



Sea Grant

UNIVERSITY OF WISCONSIN

2022-24 DIRECTORY OF PROJECTS AND PEOPLE

University of Wisconsin Sea Grant Institute



Cover photo: Bluff research in Grafton, Wisconsin

Credit: Sara Stathas

2022-24 DIRECTORY OF PROJECTS AND PEOPLE

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Great Lakes Science for Our Future

Wisconsin Sea Grant is grateful for the opportunity to serve Wisconsin and Great Lakes residents over the last 50 years.

Wisconsin Sea Grant is dedicated to researching the Great Lakes, and then sharing that research with the many people and communities who care about and rely on them. It's fishers, boaters and beachgoers who are looking for recreation. It's brewers, dairy farmers and manufacturers who use the water to make products. It's the people in Green Bay, Milwaukee and Racine who turn on their taps to get a big drink of water that comes from Lake Michigan. It's the global ship captains who carry goods to and from adjoined ports in Superior, Wisconsin, and Duluth, Minnesota, together considered the largest freshwater port in the world. There are as many uses as there are challenges for lakes Superior and Michigan, which make up the state's northern and eastern borders — 1,000 miles of shoreline and supporting 105 Wisconsin cities, villages and towns.

Follow Wisconsin Sea Grant's vision: 50 years of thriving Great Lakes ecosystems and communities on a 50th anniversary timeline at go.wisc.edu/c3j445.

Enjoy photos from 50 years of research, education and outreach at go.wisc.edu/f1em68.

Be a part of Wisconsin Sea Grant's future by signing up for periodic email alerts at go.wisc.edu/oes771.j38.

GREAT LAKES SCIENCE FOR OUR FUTURE

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From the Director

As a water chemist, I employ analytical methods when working in the lab and field. Yet, I also consider anthropogenic factors. Both ways of thinking have been important when weighing the human aspects of an ongoing global pandemic, increasingly urgent signs of climate change and overdue conversations and actions surrounding racial and social justice and their effects on the work we do at Wisconsin Sea Grant.

“It’s a fitting time for this presentation of new initiatives because in 2022 we commemorate 50 years since our designation as a Sea Grant College Program.”

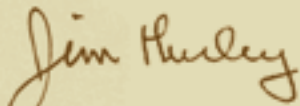
Being touched and affected by these agents of upheaval, just as you have been touched and affected, has fostered reflection. I’ve thought about changes that need to be made, while also taking the opportunity to relish the things about which I am proud. And, I’m proud that our 2022-24 call for research proposals brought in dozens of excellent ideas against this larger societal backdrop. So many proposals were fundable and, unfortunately, we didn’t have the dollars to stretch to bring them all into the fold.

With our call for research and education projects, we targeted fisheries, aquaculture, workforce development, resiliency, education and healthy ecosystems. We also put out a special call to address emerging contaminants and made an appeal for projects that strive to address justice, equity, diversity and inclusion for under-represented coastal communities. At the end of a long and rigorous review process, we ended up funding 15 new projects on five University of Wisconsin System campuses.

In addition to the research projects, we will carry out a robust work plan that embodies actionable science, bringing findings to places and people to serve Great Lakes and Wisconsin needs through outreach, communications and education. Details follow.

It's a fitting time for this presentation of new initiatives because in 2022 we commemorate 50 years since our designation as a Sea Grant College Program. These projects were built on the foundation of our past and are a beacon into the future of Great Lakes science.

Best regards,



Jim Hurley, director

Sea Grant is a partnership with public and private sectors combining research, education, outreach and technology transfer for public service.

Sea Grant is a national network of 34 university-based programs enhancing the practical use and conservation of coastal, ocean and Great Lakes resources to create a sustainable economy and environment.

Participating Institutions and Agencies 2022-24

University of Wisconsin Sea Grant Institute

Bowling Green State University

Brothertown Indian Nation

Center for Great Lakes Literacy

College of the Menominee Nation

Great Lakes Panel on Aquatic
Nuisance Species

Great Lakes Fishery Commission

Great Lakes Indian Fish and Wildlife
Commission

Gulf States Atlantic Regional Panel on
Aquatic Nuisance Species

Ho-Chunk Nation

Lake Superior National Estuarine
Research Reserve

Michigan Department of
Natural Resources

Michigan State University

Michigan Technological University

Mid-Atlantic Panel on Aquatic
Invasive Species

Milwaukee Metropolitan
Sewerage District

Minnesota Department of
Natural Resources

Minnesota's Lake Superior
Coastal Program

Mississippi River Basin Regional Panel on
Aquatic Nuisance Species

National Weather Service

Northeast Aquatic Nuisance Species Panel

Ohio Department of Natural Resources

The Ohio State University

Penn State

Purdue University

Sokaogon Chippewa Community, Mole
Lake Band of Lake Superior Chippewa

State University of New York College of
Environmental Science and Forestry

Ulster University

U.S. Department of Agriculture

U.S. Fish and Wildlife Service

U.S. Geological Survey

University of Chicago

University of Illinois

University of Michigan

University of Minnesota Duluth

University of Minnesota Twin Cities

Northland College
University of Vermont
University of Wisconsin-Green Bay
University of Wisconsin-Green Bay,
Manitowoc Campus
University of Wisconsin-Madison
University of Wisconsin-Milwaukee
University of Wisconsin-Stevens Point
University of Wisconsin-Superior
Western Regional Panel on Aquatic
Nuisance Species
Wisconsin Coastal Management Program

Wisconsin Department of Health Services
Wisconsin Department of
Natural Resources
Wisconsin Department of Public
Instruction
Wisconsin Department of Tourism
Wisconsin Department of Transportation
Wisconsin Historical Society
Wisconsin Shipwreck Coast National
Marine Sanctuary
Wisconsin State Cartographer's Office
Wisconsin Veterinary Diagnostic
Laboratory

Healthy Coastal Ecosystems

Wisconsin has more than 800 miles of shoreline adjoining the vast ecosystems of Lake Michigan and Lake Superior, including coastal, nearshore and deep-water environments. In Wisconsin, healthy coastal ecosystems, sustained by their surrounding watersheds, are the foundation of life along the coast.

Ecosystem health and associated ecosystem services¹ can directly and indirectly affect both human health and socioeconomics at both individual and community scales. Maintaining the health of coastal ecosystems is a challenge because of the diversity of stressors involved as well as the temporal and spatial scales at which systems can be affected. Responsible management of these systems requires a comprehensive way of thinking and acting, often termed ecosystem-based management.² Ecosystem-based approaches require coordination among federal, state and local jurisdictions and the active engagement of the people who live, work and play along the coasts. They also require understanding of the characteristics of species, landscapes and their interactions within each ecosystem.

In general, increasingly rapid coastal development, a changing climate, greater demands on fisheries resources and other human activities have led to water-quality degradation, increased demands on water supplies, changes to fisheries stocks, wetlands loss, proliferation of aquatic invasive species and a host of other environmental, health and socioeconomic impacts. It is essential for decision-makers and Great Lakes coastal residents to understand the interconnectedness and interactions of these systems in order to maintain vital habitats and inform restoration efforts within ecosystems and watersheds. Additionally, the impacts and loss of ecosystem services from degraded ecosystems are more likely to be felt by marginalized communities.

The legacy of striving for healthy coastal ecosystems is a strong one for Wisconsin Sea Grant. A keystone effort was two decades of comprehensive, multidisciplinary research

focused on Green Bay, Lake Michigan, making it one of the most rigorously studied estuarine systems of its size in the world. That baseline data has informed, for example, the U.S. Environmental Protection Agency's landmark national Green Bay PCB Mass Balance Study that for the first time developed an input-output model of all sources, movement and fates of a chemical contaminant in an aquatic system. That work was completed more than 20 years ago, and Wisconsin Sea Grant continues in a leadership role for the promotion of a healthy ecosystem within Green Bay and other Wisconsin Great Lakes sites. With this strategic plan, the map to continue those efforts is in place.

Likewise, Wisconsin Sea Grant recognizes the challenge of ensuring that ecosystems research is shared beyond the laboratory and makes its way to the settings where it can be used to inform decision-making. The program has committed to bridging the gap between the acquisition of new scientific knowledge, or the validation of a scientific concept or model, and the actions necessary to apply those facts. This practice of actionable science encourages the sharing and use of evidence-based tools and data to inform discussions, debate and decisions for the achievement of healthy coastal ecosystems.

- ¹ Ecosystem services include provisioning (food and water), regulating (flood and disease control), cultural (spiritual, recreational and cultural benefits) and supporting (nutrient cycling).
- ² Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans, and drives decisions at the ecosystem level to protect the resilience and ensure the health of the ocean, our coasts and the Great Lakes. It requires managing ecosystems as a whole instead of separately managing individual components or uses. This includes the application of technology to coastal resource management through synthesis, integration, training and the development of new management tools.

National and Wisconsin Sea Grant Goals

- Habitat, ecosystems and the services they provide are protected, enhanced and/or restored.
- Land, water and living resources are managed by applying sound science, tools and services to sustain ecosystems.

Anticipated Outcomes for Wisconsin and the Great Lakes Region

- Scientific understanding and technological solutions inform and improve conservation and the management of natural resources in Wisconsin and the Great Lakes basin.
- Ecosystem science and conservation priorities for Wisconsin are those that are developed through virtual or face-to-face stakeholder participation.
- Greater awareness and understanding of freshwater ecosystem functions and services they provide improve stewardship efforts among resource managers, communities and tribal nations.
- Declining biodiversity, habitats and ecosystem functions and services are restored and sustained in Wisconsin.
- Improved collaborative planning and decision-making lead to enhanced freshwater and Wisconsin coastal stewardship.
- Collaborations with state and regional partners and stakeholders support planning, research and technological solutions to address resource-management needs.

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- Community science initiatives are engaged and contribute to improving our knowledge with respect to coastal communities and ecosystems.
 - Wisconsin communities, including the underserved, have access to information and understand projected changes within coastal ecosystems and how changes will impact coastal ecosystems.
 - Wisconsin communities, including the underserved, can access case studies, training and tools to improve their ability to plan, prepare and adapt to future ecosystem conditions.

Wisconsin Sea Grant Strategies

- Support research and outreach that bridges natural sciences, social sciences and policy studies to support more holistic management and restoration of Green Bay and its watershed.
- Support research and outreach to understand the environmental and socioeconomic effects of current and emerging challenges on Great Lakes ecosystem and human health including, but not limited to, contaminants, aquatic invasive species, harmful algal blooms, bacterial outbreaks, physical processes, climate change and changes to biodiversity and ecosystem structure. Specifically, work that better understands and prioritizes invasion pathways into the Great Lakes.
- Support research and outreach to improve Great Lakes ecosystem health through innovations in measurement, predictive modeling and potential treatment or management approaches.

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- Develop tools and approaches for preserving and restoring Great Lakes ecosystems that can also be used for outreach to stakeholders.
 - Improve and enhance stakeholder access to and understanding of socioeconomic and environmental data, models and policy information in Wisconsin and the Great Lakes region that support ecosystem-based planning, decision-making and management approaches.
 - Support research and outreach to develop dynamic and interoperable information systems to support adaptive management of Great Lakes ecosystems.
 - Help residents, resource managers, businesses, industries and the agricultural sector understand the effects of human activities and environmental changes on coastal resources.
 - Help managers incorporate public input in natural resource decision-making processes. Specifically, gather information on how contaminants, aquatic invasive species, harmful algal blooms, bacterial outbreaks, physical processes, climate change and changes to biodiversity and ecosystem structure are impacting diverse and marginalized communities.
 - Work with organism in trade industries to identify non-invasive alternatives to commonly sought-after NR40-prohibited species.
 - Advance understanding of aquatic invasive species ecology, socioeconomic impacts and management approaches. Specifically:
 - Innovative aquatic invasive species prevention methods
 - Tools and approaches that optimize invasive species prevention methods

- Tools and approaches that better understand and can improve invasive species prevention actions by boaters in the absence of a watercraft inspector
- Promote and disseminate accessible outreach and education programs and events online to prevent the spread of COVID-19.

Projects

Mechanisms and Management of *E. coli* Accumulation in Beach Sand

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Over the years, Great Lakes coastal beaches have been found to have unacceptable levels of *Escherichia coli*, which is the indicator used in Wisconsin to demonstrate the presence of fecal pollution. However, *E. coli* is capable of long-term survival in the sand and persistent *E. coli* reservoirs have been found on beaches around the Great Lakes, meaning that *E. coli* levels may be elevated without a recent fecal pollution event. Previous work in this lab determined that nutrients (in addition to certain genetic variations) are the major modulator of how long *E. coli* will survive. In this project, the researchers will assess which nutrients are most limiting to *E. coli* and develop a “scorecard” for beach managers to determine the potential for their beach to maintain *E. coli* reservoirs. Importantly, this project serves as a training ground for students that integrates genomics, environmental microbiology, public health and resource management. [R/HCE-46](#)

Impact of Air-Water Interface Partitioning on Per- and Polyfluoroalkyl Substances' (PFAS) Fate in Surface Waters of the Great Lakes

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Per- and polyfluoroalkyl substances (PFAS) are chemicals used in multiple products, including fire-fighting foams. Many PFAS are toxic and resist degradation, and they are highly mobile in the environment. Their chemical properties, such as simultaneously repelling and attracting water, make predicting their behavior under environmental conditions challenging. Because they are surfactants, some PFAS can accumulate at the air-water interface. Higher concentrations of PFAS at the water surface compared to deeper water have been observed under laboratory conditions and in marine environments, but the process has not been studied under conditions relevant to tributaries of the Great Lakes. If PFAS do preferentially accumulate at the surface layer, in foams and in ice, it can complicate representative sample collection during water quality testing and may lead to elevated exposure to birds, aquatic mammals and humans. [R/HCE-47](#)

Stoichiometry Meets Genomics: Assessing Limiting Factors for Diverse CHABs and Their Associated Toxins

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Robert W. Sterner, University of Minnesota Duluth

George Bullerjahn, Bowling Green State University

Nutrients and climate warming are the main factors thought to be responsible for the increasing occurrence of cyanobacterial harmful algal blooms (CHABs) worldwide. CHABs occur in all five Great Lakes, despite the wide range of biogeochemical and temperature environments across these systems. To date, CHABs in the Great Lakes have been investigated lake-by-lake or even river-by-river, with studies in each location tuned to local perspectives and framed with different research questions. The wide geographic spread of CHABs in the Great Lakes has hindered synthetic, comparative work, making it difficult to generalize findings. This project brings together three cross-disciplinary

teams with deep experience in ecological stoichiometry, CHABs, toxins and genomics who will use a common experimental template to understand how patterns of nitrogen vs. phosphorus limitation vary across the Great Lakes and how those in turn are influenced by temperature. How separate forms of nitrogen affect bloom dynamics will also be investigated. The Minnesota and Ohio Sea Grant programs are also supporting this project. [R/HCE-49](#)

Outreach

Building Resilient Communities With Green Infrastructure (Noordyk) – Increasing frequency and severity of storms have led to flooding in many Wisconsin coastal communities. Green infrastructure can help alleviate flooding and foster additional benefits in water quality, habitat and public health. To overcome green infrastructure planning and implementation barriers, Sea Grant provides education, technical assistance and coordination so coastal communities can improve resilience. [A/AS-20.08](#)

Nature-Based Solutions for Increasing Flood Resilience in the East River Watershed, Green Bay (Noordyk) – The East River watershed suffers from water quality issues and recurring rural and urban flooding. Sea Grant and partners will support East River watershed flood resilience planning, focusing on natural, nature-based and green infrastructure flood mitigation solutions. [A/AS-20.08](#)

Wisconsin Clean Marina Program (Noordyk) – The maintenance, operation and storage of recreational vessels have the potential to release pollutants to lakes and rivers. The Wisconsin Clean Marina Program, administered by Sea Grant, promotes and celebrates voluntary adoption of measures to reduce pollution from marinas, boatyards and recreational boats. [A/AS-20.08](#)

Supporting First Nations Research, Outreach and Education in the Great Lakes

(Noordyk) – First Nations hold a strong connection to the Great Lakes and adjoining watersheds, yet they have historically been marginalized and underrepresented in coastal research, outreach and education. In collaboration with programs at UW-Green Bay, this effort seeks to increase awareness about and research in First Nations and ecosystems and provide support for Indigenous students pursuing Great Lakes environmental, social and economic career pathways. [A/AS-20.08](#)

PFAS Actionable Science (Dehnert) – Sea Grant connects with state agencies and other partners addressing PFAS in the Great Lakes ecosystem. It is building a network across the region that will identify research gaps, create collaborations across disciplines and conduct PFAS research. [A/AS-20.06](#)

Pesticide Impacts on Non-Target Organisms (Dehnert) – This project evaluates the impacts of pesticides on non-target organisms while working with lake associations, management agencies and other relevant partners to communicate the effects of aquatic pesticides in aquatic ecosystems. It will develop risk assessments for aquatic pesticide use and provide management agencies with science leading to tools that increase non-target organisms' protection. [A/AS-20.06](#)

Great Lakes Emerging Contaminants Outreach (Dehnert) – There is a need for material that describes the emerging contaminants affecting the Great Lakes and illustrates their environmental and social factors, and Sea Grant will meet that need. [A/AS-20.06](#)

Build Aquatic Toxicology Network (Dehnert) – This project will create an aquatic toxicology network between Sea Grant and Wisconsin, Great Lakes regional and national

toxicology networks, while mentoring students where toxicology and aquatic ecology intersect. This network will provide opportunities to underrepresented students and help develop the next generation of scientists. [A/AS-20.06](#)

Promoting Nearshore Coastal Habitat (Seilheimer) – In the face of ever-changing coastal dynamics, shoreline protection has increased in response to above-average water levels. Working with local, state and university partners, new green solutions that protect coastal resources while also improving habitat have been developed in southeastern Wisconsin. Designs focus on the Kenosha Dunes State Natural Area and four degraded beaches. Results from harbor habitat mapping in four Lake Michigan ports will inform greater aquatic resources use and future restoration projects. [A/AS-20.09](#)

Aquatic Invasive Species Prevention in Southeastern Wisconsin (McComb) – In cooperation with the Wisconsin Department of Natural Resources, Sea Grant coordinates aquatic invasive species (AIS) prevention activities on lakes and streams in Milwaukee, Racine and Kenosha counties. Activities focus on preventing and reducing the spread of AIS by engaging communities, lake organizations and individuals in education, watercraft inspections and lake monitoring programs. [A/AS-20.01](#)

Wisconsin Aquatic Invasive Species Partnership Coordination (Campbell) – This partnership consists of approximately 50 aquatic invasive species professionals across the state who consistently and collaboratively implement programming at the local, regional and state level. Sea Grant helps coordinate this network, provides professional development and investigates information gaps. [A/AS-20.01](#)

Great Lakes Sea Grant Network Organisms in Trade (OIT) Coordination (Campbell) – OIT invasion pathways cover a large set of activities that involve the buying and selling of plants and animals, and their potential release or escape. Invasion risk can be reduced

by preventing nonnative species from entering the marketplace and providing alternatives to pet and plant release. Addressing these pathways involves coordination between businesses, regulators, natural resource managers and researchers. Sea Grant and partners are meeting coordination and research needs to address OIT pathways. [A/AS-20.01](#)

Closing Aquatic Invasive Species Pathways (Campbell) – Aquatic invasive species can enter an environment through a wide variety of pathways. Many pathways have been addressed but others remain. Some are subsets of previously addressed pathways, such as segments of recreational boating that include waterfowl hunters or wakeboard boats, while others are rarely exercised but risky, such as Buddhist animal release. This project will identify and address all pathways. [A/AS-20.01](#)

Refining Aquatic Invasive Species Communication Techniques (Campbell) – With new invasions there will be gaps in Wisconsin’s aquatic invasive species prevention efforts. Different approaches are needed to reach new stakeholders with prevention messages, and little work is being done currently to determine what techniques are effective. Sea Grant will contribute to this efficacy assessment and train invasive species professionals to communicate effectively. [A/AS-20.01](#)

Regional and National Aquatic Invasive Species Coordination (Campbell) – The national Aquatic Nuisance Species Task Force strives to coordinate activities to prevent and control nonindigenous species within the United States. Six regional panels have been authorized by the task force to plan for, research, control and prevent aquatic nonindigenous species. These include panels for the Great Lakes and Mississippi River basins. Sea Grant plays a role on this task force by leveraging university resources to address these regional and national issues. [A/AS-20.01](#)

Plastic Free MKE: Assessment and Education to Support Lake Friendly Schools (Peroff) – Single-use plastics are a critical threat to Great Lakes water quality, human health, and fish and wildlife. Working with K-12 students in Milwaukee, this project will educate and facilitate civic engagement among Milwaukee’s youth on marine debris and plastic pollution and development of a waste audit and outreach materials. [A/AS-20.10](#)

Harvesting Manoomin as a Climate Adaptation and Resilience Strategy (Peroff) – Manoomin (wild rice) is an ecological and cultural keystone species found across the western Great Lakes, important for the health and well-being of people and wildlife; however, it is threatened by human-induced factors such as climate change. This project integrates Western science-based natural resource approaches with Traditional Ecological Knowledge and management to address manoomin adaptation needs by raising public awareness, respect and responsibility around harvesting. [A/AS-20.10](#)

Sustainable Fisheries and Aquaculture

The nation has witnessed the decline of many of its major fisheries while seafood consumption has increased and continues to be encouraged because of health benefits. To address the disparity between seafood demand and domestic harvests, the U.S. imports 90% of what is consumed, leading to a seafood trade deficit of more than \$16 billion per year. With global wild fisheries harvests at a plateau of around 185 million tons, further increases in seafood production will have to come from aquaculture. Currently, more than 50% of seafood consumed globally is now produced from aquaculture. Since 2013, global seafood production has surpassed global beef production. Although there are no projected increases in wild-capture fisheries, global aquaculture is predicted to increase by 33% over the next decade. These projections create opportunities for an expanded Great Lakes basin aquaculture industry and for innovative marketing strategies for the wild fisheries industry.

The overall economic impact of the commercial, recreational and for-hire fisheries and aquaculture industries in the Great Lakes region is \$7 billion annually. In Wisconsin, 1.4 million fishing licenses are issued each year, and anglers and the fishing industry deliver \$2.75 billion in economic impact and 30,000 jobs annually. There are 70 commercial fishers in Wisconsin who rely on fewer than 10 species and have a combined harvest of \$5 million annually.

Wisconsin's aquaculture industry contributes \$21 million in annual economic activity and more than 400 jobs to the state. There is definitely room for growth in food fish aquaculture — additional opportunities exist for job creation and meeting the demand for finfish. The Midwest consumes more than 1 billion pounds of seafood products per year but less than 4% comes from aquaculture operations in the region. There is also room for growth in diversifying the aquaculture industry. Currently, women and minorities make up a small portion of aquaculture professionals.

Wisconsin Sea Grant continues to play a leadership role in developing innovative technologies for all sectors of the seafood industry. In particular, the program has fostered the growth of periurban and urban aquaculture through research and outreach in the region's metropolitan areas. It has also capitalized on educating consumers interested in the buy-local movement. Wisconsin Sea Grant's partnership with NOAA, state and tribal fisheries managers, seafood processors, fishing associations, the aquaculture industry and consumer groups will ensure safe, secure and sustainable supplies of domestic seafood, decreasing a reliance on seafood imports now and into the future.

National and Wisconsin Sea Grant Goals

- Fisheries, aquaculture and other coastal and freshwater natural resources supply food, jobs and economic and cultural benefits.
- Natural resources are sustained to support fishing communities and industries, including commercial, recreational and subsistence fisheries and aquaculture.
- Diversity and inclusion in the aquaculture field is enhanced by seeking and welcoming diverse perspectives to enable the network to pursue its vision and mission effectively and efficiently.

Anticipated Outcomes for Wisconsin and the Great Lakes Region

- Increased understanding and technological solutions aid Wisconsin aquaculture management and production.
- Partnerships enable the Wisconsin aquaculture industry to adapt and acquire innovative technologies.

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- Freshwater resource industries employ technologies and reinforce strategies to ensure safe and sustainable Great Lakes fisheries and products.
 - Consumers understand the health benefits of Great Lakes fish and purchase safe and sustainable products.
 - Freshwater resource industries employ strategies that balance economic, community and conservation goals.
 - Commercial and recreational fishers and aquaculturists in Wisconsin are knowledgeable about efficient, sustainable and responsible tools, techniques and uses of coastal and freshwater resources.
 - Innovative solutions that increase understanding of climate impacts on state and regional fisheries and aquaculture are available and accessible to resource managers and fishing and aquaculture communities.
 - Resource managers and fishing and aquaculture communities have access to science and tools to increase Wisconsin-based capacity to adapt to future resource-management needs.

Wisconsin Sea Grant Strategies

- Support research and outreach to better understand our Great Lakes fisheries, including status and trends, measurement and modeling techniques, future scenarios, and socioeconomic costs and benefits under different management approaches and environmental conditions.
- Support research and outreach to advance an environmentally sustainable and robust recreational, commercial and subsistence Great Lakes fishery.

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- Better understand threats to Great Lakes fisheries, including, but not limited to, nutrient enrichment, invasive species, food web changes, genetics and climate change as well as effective responses.
 - Support research to improve understanding of the impacts of food web change, climate, and other stressors on early life history of valuable sport and commercial species and develop management actions to mitigate impacts.
 - Identify and better understand the barriers to expansion of the aquaculture industry in Wisconsin and implement innovative partnerships to address scientific, business, economic, policy and legal challenges.
 - Identify and better understand the barriers to women and Black, Indigenous and people of color in joining the aquaculture profession.
 - Collaborate in identifying Great Lakes regional aquaculture opportunities and best-management practices along with sustainable production systems such as recirculating aquaculture systems (RAS).
 - Support research that leads to a better understanding of the benefits and risks of consuming Wisconsin-produced fish as well as how aquaculture can address food safety and security issues during times of national and global health and food supply chain concerns.
 - Support research and outreach that encourages the application of behavioral and consumer sciences toward consumer perception and preferences, food safety, labeling and certifications, seafood demand studies and promotion of local seafood.
 - Support research to develop and improve economically viable and environmentally sustainable aquaponic operations.

- Support research to develop and improve commercially viable and environmentally sustainable aquaculture practices and techniques, including nutritional value of feeds, broodstock selection, water supply and quality, husbandry, and disease and pathogen prevention and diagnosis.
- Support the development of environmental and economically sustainable aquaculture through workforce development and trainings, K-12 education and technical assistance, including in underserved communities.
- Support development of peri-urban and urban aquaculture in new markets and provide knowledge resources to existing operations.
- Investigate emerging species and new technologies suitable for aquaculture in Wisconsin.
- Promote and disseminate accessible outreach and education programs and events online to prevent the spread of COVID-19.

Projects

Wisconsin's Fish Viruses: Normal Microbes or Emerging Threats?

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Eric Leis, U.S. Fish and Wildlife Service, La Crosse Fish Health Center

Viruses of fish are emerging in Wisconsin and around the world, but their consequences for fisheries management remain unclear. This project will identify fish viruses across Wisconsin and make data on their locations and biology fully accessible to stakeholders. The researchers have already collected thousands of samples from every region of the state from four culturally and economically important species – bluegill, brown trout,

northern pike and walleye — and will be adding lake sturgeon. A second component of the project will be an educational program called “Fish Get Sick Too!” to highlight the connections between healthy aquatic ecosystems and healthy people. Together, these activities will generate new data and tools to address for fisheries management, while highlighting the fundamental relationships among aquatic ecosystem health, human health and emerging infectious diseases. [R/SFA-24](#)

Development of Practical Feed for Walleye Aquaculture

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Michael Preul, Mole Lake Sokaogon Chippewa Community

Walleye (*Sander vitreus*) is important in Wisconsin ecosystems and as a food fish. Given strong consumer demand, fast growth rate, high fillet value and limited commercial harvest of wild walleye, there is a strong impetus for the development of walleye aquaculture and enhancement of wild fisheries. Feed is one of the constraints for developing walleye aquaculture. The challenge for feed optimization is to meet the nutrient requirements of a species while decreasing costs and environmental impacts from feed components. This project will apply novel formulation strategies to optimize the combination of macronutrients in feeds for walleye. Complementary efforts will be also undertaken to evaluate the new feed in fish hatcheries by comparing it to the feed currently used. While this project will focus on developing improved diets for walleye aquaculture, the resulting technologies and products will also benefit hatcheries that produce fingerlings for recreational stocking programs. [R/SFA-25](#)

Expansion and Diversification of Great Lakes Region Aquaculture Through Increased Production of Value-Added Products

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Value-added aquaculture products include those processed for increased convenience, shelf life or flavor (such as seasoned fish fillets) and those composed of recovered by-products (such as fertilizer or pet food). This area is ripe for expansion, as the entire U.S. market for value-added food products is worth more than \$300 billion, and the market for all fish and seafood is only \$35 billion. Expanding value-added products from aquaculture will increase the economic viability of the Great Lakes' production system by allowing goods to be transported further, while also transforming current waste products into marketable goods, which is beneficial both environmentally and economically. Researchers will survey consumers regarding their willingness to pay for value-added aquaculture products in the Great Lakes region, and they will also interview aquaculture producers to determine their motivations for producing these products, evaluate the potential for market expansion and identify barriers. [R/SFA-26](#)

Outreach

Aquaculture Outreach and Education: Continuous Activities (Hauser) – Sea Grant funding supports an aquaculture outreach and education position in collaboration with the University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility. The state-of-the-art facility has raised more than 15 different cold- and cool-water fish species at various life stages and in various aquaculture systems. The systems and species

are a part of applied research and demonstration projects that transfer directly to the industry to support sustainable aquaculture. Outreach and education components of these projects include interactive tours and demonstrations, web content, articles, reports and other publications, presentations and videos. [A/AS-20.12](#)

Aquaculture Education: K-12 and Beyond (Hauser) – Sea Grant funding supports an aquaculture outreach and education position in collaboration with the University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility. The initiative offers all-ages workforce development and exposure to sustainable aquaculture, reaching thousands of students and educators annually through interactive facility tours and workshops, classroom visits, public educational events and more. UW-Stevens Point was the first university in Wisconsin to offer an aquaculture minor and the first in the nation to offer full-semester aquaponic courses and a professional aquaponics certificate. This initiative also assists in training interns and technicians to foster workforce development in aquaculture, leading to nearly 100% job placement. [A/AS-20.12](#)

Aquaculture Technical Bulletins (Binkowski) – With the growing interest in recirculating aquaculture system technology and its application to commercial and educational activities, Sea Grant will produce technical bulletins that will serve as a guide for the necessary biological, physical and chemical production parameters for these systems. This information will support outreach efforts resulting in the development and transfer of solutions to aquaculture problems of high local, state, regional and national priority. [A/AS-20.11](#)

Great Lakes and Food Web Ecosystem Ecology (Seilheimer) – The Great Lakes waters of Wisconsin support jobs and the economy through the harvest of fish by commercial, charter and recreational fishers. The food webs supporting these fisheries are dynamic

systems influenced by invasive species, watershed activities and resource management. This effort will support outreach, education and research in Wisconsin's Great Lakes ecosystems. [A/AS-20.09](#)

Commercial Fishing Industry Support (Seilheimer) – Wisconsin's commercial fisheries provide jobs, economic resources and food. This work will attempt to reduce conflicts between commercial fishers and anglers, increase efficiency of fishing methods and strive to understand better the dynamics of fisheries bycatch. [A/AS-20.09](#)

Great Lakes Aquaculture Collaborative (Seilheimer and Hauser) – The Great Lakes Aquaculture Collaborative is a NOAA Sea Grant-funded hub that includes all the Great Lakes Sea Grant Network programs and raises Midwestern aquaculture's profile across the nation. Wisconsin Sea Grant has developed a state advisory group for the project, which provides feedback on activities from the industry perspective. The work also involves conference planning and execution and virtual farm tours. [A/AS-20.09](#), [A/AS-20.12](#)

Collaborating With Third-Party Seafood Ratings and Ranking Organizations to Affect Policy (Moen) – Dated information and complicated access to new information has prompted third-party seafood rating and ranking organizations to levy poor sustainability scores on some Great Lakes fisheries. This can damage international sale of specific Great Lakes wild-caught fish and threaten the livelihoods of Wisconsin commercial fishers and fish processors. Sea Grant is working with natural resource agencies and seafood sustainability rating and ranking organizations to exchange information so that government officials, non-profit organizations and buyers for international markets can understand how Great Lakes fisheries are some of the world's most sustainably managed stocks. [A/AS-20.01](#)

Advancing the Eat Wisconsin Fish Initiative (Moen) – The initiative provides consumers, grocers, chefs and others with fact-based information about food fish that are commercially harvested or farmed in the state. The effort also facilitates the success of commercial fishers and fish farmers by offering consultations and technical support to address industry challenges and forge a sustainable future. Eat Wisconsin Fish uses the eatwisconsinfish.org website, social media, mass media, public events and conversations with state and tribal food fish producers, lawmakers and others to improve food security, environmental health and the well-being of the people of Wisconsin. [A/AS-20.01](#)

Connecting Consumers With Fish Through Maps (Moen) – Sea Grant works with partners in the Great Lakes basin to maintain, enhance and publicize tools that connect consumers to Great Lakes regional fish and fish producers. In addition to Eat Wisconsin Fish map and story map activities, the program collects, collates and provides data and other information to support websites, maps and apps associated with the Great Lakes [Fresh Fish Finder](#) and [Eat Midwest Fish](#) [A/AS-20.01](#)

Resilient Communities and Economies

Coastal communities provide crucial economic, subsistence, social and recreational opportunities for millions of people within the Great Lakes basin. A 2020 study completed by the University of Michigan reported that more than 1.3 million jobs, generating \$82 billion in wages are tied to the inland seas. The job breakdown is 823,735 in manufacturing; 240,864 in tourism; 153,060 in transportation; 133,352 in agriculture, fishing and food production; 26,326 in science and engineering; 10,803 in utilities; and 5,416 in mining. In Wisconsin, 173,969 jobs can be linked to the Great Lakes. To accommodate more people and activity while balancing demands on coastal resources, Wisconsin must develop innovative policies, institutional capacities and management approaches to increase community resilience.

Wisconsin Sea Grant will continue to support cutting-edge research in the areas of marine-related energy sources, climate change, coastal processes, energy efficiency, preparedness, hazards mitigation, stormwater management and tourism. In Wisconsin, Sea Grant will engage diverse and shifting coastal populations, including underserved communities, in applying the best-available scientific knowledge to address increased resource demands and vulnerability. It is essential to recognize the barriers that prevent marginalized communities from accessing Great Lakes coastal ecosystems and work towards equitable coastal decision-making. Ultimately, Wisconsin Sea Grant will bring its unique research and engagement capabilities to support the development of resilient coastal communities — both human and natural — that sustain diverse and vibrant economies, effectively respond to and mitigate natural and technological hazards and function within the limits of their ecosystems.

National and Wisconsin Sea Grant Goals

- Coastal communities, including the underserved, use their knowledge of changing conditions and risks to become resilient to extreme events, economic disruptions and other threats to community well-being.
- Water resources are sustained and protected to meet existing and emerging needs of all the diverse communities, economies and ecosystems that depend on them.

Anticipated Outcomes for Wisconsin and the Great Lakes Region

- Awareness and understanding of changing conditions and hazards and the implications to their communities and are prepared to respond and adapt.
- Existing and innovative training programs improve community leaders' understanding of changing conditions in their Wisconsin communities and implement adaptive strategies.
- Access to information needed to understand the factors impacting ecosystems and participate in adaptive management planning.
- Employment of adaptive management strategies and apply tools to engage diverse members of the community to improve resilience and community sustainability.
- Access to information needed to understand how Wisconsin coastal economic activities and trends will impact environmental and community well-being.
- Access to tools, services and technologies to adapt and grow resilient Wisconsin economies.

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- Increased understanding by coastal economic sector leaders that greater resiliency can be realized through diversification and through conservation of ecosystem services.
 - Understanding watershed functions and the services those watersheds provide to support communities and economies.
 - Understanding how actions will impact water quantity and quality and are able to make informed decisions.
 - Access to sound science, data, tools and services to understand and anticipate changes in water quantity and quality.
 - Diverse, sustainable economies and industries that support existing and emerging water resource needs.
 - Access to science, tools and technologies to protect and sustain water resources and make informed decisions.

Wisconsin Sea Grant Strategies

- Support research and outreach that will lead to a better understanding of how the sediment supply from coastal bluffs influences beach and nearshore sediment transport in order to guide sound shore protection and bluff stabilization choices and build more resilient coastal communities and economies.
- Support research and outreach to promote the development and implementation of green infrastructure practices.
- Develop and apply innovative geodesign methods to promote resilient coastal communities and understand the consequences of alternative development scenarios.

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- Work with management and regulatory agencies, tribal nations and vulnerable and at-risk communities to reduce vulnerability to fluctuating water levels, storm impacts and a changing climate.
 - Support research and outreach to understand the value of and opportunities for subsistence, tourism, and commercial and recreation-related activities in coastal communities.
 - Build collaborative and diverse networks to promote sustainable tourism and outdoor recreation.
 - Support research and outreach that documents and preserves cultural and historical resources in coastal and marine areas, including those within or adjacent to the proposed marine sanctuary.
 - Support research and outreach to develop or enhance community planning and visualization tools that demonstrate the benefits, risks and impacts of land use on the coastal environment.
 - Support research that evaluates the impacts of increased climate variability and change on coastal communities.
 - Support research and outreach to assess and share the impacts of human activities on Great Lakes water quality and supply, as well as coastal and nearshore habitats.
 - Support environmental and socioeconomic research to protect the supply and quality of fresh water.
 - Support research to document the socioeconomic contributions of water-dependent industries.

- Promote research and outreach for sustainable and resilient ports, harbors and marinas, including beneficial use of dredged materials and science-based decision-making related to the timing of dredging to minimize impacts on critical fish spawning habitat.
- Support research and outreach on nature-based shore protection along Great Lakes coasts, including suitability, performance, habitat benefits, and design guidance for the various practices that are applicable to the Great Lakes.
- Promote and disseminate accessible outreach and education programs and events online to prevent the spread of COVID-19.

Projects

Bluffs, Beaches and Bars: Modelling the Hydrodynamics of Shoreline Erosion and Sand Transport in Southwestern Lake Michigan

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Lake Michigan's water level was recently near an all-time high, leading to widespread erosion of coastal bluffs and beaches. These coastal environments are integral parts of nearby communities and estimating how shorelines will evolve in response to changing lake conditions is vital for sustainable community planning. The terrestrial sediment input from eroding beaches and especially bluffs, balanced against nearshore transport processes, determines the stability of a coastal region. Estimating the rates of these processes requires obtaining in situ measurements, which is challenging but essential for developing effective shoreline protection strategies. To address this shortcoming, researchers will collect repeat topobathy and nearshore wave data to create a

hydrodynamic model that can couple offshore sediment transport with onshore erosion. These model results will be used to develop simple wave run-up / bluff erosion estimates that can be applied throughout the region. [R/RCE-19](#)

Double Duty: A Comparative Analysis of Great Lakes Double Centerboard Schooners

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Double centerboard schooners were a unique vessel type used on the Great Lakes in the mid-19th century. While single centerboards were common, double centerboards were rare, and little is known about why two centerboards were ever used in ship construction. Six double centerboard schooners remain in Wisconsin waters. Initial preliminary investigations of Boaz (1869-1900) and an unidentified wreck known as the Anclam Pier wreck, both located in northern Door County, were conducted by the Wisconsin Historical Society in the early 1990s, but data gathered are incomplete. Reevaluating these sites along with the other known four double centerboard schooners in the state will provide a unique opportunity to synthesize data through a comparative analysis and provide a historic context that will be used to interpret and develop preservation plans. This project will also allow continued collaboration with educators at maritime museums and historical societies throughout Wisconsin and the Great Lakes region. [E/RCE-01](#)

Wisconsin InterTribal Lake Winnebago Connectivity Project

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Seth Elsen, Brothertown Indian Nation

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Skip Blanc, Brothertown Indian Nation

Guided by existing data and Traditional Ecological Knowledge about Lake Winnebago, the project team will work together with tribal and non-tribal interests to formulate and implement water quality and wild rice habitat assessment plans for fieldwork beginning in spring of 2022. Researchers will work together with agencies, tribal natural resource professionals and graduate students to implement data collection and habitat assessment. Interns from participating tribes will have opportunities to participate in hands-on culturally guided fieldwork in the summers of 2022 and 2023. Based on this work, researchers will assess habitats for wild rice suitability and implement restoration. Researchers will make recommendations to Native Nations, Lake Winnebago community members, and state and federal agencies and leadership for future work that incorporates tribal perspectives in water stewardship, conservation and policymaking. [R/RCE-18](#)

Initial Estimation of PFAS Flux to Lake Michigan Through the Quantitative Understanding of PFAS Contamination Within Wisconsin's Connected Aquifers

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David J. Hart, UW-Madison and Wisconsin Geological and Natural History Survey

Yin Wang, UW-Milwaukee

Per- and polyfluoroalkyl substances (PFAS) have been mass-produced and widely used since the 1950s, and their occurrence and behavior within the Great Lakes ecosystem have raised serious health concerns. PFAS released into the environment usually seep into the shallow groundwater aquifers and enter surface water bodies such as Lake

Michigan either directly or through rivers and streams. Currently, there is a lack of quantitative understanding of both the movement of PFAS through groundwater and the export of PFAS from groundwater to Lake Michigan. Researchers will use the Wisconsin Geological and Natural History Survey's sediment repository, coupled with groundwater sampling, to develop a method to survey the spatial and temporal distribution of PFAS within Wisconsin groundwater aquifers that discharge, either directly or indirectly, to Lake Michigan. This research will provide estimates of PFAS contamination within groundwater aquifers in Wisconsin's Lake Michigan drainage basin, and subsequently the historical PFAS export to Lake Michigan. [R/RCE-20](#)

Nimaawanji'idimin Giiwitaashkodeng: We Are All Gathering Around the Fire

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Exclusion of Indigenous values, perspectives and participation in the management of coastal pine communities in the Great Lakes has reduced their resiliency and biodiversity, with direct impacts on the Anishinaabeg communities intrinsically connected to these landscapes. Combining Native Experiential Knowledge (NEK; also known as Traditional Ecological Knowledge), tree-ring data describing the dates of past fires and creation of culturally modified trees, and historical accounts, researchers will reconsider the role of fire as both an ecological and cultural process at *Zhaagawaamikong-neyaashi*, the places also known as Wisconsin and Minnesota points. The project will include extensive community outreach and engagement, and provide research experience to at least two undergraduate students. Specific outcomes will include an NEK compendium and tree-ring-based fire history for *Zhaagawaamikong-neyaashi*, a memorandum of understanding

to help motivate and guide restoration of cultural fire that is linked to these socio-ecological systems, and a dual-language (Anishinaabemowin and English) illustrated children's book. [R/RCE-17](#)

Quantification of the Kinetics of Nano- and Microplastic Release From Floating Plastics in the Great Lakes Using Membrane Coupled Surface-Enhanced Raman Spectroscopy

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Nano- and microplastics (NMPs) are ubiquitous in aquatic systems and have been detected in all of the Great Lakes. Although NMPs in marine environments have been extensively studied, NMPs in freshwater environments have not. Previous studies of NMP pollution in the Great Lakes have focused on relatively large microplastics (>100 μm). Compared with the larger particles, the smaller NMPs (<10 μm) are presumably more easily ingested by living organisms and more likely to adsorb toxic organic pollutants. However, NMPs with sizes smaller than <10 μm cannot be detected using the current analytical methods adopted in previous Great Lake studies. This research will develop an inexpensive rapid analytical method to quantify NMPs at a size range of 0.01–10 μm by leveraging membrane technology and plasmonics. This method will be used to quantify the kinetics of NMP release from floating plastics in simulated and real lake waters under environmentally relevant conditions. [R/RCE-48](#)

Outreach

Coastal Engineering Outreach, Grant Proposal Review and Permit Assistance

(Bechle) – Great Lakes shoreline and coastal regions, some fragile, are impacted by water level fluctuations, waves, erosion, flooding, storm events and development pressures. Sea

Grant and state and federal governmental partners will meet critical needs of property owners, resource managers, lenders, insurers, engineers, realtors and local, statewide and regional agencies with natural coastal hazard awareness, permit review assistance, grant proposal reviews, coastal engineering guidance, education opportunities and shoreline management tools. In particular, the “Coastal Resilience Self-Assessment” tool can help local governments consider planning and mitigation opportunities. For private landowners, the “Property Owner’s Guide to Protecting Your Bluff,” go.wisc.edu/1envs7, describes signs of bluff stability issues and actions to address them. [A/AS-20.5](#)

Nature-Based Shoreline Protection Outreach (Bechle) – Nature-based shorelines use or mimic natural features to stabilize the coast. These natural features can include vegetation, beaches, dunes and reefs. Nature-based shoreline approaches are softer or “greener” compared to conventional hard armoring with stone, concrete and steel. In many cases, nature-based shorelines use a hybrid of natural and hard features to protect the coast from erosion or flooding. This work will continue efforts that partner with stakeholders, learn from successful demonstration projects, identify locations suitable for nature-based shorelines and provide outreach. The publication, “Nature-Based Shorelines for Wisconsin’s Great Lakes Coasts,” go.wisc.edu/6char, summarizes the current status of natural shoreline protection practices. [A/AS-20.05](#)

Support Coastal Resilience Networks (Bechle, Noordyk, Chin and Hart) – A number of regional coastal resilience networks have been developed to help counties, municipalities and state agencies learn from each other and share approaches to addressing coastal hazards. These networks include Coastal Hazards of Superior, Collaborative Actions for Lake Michigan Coastal Resilience and the Southeastern Wisconsin Coastal Resilience Community of Practice. Sea Grant will continue serving in leadership roles, facilitating activities and providing technical support to these networks. [A/AS-20.05](#), [A/AS-20.08](#), [A/AS-20.07](#), [A/AS-20.02](#)

Sustainability and Resiliency for Coastal Tourism Businesses (Chin) – Building sustainability and resiliency into business practices can be challenging for the average tourism operation. Sea Grant is working with partners to compile existing resources related to climate resiliency and business sustainability and engage with local stakeholders to improve knowledge of and access to these resources. The outcomes of this work will be used to identify gaps in existing resources and future research project opportunities to develop end-user focused tools. [A/AS-20.07](#)

Local Data for Tourism Stakeholders in Coastal Communities (Chin) – There is a lack of locally focused data on tourism and outdoor recreation for coastal communities in Wisconsin. Sea Grant will work with partners to improve knowledge and availability of community-specific data on tourism and outdoor recreation activities related to Great Lakes resources and activities. [A/AS-20.07](#)

Accessibility in Coastal Spaces (Chin) – Sea Grant will work with partners to increase the accessibility of coastal spaces by evaluating water safety information needs in the Apostle Islands National Lakeshore and inventorying current accessibility features at public access points around the state. The outcomes of this work will be used to identify gaps in existing resources and future research project opportunities. [A/AS-20.07](#)

Climate Change Impacts on Tourism and Outdoor Recreation (Chin) – With the release of the 2021 Wisconsin Initiative on Climate Change Impacts (WICCI) report, Sea Grant will continue to co-coordinate WICCI's Tourism and Outdoor Recreation Working Group and explore current and emerging information needs around climate change for key tourism and outdoor recreation audiences. [A/AS-20.07](#)

Climate Change Impacts on Lake Superior (Chin) – With the renewed work of WICCI, Sea Grant will engage in efforts to understand how climate change might impact Lake Superior and its surrounding communities. The findings of this work will be used to understand community needs and engage in forward-looking planning around climate resiliency in northern Wisconsin. [A/AS-20.07](#)

Flood Resilience in Wisconsin (Chin) – Recent data show that Wisconsin experienced its wettest decade on record from 2011-21. Sea Grant will continue to work with partners to improve the flood resilience scorecard and provide technical assistance to local communities across the state. [A/AS-20.07](#)

Beach Ambassador Program for Great Lakes Water Safety (Peroff) – Issues of water safety on Milwaukee’s beaches have been exacerbated by the COVID-19 pandemic and the effect of climate change on Lake Michigan, particularly affected are communities of color. The Beach Ambassador Program, organized by Sea Grant and several Milwaukee-based partners, effectively communicates Lake Michigan beach conditions and increases awareness and knowledge among the general public to prevent further drownings. [A/AS-20.10](#)

Wisconsin Coastal Atlas (Hart) – The Wisconsin Coastal Atlas is a gateway to interactive maps, geospatial data, decision support tools and learning resources useful for Great Lakes resource managers, planners, researchers, educators, tourists, citizen scientists and coastal residents. It is a component of a coastal spatial data infrastructure for the region. Sea Grant will conduct a competitive analysis and user survey of 10 U.S. state coastal web atlases to enhance the atlas to better support adaptive coastal management. [A/AS-20.02](#)

Wisconsin Coastal Guide (Hart) – This interactive web-mapping site — [wisconsin coastal guide.org](http://wisconsincoastalguide.org) — promotes coastal heritage tourism along Great Lakes Circle Tour routes, encouraging eco-tourism and demonstrating the Wisconsin Great Lakes coasts are a resource worthy of stewardship. Sea Grant and its partner will enhance the inventory of coastal access sites, use photography to attract new visitors to the coast, develop maps of coastal access sites using state-of-the-art cartographic design and work with a publisher to produce a book featuring Wisconsin’s coastal public access. [A/AS-20.02](#)

Geodesign to Guide Green Infrastructure for Urban Stormwater Management (Hart) – Green infrastructure practices hold promise for reducing urban flooding and improving water quality. Sea Grant will develop and apply an ArcGIS GeoPlanner template to provide visualization of and support green infrastructure planning for urban stormwater management under different scenarios. ArcGIS GeoPlanner is a geodesign tool developed by Esri, the industry leader in geographic information systems. [A/AS-20.02](#)

Coastal Resilience Planning Tools (Hart) – Increasing variability of Great Lakes water levels and increasing frequency and severity of rain and storms can result in damage to coastal buildings and infrastructure. Communities plan for future development and the plans often conflict with one another when siting development and mitigating natural hazards. Sea Grant will develop interactive web maps to visualize coastal processes; inventory and analyze community plans; and apply vulnerability assessment, plan integration scorecard and collaborative scenario planning methods. [A/AS-20.02](#)

Environmental Literacy and Workforce Development

An environmentally literate person is someone who has a fundamental understanding of the systems of the natural world, the relationships and interactions between the living and non-living environment and the ability to understand and use scientific evidence to make informed decisions regarding environmental issues. Moreover, a Great Lakes-literate person understands the essential principles and fundamental concepts about the characteristics, functioning and value of the Great Lakes; can communicate accurately about the Great Lakes influence on systems and people in and beyond their watershed; and is able to make informed and responsible decisions regarding Great Lakes and watershed resources. Wisconsin Sea Grant advances these literacy principles (as described within the Great Lakes Literacy Principles document — see cgll.org/foreducators/great-lakes-literacy-principles/) in formal and informal learning environments throughout the state to produce a diverse and skilled workforce that is engaged and able to address critical Great Lakes needs.

Geographically, Wisconsin is situated in the nation's heartland with its shifting economy — from traditional manufacturing sectors to a diversified economy — opening doors to new career fields. Technology and jobs resulting from the freshwater resources of the state provide a solid platform for potential economic and personal professional growth whether in blue-collar or white-collar professions.

Wisconsin's education and workforce development efforts build on the rich educational tradition in the state — historically strong high-school graduation rates and top-ranked K-12 schools, as well as a vibrant network of higher learning and vocational-technical institutions serving communities from across the state. However, it is essential to also acknowledge educational opportunities do not reach all marginalized groups in

Wisconsin and that educational disparities exist. Wisconsin Sea Grant recognizes it cannot independently solve the issue of inequity in education so the goal is to infuse work with multicultural perspectives and approaches.

Standardized test results are one tool to measure knowledge. Wisconsin leads the nation with the widest academic disparities between Black and white students when measured by standardized test results. It is important to recognize that standardized test results are not the sole or the predominant mechanism for assessing environmental literacy. Furthermore, the notion of academic disparities is problematic in that it presumes one type of knowing — knowledge of abstract items, from words to equations, which typically form the basis of standardized tests — is more important than other forms of knowing. Wisconsin Sea Grant, continues to reflect on mechanisms to incorporate diverse cultural heritages, traditional ecological knowledge and scientific research into environmental literacy and workforce development work. The questions Ibram X. Kendi (2016) asks provide guideposts for the program’s environmental literacy and workforce development initiatives:

“What if we measured literacy by how knowledgeable individuals are about their own environment?

What if we measured intellect by an individual’s desire to know?

What if we measured intellect by how open an individual’s mind is to self-critique and new ideas?

What if our educational system focused on opening minds?”

Wisconsin Sea Grant, and its many partners, understand it has a unique opportunity to incorporate multicultural perspectives and approaches into educational and workforce

development programming. The goal is to provide equitable environmental literacy education and workforce development opportunities to the diverse communities that call Wisconsin home.

National and Wisconsin Sea Grant Goals

- An environmentally literate public that is informed by lifelong formal and informal educational opportunities that reflect the range of diversity of the nation's coastal communities.
- A diverse and skilled workforce that is engaged and enabled to address critical local, regional and national needs.

Anticipated Outcomes for Wisconsin and the Great Lakes Region

- Wisconsin teachers and students are better informed in science, technology, engineering, mathematics fields and the ways that humans are inextricably interconnected with the Great Lakes. They can employ their knowledge to support sustainable and culturally sensitive practices within their diverse communities and watersheds.
- A diverse group of stakeholders develop a sense of awareness, understanding and stewardship in order to sustain watershed, coastal and freshwater ecosystems and resources.
- Communities implement sustainable strategies when managing Wisconsin's natural resources and make decisions based on information acquired through formal and informal education.

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- Wisconsin communities are knowledgeable and equipped with the best available science and technology in order to contribute to adaptive management planning processes and stewardship.
 - All members of a community are enabled to explore and pursue the variety of occupations that are essential to sustain the state's coastal communities and ecosystems.
 - College-level courses, internships and fellowships provide increased literacy, experience and preparedness in all areas of watershed, coastal and freshwater ecosystems for all students, with a particular focus on those from under-represented groups.
 - Undergraduate and graduate students, particularly those from under-represented groups, are supported and have access to formal and experiential learning, training and research experiences.
 - Employment in all sectors of the U.S. marine and freshwater resources enterprise expands and diversifies.
 - The existing and future workforce is able to adapt and thrive in changing environmental, social and economic conditions.

Wisconsin Sea Grant Strategies

- Ensure multicultural perspectives and approaches to Great Lakes education and workforce development by engaging with leaders of diverse community partners.
- Develop Pre-K-12 resources that address the Great Lakes literacy principles and support state and national educational standards.

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- Provide financial support for education projects that incorporate multicultural perspectives and approaches, innovative technologies or practices that enhance Great Lakes education.
 - Support a graduate student and post-graduate fellows' program to provide emerging professionals with opportunities to practice stakeholder engagement and actionable science and to connect them with the full range of Sea Grant activities and Great Lakes-related employment opportunities.
 - Support research projects that engage and train graduate and undergraduate students and lifelong learners about Great Lakes and marine resources.
 - Promote the intersection of the arts, sciences and humanities to inspire a science-informed society.
 - Promote place-based learning as a way to engage communities in local stewardship and commitment to preserving and protecting the environment.
 - Identify, promote and expose students, working professionals and the unemployed to Great Lakes related career pathways to build a diverse and skilled Wisconsin workforce.
 - Promote and disseminate accessible outreach and education programs and events online to prevent the spread of COVID-19.

Projects

Snow-GLOBE Youth Citizen Science Collaborative

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Ginny Carlton, Wisconsin Sea Grant

The U.S. educational system struggles with deficiencies in the STEM skills and enthusiasm of our nation's youth, inadequate climate science education and a lack of climate change training for teachers. This project is a part of the international Global Learning and Observations to Benefit the Environment (GLOBE) program, which brings together students, teachers, scientists and citizens to promote local environmental learning and foster diverse cultural perspectives through active, nature-based investigations. Researchers will hold teacher-training workshops and provide equipment to allow schools to participate in gathering data related to lake-effect snowfall in the Great Lakes region. Student data will be included in an open-access database that will assist scientists working on remote sensing-based snow monitoring, a challenging project hampered by a lack of data. Schools' access to University of Wisconsin expertise will be facilitated by supporting class presentations and student mentorship by UW scientists and hosting a Midwest GLOBE Student Research Symposium. [E/ELWD-22](#)

Research Accelerators and Quests: Increasing Great Lakes Literacy Through Student Inquiry and Justice, Equity, Diversity and Inclusion (JEDI)

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Environmental science educational programming at University of Wisconsin-Madison Division of Extension, has collaborated with educators for the last six years to respond to their needs in environmental and STEM education. This project builds off the Milwaukee Green STEM program and the research accelerators program, which provides firsthand science experiences in the context of students' communities and culture. The next phase will equip 20 educators with the skills and tools needed to increase Great

Lakes and environmental literacy and help further refine best practices for improving Great Lakes literacy with digital tools in urban populations, using the Great Lakes quests. The quests are virtual guided tours of coastal cities in Wisconsin that highlight locations (natural areas, lighthouses, etc.) and coastal features (maritime history, ecological concepts) relevant to the area. Through the research accelerators, students and teachers will develop a community call to action to accompany stops on the quest. [E/ELWD-23](#)

Surround-Sound Documentation of the Green Bay Estuary: An Audial Arts and Education Program in Support of the Green Bay National Estuarine Research Reserve

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Bill Sallak, UW-Green Bay

The University of Wisconsin-Green Bay is the state lead on a multi-year process to designate the bay of Green Bay as a National Estuarine Research Reserve (NERR). As organizers build support for a Green Bay NERR through conversations with stakeholders, educators and natural resource professionals, it is clear that for many in the community there is a physical and emotional disconnection from the water. This project will strengthen community connections to water by bringing aural experiences and oral traditions of the bay to a broad audience. Specifically, the researchers will record interviews with community members and the sounds of the bay to create a surround-sound bioacoustic art installation and online exhibit about the cultural, historical and ecosystem significance of the shoreline and waters of Green Bay that will be installed in an eventual NERR visitor center that will reach both the Green Bay community and visitors to the region. [E/ELWD-24](#)

Outreach

Innovative Approaches in Great Lakes Literacy (Moser, Carlton) – Great Lakes education has been successful with traditional water-science topics such as water quality, fisheries, weather and climate and invasive species. Now, it must expand to address emerging problems like PFAS and marine debris and topics beyond the traditional science realm such as maritime history, shipwrecks, coastal engineering, and visual, performance and literature perspectives. Sea Grant will 1) script and perform a theatrical presentation related to marine debris and its prevention, 2) expand to new communities a place-based watershed experience focused on coastal engineering, and 3) coordinate and support the peer-reviewed education project grant funding in the Sea Grant biennial omnibus competition. [A/AS-20.03](#)

Great Lakes Education in the Wisconsin Idea (Moser, Carlton) – Sea Grant advances Great Lakes literacy principles in formal and informal learning environments to produce an engaged, diverse and skilled workforce able to address critical Great Lakes’ needs. Sea Grant participates in or leads education outreach activities for educators, students and community members. It also provides Wisconsin educators with professional learning opportunities through activities hosted by partner organizations. [A/AS-20.03](#)

Wisconsin Participation in the Center for Great Lakes Literacy (Moser, Carlton, Gen) – The Center for Great Lakes Literacy (CGLL) is a collaborative effort led by Sea Grant educators throughout the Great Lakes watershed fostering informed and responsible decisions advancing stewardship among educators, students, scientists and community members. Signature CGLL educator offerings include Great Lakes shipboard science workshops aboard the R/V Lake Guardian and the S/V Denis Sullivan, land-based in-person and virtual professional learning opportunities, a mentor program, loanable education kits and a “Students Ask Scientists” webinar series. [A/AS-20.03](#), [C/C-02](#)

Library Collections and Outreach (Moser) – The Wisconsin Water Library fulfills a unique function within the National Sea Grant College Program and has evolved into an extension and education outreach role serving libraries, community centers and other informal learning environments, reaching non-traditional Sea Grant audiences, especially those in underserved and underrepresented groups. The library also maintains a water research and outreach-support collection, as well as works by diverse authors, especially titles by Native Americans and others of color. The library will take a further step in amplifying those voices by facilitating cataloging in national databases, so these works are indexed and discoverable by other institutions. [A/AS-20.04](#)

Arts, Sciences and Humanities (Moser, Carlton) – The linkages between art, science and humanities continue to grow as these disciplines look to connect to inform each other's work. When artists seek to communicate concerns and inspirations and scientists seek to translate their work, collaborative opportunities arise to foster a science-informed public. This allows Sea Grant to reach new audiences, especially those in underrepresented groups. [A/AS-20.03](#)

Watershed and Great Lakes Education Experiences (Seilheimer) – Wisconsin's Great Lakes coast is unique, but it can be underappreciated by residents. Working with partners, this project will continue the successful NOAA Bay Watershed and Education Training Program for teachers' professional development, while also increasing watershed accessibility and engagement for students with disabilities and their instructors. [A/AS-20.09](#)

Building a Commercial Fisher and Fish Processing Training Program (Moen, Seilheimer) – Wisconsin's commercial fishing industry has prioritized the need to identify a workforce and the next generation of commercial fishers and fish processors. Responding, the Wisconsin and Michigan Sea Grant programs are working with state

and tribal commercial fishers, fish processors and natural resource agencies to frame and pilot a culturally sensitive and realistic recruitment, training and retention program to support the industry and its workers. [A/AS-20.01](#), [A/AS-20.09](#)

WaterMarks: An Art/Science Framework for Community-Engaged Learning and Environmental Stewardship (Peroff) – WaterMarks is a Milwaukee-wide project combining public art and science to establish community-based informal science learning initiatives in six diverse Milwaukee neighborhoods. Integrated research and evaluation will gather data on the processes of informal science learning, program development and community engagement through neighborhood walks, community workshops and art projects focused on urban water systems and art installations called WaterMarkers. [A/AS-20.10](#)

Place-based Learning, Spatial Narratives and Deep Maps to Promote Coastal Stewardship (Hart) – Place-based learning brings hands-on experiences to local settings, meeting academic objectives, enhancing community vitality and protecting environmental quality. Spatial narratives use multimedia links in interactive web maps (deep maps) to connect related spatial content, linking seemingly separate social and ecological perspectives. The narratives and maps also build stewardship. Sea Grant will continue partnerships to develop Great Lakes quests (clue-driven learning activities) about coastal issues and places and refine spatial narrative and deep map methods in coastal settings. [A/AS-20.02](#)

Additional Projects

In addition to the research, education and extension projects on these pages, Sea Grant leverages its people and expertise to engage in other state-based or regional efforts using funding sources other than those from the base of Sea Grant funding. It is an efficient use of dollars and broadens the reach of Great Lakes research. The list of projects and funding sources is fluid, as projects wind down and new ones begin. Here is a snapshot at the time of publication of this directory:

National Oceanic and Atmospheric Administration Marine Debris Program

- The Play's the Thing: Using Drama as an Introduction to Marine Debris Prevention and Meaningful Stewardship

National Oceanic and Atmospheric Administration - National Sea Grant Office

- Implementing Strategies to Help Build Resilient Commercial Food-Fish Industries in Wisconsin in the Wake of the COVID-19 Pandemic
- Collaborative Reporting: A Sea Grant Reporting Cross-cutting Meeting

U.S. EPA -Training the Next Generation

Freshwater Collaborative of Wisconsin - Undergraduate Research Experiences

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Sea Grant Fellowships/Scholarships

Dean John A. Knauss Marine Policy Fellowship

seagrant.noaa.gov/knauss

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(608) 262-0905*

This competitive program provides an opportunity for one-year expenses-paid internships with a federal legislator or an agency in the Washington, D.C., area. Twenty-five Wisconsin students have been among those selected for Knauss fellowships since 1982.

J. Philip Keillor Wisconsin Coastal Management – Sea Grant Fellowship

go.wisc.edu/9ec36w

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Named in honor of longtime Wisconsin Sea Grant Coastal Engineer J. Philip Keillor, this one-year opportunity provides on-the-job education and training opportunities in coastal resource management and policy.

Sea Grant/NOAA Fisheries Graduate Fellowship

seagrant.noaa.gov/NMFS-SG-Fellowship

This program in population dynamics and marine resource economics was established by NOAA Sea Grant and NOAA Fisheries for Ph.D. candidates who are interested in either of these two disciplines.

Carl J. Weston Memorial Scholarship

go.wisc.edu/9ec36w

Contact: Jennifer Hauxwell, associate director, University of Wisconsin Sea Grant Institute, (608) 263-4657, jennifer.hauxwell@aqu.wisc.edu

The Carl J. Weston Memorial Scholarship was established in 1995 to aid undergraduate students working on Wisconsin Sea Grant-supported projects. Funding source: Dr. and Mrs. Carl B. Weston.

Wisconsin Sea Grant Summer Internships

go.wisc.edu/1a23fv

Contact: David A. Hart, assistant director for outreach, University of Wisconsin Sea Grant Institute, (608) 262-6515, dhart@aqu.wisc.edu

Opportunities for undergraduate mentoring shift each year, but the core goal of the internship program is to offer an applied research, environmental outreach and/or community engagement experience.

Freshwater Collaborative of Wisconsin and Water@UW-Madison Undergraduate Research Experiences

go.wisc.edu/ae70mk

Contact: Jim Hurley, director, University of Wisconsin Sea Grant Institute, (608) 262-0905 info@seagrant.wisc.edu

This program links more than 140 faculty and staff with aspiring water science undergraduates for a summer research experience.

Program Resources

Aquatic Sciences Chronicle

aqua.wisc.edu/chronicle

Published four times a year, this newsletter reports on the activities of Sea Grant and its complementary program, the University of Wisconsin Water Resources Institute. Visit the website to review current and past issues, and sign up for free delivery, either in print or electronically.

Sea Grant Publications

aqua.wisc.edu/publications

This well-stocked virtual publications center offers dozens of items for free download or at a reasonable cost to cover their production and shipping. Find fact sheets, fish recipes, posters, books and maps.

Social Media Channels

seagrants.wisc.edu

Visit the Sea Grant homepage and look for the links to many social media channels, including Twitter, Flickr, Facebook, YouTube and the blog Great Lakes Takes. It's a convenient way to connect, get program updates or access information in alternate formats like video or audio podcasts.

Wisconsin's Water Library

aqua.wisc.edu/library

This library contains more than 30,000 volumes of water-related information, with particular emphasis on Wisconsin and Great Lakes topics. Any state resident can access and benefit from the collection.

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Useful Websites

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seagrant.wisc.edu

Funding Opportunities

seagrant.wisc.edu/research

Sea Grant Program Information

go.wisc.edu/8pezp3

NOAA National Sea Grant

seagrant.noaa.gov



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