nationally relevant datasets and information to a wide range of users. Within this framework, there is increased effort to deliver more coordinated and collaborative datasets and products related to water levels, waves, and webcam imagery. The Great Lakes node of IOOS is working with multiple partners to deliver these types of data to our local and regional users, as well as make them accessible to the national database. This presentation will provide an overview on efforts within the Great Lakes Observing System related to water levels, waves, and webcam imagery from multiple partners, as well as a look into what the national collaborative effort is developing.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Shelby Brunner; Connor Brooks; Michael Sutherland; and Katie Rousseau, Great Lakes Observing System, Ann Arbor, MI

Keywords:

- Real-time observing
- Buoys
- Webcams

Coastal Resilience Monitoring in the Great Lakes

Moderator(s):

- Shelby Brunner and Michael Sutherland, Great Lakes Observing System (GLOS), Ann Arbor, Michigan

Presentation Title:

Automated Nearshore Observations of Great Lakes Coastal Dynamics Using the Integrated Radar Monitoring System (IRaMS)

Nearshore zones across the Great Lakes are dynamic environments susceptible to rapid shifts in beach safety, navigation hazards, infrastructure damage, and shoreline erosion. Traditional in-situ wave instrumentation often fails to capture the continuous spatiotemporal complexities necessary for practical coastal solutions. To bridge this gap, the U.S. Army Corps of Engineers Detroit District developed the Integrated Radar Monitoring System (IRaMS). This presentation outlines the operational efficacy of four semi-permanent IRaMS stations established along the Lake Michigan coastline over the past two years, with ongoing integration underway to host and disseminate data via the Great Lakes Observing System (GLOS)., The IRaMS architecture integrates off-the-shelf marine X-band radar (9.8 GHz) with a field-deployed single-board computer. Autonomous operations use an 80W solar panel and a smart-sampling algorithm that triggers a 5-minute, 1 Hz collection sequence across a 200m to 4km radial domain when forecasted wave thresholds are exceeded. Uniquely, IRaMS continues operations through the winter, capturing nearshore wave-ice interactions unavailable via traditional methods. Automated cloud processing generates georectified spatial maps within 5 minutes. Wave heights across the surf zone are calculated landward at 1–2m intervals using a spatial propagation model driven by radar-measured wave speeds, spectra, and depths, applying energy flux conservation and Green's Law to capture breaking thresholds and sandbar de-shoaling. Additional derived parameters include surface currents, bathymetry via linear dispersion inversion, and surf-zone sediment transport resolved by routing stable hydrodynamic velocity fields into the Bailard energetics model. Maintaining a ±10–15% accuracy relative to independent in-situ gauges, this network provides a scalable, year-round data pipeline for Great Lakes hazard mitigation."

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Jesse McNinch and Jonathan Waddell, US Army Corps of Engineers, Detroit, Michigan

Keywords:

- Coastal monitoring
- Automated sampling
- X-band radar

Coastal Resilience Monitoring in the Great Lakes

Moderator(s):

- Shelby Brunner and Michael Sutherland, Great Lakes Observing System (GLOS), Ann Arbor, Michigan

Presentation Title:

High-frequency Radar in the Straits of Mackinac

In 2019, the very first operational high-frequency radar (HFR) was deployed in the Great Lakes at the Straits of Mackinac. Since 2022 a pair of HFRs have provided continuous, publicly-available surface current data for the region to the immediate west of the Mackinac Bridge, supporting the significant potential for the use of HF radar to provide reliable current measurements in freshwater. This technique is widely utilized in coastal ocean environments and the potential for the Great Lakes is still being evaluated. In this talk, we will give a background on the system, show analysis that compares current measurements from co-located observational buoys, and demonstrate a novel machine learning method that processes historical spatiotemporal current measurements to predict future currents. Future ideas for Great Lakes HF radar installations will also be discussed.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- High-frequency radar
- Observing
- Surface currents

Coastal Resilience Monitoring in the Great Lakes

Moderator(s):

- Shelby Brunner and Michael Sutherland, Great Lakes Observing System (GLOS), Ann Arbor, Michigan

Presentation Title:

An Open-Source Framework for Continuously Updated Coastal Elevation Models in the Great Lakes

Accurate, up-to-date coastal elevation data are fundamental to understanding shoreline change, modeling coastal hazards, and planning resilient infrastructure. However, traditional lidar and hydrographic surveys are expensive, infrequent, and often leave substantial gaps in shallow nearshore environments where many coastal processes occur. These limitations reduce the ability of Great Lakes communities to monitor dynamic coastlines and respond to changing environmental conditions. Through support from the Great Lakes Observing System (GLOS), the Continuously Updated Digital Elevation Model (CUDEM) framework is being extended to create an open-source, repeatable approach for generating high-resolution coastal elevation models throughout the Great Lakes. The project integrates authoritative lidar and sonar surveys with freely available Sentinel-2 multispectral imagery and ICESat-2 photon altimetry to expand bathymetric coverage in data-sparse nearshore areas. By leveraging routinely collected satellite observations, the framework enables more frequent updates to coastal elevation products while reducing the cost and effort associated with traditional mapping campaigns. This presentation will describe the development of the integrated CUDEM workflow, including satellite-derived bathymetry, dynamic vertical referencing, and the creation of a containerized toolkit that allows users to generate updated digital elevation models using reproducible, open-source workflows. By making advanced coastal mapping data accessible to regional partners through the GLOS Seagull platform, this project provides a scalable foundation for sustained coastal monitoring and supports a more resilient and data-informed Great Lakes region.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Coastal Monitoring
- Coastal Resilience
- Coastal Observing

Coastal Resilience Monitoring in the Great Lakes

Moderator(s):

- Shelby Brunner and Michael Sutherland, Great Lakes Observing System (GLOS), Ann Arbor, Michigan

Presentation Title:

Strengthening Coastal Resilience Through Water Level Monitoring in the Eastern Basin of Lake Erie

Coastal communities along the eastern basin of Lake Erie are increasingly vulnerable to flooding, erosion, and rapidly changing water levels driven by seiche events, extreme precipitation, and other climate-related stressors. While water levels on the open lake are well monitored, far less is known about how these coastal processes propagate into tributary systems, where lake-driven backflow, watershed runoff, and ice processes can combine to create localized flooding and infrastructure impacts. This lack of real-time observations limits the ability of communities to anticipate hazards, design resilient infrastructure, and understand the evolving dynamics of the coastal zone. Through support from the Great Lakes Observing System (GLOS), Buffalo Niagara Waterkeeper established a network of ten real-time water-level monitoring stations throughout tributaries of the Niagara River–Lake Erie watershed. By monitoring locations near tributary mouths as well as upstream reaches, the network captures the interaction between coastal water-level fluctuations and watershed hydrology, providing new insight into how Lake Erie influences inland flooding and stream conditions. This presentation will describe the planning, siting, and implementation of the monitoring network, including considerations for sensor deployment, data management, and long-term sustainability. It will also highlight how expanded tributary observations strengthen coastal resilience by improving situational awareness during seiche-driven flooding, informing resilient infrastructure and habitat restoration projects, supporting community planning and emergency preparedness, and filling a longstanding observational gap along one of the Great Lakes' most dynamic coastlines. The project demonstrates how locally operated observing systems can enhance regional coastal intelligence while contributing to a more connected Great Lakes observing network.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Jeanne Beiter, Buffalo Niagara Waterkeeper, Buffalo, New York

Keywords:

- Coastal Monitoring
- Coastal Resilience
- Coastal Observing

Coastal Resilience Monitoring in the Great Lakes

Moderator(s):

- Shelby Brunner and Michael Sutherland, Great Lakes Observing System (GLOS), Ann Arbor, Michigan

Presentation Title:

Expanding Wave Observations to Improve Maritime Safety and Coastal Resilience in Lower Green Bay, Lake Michigan

Lower Green Bay is one of the most heavily used recreational and commercial waterways in the Great Lakes, yet has historically lacked sufficient in situ wave observations to adequately characterize local conditions. The bay's unique embayment geometry, long fetch, and rapidly changing weather create complex wave environments that can vary significantly over relatively short distances, limiting situational awareness for recreational boaters, commercial operators, forecasters, and emergency managers. Through support from the Great Lakes Observing System (GLOS), NEW Water expanded the lower Green Bay observing network by deploying two new real-time wave buoys and upgrading an existing long-term monitoring station with wave sensing capabilities. These assets enhance the existing monitoring capabilities in providing continuous observations of waves, meteorological conditions, and water quality. This presentation will describe the planning, implementation, and operation of the expanded observing network, including considerations for sensor selection, deployment logistics, data management, and long-term sustainability. The presentation will also discuss lessons learned during implementation, approaches for making real-time observations accessible to a broad user community, and the importance of partnerships in sustaining regional observing infrastructure. By addressing a longstanding observational gap in lower Green Bay, this project strengthens the information available to support safer navigation, improved weather forecasting, and enhanced coastal resilience while providing a model for expanding operational observing systems throughout the Great Lakes.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Peyton Schroeder and Ben Young, Green Bay Metropolitan Sewerage District, Green Bay, Wisconsin

Keywords:

- Coastal Monitoring
- Coastal Resilience
- Coastal Observing

Coastal Resilience Monitoring in the Great Lakes

Moderator(s):

- Shelby Brunner and Michael Sutherland, Great Lakes Observing System (GLOS), Ann Arbor, Michigan

Presentation Title:

Expanding and Modernizing the Great Lakes Coastal Observing Network in Michigan's Upper Peninsula

Long-term coastal observing systems are essential for understanding dynamic Great Lakes conditions and provide real-time information needed to support safe navigation, emergency response, resource management, fisheries and climate resilience. As observing infrastructures ages, maintaining continuity of these critical datasets while expanding coverage into underserved regions has become an increasing priority. Through support from the Great Lakes Observing System, the Superior Watershed Partnership (SWP) is modernizing and expanding the coastal observing network across Michigan's Upper Peninsula. The project replaces three buoys that have provided over a decade of spring-through-fall observations along Lake Superior's southeastern shoreline. It expands real-time monitoring through partnerships with the Keweenaw Bay, Bay Mills, and Hannahville Indian Communities. These investments increase the SWP network to seven buoys, improving coverage across both Lake Superior and northern Lake Michigan. SWP plans to expand their buoy program into Lake Huron and continue to support international climate research at Stannard Rock Lighthouse by the National Oceanic and Atmospheric Association, the Great Lakes Evaporation Network and Environment Canada. Stannard Rock Lighthouse is located 28 miles offshore in Lake Superior, and has been owned and maintained by SWP since 2015. The presentation will describe the planning and implementation of the expanded buoy network, including efforts to maintain data continuity, modernize infrastructure, and coordinate deployments across multiple partner organizations. It will highlight how sustained coastal observations support improved weather and wave forecasting, maritime safety, Tribal and community decision-making, and climate resilience. The project demonstrates how strategic network expansion and regional partnerships can build more resilient, reliable, and sustainable coastal observing systems for the Great Lakes.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Jeff Koch; Geri Grant; Kathleen Henry; and Carl Lindquist, Superior Watershed Partnership, Marquette, Michigan

Keywords:

- Coastal Resilience
- Coastal Observing
- Coastal Resilience Monitoring in the Great Lakes

Collaborating Across Research, Management, Outreach, and Education – Success in Partnership

Collaborating Across Research, Management, Outreach, and Education – Success in Partnership

Moderator(s):

- Julie Fiorito and Kristin TePas, Illinois-Indiana Sea Grant, Chicago, Illinois

Presentation Title:

Hosah Prairie - An Exceptionally Biodiverse Lakefront Ecosystem Under Threat

Given the exceptional floristic richness of the Zion Beach Ridge Plain at Hosah Park, in 2025 the Illinois Native Plant Society provided funding to survey the vegetation and report on its condition. The resulting report included a history of the tiny 23 acre park, a qualitative and quantitative analysis of its rich vegetation, and a presentation of the plant species considered by the State of Illinois to be rare, threatened, endangered or of special concern. Included was a delineation of the plant community associations, along with an assessment of their present condition. Knowledge of Hosah Park's varied ecosystems has accrued from a history of botanical interest since the first decade of the 20th century, and has benefited from a growing program of ongoing stewardship. This presentation will detail new vascular plant species we discovered during the survey; discuss how Hosah Park's 415 vascular plant species compare to the 880 currently described from the wider, Ramsar-dedicated Chiwaukee-Waukegan Beach Ridge Plain; and describe community and interagency partnerships that have resulted in supporting ongoing restoration efforts, educational outreach to nearby underserved communities, and collaborations with adjacent landowners, to serve as a model for future restoration and collaboration projects elsewhere in the region.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Ecosystem Monitoring
- Floristics
- Community Engagement

Collaborating Across Research, Management, Outreach, and Education – Success in Partnership

Moderator(s):

- Julie Fiorito and Kristin TePas, Illinois-Indiana Sea Grant, Chicago, Illinois

Presentation Title:

Dressing Up as Alien Researchers to Educate about Lake Michigan: Using Cosplay to Reach New Audiences

Humans have been telling stories to one another for as long as they have existed. The ways we connect with those stories have changed from oral traditions by the campfire to video games and other modern media; however, the emotional response we have to these stories remains true. Effective science communication requires us to tap into our natural storytelling ability to convey the importance of the matters we discuss. Cosplay, a combination of the words "costume" and "play," has become another way for storytelling as well as a way for fans of a media to connect with one another over favorite fictional worlds and characters. By dressing up as a fictional character, barriers to communicating real world science can be broken down as the public realizes that they have secretly been interacting with science the whole time. In this talk, I provide an example of how cosplay can be used to discuss Great Lakes science through a collaboration between Illinois-Indiana Sea Grant and Cosplay For Science. I will explain how dressing up as an elf from Dungeons & Dragons can make your messages more palatable, how to connect big stories to real science, and the story of how fictional alien bacteria inspired my community to care more deeply about Lake Michigan.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Karter Burgdorf, IL-IN Sea Grant, Chicago, Illinois; Margaret Lawrence, IL-IN Sea Grant, West Lafayette, Indiana; Janice Milanovich, IL-IN Sea Grant, Chicago, Illinois

Keywords:

- Science communication
- Outreach

Collaborating Across Research, Management, Outreach, and Education – Success in Partnership

Moderator(s):

- Julie Fiorito and Kristin TePas, Illinois-Indiana Sea Grant, Chicago, Illinois

Presentation Title:

Bridging Classrooms and Open Waters: Partnership Between Illinois-Indiana Sea Grant and Chicago Public Schools

Come learn how an innovative partnership between Illinois-Indiana Sea Grant and Chicago Public Schools has been put into action through cultivating the next generation of environmental stewards by fostering a deep appreciation for the Lake Michigan watershed. Gerard Kovach experienced a once in a lifetime professional development across Lake Michigan on board the EPA R/V Lake Guardian. This was the catalyst for establishing sustained relationships with scientists and outreach specialists that put students in the driver seat towards their own action research and environmental stewardship.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Gerard Kovach, Chicago Public Schools, Chicago, IL

Keywords:

- Water quality
- Education
- Collaboration

Collaborating Across Research, Management, Outreach, and Education – Success in Partnership

Moderator(s):

- Julie Fiorito and Kristin TePas, Illinois-Indiana Sea Grant, Chicago, Illinois

Presentation Title:

Collaborative Approaches to Lake Michigan Outreach Through Loanable Education Kits

Loanable educational kits offer a powerful way to extend learning across educational disciplines, including science, social studies, and environmental stewardship. They are especially powerful when developed and implemented through strong partnerships. This poster or session will showcase how Illinois-Indiana Sea Grant has partnered with individual educators, nature centers, parks, and conservation professionals to share hands-on teaching tools. The session or poster will provide practical examples, lessons learned, and ideas for adapting similar tools to support outreach, education, and stewardship efforts throughout the Lake Michigan basin. Attendees will leave with resources and inspiration for creating meaningful, place-based learning experiences in their own communities. Whether presenting a session or sharing a poster, we'd like to bring some of our kits, including the Great Lakes basin floor map, to demonstrate the power of these teaching tools.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

*,†Janice Milanovich and Kristin TePas, IL-IN Sea Grant, Chicago, Illinois

Keywords:

- Environmental Education
- Loanable Education Kits

Connecting on Coastal Resilience: Exploring Multi-Scale Communities of Practice, Networks, and Collaborations in Lake Michigan

Connecting on Coastal Resilience: Exploring Multi-Scale Communities of Practice, Networks, and Collaborations in Lake Michigan

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

CALM: Addressing Coastal Hazards through a Regional Community of Practice

Lake Michigan communities face coastal flooding and erosion hazards that are driven by extreme lake levels and storm events. However, decadal water level fluctuations can cause hazard impacts to be forgotten in between extremes, resulting in a reduced capacity to address coastal hazards when extreme conditions return. Following the high water levels and winter storms of 2020, coastal communities expressed a need for structure and leadership to guide knowledge sharing and collaborative action between coastal communities. To meet this need, state and local partners built upon the work of the Southeastern Wisconsin Coastal Resilience Project and formed the coast-wide Collaborative Action for Lake Michigan (CALM) Coastal Resilience community of practice (CoP). The community of practice is a group of connected state and local government staff, planners, engineers, educators, subject-matter experts, and concerned citizens who use shared knowledge and resources to address common coastal challenges. Since its formation, CALM has provided members with learning opportunities, relationship-building activities, technical assistance, and regular communication about hazards and resources. Encouragingly, members report that CALM's regional CoP model has helped them reduce risk and improve planning for coastal hazards. Now in its fifth year, CALM continues to evolve and partner with local resource managers and organizations to meet its members' needs.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Coastal resilience
- Community of practice
- Collaboration

Connecting on Coastal Resilience: Exploring Multi-Scale Communities of Practice, Networks, and Collaborations in Lake Michigan

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

Building Flood Resilience Together: The East River Collaborative's Community-Driven Approach in Northeast Wisconsin

The East River Watershed in Northeast Wisconsin drains, indirectly, to Lake Michigan and has experienced increasing flood impacts driven by land use change, rapid population growth, climate trends, and fluctuating lake levels. In response to significant flooding in 2019 and 2020, the East River Collaborative (ERC) was established as a partnership of municipal, state, federal, university, and nonprofit organizations working to advance watershed-scale flood resilience. Early ERC efforts included flood modeling, stakeholder engagement, community resilience assessments, and development of a watershed resilience framework. Building on this foundation, the ERC expanded municipal and community engagement through initiatives such as East River Trail corridor planning, green infrastructure code audits, and flood-mitigation project design that improves both resilience and water quality. The ERC is also developing a decision-support tool and an implementation plan to site and prioritize future watershed efforts. To strengthen local capacity, the Collaborative has facilitated peer-learning opportunities, including a two-day exchange with the Milwaukee Metropolitan Sewerage District and community organizations leading neighborhood-scale flood resilience efforts. To better understand community needs, the ERC partnered with Wello to conduct qualitative interviews documenting residents lived experiences with recurring flooding. In collaboration with the University of Wisconsin's Madison Division of Extension, the ERC is also surveying 3,000 households within the 100-year floodplain. Preliminary findings will explore flood experiences, risk-reduction actions, and preferred communication channels to inform future outreach and mitigation strategies. This presentation highlights how the East River Collaborative is integrating technical analysis, community engagement, and partnership-building to support community-informed flood resilience and nature-based mitigation across the watershed.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Kari Hagenow, The Nature Conservancy, De Pere, Wisconsin

Keywords:

- Flood Resilience
- Community Planning
- Community of Practice

Connecting on Coastal Resilience: Exploring Multi-Scale Communities of Practice, Networks, and Collaborations in Lake Michigan

Moderator(s):

- Sarah Peterson, Illinois-Indiana Sea Grant, Chesterton, Indiana

Presentation Title:

The Resilient Illinois and Indiana Shorelines (RIIS) Network: Exploring Cross-Agency Collaboration to Foster Resilience in Southern Lake Michigan

Communities of Practice (CoPs) have been widely utilized to enhance coastal resilience in the Great Lakes and beyond. This presentation takes a deeper dive into the newly formed Resilient Illinois and Indiana Shorelines (RIIS) network, co-developed in collaboration between Illinois-Indiana Sea Grant, the Indiana Lake Michigan Coastal Program, and the Illinois Coastal Management Program. First, the speakers will discuss the development of the RIIS network, including practical tips, common challenges, and key planning considerations. Next, the speakers will share insights into effective bi-state and cross-agency coordination, highlighting key considerations, benefits, and lessons learned. Finally, the speakers will present initial findings from the RIIS network planning survey, outlining future directions for the CoP.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

[*,†]Sarah Peterson, IL-IN Sea Grant, Chesterton, Indiana; [*]Joe Exl, Lake Michigan Coastal Program, Chesterton, Indiana; *Carla Rosenfeld, Illinois Coastal Management Program, Chicago, Illinois; *Esther N. Chavira-Metza, Illinois Coastal Management Program, Chicago

Keywords:

- Coastal Resilience
- Network
- Community of Practice

Connecting on Coastal Resilience: Exploring Multi-Scale Communities of Practice, Networks, and Collaborations in Lake Michigan

Moderator(s):

- Sarah Peterson

Presentation Title:

Planning and Public Values for Coastal Adaptation and Conservation

Coastal adaptation and conservation along Lake Michigan are often framed as technical challenges, yet implementation ultimately depends on public support and community values. This presentation highlights findings from two planning and social science initiatives along Indiana's Lake Michigan shoreline. The first examines how shoreline landowners evaluate traditional and nature-based erosion management strategies, revealing that aesthetics, perceived effectiveness, recreational access, and firsthand experiences with erosion all influence support for adaptation efforts. Communities experiencing the greatest shoreline impacts demonstrated greater willingness to accept landscape change, suggesting the importance of "adaptation tolerance" in coastal decision-making. The second project supports development of Indiana's Coastal and Estuarine Land Conservation Plan through stakeholder engagement, regional surveys, participatory GIS, and spatial conservation planning. The work integrates community values with geospatial analysis to identify conservation priorities and guide long-term investment in resilient coastal landscapes. The presentation also highlights how Purdue landscape architecture capstone projects have applied these findings through community-based planning and design efforts across Northwest Indiana. Together, these projects demonstrate the critical role of planning, public engagement, and human dimensions research in advancing coastal resilience throughout the Lake Michigan basin.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

Aaron Thompson, Purdue University, West Lafayette, Indiana

Keywords:

- Conservation Planning
- Environmental Design
- Connecting on Coastal Resilience: Exploring Multi-Scale Communities of Practice, Networks, and Collaborations in Lake Michigan

Contaminants of Emerging Concern in the Lake Michigan Watershed

Contaminants of Emerging Concern in the Lake Michigan Watershed

Moderator(s):

- Sarah Zach, Illinois-Indiana Sea Grant, and Beth Meschewski, Illinois Sustainable Technology Center, Champaign, Illinois

Presentation Title:

Trifluoroacetic Acid in Great Lakes Waters

Trifluoroacetic acid (TFA) is increasingly recognized as a widespread and returning environmental contaminant, first identified as a concern following the phaseout of chlorofluorocarbons (CFCs). Here, we measured TFA along with 26 legacy PFAS in precipitation (n = 273) at five Integrated Atmospheric Deposition Network (IADN) sites and in lake water (n = 117) from all five Great Lakes between 2021 and 2024. The median TFA concentration in precipitation (448 ng L-1; 369–737 ng L-1) was 1–2 orders of magnitude higher than Σ26PFAS (median 3.28 ng L-1). The median flux of TFA and Σ26PFAS was 311 and 2.25 μg m−2 year−1, respectively. Spatially, TFA and Σ26PFAS concentrations in precipitation were highest at urban locations with lower levels found at rural and remote sites. In open lake water, concentrations were high-est in Lake Ontario and lowest in Lake Superior. TFA concentrations in precipitation increased significantly between 2021 and 2024 at all sites with doubling times of 1.4-2.3 years. Seasonal differences were pronounced, with significantly higher TFA concentrations in summer than in the other seasons, consistent with enhanced summertime atmospheric oxidation of volatile precursors. TFA concentrations in lake water were 3-5 times higher than measurements from the late 1990s, suggesting long-term enrichment in open lake water.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- PFAS
- Water
- Atmospheric deposition

Contaminants of Emerging Concern in the Lake Michigan Watershed

Moderator(s):

- Sarah Zach, Illinois-Indiana Sea Grant, and Beth Meschewski, Illinois Sustainable Technology Center, Champaign, Illinois

Presentation Title:

From Highways to Waterways: Evaluating Road-derived Contaminant Flow into Lake Michigan

Stormwater runoff from roads and highways is a major pathway for untreated pollutants entering adjacent aquatic ecosystems, particularly in the southern Lake Michigan region. High-traffic transportation corridors are significant sources of road-derived contaminants, including suspended sediments, chlorides, heavy metals, and microplastics. Among these pollutants, tire wear particles (TWPs) have emerged as a contaminant of growing concern due to their widespread occurrence and potential ecological impacts. This project seeks to quantify TWP loadings to southern Lake Michigan by integrating roadway and traffic characteristics with stormwater modeling approaches. Traffic volume, vehicle composition, roadway attributes, and environmental factors will be incorporated to estimate TWP generation, while watershed-scale hydrologic and water quality models will be used to simulate particle transport from roadways to receiving waters. Field sampling will provide data for iterative model calibration and validation, improving predictive performance under a range of climatic and management scenarios. The project will generate critical insights into the magnitude and spatial distribution of TWP contamination affecting southern Lake Michigan. By explicitly incorporating roadway and traffic variables into a stormwater quality modeling framework, the approach enables scalable and cost-effective simulation of TWP generation and transport across watersheds.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Tire-wear particles
- Stormwater
- Field sampling

Contaminants of Emerging Concern in the Lake Michigan Watershed

Moderator(s):

- Sarah Zach, Illinois-Indiana Sea Grant, and Beth Meschewski, Illinois Sustainable Technology Center, Champaign, Illinois

Presentation Title:

PFAS Transfer Through Stream Food Webs Across Lake Michigan Watersheds

Per- and polyfluoroalkyl substances (PFAS) move through aquatic food webs, linking contaminated basal resources to invertebrates, fish, wildlife, and human consumers. Predicting PFAS transfer through stream food webs remains challenging because exposure is shaped by multiple environmental and trophic factors. We investigated PFAS burdens in stream food webs from nine northwestern Indiana streams. Water and sediment were also analyzed to identify potential PFAS sources and sinks across streams. Basal resources, including biofilm, detritus, and algae, were sampled opportunistically where present to evaluate potential dietary sources of PFAS exposure to organisms. Overall, PFAS concentrations were higher and more consistently detected in sediment (1.1 Â± 0.1 ng/g; mean Â± SE) than in stream water (0.008 Â± 0.0028 ng/mL). Preliminary results indicate that PFAS concentrations varied among macroinvertebrate functional feeding groups (FFGs), while parasites exhibited the highest PFAS concentrations overall. Among free-living FFGs, shredders had the highest PFAS concentrations (6.975 Â± 0.290 ng/g), approximately twofold higher than the other feeding groups. Macroinvertebrates integrate temporally variable contaminant inputs and serve as a key trophic link to fish, wildlife, and humans, making them valuable indicators of PFAS exposure risk in stream ecosystems. Although PFAS concentrations in abiotic matrices varied among streams, with sediment generally containing higher concentrations than water, these patterns did not consistently explain biological exposure, suggesting that multiple factors, including watershed characteristics, land use, industrial activities, and trophic pathways, may influence PFAS transfer through stream food webs.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- PFAS
- Aquatic Ecology
- Biota

Contaminants of Emerging Concern in the Lake Michigan Watershed

Moderator(s):

- Sarah Zach, Illinois-Indiana Sea Grant, and Beth Meschewski, Illinois Sustainable Technology Center, Champaign, Illinois

Presentation Title:

Marine Debris in the Great Lakes: Highlighting Impacts, Actions, and Opportunities

Marine debris ”ranging from abandoned and derelict vessels to single-use plastic items and more “is a widespread pollution issue affecting the world’s ocean, Great Lakes, and tributaries with many negative consequences. Lake Michigan is no exception to the reality and harms of these solid, human-made contaminants. As a place-based issue, there are important nuances to the impacts of macro and micro debris on Lake Michigan when compared to marine environments. Similarly, localized solutions as well as whole community approaches are required for sustained benefits. This presentation will examine the very actions underway to support the health of the entire Great Lakes basin and its people by tackling marine debris. Learn how nationally-coordinated shoreline monitoring, strategically-deployed interception devices, large-scale removal efforts, and public prevention campaigns work in concert to move the needle on Great Lakes marine debris.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Marine Debris
- Plastic Pollution
- Microplastics

Contaminants of Emerging Concern in the Lake Michigan Watershed

Moderator(s):

- Sarah Zach, Illinois-Indiana Sea Grant, and Beth Meschewski, Illinois Sustainable Technology Center, Champaign, Illinois

Presentation Title:

Beyond Standard Exposure Models: Tribal Lifeways, Exposure Pathways, and Emerging Contaminant Risk Assessment

Emerging contaminants, including PFAS, microplastics, pharmaceuticals, and other persistent chemicals, present growing challenges for environmental and public health. Traditional risk assessment approaches often rely on generalized exposure assumptions that do not adequately reflect Tribal lifeways, cultural practices, subsistence activities, or the unique relationships Tribal communities maintain with the environment. As a result, contaminant exposures and associated health risks may be underestimated or overlooked. This presentation will examine how Tribal exposure pathways differ from conventional exposure scenarios and why these differences are essential for accurately characterizing health risks. Examples will include the consumption of culturally significant foods such as fish, wild rice, berries, medicinal plants, and game; ceremonial and cultural uses of natural resources; and the interconnected relationship between environmental contamination, cultural practices, and community health. Drawing on work conducted through the Great Lakes Inter-Tribal Epidemiology Center and the National Tribal Toxics Council, this presentation will highlight how Tribal Nations are informing more representative approaches to exposure assessment through Tribal knowledge, community partnerships, and Tribal data sovereignty. It will also discuss ongoing efforts to strengthen the consideration of Tribal populations in chemical risk evaluations and environmental health decision-making. Participants will gain a greater understanding of why incorporating Tribal lifeways into contaminant research is essential for producing scientifically rigorous, equitable, and culturally relevant public health policies. The presentation will conclude with practical recommendations for researchers, regulators, and public health professionals seeking to improve emerging contaminant risk assessments and better protect Tribal communities.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Tribal Health
- Exposure Assessment
- Emerging Contaminants

Contaminants of Emerging Concern in the Lake Michigan Watershed

Moderator(s):

- Sarah Zach, Illinois-Indiana Sea Grant, and Beth Meschewski, Illinois Sustainable Technology Center, Champaign, Illinois

Presentation Title:

Emerging Contaminants in the Lake Michigan Watershed: Science, Stewardship, and Solutions

Contaminants of emerging concern (CECs) continue to challenge efforts to protect and restore water quality throughout the Lake Michigan watershed. As scientific understanding evolves, new contaminants are being identified, monitoring efforts are expanding, and questions remain regarding their sources, occurrence, transport, persistence, and potential impacts on aquatic ecosystems and human health. Addressing these challenges requires collaboration among researchers, resource managers, regulators, educators, and community stakeholders. This presentation will provide an overview of current issues surrounding emerging contaminants in the Lake Michigan watershed, drawing from recent research and ongoing monitoring efforts. Topics may include contaminants such as per- and polyfluoroalkyl substances (PFAS), pharmaceuticals, microplastics, and other chemicals of emerging concern, with emphasis on their environmental relevance, pathways into surface waters, and implications for water resource management. The presentation will also explore opportunities for pollution prevention, public outreach, and collaborative approaches that can help reduce contaminant inputs and support informed decision-making. Specific examples and case studies will be selected based on the most recent information available at the time of the meeting. By integrating current science with perspectives on stewardship, education, and practical solutions, this presentation will encourage discussion on how research, outreach, and partnerships can advance the protection of Lake Michigan and its watershed while addressing the evolving challenges posed by emerging contaminants.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

John W Scott, Illinois Sustainable Technology Center, Champaign, Illinois

Keywords:

- Emerging contaminants
- Lake Michigan
- Water quality

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Lake Michigan CSMI 2025's Water Quality Spatial Data Summary and Nutrient Uptake of Green Bay

In summer 2025, staff from the U.S. EPA Office of Research and Development, now the Office of Applied Science and Environmental Solutions (OASES), aboard the R/V Lake Explorer II conducted shipboard processing and laboratory analyses of water quality samples collected during the Coordinated Science and Monitoring Initiative (CSMI) survey of Lake Michigan, along with nutrient uptake assays in Green Bay. This work supports EPA priorities to reduce nutrient-driven pollution, including harmful algal blooms, and to monitor water quality trends over time. The data also support broader CSMI Annex 10 Science objectives by strengthening indicators for eutrophication, lower food web condition, and water quality modeling. In addition, the project aligns with Great Lakes Restoration Initiative (GLRI) Action Plan IV priorities, particularly Nearshore Health and Nonpoint Source Pollution, by quantifying nutrient conditions and bloom potential. Analyses are evaluating the spatial distribution of water quality characteristics across Lake Michigan, with a focused assessment of nutrient dynamics supporting harmful algal bloom communities. Results are being used to calibrate and validate lake models, identify hotspots, refine sampling strategies, and inform adaptive management of nutrient inputs affecting Green Bay and the broader basin. Collectively, these datasets and tools improve binational understanding of nutrient dynamics and support management decisions that protect human health, ecosystems, and the Lake Michigan economy. The views expressed in this abstract are those of the author(s) and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Water quality
- Nutrients
- HABs

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Delineating Tributary Regions of Influence in Lake Michigan-Huron with Biophysical Modeling and Remote Sensing

A recurring CSMI science goal for Lakes Michigan and Huron is to understand how tributaries influence nutrient transport and productivity patterns. Advancing our understanding of nearshore water quality requires capturing the spatial dynamics and persistent patterns influenced by major river tributaries. This study presents results from a biophysical model linked to the Lake Michigan-Huron Operational Forecast System model, based on the FVCOM-GEM linked hydrodynamic and biogeochemical models. We developed a set of simulations to delineate nearshore regions of influence for priority tributaries by comparing estimated historical loading and idealized load elimination scenarios. To evaluate these simulations, spatial and temporal patterns of phosphorus and chlorophyll-a concentrations were analyzed across regional maps and transects extending from river mouths to offshore environments. Simulated patterns were assessed against historical in situ monitoring data. Additionally, these model outputs were compared against long-term satellite climatologies to determine how effectively the simulations capture persistent patterns in nearshore chlorophyll-a, suspended minerals, and dissolved organic carbon. This study improves our understanding of river influences on lower food web and nearshore water quality dynamics.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Biophysical Modeling
- Nearshore productivity
- Remote Sensing

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Biophysical Modeling in Support of Cooperative Science and Monitoring Initiative Lake Michigan-Huron 2020-2025

Under CSMI Lake Michigan 2020 and Lake Huron 2022, GLERL and CIGLR developed a biophysical model, based on NOAA's Lake Michigan-Huron forecast system model. The physical model is the Finite Volume Community Ocean Model, which has been applied to Lake Michigan-Huron with a resolution of ~200m at the coast, and ~2km offshore. A linked biophysical model for Lake Michigan was previously developed and assessed, consisting of a phosphorus-limited lower food web representing phytoplankton, zooplankton, detritus, and dreissenid mussel biomass. Dissolved organic carbon was added as a tracer for tributary inputs. In collaboration with USGS, daily inputs of phosphorus were estimated (2011-2023) using a combination of monitored priority tributaries and a SPARROW model-ratio method for unmonitored areas. Work in support of CSMI 2025 focuses on further development of the Lake Michigan-Huron biophysical model to include simulation of suspended sediment and improved representation of light attenuation in nearshore areas. We will highlight results responsive to CSMI science priorities related to spatial and temporal biological hotspots of productivity resulting from tributary inputs of nutrients and suspended sediment, and nearshore transport processes including upwelling events. Capabilities to model nearshore water quality are essential to development of strategies to achieve nearshore water quality objectives under the Great Lakes Water Quality Agreement.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- CSMI
- Lake Michigan
- Biophysical Modeling

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Sounding Out the Future: Acoustic Survey Comparability Between Autonomous and Crewed Vessels in Lake Michigan

Acoustic surveys are central to Great Lakes forage fish assessments, but cost and operational constraints place limits on survey effort of crewed research vessels (CRVs), resulting in decreased precision of lakewide abundance estimates prey. High-endurance uncrewed surface vessels (USVs) offer a means to expand survey coverage, but whether autonomous platforms can deliver comparable or improved estimates to CRVs at a whole-lake scale has not been rigorously tested. We compared concurrent 2021 Lake Michigan hydroacoustic surveys conducted by a USV (642 EDSUs, 1,291 km) and CRVs (310 EDSUs, 619 km). Despite the USV recording lower nautical area scattering coefficients (NASC) lake-wide, it produced higher total fish density than the CRV due to smaller in situ target strength (TS) measurements overall in the USV data. However, this difference was not consistent across lake areas, with the northern regions having higher USV fish densities and the southern region having higher CRV fish densities. This is likely due to spatial mismatch between USV and CRV surveys as the USV mission was designed for paired ship–drone transects, not a dedicated whole-lake survey. The paired USV-CRV transects did not reveal systematic differences in acoustics returns across the two platforms in Lake Michigan. When total fish density was apportioned to species using nearest-trawl catch compositions, platform differences were larger, with some species and strata showing ratios several times the CRV estimate, reflecting spatial mismatch in trawl assignment that arose because the two platforms occupied different transect positions within each stratum. Future surveys using USVs to gather acoustic data would benefit from coupled CRV-based trawl sampling and incorporation of uncertainty in both acoustic and trawl sampling when calculating fish group-specific estimates.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Acoustic survey
- Uncrewed surface vehicle
- Species apportionment

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

What Have We Learned from 28 Years of Quagga Mussel Population Dynamics in Lake Michigan?

After being recorded in Lake Michigan in 1997, invasive quagga mussels rapidly spread across the lake bottom and now comprise over 98% of the combined biomass of benthic and planktonic invertebrates. Mussels divert energy from the pelagic to the bottom environment, enhancing bottom-pelagic coupling and controlling phosphorus cycling in the lake. We followed the population dynamics of quagga mussels for 28 years across four depth zones: ≤ 30, > 30-50, >50-90, and > 90 m. We found that population dynamics differed significantly among depth zones, ranging from negligible in the deepest zone to very high, with a boom and >3-fold decline in mussel biomass in high-resource, high-mortality nearshore habitats. Early in the invasion, the majority of mussels occurred in the well-mixed nearshore zone, where an abundant food supply, coupled with warm temperatures, results in high mussel growth and a strong ecological impact. Later in the invasion, the bulk of dreissenids moved to the deep profundal zone, with its much more stable environment and lower temperatures, resulting in slow growth, long lifespans, and a weaker impact on pelagic communities. In 2025, we recorded a significant decline in lake-wide population density compared to 2020 and the first, although nonsignificant, decline in biomass. We project that mussel population declines over the next two decades will be associated with partial ecosystem recovery, including increases in total phosphorus, biomass, and production of pelagic communities.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Aquatic ecology
- Quagga mussels
- Population dynamics

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

***Chironomidae* Community Assemblage Shifts in Lake Michigan 2021-2025**

Benthic macroinvertebrates are ideal indicators of ecosystem health due to their relative immobility and longevity in freshwater environments. *Chironomidae* and *Oligochaeta* species have well established tolerances along the range of quality from unimpacted to strongly impaired and have been widely used in historical monitoring of the Great Lakes. Following the introduction of *dreissenids*, Lake Michigan has experienced increases in water clarity and a shift in nutrient dynamics from the water column to benthic habitats, which has contributed to an increasing trend in water temperatures and changes to the benthic community composition. We analyzed benthic samples collected during the U.S. EPA Great Lakes National Program Offices' Cooperative Science and Monitoring Initiative (CSMI) in 2021 and 2025. The *chironomids* comprised approximately 4% of the benthic density across the lake but make up over 35% of the unique taxa richness. The dominant *chironomid* genera in both CSMI years were *Micropsectra sp.* and *Chironomus sp.*, but the 2025 survey showed significant increases in Polypedilum sp. and Psectrocladius sp. and declines in *Orthocladius sp.* The *chironomid* diversity in shallow zones (<30 meters) of Lake Michigan has increased since 2021, with a shift from collector-gatherer taxa to a mix of shredders and collector-gatherers . We will analyze benthic video and abiotic data to investigate the causes of these changes in the *chironomid* community and how it relates to the changing habitat structure of the nearshore zone.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Chironomidae
- Aquatic Ecology
- Benthos

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Lake Michigan Quagga Mussel Body Condition and Reproduction: A CSMI Perspective

For more than two decades, invasive quagga mussels have exerted substantial impacts on Lake Michigan. Quagga mussel populations exhibit depth and lake-specific differences, which reflect how the mussels respond to the environmental conditions. In 2025, we assessed quagga mussel body condition (relative tissue mass for a given length) and reproductive status (maturation stage of gametes) at up to 24 stations across Lake Michigan, most of which were collected during the Cooperative Science and Monitoring Initiative (CSMI) Benthic Survey on board the USEPA R/V Lake Guardian. Body condition was higher in the <30 m depth zone than at the 31-50 m, 51-90 m, and >90 m depth zones. Compared to body condition data collected during the 2015 and 2021 Lake Michigan CSMI surveys, quagga mussels in 2026 from sites >50 m tended to have relatively less tissue mass, which could indicate a reduced nutritional state or lower reproductive activity. Some regional differences in body condition were evident, but they were not as substantial as differences among depth zones. As for reproductive status, three-quarters of mussels from <50 m had mature gametes compared to about half of mussels collected from >50 m. Mussel body condition and reproductive output can inform future population trends of invasive mussels in Lake Michigan.

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Keywords:

- Quagga mussel
- Reproduction
- Invasive species

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Status and Temporal Trends in Lake Michigan Benthic Community

The 2025 Lake Michigan benthic survey was conducted as part of the U.S. EPA Great Lakes National Program Office Great Lakes Biology Monitoring Program and the Coordinated Science and Monitoring Initiative (CSMI) and addressed the CSMI priority of assessing lower food-web health through nearshore-to-offshore monitoring of benthic invertebrates, *Diporeia*, and *Dreissena*. Benthic communities were sampled at 79 stations, with an additional 19 stations surveyed for Dreissena and Diporeia. A total of 95 benthic macroinvertebrate taxa were recorded. *Oligochaeta* were the most diverse group (40 species and higher taxa) and accounted for 21% of lake-wide density, while the invasive quagga mussel (*Dreissena rostriformis bugensis*) comprised 73% of total benthic density and 99.8% of biomass. Mean benthic density declined from 8,552 ± 1,142 ind. m^{-2} in 2021 to 6,021 ± 508 ind. m^{-2} in 2025, primarily due to a significant 1.4-fold decline in Dreissena. Diporeia was observed at only 13 stations, with an average density of 7.7 ± 3.6 m-2, marking a continued decline from 2021's density (12.4 ± 7.2 m-2). Historical records dating back to the 1930s indicate that densities of *Diporeia*, *Oligochaeta*, and *Sphaeriidae* increased from 1964 to 1980, likely in response to phosphorus enrichment. Since the late 1980s, *Diporeia*, historically the most abundant benthic macroinvertebrate in the lake, has experienced a drastic decline, likely due to reduced primary production and competition for food with *dreissenids*. *Sphaeriidae* densities continue to decline across the whole lake as well. In contrast, *Oligochaeta* increased in abundance since 2000, benefiting from the expansion of *Dreissena*. Continued monitoring is essential to determine whether the recent decline in *Dreissena* will continue and to evaluate its implications for other benthic taxa and overall food-web dynamics in Lake Michigan.

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Keywords:

- Lower food web
- CSMI
- Benthos

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Review of Previous Lake Michigan CSMI Larval Fish Surveys

Pelagic prey fish populations in Lake Michigan have been declining for the past two decades and understanding the factors responsible for these declines is a high priority for fisheries managers. A popular hypothesis among fisheries scientists states that survival during the first year of life and recruitment to the fishery is predicated on how well newly hatched larvae can successfully transition to exogenous feeding. Previous CSMI field efforts in Lake Michigan (2015, 2020-21) evaluated this hypothesis on a lake-wide scale by characterizing larval fish emergence, diets and growth rates across multiple transects. Although specific linkages between larval fish abundance and growth and lower trophic level productivity have been elusive, many of the lessons learned from these large-scale, multiple-collaborator projects have been incorporated into current larval fish sampling designs. Here, we review the results from previous CSMI larval fish studies to summarize long term trends if larval fish performance in Lake Michigan and to review logistical and methodological considerations that need to be considered when designing larval fish surveys for the Great Lakes.

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Keywords:

- Larval fish
- Recruitment
- Pelagic

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Assessing Larval Fish Recruitment Bottlenecks Through Intensive Collaborative Nearshore Sampling

Recruitment of Great Lakes fishes is highly variable, and small changes in growth and survival during early life can strongly affect year-class strength and subsequent fishery production. In Lake Michigan, continued low abundance of alewife (*Alosa pseudoharengus*), a critical prey fish for *salmonines*, has raised concern that processes operating during the larval-stage may constrain recruitment. Previous CSMI studies identified several potential mechanisms, including limitations associated with reduced lower-trophic-level productivity and increased exposure to ultraviolet radiation, but inference was limited by monthly sampling and an emphasis on offshore habitats. To address these limitations, seven agencies and universities coordinated weekly nearshore (<25 m) sampling from May through July at 10 sites distributed across Lake Michigan, including Green Bay, as well as complementary offshore sampling at a subset of sites in the southern basin. Sampling targeted ichthyoplankton, zooplankton, water quality, and, at a subset of sites, ultraviolet light attenuation. Larval fishes will be identified to the lowest practical taxonomic level, and we will evaluate spatial and temporal variation in larval alewife diet and growth. Analyses will evaluate phenology across the larval fish community and test relationships among larval alewife density, growth, diet, prey availability, productivity, and environmental conditions. We will also explore the same relationships among other species of interest (i.e., yellow perch *Perca flavescens*) or those that are common across study sites (i.e., rainbow smelt *Osmerus mordax*). This presentation will provide an overview of the lakewide sampling effort, describe planned analyses of alewife and yellow perch diet and growth and community-wide phenology, and summarize logistical challenges, methodological tradeoffs, and lessons learned from implementing a large-scale, multi-institution nearshore sampling program.

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Keywords:

- Alewife
- Recruitment bottleneck
- Larval

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Investigating Larval *Coregonine* Recruitment Bottlenecks in Beach Zones of Lake Michigan

Communities across the Great Lakes basin are growing increasingly concerned about a recruitment bottleneck for whitefishes and ciscoes that may be occurring within their first year of life. While the underlying mechanisms are unclear, one long-standing hypothesis is poor zooplankton prey availability in nearshore nursery areas during the larval period which could lead to reduced fitness or starvation. To investigate this hypothesis, we coordinated with multiple agencies and sampled larval *coregonines*, their zooplankton prey, and water chemistry at beach sites around Lake Michigan, specifically targeting areas of contrasting productivity, during the 2025 Lake Michigan Cooperative Science and Monitoring Initiative year. Sampling was conducted on the beach (< 1 m bottom-depth) with hand-towed neuston nets and seines. Zooplankton tows were collected within proximity to all fish samples. Only Lake Whitefish larvae have been observed at southern sites (Muskegon, South Haven, St. Joe) thus far, while northern sites are showing high *coregonine* diversity (visual identification only) and generally higher densities. Wild zooplankton identification, as well as larval fish genetic identification, diet, growth (length at age, daily aging using otoliths), and density analyses are underway as we wrap up the laboratory processing year of CSMI (2026). We look forward to presenting preliminary results.

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Keywords:

- Larval fish
- Lake whitefish
- Cisco

Cooperative Science and Monitoring (CSMI) Efforts in Lake Michigan

Moderator(s):

- Paris Collingsworth, Purdue University, West Lafayette, Indiana

Presentation Title:

Putting 2025 Age-0 Lake Whitefish CSMI Data Into a Temporal and Ecological Context

Age-0 lake whitefish were collected at Grand Haven, Muskegon, and Montague, Michigan with a hand towed neuston net and a beach seine during CSMI collections in spring 2025. Diet composition (by number) for larval fish caught in the neuston net (14-22 mm) was dominated by *cyclopoid copepods* (53%) and *Bosmina* (32%). Diet composition (by number) for early juvenile fish caught in the beach seine (20-39) was dominated primarily by *cyclopoid copepods* (78%), with smaller contributions from *calanoid copepods* (12%) and *Bosmina* (5%). Overall zooplankton abundance was higher during beach seine collections (24,223/m3) than during neuston collections (4,949/m3). *Cyclopoid copepods* accounted for 20 and 38% of the zooplankton (by number) during neuston and beach seine collections, respectively, compared to 2% and 12% for *calanoid copepods* and 7% and 8% for *Bosmina*. *Nauplii* accounted for 55% and 23% and *Dreissena veligers* for 12% and 7% of the zooplankton during each respective collection period, but neither were eaten by age-0 lake whitefish. Age-0 lake whitefish diets and abundance and environmental conditions (e.g., zooplankton, temperature) in 2025 will be compared to results from collections at these sites in previous years (2014-2024) to provide context for results from the 2025 CSMI sampling effort.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Lake whitefish
- Feeding ecology

Environmental Sensing

Environmental Sensing

Moderator(s):

- Kendahl Klatt, Purdue University, West Lafayette, Indiana

Presentation Title:

Buoy BFFs: Maintaining a Long-Term Lake Michigan Observing Network Through Collaboration & Community

For more than 15 years, the University of Wisconsin-Milwaukee School of Freshwater Sciences, in partnership with the Great Lakes Observing System (GLOS) and numerous agency and community collaborators, has built and sustained a long-term environmental observing network across Lake Michigan. Centered around 5 real-time monitoring buoys, the fleet provides continuous seasonal meteorological, weather forecasting, drinking water protection, and public safety. Complementary technologies, including autonomous and remotely operated vehicles, expand monitoring capabilities by providing targeted surveys that help to fill in data gaps between fixed-station measurements. The continued evolution of this collaborative observing system demonstrates how sustained partnerships, shared infrastructure, and integrated monitoring techniques can advance Lake Michigan sciences while providing lasting value to researchers, resources managers, industry, and the public.

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Keywords:

- Buoys
- Long-Term Monitoring
- Collaborative Network

Environmental Sensing

Moderator(s):

- Kendahl Klatt, Purdue University, West Lafayette, Indiana

Presentation Title:

Winter Autonomous Vehicle Deployments on Lakes Michigan and Erie

Winter ecology is a largely neglected area of study. Historically, most fieldwork has occurred during the summer open-water period, as winter observations are much more challenging to obtain. However, winter observations are essential for understanding and forecasting food web / ecosystem response and adaptation to change. The absence of winter information thus compromises our overall understanding of the Great Lakes ecosystem and, critically, our ability to understand parameters essential for successful fishery restoration efforts. However, data collection during the winter months is difficult from research vessels and can be dangerous due to lake ice, icing on vessels, and severe storms. Therefore, AUVs may represent the most effective technology for obtaining critical food web and fishery information, as they can operate beneath ice cover and safely navigate severe weather conditions that prohibit traditional research vessel operations. This presentation will capture the results of two years of winter AUV deployments in 2025 and 2026. AUVs were used to collect bioacoustics and water quality conditions before and after winter storms as well as just after ice cover receded.

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Keywords:

- Winter ecosystems
- Autonomous vehicles

Environmental Sensing

Moderator(s):

- Kendahl Klatt, Purdue University, West Lafayette, Indiana

Presentation Title:

Evaluating Mysid (*Mysis diluviana*) Densities in Lake Michigan With two Decades of Fisheries Acoustics Data

Mysids (*Mysis diluviana*) are a critical species in Lake Michigan, providing the food source for important forage fish such as Alewife (*Alosa pseudoharengus*) and Bloater (*Coregonus hoyi*) which in turn support sport fisheries for salmonids such as Chinook salmon (*Oncorhynchus tshawytscha*). Current approaches for monitoring mysid populations rely on long-term net-based surveys conducted at night from large research vessels and have highlighted a decline in Lake Michigan mysid densities in the past decade. Interagency standardized nighttime active hydroacoustic surveys have been used to monitor prey fish abundance and biomass since 2004. This dataset covers an important period of changes in the Lake Michigan food web including increasing offshore water clarity due to establishment of quagga mussels (*Dreissena bugensis*), decreasing prey fish biomass, and increasing abundance of juvenile Lake Trout (*Salvelinus namaycush*). This acoustic dataset can also be used to assess spatial and temporal trends in mysid abundance and increase our understanding of mysid dynamics across Lake Michigan over multi-decadal time scales.

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Keywords:

- Aquatic Ecology
- Zooplankton/Mysids

Environmental Sensing

Moderator(s):

- Kendahl Klatt, Purdue University, West Lafayette, Indiana

Presentation Title:

Regional Patterns Of Shoreline Recovery Along Lake Michigan Following Record High Water Levels

Between 2020 and 2024, Lake Michigan experienced widespread shoreline recovery following historically high water levels. Recovery has not occurred uniformly across the lake, with local geomorphology, shoreline type, and wave climate impacting coastal response. This study quantifies regional shoreline change across the full shoreline of Lake Michigan using satellite-derived shorelines, shoreline classification data, and geospatial analysis. Shorelines were extracted from PlanetScope imagery with spatial resolution of 3 meters, and compared between 2020 and 2024 to quantify shoreline movement. Shoreline change was evaluated using a transect-free nearest neighbor algorithm, while nearshore slope, shoreline type, and wave climate were incorporated to investigate controls on recovery. Spatial statistics were used to identify regional clustering and variability in recovery patterns. Results indicate that shoreline recovery varies substantially among coastal environments. Sandy beaches exhibited greater recovery than armored or hardened shorelines, and recovery magnitude differed between embayed and open-coast settings. Spatial clustering demonstrates that shoreline recovery is controlled by local geomorphology and broader sediment transport rather than water-level change alone. This work provides one of the first regional assessments of post-high-water shoreline recovery across the entirety of Lake Michigan at a high-spatial resolution. Satellite observations combined with shoreline characteristics and environmental datasets improves understanding of coastal resilience and provides information useful for shoreline management and future monitoring efforts.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):v

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Keywords:

- Remote sensing
- Shoreline recovery
- Shoreline type

Environmental Sensing

Moderator(s):

- Kendahl Klatt, Purdue University, West Lafayette, Indiana

Presentation Title:

Response and Recovery of the Indiana Nearshore Morphology to a High-Water Period, 2013-2025

Sandbar morphology governs where waves break and how wave energy is distributed across the nearshore, affecting sediment redistribution and shoreline erosion. Lake Michigan's rapid water-level rise from 2013–2020 and subsequent decline altered both shoreline position and the morphology of the nearshore sandbar system. This study uses an automated GIS algorithm to process multispectral satellite imagery acquired from 2013 to 2025 across the Indiana shoreline, characterizing regional nearshore morphology, evaluating its evolution during the 2013–2020 water-level rise, and assessing its response during the 2020–2025 recovery period. Results were validated against topobathymetric LiDAR and 41 bathymetric survey transects. The imagery-derived shoreline agreed with the LiDAR waterline within 6–10 m. Sandbar crest positions produced an RMSE of 7.4 m, an R-squared of 0.992, and an 83.1% detection rate. The Indiana nearshore is best characterized as a double-barred, intermediate system with a persistent, comparatively dissipative outer bar and a more rhythmic, transient inner bar. Morphology became more continuous and persistent eastward, with the greatest variability near Marquette Park. During rising water levels, the shoreline recessed 36 m at 3.9 m/yr, and sandbars generally migrated landward. During recovery, the shoreline advanced 37 m at 4.8 m/yr, and sandbars generally migrated offshore. Surveyed profiles also indicated bar flattening and coalescence. Because water-level rise and fall occurred at nearly equal rates, the faster shoreline recovery and differing response slopes indicate that change reflected both passive flooding and non-equilibrium erosion. These results demonstrate the value of satellite imagery for long-term Great Lakes nearshore monitoring and coastal management.

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Keywords:

- Sandbar
- Remote Sensing
- Water Level

Environmental Sensing

Moderator(s):

- Kendahl Klatt, Purdue University, West Lafayette, Indiana

Presentation Title:

Topobathymetric Monitoring of the Indiana Shoreline for Coastal Resilience

Coastal monitoring is important to assess coastal changes, calibrate predictive models, and monitor the coastal response to both anthropogenic and natural factors. In this work, we detail a comprehensive set of coastal monitoring activities that have been carried out for the entirety of the Indiana shoreline. The survey project has involved baseline and repeated surveys along a set of 58 cross-shore transects using boat-based single-beam sonar for bathymetry and GNSS rod measurements for subaerial and shallow nearshore areas. Additionally, five of these transects in the Indiana Dunes State Park have been revisited with multiple follow-up surveys to assess coastal changes on sub-annual timescales. The collected data provide a useful baseline for the quantification of coastal changes, and an improved understanding of sediment transport and coastal characteristic along the Indiana coast. Cross-shore profiles show significant variation along the Indiana coastline in terms of profile slopes, sandbar morphology, and adherence to expected equilibrium profile shapes. Higher-frequency surveys carried out in the Indiana Dunes State Park show evidence of seasonal profile evolution consistent with expected annual behavior. Additional data extracted from satellite imagery provides context for these directly-measured topobathymetric profiles, and comparison with topobathymetric LiDAR surveys highlights the degree to which the Indiana shoreline has rebounded since the record high water levels in 2020. Future work will involve the establishment of a regular monitoring program that builds on these baseline surveys, and the application of novel survey methods involving autonomous survey boats and unmanned aerial vehicles.

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Keywords:

- Shorelines
- Coastal Resilience
- Coastal Engineering

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Spatial Patterns in Fish Assemblages Among Connected Habitats in a Lake Michigan Tributary

We sampled three connected habitats in an eastern Lake Michigan watershed to examine how the fish assemblage changes over a short distance (<13km). We studied the Muskegon River watershed, which featured three connected habitats: a large river system (Muskegon River), a drowned river mouth lake (Muskegon Lake), and a Great Lake (Lake Michigan). Three nighttime beach seine hauls were conducted in predominately sandy littoral sites in the Muskegon River, Muskegon Lake, and Lake Michigan, respectively each month during June-October 2026. Preliminary results from June-July suggested that the most dominant species captured varied among habitats. Sand/Mimic Shiner (*Minniellus stramineous/Paranotropis volucellus*) were most dominant in the Muskegon River, Banded Killifish (*Fundulus diaphanous*) in Muskegon Lake, and Spottail Shiner (*Hudsonius hudsonius*) in Lake Michigan. Fish species richness was greatest in the Muskegon River, followed by Muskegon Lake, and Lake Michigan. Nonmetric multidimensional scaling showed an overall difference between habitats, although Lake Michigan and Muskegon Lake did not significantly differ. Despite these differences in the fish community among habitats, there was little variation in water quality. Our preliminary results suggested that fish assemblages can vary among connected habitats, even over short distances when water quality was relatively constant.

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Keywords:

- Fish Assemblage
- Habitat Heterogeneity
- Spatial Patterns

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Mixed Stock of Yellow Perch in Eastern Lake Michigan and Adjacent Drowned River Mouths

Tracking seasonal movements of fish stocks is essential for effective management and conservation. Yellow perch Perca flavescens in eastern Lake Michigan are present in both nearshore habitats and drowned river mouths (DRM), productive, coastal systems that link Lake Michigan and its tributaries. Yellow perch in DRMs make up different populations from Lake Michigan. Some Lake Michigan perch will migrate into DRMs to overwinter, returning to Lake Michigan in the spring. We sampled perch during summer and winter in 2022-2023 at four Lake Michigan sites and six DRMs. Additional creel surveys at four of the DRMs in the winter were carried out to determine fishery harvest of resident and migrant perch. Fin clips from each fish were used for genetic analysis. Muscle samples were analyzed for four stable isotope ratios: Î´2H, Î´18O, Î´13C, and Î´15N. Genetic paneling and stock identification using SNPs showed that perch from Lake Michigan and from DRM lakes constitute distinct populations, and that migrants from Lake Michigan were present in all but one DRM in the winter. A principal component analysis of stable isotopes was able to differentiate Lake Michigan residents from DRM residents. Since genetics-based and stable isotope-based population identification showed strong agreement, we examined the sex ratios and sizes of perch assigned to the same population through either method. Regardless of population assignment, females were consistently larger than males. Lake Michigan residents were more likely to be male and larger than DRM residents. Additionally, Lake Michigan migrants into DRMs were more likely to be female than Lake Michigan residents and were larger than either group. Perch from both populations were present in similar numbers in fishery-dependent data and showed insignificant differences in size. These results provide further support for winter DRM harvest representing a mixed stock fishery that may have impacts on both populations.

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Keywords:

- Yellow perch
- Mixed stock
- Seasonal migration

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Habitat Use, Trophic Support, and Movement of Lake Sturgeon in a Great Lakes Estuary: Linking Milwaukee Harbor to the Nearshore Zone of Lake Michigan

The Milwaukee River Estuary is a heavily modified embayment where riverine, harbor, and nearshore habitats converge, yet the relative contribution of these habitats to fish production and trophic support remains poorly resolved. Lake sturgeon rehabilitation in the Milwaukee River and adjoining harbor has been supported for over 20 years through stocking and dam removal, and while lake sturgeon biology and ecology are well studied broadly, little is known about the habitats and resources juvenile lake sturgeon use within this system. Here, we integrate acoustic telemetry and stable isotope analysis to characterize movement, harbor residency, and resource reliance of juvenile lake sturgeon (*Acipenser fulvescens*) across the harbor and nearshore environment. Fish and invertebrates were captured throughout the harbor using gillnets, petite ponar grabs, and zooplankton tows, sorted by taxa, and analyzed for stable isotopes of carbon and nitrogen. A subset of captured lake sturgeon were surgically implanted with Innovasea acoustic transmitters, and a receiver array was deployed throughout the river, inner and outer harbor, and adjacent nearshore zone. Preliminary results indicate that juvenile lake sturgeon extensively use the northern and southern outer harbor, with comparatively little use of the lower river or inner harbor, and that some individuals regularly transit between the harbor and the Lake Michigan nearshore zone. Stable isotope data likewise suggest a mix of harbor-resident and transient individuals exhibiting habitat-specific isotope signatures, and mixing models indicate that lake sturgeon draw on both harbor and nearshore energy sources, with strong reliance on round goby. Together, these findings suggest that connectivity between constructed harbor habitat and the adjacent nearshore supports the dietary diversity and growth of this recovering lake sturgeon population.

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Keywords:

- Lake Sturgeon
- Food webs
- Fish ecology

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Using Environmental Tracers to Determine Early-life Habitat Utilization of Alewife, *Alosa pseudoharengus*

Alewife (*Alosa pseudoharengus*) spawn in multiple habitats in Lake Michigan including drowned-river mouth lakes (DRMLs), tributaries, and nearshore environments. Due to its large volume compared to other habitats, the nearshore region of Lake Michigan has been considered the primary source of alewife recruits. However, habitat utilization of freshwater river mouths by young fish remains under-described. DRMLs and tributaries provide warmer, more productive environments compared to the relatively cool, oligotrophic Lake Michigan. Thus, on a volumetric basis DRMLs and tributaries may provide higher quality nursery habitat than Lake Michigan. Moreover, during cool years of low recruitment DRMLs and tributaries have the potential to provide a greater number of recruits to the population. Using samples collected during the fall of 2021 and 2022, we assessed otolith core and soft tissue stable isotope ratios of carbon (δ13C), nitrogen (δ15N), oxygen (δ18O), and hydrogen (δ2H) of juvenile alewife to evaluate their early-life habitat utilization. Our study demonstrates that habitat utilization of juvenile alewife is more complex than prior assumptions and can be multi-directional between habitats. We observed that tributary habitats are not only important spawning and nursery habitats for larval alewife but may also provide juvenile alewife reared in Lake Michigan additional resources to increase growth before winter. Ultimately, further studies are needed to understand how these migration behaviors and habitat occupancies of juvenile alewife may influence recruitment variability of alewife in Lake Michigan.

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Keywords:

- Alewife
- Migration
- Stable isotopes

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Abundance, Growth, and Diet Analysis of Larval Yellow Perch from Lake Michigan and Connected Tributary Habitats

Early life stages are a critical period in fish development that can strongly influence future recruitment success. Yellow perch (*Perca flavescens*), an ecologically and economically important species in Lake Michigan, spawn in diverse habitats including tributary mouths, drowned-river mouth lakes, and nearshore waters. These habitats differ in temperature, productivity, and prey availability, all of which are factors that may affect larval survival and growth. To evaluate these effects, larval yellow perch were collected from early May to late June in 2021 and 2022 across multiple habitats. Individuals collected from each habitat were measured for total length, sagittal otoliths were extracted and analyzed to estimate growth rates, and diets/ gut contents were quantified for a subset of larval samples. By linking larval growth with diets and early-life environments, this study provides insights into recruitment dynamics and supports sustainable fisheries management and the assessment of ecological changes in Lake Michigan.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Great Lakes
- Early-Life History
- Aquatic Ecology

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Seasonal Differences in Alewife Habitat Use in Lake Michigan Under Contemporary and Historic Conditions

Broad-scale ecological change can alter fish phenology and habitat use, affecting nutrient transport among habitats and potentially reducing the effectiveness of standardized population-monitoring programs. In Lake Michigan, increased water clarity, reduced forage availability, and benthic habitat alteration following the proliferation of invasive mussels have substantially changed resource distributions and habitat quality. One affected species is alewife (Alosa pseudoharengus), a critical forage fish for economically valuable salmonids. Since 2014, the alewife density index from the U.S. Geological Survey's fall bottom-trawl survey has remained extremely low, diverging from a parallel hydroacoustic survey index that indicates comparatively stable densities. One hypothesis is that alewife have shifted their daytime fall habitat use toward areas less vulnerable to bottom trawls, such as shallow or pelagic habitats. To evaluate this hypothesis, we conducted spring bottom-trawl sampling from 2021 through 2024, based on evidence from Lake Ontario that alewife are best indexed in spring when aggregated in deep water. We present results from the contemporary spring survey and compare current seasonal differences in alewife habitat use and density with historical USGS bottom-trawl data (both spring and fall) collected before large-scale ecosystem change. Our results suggest that spring bottom trawling indexes yearling alewife more effectively, whereas adult density estimates are similar to those observed during the fall survey, indicating that seasonal differences in habitat use have not been the primary driver behind recent low index values. This general seasonal pattern was evident both before and after large-scale ecosystem change; however, contemporary alewife appear to remain in deeper water later into the spring than they did historically.

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Keywords:

- Alewife
- Migration
- Lake Michigan

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Habitat Type and Tropic Position Influence Habitat Connectivity in Lake Michigan Food Webs

Energy channels and food web structures underpinning the production of socioeconomically important Lake Michigan fishes have been widely disrupted by habitat degradation and aquatic invasive species. For the past twenty years, stable isotope studies have provided new insights into food web structure in diverse nearshore habitats and their connectivity to adjacent habitats. This growing body of studies provides an opportunity to identify common patterns and processes. First, a persistent east-west difference in energy channels supporting food webs is found, likely owing to habitat differences. Second, nearshore habitat food web structure varies widely and can be strongly influenced by habitat-specific stressors. Third, higher tropic position fish are important for habitat coupling. Fourth, aquatic invasive species strongly influence nearshore-offshore food web shifts. These findings suggest that fisheries production is influenced by the spatial orientation of heterogeneous habitats at multiple, overlapping spatial scales.

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Keywords:

- Fish
- Tropic Level
- Stable isotopes

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Stable Isotope Analysis Reveals Trophic Structure of Nearshore Food Webs in Lake Michigan

In Lake Michigan, non-native benthic invertebrates and forage fishes are now common constituents of nearshore food webs. However, limited information exists on the energetic connections among food web constituents in this altered nearshore habitat or on the spatial variation in food web structure around the lake. We used C and N stable isotope ratios to describe feeding relationships among fish and invertebrate species collected at 8 nearshore sites around Lake Michigan in 2015. We used the Bayesian mixing model Simmr to predict the contributions of common prey items to three abundant nearshore fish species: Round Goby(*Neogobius melanostomus*), Alewife (*Alosa pseudoharengus*), and Spottail Shiner (*Notropis hudsonius*). Carbon ratios (Î´13C) for invertebrates and bottom-oriented fish were enriched on the west side of the lake relative to the east side, indicating increased reliance on benthic primary production. Non-native benthic (*Hemimysis*, and *Echinogammarus*) and pelagic (*Bythotrephes*) invertebrates contributed most of the energy to forage fishes in nearshore Lake Michigan. This is a substantial departure from previous Lake Michigan food webs. The incorporation of non-native benthic species into the food web has important ecological implications as pelagic energy is diverted toward the benthic region by *dreissenid* mussels. Enhanced benthic primary production supports abundant benthic invertebrate populations which can be exploited by nearshore forage fish.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Food webs
- Stable isotopes
- Fish diets

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Recent Opposing Trends in Crustacean Zooplankton and Mysis in Lake Michigan

Several agencies conduct long-term monitoring of nutrients, the lower foodweb, and fisheries of Lake Michigan. Since 1998, Lake Michigan zooplankton have notably shifted toward the *calanoid copepod* dominated community of Lake Superior, and mysids have also steadily decreased in density and biomass. in the last five years *cladocerans* have become more abundant in Lake Michigan summer nets, suggesting higher production and potential recovery and a shift away from a *calanoid copepod* dominated system. This change may help planktivorous alewife populations rebound. In contrast, the increase in *cladocerans* may be an indication of continued lower predation pressure by alewife. *Mysids* have continuously decreased in shallow and intermediate depth regions of Lake Michigan including the southern deep basin, suggesting little overall recovery but an encouraging persistence in the deep northern basin where a dark daytime refuge is maintained.

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Keywords:

- Zooplankton
- Mysis
- Long-term monitoring

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Comparison of Larval Bloater, *Coregonus Hoyi*, Diets Across Lake Michigan

in the past 40 years, total biomass of planktivorous prey fishes has declined in Lake Michigan. Bloater (*Coregonus hoyi*) are a native species in Lake Michigan that historically served as an important forage base for lake trout and other piscivores. The continued successful production and recruitment of bloater should be beneficial to support diverse piscivores and the fishery that depend on them. In more recent decades, Lake Michigan has experienced nutrient loading, climatic and invasive species induced ecosystem level changes, such as decreased primary productivity, increased water clarity, and shifts in zooplankton phenology and assemblage structure. These changes could negatively impact larval bloater growth, survival and ultimately recruitment. To explore such potential consequences, collaborating researchers participating in the Cooperative Science and Monitoring Initiative (CSMI) performed a lake-wide study in 2021 to collect larval fishes, including bloater, across Lake Michigan. In this study, we examined diets of larval bloater collected along 11 transects at varying distances from shore. Results indicate that the proportion of larvae with empty stomachs decreased as larvae increased in size, and that copepods remain the most abundant prey source in the digestive tracts of larvae collected across Lake Michigan. Despite shifts in zooplankton assemblage composition and size structure, larval bloater diet patterns remain relatively consistent with previous studies.

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Keywords:

- Fisheries management
- Fisheries ecology

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Quantifying Sunburn in Larval Fishes Collected from Lake Michigan Nursery Habitats of Varying UV Transparencies

Following the introduction of dreissenid mussels, as well as water quality management improving, Lake Michigan has experienced significant declines in larval fish, with increased underwater exposure to harmful ultraviolet radiation (UV) being identified as a potential impediment. Laboratory experiments have demonstrated UV as an environmental stressor that can reduce survivorship of yolk-sac larvae for both Lake Whitefish (Adikameg in Ojibwe, *Coregonus clupeaformis*) and Alewife (*Alosa pseudoharengus*). Both species are declining in historic nursery habitats in Lake Michigan, where UV penetrates throughout the entire water column. However, these species persist in less transparent nursery habitats where UV exposure is restricted to depths < 1 m. We hypothesized that apoptotic tissue damage, programmed cell death caused by irreparable UV damage to DNA, increases with the deepening of the 1% UV depth, a measurement for UV transparency of a habitat. Larval fish were collected throughout nearshore Lake Michigan, and a corresponding UV measurement was taken for each collection site, with samples being collected in 2025. Within these samples, 506 Coregonines and 1,330 Alewife were collected. In Lake Whitefish, most individuals were collected from shallow, transparent sites with little to no refugia from UV. In contrast, Alewife were collected from deeper water displaying a gradient of transparencies with varying UV refugia. Alewife collected from transparent sites exhibited more apoptosis than those collected from low transparency sites. While preliminary findings suggest that a deeper 1% UV depth leads to elevated apoptotic tissue damage in Alewife, additional collections of Lake Whitefish from low-transparency locations are required to further support these observations. Understanding the role UV plays in affecting larval fish will help identify key nursery habitats, where UV-refugia exists, and historic nursery habitats where refuge from UV may be needed.

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Keywords:

- Apoptosis
- Larval Fish
- UV

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Between a Rock and Something Like a Hard Place?

Lake Michigan rocky places are diverse, including fairly featureless glacially scoured sheets of Paleozoic bedrock, isolated glacial dropstones on an otherwise featureless bottom, and drowned glacial features such as drumlins . However, there are rugous hard clay features that may be interpreted by the biota as "rock" or "not rock." This may create unique biotic ensembles making classification of hard bottoms a heretofore unrecognized heterogeneity. The heterogeneity derives in part when some group of biota accepts something as quasi rock-like whilst others do not recognize it as rock. Hence hard versus "hard-like" bottoms can have functionally different ensembles of biota.

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Keywords:

- Aquatic Ecology
- Habitat

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

A Comparative Approach to Quantifying the Ecological and Sedimentary Impacts of Nearshore Reefs in Southern Lake Michigan

The general lack of quantitative data on the effectiveness of shoreline protection structures at enhancing Great Lakes coastal habitat limits the ability of managers to implement them effectively across the region. With ongoing pressure to enhance coastal resiliency across the Great Lakes, there is an urgent need to (a) collect data addressing biological and geological impacts of different types of engineered nearshore reefs, and (b) translate/communicate findings to the diverse stakeholder groups throughout the heavily populated Great Lakes coastal zone, from angler groups to the civil engineering community. Here we present findings from a project focused on evaluating the effectiveness of nature-based submerged shoreline-protection structures from two different nearshore constructed reef complexes in southwestern Lake Michigan. The abundance and diversity of the aquatic community (invertebrates, benthic and pelagic fishes) and sedimentary topography were studied at both reef locations, with nearby control sites offering broader spatial and temporal contexts for ecological system dynamics. This comparative dataset will help to quantify the ecological impacts of nature- based methods of shoreline protection, enhancing their utility throughout the Great Lakes region.

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Keywords:

- Reefs
- Nearshore
- Coastal resiliency

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Assessing Physical, Chemical, and Biological Benefits of Historic Artificial Sediment Mounds in Nearshore Lake Michigan

Historic open-water sediment placement sites may provide productive habitat within otherwise relatively uniform areas of the Lake Michigan lakebed. In support of the 2025 Lake Michigan Cooperative Science and Monitoring Initiative, we assessed five historic sediment mound locations to determine whether they support physical, chemical, and biological conditions comparable to or better than nearby reference conditions. Sediment mound sites were evaluated using measurements of sediment composition, grain size, benthic macroinvertebrate abundance and biomass, water quality, nutrient concentrations, primary productivity, and zooplankton community structure. Results were compared with long-term monitoring data collected by the US EPA Lake Guardian program at locations with similar depths and regional conditions. For this assessment, mound conditions that were similar to reference sites were considered evidence that historic open-water placement did not reduce habitat quality, while conditions that exceeded reference values indicated potential ecological benefits. Both outcomes are useful for defining the long-term physical, chemical, and biological functions of artificial sediment mounds. These findings provide an opportunity to evaluate whether historic sediment placement areas function as suitable or enhanced lower trophic feeding habitats. Understanding these differences may support new strategies for selecting and designing future open-water placement locations that meet sediment management needs while maintaining or improving ecological function.

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Keywords:

- lower trophic productivity
- Open-water sediment placement
- Lake Michigan habitat assessment

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Calumet Region Smallmouth Bass: Movement and Habitat Use in an Area of Anthropogenic Complexity

Smallmouth bass (*Micropterus dolomieu*) are an important predator and popular sportfish in nearshore Lake Michigan and connected waterways. Little is known about smallmouth bass movement and habitat use in southern Lake Michigan and the Calumet Region. The Calumet Region is characterized by an industrialized landscape and highly modified waterways comprising part of the Chicago Area Waterway System and the Lake Michigan shoreline of Illinois and Indiana. Smallmouth bass are found in the Calumet River system, including Lake Calumet, as well as nearshore Lake Michigan, and are a highly targeted sportfish for tournaments in this region. We used acoustic telemetry to understand smallmouth bass use of these habitats and to elucidate connectivity and movements between these habitats throughout the year. We implanted V13 (Innovasea) transmitters in 50 smallmouth bass in 2024, including fish caught in Lake Michigan (N=28) and fish caught in the Calumet River system (N=22). Movements of these fish were detected by an array of Innovasea stationary receivers encompassing multiple habitats. Data collection is ongoing, but results so far illustrate substantial individual variation, with some bass appearing to reside in the river system or Lake Michigan year-round, and others making movements between multiple river system habitats and Lake Michigan. Temperature was an important driver of movement, highlighting the potential for thermally heterogeneous river and harbor habitats connected to Lake Michigan to provide seasonally important resources for smallmouth bass.

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Keywords:

- Smallmouth Bass
- Telemetry
- Movement

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Changes in the Black Bass Fishery in Indiana Waters of Lake Michigan

The black bass population in Indiana's waters of Lake Michigan has changed substantially over the past 40 years. Smallmouth bass populations grew substantially during the late 1980s into the 1990s, leading to an established and robust population by the mid-2000s. These changes were likely driven by increases in protected harbor areas through building of industrial and small boat harbors and break walls, along with cascading ecosystem changes driven by dreissenid mussels and round gobies. Angler effort increased significantly throughout the 1990s and 2000s as a viable bass fishery established. Regulation changes in the late 1990s, in conjunction with national focus on tournaments and catch-and-release fishing may have changed angler behavior to focus less on harvesting bass and more on catch-and-release. Recent electrofishing surveys show bass populations have larger size structure than in previous decades, perhaps due to low harvest rates and the changing ecosystem. Both creel survey and recent electrofishing data show that nearshore protected waters now support abundant largemouth bass populations, whereas they were absent in the 1990s and early 2000s. This change may be driven by a combination of ecosystem changes, increased water clarity and weed growth, and warming nearshore waters.

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Keywords:

- Population change
- Angler behavior
- Creel survey

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Nearshore-Offshore Movements and Feeding Dynamics of Lake Michigan Forage Fish

Lake Michigan has undergone substantial ecological change due to invasive dreissenid mussels, altered nutrient pathways, and other anthropogenic stressors that have changed ecosystem productivity and food-web dynamics. These changes have the potential to influence how forage fishes utilize nearshore and offshore habitats, thereby affecting the spatial and temporal transfer of energy through the ecosystem. We examined the movement and feeding ecology of three common forage fish species – alewife, spottail shiner, and yellow perch – at nearshore sites in Lake Michigan. Fish were sampled using gillnets deployed parallel to the shore across multiple depth strata and times of day. Capture orientation was used as an indicator of nearshore-offshore movement, while stomach fullness indices provided insights into feeding activity. Preliminary analyses revealed species-specific variation in movement and feeding patterns across spatial and temporal scales, suggesting that habitat use and foraging behaviors are influenced by a combination of environmental and temporal factors. These findings improve our understanding of how forage fishes differentially utilize nearshore and offshore resources and contribute to nearshore-offshore connectivity through movement and feeding dynamics. Improved understanding of these linkages, along with novel approaches for assessing fish movement, may help inform ecosystem-based management and monitoring efforts in the Great Lakes.

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Keywords:

- Diel horizontal migration
- Forage Fish
- Feeding Ecology

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

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Presentation Title:

A Quantification of Different Algal Types: Benthic Algae Community Composition in Nearshore Areas of Four Great Lakes With Special Emphasis on Lake Michigan

Cladophora is a benthic alga in the Laurentian Great Lakes known for frequently growing to nuisance levels and causing fouling of beaches. When setting out to assess in-lake *Cladophora* growth in 2018, our team instead found very high biomass of diatoms at a station in northern Lake Michigan. This caused us to increase our focus on algal diversity and, from 2018 to 2023, samples of benthic algae from two transects each in Lakes Erie, Huron, Michigan, and Ontario were collected and community composition was determined from field, laboratory, and microscope observations. This analysis shows that while *Cladophora* is often a primary contributor to algal biomass, the benthic community can also be dominated by diatoms, *Chara*, and non-branching filamentous green algae often at elevated biomass. Within a transect, algal communities were relatively stable across depth and time. However, differences in algal type were observed among lakes and, for some lakes, between the two transects. For example, in Lake Michigan, the two transects show very different algal profiles - one dominated by *Chara* while the other is dominated by diatoms. Understanding the community composition of nuisance-producing algae is important for improving lake-wide benthic growth models and may be helpful in decision-making of coastal managers.

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Keywords:

- Nuisance Algae
- Cladophora
- Benthic Algae

Habitat Heterogeneity in Lake Michigan: Implications for Food Webs, Fish, and Fisheries

Moderator(s):

- Tomas Höök, Purdue University, West Lafayette, Indiana; Les Warren, Purdue University, West Lafayette, Indiana; Carl Ruetz, Grand Valley State University, Muskegon, Michigan

Presentation Title:

Effects of Bio-Oregon and Otohime Feeds on Larval Lake Trout *Salvelinus namaycush* Growth, Condition, and Thiamine Levels

Lake trout (*Salvelinus namaycush*) are an important salmonid of the Great Lakes, their populations were depleted throughout the 20th century due to overfishing, habitat degradation, and predation by invasive sea lamprey (Petromyzon marinus). Hatchery supplementation by state and federal agencies has been central to restoration efforts, yet self-sustaining wild populations remain limited across their historic range. Thiamine (Vitamin B1) deficiency in Great Lakes salmonids is associated with impaired early development, reduced survival, and reproductive failure. Early mortality syndrome (EMS), linked to maternal thiamine deficiency, poses a persistent threat to hatchery and wild lake trout recruitment, making thiamine dynamics during early life stages critical to improving conservation outcomes. This study compared the effects of two larval diets, Bio-Oregon and Otohime, on lake trout fry growth, thiamine content, and lipid content over an 84-day feeding trial. Eggs were obtained from wild fish captured in the Northern Refuge of Lake Michigan and a hatchery broodstock of the Lewis Lake strain from the Jordan River National Fish Hatchery. Fry were housed in 235-gallon tanks of approximately 650 fish each and sampled intensively from yolk sac absorption through one-week post-absorption, with additional sampling at days 21, 42, 63, and 84. Preliminary analysis of length and weight data revealed no significant difference in growth between fry fed Bio-Oregon versus Otohime across both stocks, suggesting either diet is equally suitable for supporting early lake trout growth and providing guidance for hatchery managers selecting between these feeds. Thiamine and lipid analyses are ongoing, and complete results on the effects of diet composition on nutrient accumulation and energy reserves will be presented. This work contributes to a broader understanding of thiamine dynamics during early lake trout development in the context of Great Lakes restoration.

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Keywords:

- Fisheries Conservation
- Great Lakes Restoration
- Thiamine Deficiency

Illinois Coastal Monitoring: Partnering for Success

Illinois Coastal Monitoring: Partnering for Success

Moderator(s):

- Carla Rosenfeld, Illinois Department of Natural Resources, Chicago, Illinois

Presentation Title:

Overview of the Illinois Coast and Coastal Management Program and the Need for Strategic Monitoring

The Illinois Department of Natural Resources Coastal Management Program (IDNR CMP) and the University of Illinois' Prairie Research Institute (PRI) have partnered for over a decade to better understand the geological, hydrological, and ecological systems of Illinois' Lake Michigan shoreline. IDNR CMP aims to engage and connect communities with the Lake Michigan coastal region, enhance coastal stewardship, promote balanced use of coastal resources, improve interagency coordination, and support communities that are most vulnerable to the impacts of coastal hazards. The IDNR CMP partnership with PRI increases Illinois coastal stakeholder knowledge of coastal dynamics and enables IDNR CMP to work with communities and other partners to identify sustainable solutions to coastal management. Under volatile lake level conditions and potential future climate change impacts, this partnership is essential for monitoring ongoing and emerging coastal issues and making informed management decisions that increase Illinois coastal health and resilience.

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Keywords:

- Illinois
- Monitoring
- Partnership

Illinois Coastal Monitoring: Partnering for Success

Moderator(s):

- Carla Rosenfeld, Illinois Department of Natural Resources, Chicago, Illinois

Presentation Title:

Sediment dynamics: Understanding Sediment Transport and Morphodynamics Using Integrated Coastal Monitoring Along the Illinois Shoreline

Between 2023 and 2024, the Illinois Department of Natural Resources Capital Development Board completed a shoreline protection project at Illinois Beach State Park that included offshore breakwater construction and beach nourishment designed to rebuild previously eroded beaches, enhance coastal resilience, and reduce future shoreline erosion. The Illinois State Geological Survey has acquired seasonal datasets using small unmanned aerial systems (sUAS) structure-from-motion photogrammetry, single beam sonar, and RTK-GPS surveys as part of a long-term integrated coastal monitoring effort to evaluate shoreline, topographic, and bathymetric response within and adjacent to the project area. Initial monitoring results indicate nearshore sediment deposition, tombolo formation behind the offshore breakwaters, and shoreline advance within portions of the nourished beaches, reflecting changes in sediment transport and coastal morphology. While beaches within the project area appear stable and exhibit reduced erosion, adjacent downdrift shorelines have experienced increased erosion and shoreline retreat following construction. Continued monitoring is essential for evaluating project performance, improving our understanding of sediment transport processes, and informing adaptive shoreline management strategies that enhance long-term coastal resilience along the Illinois coast of Lake Michigan.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Coastal monitoring
- Coastal resilience
- Coastal geology

Illinois Coastal Monitoring: Partnering for Success

Moderator(s):

- Carla Rosenfeld, Illinois Department of Natural Resources, Chicago, Illinois

Presentation Title:

Shoreline Protection Structures as Nearshore Habitat Enhancement in Illinois Beach State Park

Illinois Beach State Park (IBSP), in southwestern Lake Michigan, contains the last remaining stretch of natural beach-ridge coastline in Illinois. The park is home to globally significant panne wetlands, a wide variety of flora and fauna, and attracts visitors each year for beach recreation, camping, hiking, and boating and is free and open to the public year-round. Nearby coastal development and shoreline armoring have disrupted natural coastal processes within IBSP, resulting in coastal geomorphological impacts. In 2024, a large-scale shoreline protection project, containing 22 emergent breakwaters, was installed along the Lake Michigan shoreline at IBSP to protect this valuable coastal habitat. Additional sub-aquatic habitat features were installed at a subset of the structures with the goal of further enhancing aquatic habitat. The Illinois Natural History Survey, in partnership with the Illinois DNR Coastal Management Program (IDNR CMP), began an intensive evaluation of these structures in 2026. Goals of the evaluation program are to 1) quantify the effect of the breakwater structures on aquatic species abundance and diversity, and 2) determine the potential increased benefit of the sub-aquatic habitat features to aquatic species. Targets for evaluation include physical conditions, aquatic vegetation, larval fish, and pelagic fish. Impressions from initial surveys conducted in the spring and summer of 2026 will be shared during this presentation, as well as how observed changes to the aquatic system resulting from the breakwaters may fit in with observations of other research groups quantifying botanical and geological systems within IBSP. The IDNR CMP's support of a robust scientific approach when evaluating these structures will put the state of Illinois on the forefront of coastal science in the Great Lakes, paving the way additional successful coastal protection projects in the future.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Aquatic Species
- Reefs
- Coastal Habitat

Illinois Coastal Monitoring: Partnering for Success

Moderator(s):

- Carla Rosenfeld, Illinois Department of Natural Resources, Chicago, Illinois

Presentation Title:

Floristic Inventory and Plant Communities Updates: 50 Years of Changes at Illinois Beach State Park

Illinois Beach State Park (IBSP) is designated as a Wetland of International Importance by the RAMSAR convention due to its remarkable biodiversity and conservation value. Located along the western shore of Lake Michigan in northeastern Illinois, IBSP represents an important natural area in the Chicago region, where over 90% of the Illinois shoreline has been developed, nearly all remaining natural shoreline is within the park's boundaries. The topography of IBSP consists of an alternating series of high ridges and low swales running parallel to the shore of Lake Michigan, indicating the position of previous, post-glacial shorelines. This ridge-swale topography supports a large variety of habitats, and in turn, a diverse assemblage of species. In this study a comprehensive survey of the flora and mapping of plants communities (last mapped in 1976) was conducted in 2025. Within the 600 acre project boundary we recorded over 800 vascular plants , including 30 threatened or endangered species in Illinois, one species thought to be extirpated from the state, and one new native state record. In addition, the number of acres associated with some plant communities have changed considerably since 1976. This floristic inventory will provide the baseline data for future restoration work and erosion mitigation efforts at IBSP.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Floristics
- Illinois Beach
- Ecology

Illinois Coastal Monitoring: Partnering for Success

Moderator(s):

- Carla Rosenfeld, Illinois Department of Natural Resources, Chicago, Illinois

Presentation Title:

Using Drone Imagery to Classify Vegetative Communities in a Lake Plain Wetland Complex

Illinois Beach State Park (IBSP) is part of the Chiwaukee Illinois Beach Lake Plain wetland complex that spans Illinois and Wisconsin. This complex supports six globally rare wetland community types and 63 state-protected and two federally protected plant and animal species. The disappearance and degradation of wetlands and shorelines at IBSP due to anthropogenic causes and shifting climate patterns threaten their biodiversity and ecosystem services. Considerable restoration efforts have been made, including off-shore breakwater structures, beach renourishment, and plans to restore hydrology within the park. As part of a collaborative monitoring project, drone imagery is being collected to supplement on-the-ground quantitative and qualitative surveys within IBSP. For the coastal beach community, we are examining drone images generated by the on-going ISGS coastal monitoring project (dating to 2018) to determine changes in the vegetation before and after installation of the offshore structures and beach renourishment along Lake Michigan. These images are collected at 75 m heights with 80% overlap, which is sufficient to recognize major plant communities in the beach and near-shore areas. Additional drone imagery is being collected along vegetative sampling transects within the IBSP-North Unit. Flights as low as 30 m were conducted in 2025, and flights up to 75 m will be flown in July-August 2026. An pilot study using an NDVI sensor will compare across and within community types to determine whether details such as hydrology and plant health (e.g., cattail marshes post-herbicide treatment) can be determined remotely. Drone imagery will be combined with topographic imagery and ground-truthed polygons and polylines that delineate distinct species populations and plant communities within the transect areas. From this analysis, it is hoped that similar surveys can be conducted at other less intensively surveyed sites within the Chiwaukee Illinois Beach Lake Plain.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Drone
- Remote sensing
- Community classification

Illinois Coastal Monitoring: Partnering for Success

Moderator(s):

- Carla Rosenfeld, Illinois Department of Natural Resources, Chicago, Illinois

Presentation Title:

Characterizing Wetland Hydrology and Water Quality at Illinois Beach State Park to Guide Coastal Wetland Restoration

Most of Illinois' remaining Great Lakes coastal wetlands are located within the Lake Michigan plain at Illinois Beach State Park (IBSP). These globally significant wetlands provide critical ecosystem services; however, these wetlands are threatened by fluctuating lake levels, shoreline erosion, and pollution. Further, the park receives runoff from surrounding urban and agricultural watersheds that ultimately drain into Lake Michigan, transporting pollutants particularly chloride and nutrients, which can affect wetland quality and function. Protection, restoration, and adaptive management of these areas require an understanding of wetland hydroperiod, hydrologic connectivity, and water quality. In this study, continuous water-level monitoring is used to characterize hydroperiod and hydrologic responses throughout the lake plain, while surface water and groundwater sampling is analyzed to assess water quality and spatial variability of chloride and nutrients. Preliminary results show water-levels across wetland habitats are driven primarily by seasonal precipitation and regional groundwater recharge, with shoreline habitats supported by the lake during dry periods. Local hydroperiods vary across wetlands, reflecting differences in elevation and water source. Prairie habitats generally exhibit shorter hydroperiods, while freshwater marshes tend to retain water longer and persist through mid-summer. Water-quality analyses show chloride and nutrient concentrations are generally higher and tend to repeatedly exceed background concentrations in wetland habitats proximate to pollution sources, including major roadways and surface water drainage. Continued monitoring will improve understanding of hydrologic and water-quality processes and provide guidance for wetland restoration, preservation, and long-term management to protect and enhance coastal wetlands at the park.

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Keywords:

- Coastal wetland hydrology
- Water quality
- Restoration

Illinois Coastal Monitoring: Partnering for Success

Moderator(s):

- Carla Rosenfeld, Illinois Department of Natural Resources, Chicago, Illinois

Presentation Title:

From Classroom to Lakefront: Translating Prairie Research Institute Research for Multiple Audiences.

Expanding public engagement with conservation requires multiple, meaningful points of connection between science and the community. In this talk, we will present on a variety of projects by PRI to enhance knowledge and understanding of the coastal ecosystem and conservation; from passive measures like trailside signs to experiential learning opportunities with the Traveling Science Center, the Coastal Wave Tank, the Eco-Ambassador internship program, and public outreach events. , With our public outreach, we aim to reach community members of all ages. We use passive outreach initiatives, such as eye-catching interpretive signage, to connect science to the broader community. We incorporate actions, like the CoastSnap Citizen Science project, to deepen that connection. By participating in public events we are able to connect directly with people of all ages. , Through our school visits, the Traveling Science Center provides brief structured sessions (30-45 minutes) and opportunities to go more in depth with conservation science. The Coastal Wave Tank serves as an interactive visual teaching students about Great Lakes coastal processes such as erosion, as well as how we manage the ever-changing shoreline dynamics to protect our coastal resources. These experiences serve as touchpoints that spark curiosity and make scientific research accessible to elementary and middle school learners. , The Eco-Ambassador internship offers a deeper engagement through an 8-week, paid opportunity for youth aged 16-20 to interact with conservation touchpoints throughout Illinois Beach State Park. Guided by local experts and Prairie Research Institute researchers, participants experience touchpoints and create capstone projects to present to the community., These programs illustrate how layered engagement – ranging from brief encounters to sustained leadership development – can broaden participation in conservation and strengthen connections between science and the public."

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Public engagement
- Environmental science
- Education

Remediation, Restoration, and Revitalization at Great Lakes Areas of Concern

Remediation, Restoration, and Revitalization at Great Lakes Areas of Concern

Moderator(s):

- Michael Spinar, IN Department of Environmental Management, and Stacy Hron, WI Department of Natural Resources

Presentation Title:

From Sediment to Habitat: Advancing Restoration in the Milwaukee Estuary Area of Concern Through Collaboration

The Milwaukee Estuary Area of Concern (AOC) is entering a transformative phase of remediation and restoration. With 28 management actions underway, partners are coordinating contaminated sediment remediation, habitat restoration, and ecological recovery efforts at a scale rarely seen in the Great Lakes. These projects represent significant progress toward addressing Beneficial Use Impairments and advancing the long-term goal of AOC delisting. This presentation will provide an overview of the Milwaukee Estuary AOC portfolio of projects, focusing on the design of the largest Great Lakes Legacy Act (GLLA) Project Agreement funded under the Great Lakes Restoration Initiative (GLRI). Attendees will gain insight into the planning, design, and coordination required to implement a project of this magnitude, as well as the opportunities and challenges associated with aligning multiple restoration efforts across a large urban watershed. A central theme to the presentation is the partnership model that has made this possible. Federal, state, county, municipal, nonprofit, and other local partners are working together through a unique non-federal sponsor approach that distributes cost-share responsibilities among several local entities rather than relying on a single sponsor. This collaborative framework has increased implementation capacity and positioned the Milwaukee Estuary AOC to advance multiple high-priority projects simultaneously. The presentation will also showcase several fish and wildlife habitat restoration projects being led by local sponsors throughout the AOC. These examples will illustrate how coordinated habitat restoration is improving ecological connectivity, enhancing aquatic and riparian habitats, and supporting the recovery of native fish and wildlife communities while complementing contaminated sediment remediation efforts.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- GLLA
- Remediation
- Restoration

Remediation, Restoration, and Revitalization at Great Lakes Areas of Concern

Moderator(s):

- Michael Spinar, IN Department of Environmental Management, and Stacy Hron, WI Department of Natural Resources

Presentation Title:

Measured Recovery to PCB Exposure in Fish and Wildlife in the Lower Fox River and Green Bay

In the 1950s, the Lower Fox River Valley contained a high concentration of papermills, which led to widespread polychlorinated biphenyl (PCB) contamination in the river with the adoption of carbonless paper manufacturing and recycling. PCB-contaminated sediments were found throughout the entire 39 miles river and in the bay of Green Bay. To address this, the Lower Fox River PCB Cleanup Project divided the river into five operable units (OUs) and undertook remedial actions, including dredging, capping, and sand covers to reduce sediment PCB concentrations to below 1 ppm. Active remediation was completed in 2020, and all OUs are currently in the long-term monitoring stage. This presentation reviews various biological measures of recovery, including those in fish and wildlife within the initial years post-remediation. Measured PCB levels in fish, mallards, and colonial fish-eating birds indicate a system trending toward recovery.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Green Bay
- PCBs

Remediation, Restoration, and Revitalization at Great Lakes Areas of Concern

Moderator(s):

- Michael Spinar, IN Department of Environmental Management, and Stacy Hron, WI Department of Natural Resources

Presentation Title:

Connecting Restoration to Stewardship: Using Immersive Education and Community Partnerships to Engage Youth in the Grand Calumet River Area of Concern

The Grand Calumet River Area of Concern (AOC) in northwest Indiana has undergone extensive remediation and habitat restoration through collaborative federal, state, and local efforts. While restoration success is often measured through ecological outcomes, sustaining long-term benefits also depends on public understanding, community engagement, and the development of future environmental stewards. This presentation highlights two Illinois-Indiana Sea Grant initiatives that connect AOC restoration with youth education and community outreach: the Grand Calumet River Area of Concern Virtual Reality Experience and Grand Calumet Stewardship Day. The virtual reality program allows students to explore the Grand Calumet River corridor, compare degraded and restored habitats, learn about contaminated sediment remediation, and investigate local plant and animal communities through an immersive educational experience. Grand Calumet Stewardship Day extends these concepts into the field by bringing elementary school students to the watershed, where they engage with scientists, conservation practitioners, and environmental educators through hands-on activities focused on fish and wildlife, dune and swale ecosystems, and water resource stewardship. Organized through partnerships among Illinois-Indiana Sea Grant, The Nature Conservancy, schools, and environmental agencies, the event reaches approximately 70 students annually and provides direct exposure to restoration efforts in their community. Together, these projects demonstrate how collaboration across research, management, outreach, and education can increase awareness of AOC restoration, strengthen connections between restoration practitioners and local communities, and foster the next generation of Great Lakes stewards. We discuss partnership development, educational design, evaluation outcomes, and lessons learned that may be transferable to other Areas of Concern and Great Lakes restoration initiatives.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Areas of Concern
- Youth Education
- Engagement

Remediation, Restoration, and Revitalization at Great Lakes Areas of Concern

Moderator(s):

- Michael Spinar, IN Department of Environmental Management, and Stacy Hron, WI Department of Natural Resources

Presentation Title:

Monitoring in the Grand Calumet River Area of Concern to Assess the Status of a Designated Eutrophication Impairments after Restoration

Eutrophication has been regularly documented in the Grand Calumet River (GCR) and Indiana Harbor Canal (IHC) in northwest Indiana. In response to the 1987 amendment to the Great Lakes Water Quality Agreement between the United States and Canada, and to the designation of the Grand Calumet River as an Area of Concern by the U.S. Environmental Protection Agency, multiple remediation efforts have been undertaken. To evaluate the status of eutrophication following these efforts, the U.S. Geological Survey, in cooperation with the U.S. Environmental Protection Agency and the Indiana Department of Environmental Management, collected data from the GCR and IHC in 2021 and 2022 to document the effects of remediation and combined sewer overflow releases on water quality. Continuous monitoring included dissolved oxygen, water temperature, chlorophyll fluorescence, specific conductance, and pH. Discrete samples were analyzed for biological and chemical oxygen demand, nutrients, nitrogen and oxygen isotopes in nitrate, nitrogen isotopes in ammonia, hydrogen and oxygen isotopes in water, and algal community composition (cyanobacteria and eukaryotic algae) using metabarcoding. Eutrophic conditions were observed throughout the study area. Isotopic signatures indicated that nitrate sources were primarily soil organic nitrogen or combined sewer overflows (CSOs). CSOs had substantial effects on water quality, whereas remediation status had comparatively little influence. Several algal taxa with nuisance potential were identified, including *Microcystaceae* (cyanobacteria) and *Chrysophyceae*, *Cryptophyceae*, and *Bacillariophyceae* (all eukaryotic algae). When sites with irregular flow patterns were excluded, minimum dissolved oxygen concentrations were generally higher downstream from remediated sites than from unremediated sites.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Area of Concern
- Eutrophication
- eDNA

Remediation, Restoration, and Revitalization at Great Lakes Areas of Concern

Moderator(s):

- Michael Spinar, IN Department of Environmental Management, and Stacy Hron, WI Department of Natural Resources

Presentation Title:

Grand Calumet River AOC: Navigating the Challenges in Designing the Junction Reaches and Junction Marsh Remedy

The Grand Calumet River (GCR) and Indiana Harbor Canal (IHC) in East Chicago, Indiana, are part of a designated Great Lakes Area of Concern (AOC) due to decades of industrial activity that resulted in widespread sediment contamination that included polychlorinated biphenyls, polycyclic aromatic hydrocarbons, metals, and petroleum-related compounds. The Junction Reaches project targets approximately 3 miles of interconnected river and canal segments, including adjacent wetland habitat. The primary objectives of the remedial design are to: (1) remove or isolate contaminated sediments, including all PCB-impacted sediments exceeding 50 milligrams per kilogram (mg/kg); (2) restore aquatic habitat and beneficial uses by addressing the beneficial use impairments (BUIs); and (3) restore the 15-acre Junction Marsh wetland. The design supports broader AOC delisting goals under the Great Lakes Legacy Act while accommodating ongoing industrial land use, navigation constraints, stakeholder requirements and supports stakeholder future recreational use of the waterways. The selected remedy is a hybrid dredging and capping design, informed by prior investigations, feasibility studies, and lessons learned from earlier GCR remediation phases. Targeted dredging depths are designed to meet both cleanup criteria and meet flood control constraints. Dredged material will be hydraulically transported to, dewatered using geotextile tubes, treated, and transported to licensed landfills. An engineered multilayer sediment cap will be placed over remaining sediments to isolate contaminants and prevent resuspension for a 100-year design life. The design also incorporated an integrated hydraulic and geotechnical design to ensure the final remedy does not increase flood elevations, while maintaining interim and long-term stability to ensure long-term cap integrity. Finally, the site and habitat restoration includes stabilization of banks, invasive species treatment, and restoration of the marsh.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Grand Calumet AOC
- Remediation
- Restoration

Safer Shores, Stronger Partnerships: Advancing Water Safety on Lake Michigan

Safer Shores, Stronger Partnerships: Advancing Water Safety on Lake Michigan

Moderator(s):

- Leslie Dorworth, Purdue University Northwest, Hammond, Indiana

Presentation Title:

The Great Lakes Water Safety Consortium: Connecting Research, Education, and Action

Since 2010, the Great Lakes have taken more than 1,300 lives. No single agency owns this problem. Drowning prevention is split across eight states, one province, federal and tribal partners, county health departments, harbormasters, school districts, and volunteer beach patrols – each holding a piece of the picture, and rarely the whole thing. The Great Lakes Water Safety Consortium (GLWSC) exists to close that gap. It is a regional network of organizations, agencies, researchers, educators, first responders, and community leaders working to reduce drowning and improve water safety across the basin. This presentation introduces the Consortium – its origins, structure, and the collaborative model that lets a volunteer-driven network share best practices faster and more broadly than any single institution could alone. Attendees will see that model in practice. The Consortium's Comprehensive Great Lakes Drowning Incident Database now documents over 3, 500 incidents across fifteen years, giving researchers and managers a shared evidentiary base where none existed. Its Education & Training Committee is aligning water safety instruction across state lines. Its communication work translates rip current forecasting and rescue data into messages that reach people before they reach the water. And in October 2026, the Consortium convened its latest regional conference in South Haven, Michigan – this session will share early outcomes from that gathering, four weeks after it closes. Participants will leave knowing what regional water safety infrastructure already exists, where the gaps remain, and how their own organization can plug into it. Because the answer to a basin-wide problem was never going to be one organization working harder. It was always going to be all of us working together.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Drowning Prevention
- Water Safety
- Great Lakes Collaboration

Safer Shores, Stronger Partnerships: Advancing Water Safety on Lake Michigan

Moderator(s):

- Leslie Dorworth, Purdue University Northwest, Hammond, Indiana

Presentation Title:

The Burden and Circumstances of Drowning in Michigan: A Statewide Assessment to Inform Prevention

Background: Bordering four of the five Great Lakes and home to thousands of inland lakes, rivers, and streams, Michigan faces unique drowning prevention challenges. The CDC Foundation, in collaboration with the Michigan Department of Health and Human Services and state and local partners, produced a statewide drowning report assessing the burden and circumstances of drowning in Michigan and identifying lessons and considerations for strengthening surveillance and prevention., Methods: Drowning deaths (2009–2023), hospitalizations (2016–2023), and emergency department (ED) visits (2018–2023) were analyzed using Michigan vital records and hospital discharge data with expanded case criteria. Additional analyses examined current-related fatalities and wave conditions along Michigan's Great Lakes shoreline. Nine state, local, and nonprofit organizations completed a questionnaire on drowning surveillance activities, data gaps, and resource needs., Results: Expanded case criteria identified more fatal and nonfatal drowning incidents than traditional methods. Drowning burden peaked during the summer months, particularly in July. Children aged 1–4, adults aged 75 and older, non-Hispanic American Indian/Alaska Native residents, and non-Hispanic Black residents were identified as populations at increased risk for drowning. Lake Michigan accounted for nearly 80% of current-related deaths along Michigan's Great Lakes shoreline. Limited data access and insufficient staff support were the most frequently reported surveillance challenges through the questionnaire., Conclusions: The statewide drowning report identified key demographic, seasonal, and environmental patterns, along with surveillance challenges, providing a foundation for strengthening drowning surveillance and informing coordinated prevention efforts across Michigan and the Great Lakes region."

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Drowning
- Water Safety
- Michigan

Safer Shores, Stronger Partnerships: Advancing Water Safety on Lake Michigan

Moderator(s):

- Leslie Dorworth, Purdue University Northwest, Hammond, Indiana

Presentation Title:

Data to Action: Using the Michigan Injury Indicators Dashboard to Support Drowning Prevention Work

Background Data is a key element for drowning prevention programs and can aid community partners and local public health in understanding the burden of injury in their individual communities. However, finding up to date and easily accessible drowning data can be difficult. To improve access and use of drowning and other injury data in the state of Michigan, a data dashboard was developed by the Michigan Department of Health and Human Services. Methods Tableau was used to develop an interactive dashboard presenting data on fatalities, nonfatal hospitalizations, and nonfatal emergency department visits among Michigan residents due to injury, including drowning-related injuries. Data can be filtered by injury type, year(s), and county of patient residence and is presented by basic demographics (such as race, sex, and age group), trends over time, and county of residence. Data can also be viewed by either count, rate, or percent of total and downloaded from the dashboard, allowing for additional analyses by the user. Results The Michigan Injury Indicators Dashboard was published in November 2025 and has seen over 1,000 unique users since its initial launch. This dashboard has been shared with a number of drowning partners both within and outside of Michigan. Drowning data on the dashboard can help users understand the high risk groups in Michigan. For example, the highest rates of drowning deaths are seen among adults aged 75 years and older, males, American Indian, and Black Michiganders. Trends are similar for nonfatal data, however 0-14 year-olds tend to have higher rates than older adults. Conclusion Data dashboards such as the Michigan Injury Indicators Dashboard can be useful tools in providing easily accessible drowning data to the public and supporting drowning prevention efforts. The data on this dashboard will continue to be updated on an annual basis and shared with relevant drowning prevention partners.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Drowning Data
- Dashboard

Safer Shores, Stronger Partnerships: Advancing Water Safety on Lake Michigan

Moderator(s):

- Leslie Dorworth, Purdue University Northwest, Hammond, Indiana

Presentation Title:

A Review of Great Lakes Drowning Fatality & Rescue Statistics: Applications to Beach Forecasting and Water Safety Efforts

An overview and summary of drowning rescue and fatality statistics from the NWS Great Lakes Current Incident Database (GLCID) and the consolidated drowning database project led by the Great Lakes Water Safety Consortium's (GLWSC) Data & Metrics Committee will be provided. This will include an introduction to the publicly available GLCID Dashboard at Michigan Tech University's Great Lakes Research Center. Lastly, the presentation will review key applications of the data to beach forecasting and water safety outreach and education efforts.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Drowning Statistics
- Beach Hazards
- Beach Forecasts

Safer Shores, Stronger Partnerships: Advancing Water Safety on Lake Michigan

Moderator(s):

- Leslie Dorworth, Purdue University Northwest, Hammond, Indiana

Presentation Title:

Water Safety Education- Building Skills and Knowledge

Water safety education as a collaborative effort between regions (i.e.: Great Lakes), non-profit organizations, community groups, schools, local government, health departments, hospitals, first responders, residents and visitors. Ideally the topic is broad and includes personal safety, group safety, terminology, equipment and water quality. Building skills is the key component to creating a culture of being in and on the water safely. It includes developing the ability to understand water conditions, evaluate the risks to avoid water emergencies and have survival skills to fall back on. It encourages smart choices, reduces peer pressure and increases participation in water sports. This type of approach will help reduce drowning and increase the number of competent people in the water and along our shores.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Water Safety

Science to Support Restoration of Instream and Nearshore Habitats

Science to Support Restoration of Instream and Nearshore Habitats

Moderator(s):

- Erin Argyilan, National Parks Service, and Joe Gruzalski

Presentation Title:

The Quality and Quantity of Connectivity Along the U.S. Coastal Zone: Featuring Lake Michigan Connectivity

The Great Lakes Coastal Zone (GLCZ), the world's longest continuous freshwater coastline, consists of interspersed natural and developed landcover and is inhabited by millions of people. Anthropogenic change has fragmented the GLCZ, decreasing landscape connectivity. We evaluated functional landscape connectivity of the U.S. GLCZ, assessing regional connectivity, protected areas' effects on connectivity, and identified pinchpoints where connectivity is most vulnerable. We modeled landscape connectivity to describe corridors and redundant pathways for two scenarios: (1) continuous terrestrial habitat patches and (2) protected areas. We compared these two scenarios by total corridor area and quality at two spatial scales (coastal zone and ecoregion). We used random forest analyses to examine how ecological factors influenced the connectivity rank and pinchpoint values. A principal components analysis identified how land cover influenced connectivity among ecoregions. The GLCZ was 69% connected. Although 91% of the GLCZ's high-quality habitat was within corridors, less than 50% of the corridor area was high-quality (low resistance to movement). While the northernmost region retained high-quality connectivity, connectivity loss and degradation increased with development further south. Corridors between protected areas provided less connectivity, of worse quality, in areas of development and agriculture. Lower connectivity was associated with higher impervious surface cover. Protected area placement affected both the quantity and quality of connectivity. Improving and maintaining functional connectivity could be accomplished by strategically restoring and protecting habitats most vulnerable to connectivity loss, predominantly in urban and agricultural regions. Our connectivity improvement index is a useful tool to identify areas where connectivity may be improved.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Coastal Zone
- Connectivity
- Land Use Change

Science to Support Restoration of Instream and Nearshore Habitats

Moderator(s):

- Erin Argyilan, National Parks Service, and Joe Gruzalski

Presentation Title:

Spatial Patterns of Great Lakes Searocket at Illinois Beach State Park

Great Lakes Searocket, *Cakile edentula* (Bigelow) Hook. var. *lacustris* Fernald (Brassicaceae) is an annual species of conservation concern in several states surrounding Lake Michigan, USA. In 2023, due to concerns associated with a series of projects aimed at mitigating beach erosion and flooding at Illinois Beach State Park (IBSP; Lake County, IL), seeds were collected from two Great Lakes Searocket locations that could be impacted. In early 2024, after completion of a beach nourishment project at the site, Great Lakes Searocket seeds were spread using the broadcast seeding method. in the fall of 2024, 2025, and 2026, the spatial patterns of the Great Lakes Searocket were documented. At 17 locations presence/absence and percent cover of Great Lakes Searocket were recorded by using transects and quadrats. Overall, this study has documented the successful establishment, hotspots of concentration, and annual variation of Great Lakes Searocket at IBSP. The success of this reintroduction is due to the life history of the species, including dispersal biology and ecology, and habitat protection at IBSP.

Project Author(s) (If more than one: * denotes presenter, † denotes corresponding author):

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Keywords:

- Cakile edentula var. lacustris
- rRre plant
- Illinois Beach State Park

Science to Support Restoration of Instream and Nearshore Habitats

Moderator(s):

- Erin Argyilan, National Parks Service, and Joe Gruzalski

Presentation Title:

Dominance and Decline in Butterfly Communities Across 25 Years in Midwestern Oak Savannas

Oak savannas are among the most imperiled habitats worldwide, characterized by their unique structure and biodiversity. These ecosystems have experienced significant decline due to fire suppression and habitat conversion to agriculture. To evaluate long-term shifts in butterfly diversity and environmental conditions, we conducted extensive surveys across 17 sites along a canopy cover gradient in 1998-1999 and re-surveyed the same locations in 2023. We used a machine learning approach and counterfactual analysis to model how management-relevant environmental variables drive changes in butterfly density and species richness over the 25-year interval. Our results demonstrate widespread decline in butterfly density and richness across most sites. While floral abundance, floral richness, percent ground cover, and percent oak cover emerged as common predictors of these shifts (out of 13 features evaluated), we found that the strongest environmental predictors were highly sensitive to the initial community assembly composing the response (density or richness) in our models. For example, removing dominant species - such as the extirpated Karner Blue (*Plebejus samuelis*) and the highly abundant Little Wood Satyr (*Megisto cymela*) â€“ fundamentally altered model outcomes. Excluding the latter taxon amplified the predictive importance of floral resources while reducing the influence of oak sapling cover, perhaps because adult *M. cymela* are non-nectar feeders found along forest edges. Our findings emphasize that hyper-dominant or extirpated taxa can mask environmental drivers relevant to the broader community. Ultimately, predictive models must address community dominance to effectively guide adaptive restoration efforts in these critical ecosystems.

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Keywords:

- Pollinator Ecology

Science to Support Restoration of Instream and Nearshore Habitats

Moderator(s):

- Erin Argyilan, National Parks Service, and Joe Gruzalski

Presentation Title:

Weevil Infestations and Other Insects Observed on Pitcher's Thistle (*Cirsium pitcheri*), A Threatened Plant Endemic to the Great Lakes, Throughout the Indiana Dunes National and State Parks

Pitcher's thistle, *Cirsium pitcheri*, is a federally threatened monocarpic perennial plant endemic to the dunes of Lake Michigan and the Great Lakes region. U.S. Geological Survey scientists and National Park Service resource management staff have been monitoring Pitcher's thistle populations throughout the Indiana Dunes National and State Parks since 1988. Through these monitoring efforts, it was discovered that multiple invasive weevil species were introduced into the parks and becoming a nuisance to Pitcher's thistle causing significant damage to its development and subsequent seed production. In an effort to explore management techniques for mitigating the presence and abundance of invasive weevil species, U.S. Geological Survey scientists conducted a study whereby grasses and litter within 1-meter of adult Pitcher's thistle plants were entirely removed while other experimental plants were left untouched. It is suspected that weevils use nearby grasses, vegetation, and litter as an alternative host or as refugia from more extreme weather conditions in place of exclusively occupying Pitcher's thistle. With further analysis, we hope to explore whether grass and litter removal negatively impacts weevil abundance and oviposition while positively impacting the proportion of viable seeds produced from adult plants. As a non-target observation throughout multiple seasons of monitoring, we have also documented and identified numerous genera of insects that utilize Pitcher's thistle at every life stage. Understanding the complexity of insect communities that require Pitcher's thistle for development and survival, or utilize the plant as habitat, is critical for protecting this species and further emphasizes the importance a single federally threatened plant can have on an entire dune ecosystem.

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Keywords:

- Coastal Ecology
- Threatened Plants
- Entomology

Science to Support Restoration of Instream and Nearshore Habitats

Moderator(s):

- Erin Argyilan, National Parks Service, and Joe Gruzalski

Presentation Title:

Conserving Coastal Dunes from the Perspective of Pitcher's Thistle (*Cirsium pitcheri*)

Along the shoreline of Lake Michigan is a narrow ribbon of non-forested coastal sand dunes harboring many unique and unusual plant species. Of the three federally listed species, Pitcher's thistle is the most widespread and is listed as federally threatened. We draw from three projects to illustrate the abundance of habitat; how open dune habitats are changing over a 28-year time span and the viability of Pitcher's thistle across the narrow dune system. To address these topics, we used analysis of aerial photography of the coastal dunes to estimate the area of suitable and potential habitat for Pitcher's thistle. We used vegetation data from 1991 and 2018 associated with 11 permanent plots along a latitudinal gradient from Indiana Dunes National Park, Pictured Rocks Dunes (Michigan), and Sleeping Bear Dunes (Michigan) to examine how the process of dune succession is impacting Pitcher's thistle habitats. Finally, we synthesize landscape conditions (e.g. maximum dune elevation, mean width of dune habitat, distance to nearest population) for Pitcher's thistle to quantify geographic patterns of viability for this species. We found that 28% of suitable habitats for Pitcher's thistle are less than 1 hectare in size. We found that all 10 of 11 sites are undergoing vegetation successional advancement toward more vegetation cover, to the detriment of Pitcher's thistle but the large continuous perched dunes and dune complexes are experiencing positive population growth. Our landscape synthesis analysis demonstrated that southern Lake Michigan populations are small in habitat area, have low genetic diversity and small population sizes. Northern populations are separated into two classes, 1) those with moderate suitable habitat areas, high genetic variability, and low population size along linear coastal beach dunes that are vulnerable to lake level fluctuation and 2) continuous perched dunes and dune complexes that have large habitat area, high genetic diversity, and large population sizes. Thus, these continuous perched dunes and dune complexes are most viable of all populations. We discuss the implications of these studies for the conservation of the varied organisms inhabiting coastal sand dunes of Lake Michigan/Huron.

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Keywords:

- Sand dunes
- Conservation
- Vegetation succession

Poster Symposium

Poster Symposium

Presentation Title:

Coupled Topobathymetric Surveys and Satellite Imagery Analysis Reveal Nearshore Bar Dynamics on Event to Annual Timescales

It is generally understood that sediment in coastal systems is cycled between the onshore and nearshore environments during storms and over seasons and that this is important for the recovery and resilience of the beach. However, few studies have characterized beach and nearshore morphodynamics on these short temporal scales, particularly on large lakes such as the Great Lakes where ~1 m lake level fluctuations can occur on seasonal to annual timescales. To address this gap, we combined topobathymetric surveys with high temporal resolution Planet satellite imagery to examine event, seasonal, and annual nearshore bar dynamics at Oval Beach along the eastern Lake Michigan shore, an unarmored, open coast, multi-barred beach backed by an extensive dune system. Initial results over a six-month period indicate substantial beach erosion accompanied by upper shoreface accretion. However, the observed sediment volume changes were not balanced, with beach erosion being approximately 2.5 times greater than the deposition, suggesting sediment transport either beyond the surveyed nearshore, potentially past the depth of closure, or away from the site in the longshore drift. The satellite imagery revealed substantially more cross-shore movement of the outer bar in comparison to the middle and inner bars over monthly to seasonal timescales. This is likely in part due to the outer bar breaking waves during storms yet remaining largely inactive during calm, non-storm periods, a phenomenon that has been well-documented on ocean coasts. The inner bars are also activated during storms, but sediment in these bars can also be mobilized during fair weather periods. These dynamics coupled with additional sediment being sourced to the bars from beach erosion may result in apparent minimal inner bar movement on monthly to seasonal timescales despite the beach and upper shoreface generally being the most dynamic portion of the nearshore system on these shorter timescales.

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Keywords:

- Coastal hazards
- Coastal resilience
- Beach erosion

Poster Symposium

Presentation Title:

Assessing PFAS in the Lake Michigan Food Web Along the Wisconsin Coast

In 2023, the Wisconsin Department of Natural Resources received funding through the Great Lakes Restoration Initiative to describe current concentrations of PFAS in water, sediment, mussels, multi-trophic level fish, and eagles along Wisconsin's Lake Michigan nearshore waters. The goals of this project are to identify patterns of accumulation that might suggest trophic levels/species that will have greater health impacts from PFAS and enhance understanding of how PFAS accumulate through the Lake Michigan food web. PFAS was analyzed in water, sediment, phytoplankton, zooplankton, mussels, fish, and eagle nestling along Wisconsin's Lake Michigan and Green Bay shoreline. Results indicate distinct PFAS profiles in the surface water of Green Bay compared to water collected along the Lake Michigan coastline. This pattern is also prevalent in the bald eagle samples. This presentation will include a summary of the surface water and biota results with a focus on bald eagles and fish.

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Keywords:

- PFAS
- Wisconsin
- Food web

Poster Symposium

Presentation Title:

DendroDune: Forest-Dune Dynamics Inferred from Tree Rings

Indiana Dunes National Park (IDNP) is home to Mount Baldy, the largest active dune on the Lake Michigan shorelines. At this locality, a period of dune stabilization at ~3 ka led to formation of a paleosol, on which an oak savanna forest type grew with black oak (*Quercus velutina*) as the predominant species. Since the construction of piers and breakwaters in Michigan City in the late 1800's that starved local sediment flux, Mount Baldy has destabilized, resulting in an average inland dune movement of 1.9 m/year that has buried much of the oak savanna forest. Dune migration at Mount Baldy has been investigated using historical aerial imagery, LIDAR data, and field surveys; however, these data sources are limited in temporal coverage and resolution. The buried trees on Mount Baldy offer another lens into past dune movements, as trees record environmental conditions through their annual growth rings. Here, we applied dendrochronological techniques on the buried black oak trees at Mount Baldy to determine their burial responses. Preliminary results show that black oaks exhibit severe growth suppression following burial, similar to what has been reported for European oaks. The timing of responses in living trees is consistent with modern dune movements as observed from imagery, and the timing of responses in dead trees enables the reconstruction of past dune movements at annual resolution over the past century. This tree-ring-based reconstruction presents a new approach, with superior temporal resolution and coverage, to understanding geomorphic-ecological interactions at coastal sand dunes.

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Keywords:

- Dendrochronology
- Geomorphology
- Dendrogeomorphology

Poster Symposium

Presentation Title:

Mercury Cycling in Lake Michigan: A Contemporary View of Spatial Variation and Bioaccumulation

Lake Michigan is historically one of the most extensively studied lakes for mercury (Hg) cycling, including a whole-lake mass balance and extensive investigations of Hg fate and transport in Green Bay and the Fox River in the late 1990s. However, 30 years later, numerous alterations have occurred in Hg delivery to Lake Michigan including decreasing atmospheric Hg deposition in response to national and international regulations and declines in legacy Hg delivery following Area of Concern (AOC) clean-ups. These changes in Hg source delivery also coincided with changes to the food web including the introduction of invasive species and presence of nuisance algae, which have been shown to drastically alter bioaccumulation in sport fish. We currently lack contemporary lake-wide data assessing Hg contributions to the food web across nearshore to offshore gradients in Lake Michigan. Thus, as part of the Cooperative Science and Monitoring Initiative (CSMI) in 2025, we focused on elucidating the spatial distribution of Hg and methylmercury (MeHg) in surface waters and plankton and paired these data with Hg source attribution in sediments from the Great Lakes Sediment and Surveillance Program (GLSSP). Here, we compare Hg distribution and speciation in Lake Michigan between nearshore and offshore environments to inform bioaccumulation in the pelagic food web. In addition, we will examine the Hg concentration and source data in a holistic Great Lakes perspective by integrating data from previous CSMI cycles in Lake Huron, Lake Ontario, and Lake Erie.

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Keywords:

- Mercury
- Food Web
- Sediment

Poster Symposium

Presentation Title:

Walleye Exposure to PFAS and Associated Gene Expressional Effects

Walleye (*Sander vitreus*) is an economically, environmentally, and culturally important fish species in the Great Lakes region yet face many challenges including habitat degradation, fishing pressures, and climate change. One mechanism of habitat degradation is the introduction of contaminants such as PFAS, or per- and polyfluoroalkyl substances, which are a diverse group of manmade widespread toxic compounds found in the environment at varying concentrations. Concurrence of the chemistry of PFAS compounds with organ-specific cell types and varied protein frequencies are known to affect bioaccumulation and cellular stress metabolic profiles in fish. To better understand specific PFAS/fish interactions, we investigated the sublethal effects of 7 PFAS compounds on young Walleye in a laboratory controlled 28 day experiment. We exposed 24 fish (six per treatment) to either Control, PFOS, 8:2 MonoPAP, or ∑6 PFAS wherein the six PFAS in the mixture included PFOS, PFBS, PFOA, PFNA, HFPO-DA (GenX), and PFHxS. Walleye were exposed via ambient water at doses of 350 ng/L except in the case of the ∑6 PFAS wherein each compound was individually at 60 ng/L, for a summative dose of 360 ng/L. Fish samples were collected of brain, muscle, eye, gill, heart, liver, kidney, intestine, and stomach tissues and analyzed via RNA sequencing. The tissue samples were also analyzed for PFAS using adapted EPA 1633 protocol and the RNA extraction was performed using Qiagen RNAeasy mini kits. We hypothesized that differential gene expression of the multiple pathways, such as the $PPAR_{\gamma}$ gene pathway would vary by PFAS treatment such that increases in PFAS bioaccumulation per tissue would be linked with greater magnitude of transcriptional responses. The results of this study will help gain insight into sublethal effects of contaminants in a keystone Great Lakes species via multiple compound exposures, with potential for follow up mechanistic studies.

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Keywords:

- PFAS
- Fish
- Emerging Contaminants

Poster Symposium

Presentation Title:

Condition-Adjusted Wetland Ecosystem Accounting for Nutrient Reduction and Watershed Planning: A Statewide Illinois Framework Applied to the Lake Michigan Basin

Wetlands provide ecosystem services, including water quality, flood, climate, and habitat benefits. Yet this evidence is scattered across studies, metrics, and valuation methods, making it hard to apply in practice. We address this gap with an ecosystem accounting framework that translates wetland science into spatially explicit planning metrics, following the UN System of Environmental-Economic Accounting–Ecosystem Accounting (SEEA EA)., Illinois wetland extent is mapped on a statewide 30 m grid, and condition is estimated from floristic quality using a generalized additive model trained on 244 Critical Trends Assessment Program (CTAP) sites. A condition scalar, w(x), adjusts service values by ecological condition rather than uniform per-hectare rates. Climate regulation, water purification, and flood regulation are exchange-value proxies; biodiversity is reported separately as a welfare value. Statewide, Illinois vegetated wetlands generate $859 million/year in exchange-value services and $276 million/year in biodiversity welfare value, with water purification the largest component. Within the Peterson et al. classification, about $522 million/year occurs in wetlands classified as unprotected. Per acre, exchange value averages about $880/year, more than double the upper end of 2025 Illinois cropland cash rent ($198–$381/acre), a public–private value gap., In the Illinois portion of the Lake Michigan Basin, about 19 km^2 of wetlands provide $3.5 million/year in exchange-value services ($758/acre) and $1.4 million/year in biodiversity welfare value, and retain about 517 tonnes of nitrogen/year. Within the classified basin area, exchange value falls within managed-biodiversity or county stormwater ordinance tiers, while about 40% of basin service value lies outside the classification, mitigation prioritization, and conservation targeting for Lake Michigan Basin planning."

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Keywords:

- Wetland ecosystem accounting
- Ecosystem service valuation
- Lake Michigan watershed planning

Poster Symposium

Presentation Title:

Environmental DNA in Conservation and Restoration Programs: Applications in Lake Michigan

Environmental DNA (eDNA) and complementary, DNA-based technologies (e.g., high throughput sequencing, HTS) have significantly contributed to advancing research in conservation biology programs in both aquatic and terrestrial ecosystems. Unlike traditional monitoring approaches where organisms are observed or captured, collecting samples such as water, soil, or flowers for eDNA analysis is advantageous for detecting a variety of organisms in those samples. Quantitative polymerase chain reaction (qPCR) and HTS (e.g., metabarcoding) are two DNA-based technologies commonly used in this endeavor for individual species (qPCR) or communities (HTS). The U.S. Geological Survey has integrated eDNA technologies into their research related to assessing fish communities in lakes and associated waterways and restoration of degraded habitats in the Great Lakes basin. Three studies relevant to Lake Michigan and its associated waterways are presented here. Briefly, we used HTS to identify and characterize cyanobacteria and eukaryotic algae as potential indicators of eutrophication (an indicator of beneficial use impairment) in the Grand Calumet River Area of Concern (GCR-AOC). Quantitative PCR was used to survey several local streams and river outfalls, as well as offshore sites to better understand the distribution and occupancy of an invasive fish (*Neogobius melanostomus*) in these waters. Lastly, we evaluated the usefulness of an autonomous eDNA sampler – capable of collecting eDNA samples at different water columns (i.e., epilimnion, metalimnion, hypolimnion, and benthic zones) – to assess microbes and fish communities in southern Lake Michigan. Collectively, these studies highlight the value of DNA-based technologies in conservation biology programs in support of ongoing restoration efforts in the Great Lakes basin.

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Keywords:

- eDNA
- Area of Concern
- ESP

Poster Symposium

Presentation Title:

Detection of Spawning Cisco (*Coregonus artedi*) in Great Lakes Tributaries by Environmental DNA

Coregonines were once abundant in all the Great Lakes, but their diversity and abundance have declined due to overfishing, loss of habitat, and invasive species. There have been intense efforts by resource managers, U.S. tribes, and stakeholders to restore and conserve these fishes. With evidence of cisco (*Coregonus artedi*) spawning in multiple Great Lakes tributaries to northern Lake Huron for the first time since the 1880s, identification of additional tributaries supporting spawning would be beneficial to restoration programs. Traditional visual and electrofishing surveys are time-consuming and difficult, especially when tributaries are inaccessible by boat. Thus, environmental DNA (eDNA) technology, a versatile and powerful tool, may offer opportunities for identification of fish without collecting live specimens. We validated a species-specific, DNA-based method that uses quantitative polymerase chain reaction (qPCR) to detect cisco. Samples collected from 2022 to 2025 include water (n=72) and sediment (n=26) from six tributaries to northern Lake Huron. In brief, qPCR results indicated water and sediment samples from 2022 (Spanish River) and 2025 (Magnetawan and Key Rivers, Chikanishing Creek) had no detections or detections below the quantification limit by qPCR, consistent with few to no observed ciscoes at the time of sampling. In contrast, almost all eDNA samples from 2023 (Spanish River) and 2024 (Mississagi and Serpent Rivers) showed strong signals in water and sediment, mirroring visual observations of ciscoes and their gametes in the water. Collectively, eDNA can expand existing surveys in identifying coregonine spawning habitats in support of ongoing restoration programs. In late November, the USGS team, in collaboration with the Bay Mills Indian Community and the Ontario Ministry of Natural Resources, will be conducting a widespread eDNA survey of 20 tributaries associated with Lakes Michigan, Superior, and Huron to identify cisco spawning sites.

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Keywords:

- Coregonines
- Environmental DNA
- Restoration

Poster Symposium

Presentation Title:

Reconstructing the Historical Diversity and Contemporary Origins of Lake Michigan Cisco (*Coregonus artedi)* Using Genetic and Morphometric Evidence

Cisco Coregonus artedi once supported a major commercial fishery in Lake Michigan that collapsed during the mid-20th century mainly due to overfishing. Early research suggested that, unlike Lake Huron, Lake Michigan supported only a single ecological morph as late as the 1920's, the typical artedi form. However, the contemporary population, now concentrated in northeastern Lake Michigan after a major resurgence beginning in 2011, has morphometric characteristics resembling the shorthead morph documented from the east-central main basin of northern Lake Huron. Recent genetic and morphological evidence indicate that these populations are too distinct for the Lake Michigan population to represent a recent founding from Lake Huron. We used historical specimens and scale samples to evaluate the genetic and morphometric diversity of early-20th-century Lake Michigan Cisco and assessed connections between historical stocks and the contemporary population. Analyses of a subset of Walter Koelz's 1920s collection indicate that Lake Michigan supported at least two, and potentially three or four, distinct ecomorphs. Contemporary Cisco are most similar to an ecomorph formerly common in the Grand Traverse Bay area. Preliminary genetic analyses also indicate that Green Bay supported a population clearly differentiated from that of the main basin, consistent with differences in several morphometric traits. These results suggest that historical Cisco population structure in Lake Michigan was more complex than previously recognized and that the contemporary population represents a surviving lineage of a distinct historical ecomorph. We discuss implications for Cisco restoration and for potential rapid evolution during population collapse and resurgence.

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Keywords:

- Genetic
- Cisco
- Morphometric



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