Sea Grant
UNIVERSITY OF WISCONSIN

2024–26 DIRECTORY OF PROJECTS AND PEOPLE

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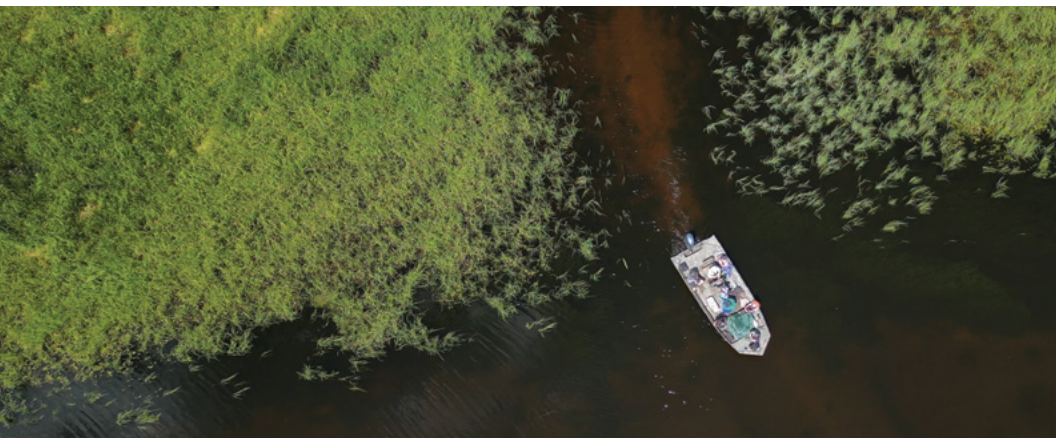

On the cover: Summer scholars Isabelle Haverkampf and Gweni Malokofsky surveying wild rice in Green Bay with University of Wisconsin-Green Bay Assistant Researcher Amy Carrozzino-Lyon and Sea Grant Fisheries Outreach Specialist Titus Seilheimer. Image by Wisconsin Sea Grant

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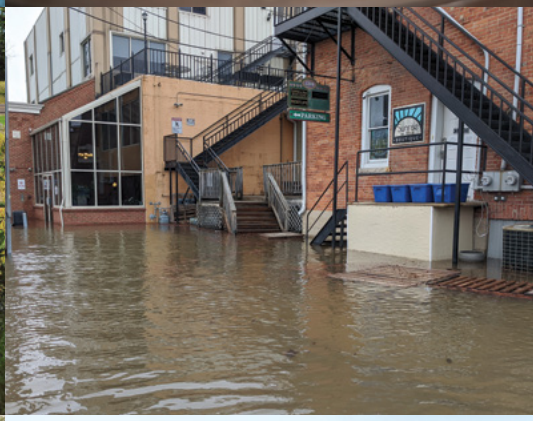
GREAT LAKES SCIENCE FOR OUR FUTURE

INSIDE



FROM THE DIRECTOR

A spark. The projects on these pages began with a spark. It was a spark of curiosity, ingenuity and scientific rigor. The spark mixed with a strong motivation to offer solutions to challenges and capitalize on opportunities related to coastal communities and the Great Lakes. All of these traits and conditions coalesced into research and education preproposals, 41 of them, submitted by investigators from institutions across Wisconsin.

Those submissions then kicked off a nearly 12-month review process that pulled in more than 100 external reviewers from around the globe and two in-person technical review panels, winnowing the number of projects funded to 12.

These projects reflect our focus in the areas of healthy coastal ecosystems, resilient communities and economies, sustainable fisheries and aquaculture, and environmental literacy and workforce development. In nine cases, the projects are led by people who have not previously led a Sea Grant project. These efforts will pull in support and partners from more than 20 academic and agency settings. Funded research will be complemented by the efforts of our dedicated extension, education and communication staff members.

Of all of this, I'm enormously proud. I'm proud of the people we support and the projects that will be completed. In the coming two years, follow along with us as those original sparks turn into results and actions.

Best regards,

Christy Remucal, interim director

WISCONSIN SEA GRANT MISSION

Support and enhance the sustainable use, conservation and health of Great Lakes resources and the well-being of Great Lakes communities through research, education and outreach.

PARTICIPATING INSTITUTIONS AND AGENCIES 2024-26

1854 Treaty Authority

Alverno College

Bay-Lake Regional Planning Commission

Great Lakes Fish and Wildlife Commission

Lac Courte Oreilles Ojibwe University

Michigan State University

Northern Illinois University

The Ohio State University

Red Cliff Band of Lake Superior Chippewa, Treaty Natural Resources Division

Sokaogon Chippewa Community, Mole Lake Band of Lake Superior Chippewa

Southeastern Wisconsin Regional Planning Commission

Town of Campbell, Wisconsin

U.S. Geological Survey

University of Chicago

University of Maryland

University of Michigan

University of Minnesota

University of Wisconsin-Green Bay

University of Wisconsin-Green Bay, Manitowoc Campus

University of Wisconsin-La Crosse

University of Wisconsin-Milwaukee

University of Wisconsin–Madison

University of Wisconsin-Oshkosh

University of Wisconsin-Stevens Point

University of Wisconsin-Superior

Voigt Intertribal Task Force

Wisconsin Department of Health Services

Wisconsin Department of Natural Resources

Wisconsin Department of Tourism

Wisconsin Department of Transportation

Wisconsin Department of Workforce Development

Wisconsin Historical Society

Wisconsin State Cartographer's Office

FOCUS AREAS

Wisconsin Sea Grant's focus areas enable the program to harness and apply its energy and resources to imminent and emerging Great Lakes' needs. By addressing the following focus areas, Sea Grant researches and attends to the lakes' ecosystems, strives for sustainable fisheries and aquaculture operations, aims to prepare communities to address risks and build resilience, fosters an engaged workforce, and encourages environmental literacy. These focus areas are enriched by and responsive to the needs of interested parties, which ensures that local-level input identifies and develops methods to address what is most relevant to Wisconsin and the Great Lakes. Focus areas provide an order to the wide expanse of Sea Grant's topical interests and initiatives. Further, they are interrelated, and a single activity may reflect and advance the goals, actions and desired outcomes of more than one of these priorities. The areas are: Healthy Coastal Ecosystems, Sustainable Fisheries and Aquaculture, Resilient Communities and Economies, and Environmental Literacy and Workforce Development.

Healthy Coastal Ecosystems

> **GOAL:** Coastal and Great Lakes habitats, ecosystems and the services they provide are protected, enhanced and/or restored.

Ecosystem Protection and Restoration

- Support research, outreach and communications to understand the environmental and socioeconomic effects of challenges facing Great Lakes ecosystems, including physical processes and changes to biodiversity and ecosystem structure.
- Help residents, resource managers, businesses, industries and the agricultural sector understand the effects of human activities and environmental changes on coastal resources.
- Develop new or improved approaches for reducing or preventing harmful algal blooms.
- Support research, outreach and communications to understand the important role that tributaries, coastal wetlands and nearshore habitat play for fisheries and other aquatic life.
- Co-develop, improve and share knowledge, decision-support tools, technologies and approaches to protect, enhance and restore ecosystems.

Aquatic Invasive Species

- Conduct research, outreach and communications that lead to a better understanding and prioritization of invasion pathways into the Great Lakes.
- Develop innovative and effective communication approaches to reach interested parties with aquatic invasive species prevention messages.
- Develop tools and approaches that better understand and improve aquatic invasive species prevention actions.
- Conduct research, outreach and communications about the ecological impacts of invasive species on food webs and important species.

Emerging Contaminants

- Support research, outreach and communications to understand the environmental and socioeconomic effects of current and emerging contaminants on Great Lakes ecosystems and human health including, but not limited to, per- and polyfluoroalkyl substances (PFAS), microplastics, pesticides and herbicides.

Marine Debris

- Support research, outreach and communications that address knowledge gaps and inform action related to the prevention and removal of marine debris impacting the Great Lakes.

> **GOAL:** Land, air and living resources are managed by applying science, tools and services to sustain resilient coastal and Great Lakes ecosystems.

Ecosystem Management

- Support a science- and management-driven framework that integrates research, observations, monitoring and modeling and that includes community engagement and traditional and local knowledge to provide a scientific basis for informed decision-making.
- Identify and advance successful strategies that enhance resilient ecosystems and watersheds in the context of changing conditions, including environmental variability.
- Utilize integrated assessment methods that bridge natural sciences, social sciences, economics and policy studies to support more holistic management and restoration of Great Lakes resources, including freshwater estuaries and urban harbors.
- Utilize ecosystem-based science and management to address the interconnections between land use and nutrient input from watersheds and impacts on receiving waters, with an emphasis on restoration of the Green Bay ecosystem.

RESEARCH PROJECTS

Developing Rapid Multi-Source Detection Approaches for Monitoring Microbial Pollutants in Recreational Waters

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Kayley Janssen, UW–Madison

Microbial pollutants are a serious concern for public health that drive economic loss through reduced recreational opportunities at beaches and in coastal waters, loss of coastal property value and increased costs to drinking water treatment. Fecal contamination of recreational waters is a primary concern, and there is a need for rapid and cost-effective detection of fecal pollution as well as approaches that can identify multiple pollution sources in single samples. This project will develop the framework – the molecular procedures and data processing workflow – to meet these needs. Once performance metrics are met, researchers will test the capability of each assay against standard fecal monitoring methods used as part of ongoing Lake Michigan beach monitoring programs. Protocols, results and assay performance capabilities will be shared widely with organizations in charge of water quality monitoring in Wisconsin and the Great Lakes region. R/HCE-51

Development of a Portable Membrane Sampler for Nano- and Low-Micrometer Microplastics in the Great Lakes

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Haoran Wei, UW–Madison

Microplastic pollution poses a threat to Great Lakes ecosystems. Although larger microplastics have been regularly detected in all five Great Lakes, the presence and distribution of their smaller counterparts – nano- and low-micrometer microplastics (NLMMPs) – are mostly unknown due to the demanding nature of current sampling methods, which entail transporting hundreds to thousands of liters of water to a laboratory. As a result, mapping NLMMPs across Great Lakes waters and gaining a holistic understanding of NLMMP pollution have been difficult. This project will develop a portable sequential membrane filtration sampler that can collect and pre-concentrate NLMMPs in the Great Lakes and measure the

influence of environmentally relevant factors on membrane fouling and NLMMP recovery performance. This project will expand low-cost coastal/nearshore monitoring for NLMMPs in the Great Lakes, enhance understanding of NLMMPs' occurrence and distribution and offer new insights into the effects of NLMMPs on food webs and lake ecosystems. R/HCE-52

Development of a Risk-Based Framework for Beach Closing Decisions

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Kayley Janssen, UW–Madison

Beaches contaminated with waterborne pathogens pose a risk to swimmers. Water quality is evaluated using indicator organisms; however, these organisms are common to many different sources of fecal pollution (gulls, sewage, agricultural animals) and some of these do not carry human pathogens. This project will test the hypotheses that 1) many water quality advisories are driven by gull waste and/or *E. coli* in the sand that is mobilized into the water during rain events and 2) some beaches can be contaminated by more serious and high health risk pollution sources intermittently and under specific conditions. Researchers will develop a source tracking strategy at three to five beaches and engage beach managers to draw upon their expertise and local knowledge. Importantly, they will incorporate new tracking markers into their workflow – a novel highly sensitive human-specific bacterial marker and two human viral markers. Results will be interpreted in the context of the level of risk posed by different sources and shared with beach managers. R/HCE-53

Comparative Toxicity and Bioaccumulation of Various Per- and Polyfluoroalkyl Substances (PFASs) in Larval Fishes

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Gavin Dehnert, Wisconsin Sea Grant
Sean Strom, Wisconsin Department of Natural Resources
Sarah Yang, Wisconsin Department of Health Services
Lee Donahue, Town of Campbell, Wisconsin

PFAS, also known as "forever chemicals," are associated with multiple adverse health effects in both humans and wildlife, and they currently

affect more than 50 communities across Wisconsin. There are more than 7,000 unique PFAS chemicals, yet our understanding of their toxicity and associated health risks is primarily based upon two legacy PFAS compounds – PFOS and PFOA. This project will address key data gaps by comparing the bioavailability and sublethal toxicity of two newer PFAS – PFHxS and F-53B – to PFOS in standard laboratory species (fathead minnow and zebrafish) and in species of concern in the Great Lakes (walleye, northern pike and sturgeon). Data from this work will be useful in informing regulatory agencies in the development of PFAS use restrictions and water quality criteria, establishing limits for protecting fish and other aquatic wildlife, and informing cleanup activities for contaminated sites within Great Lakes ecosystems. R/HCE-54

People and Plastics: Engaging Community Scientists in Ecotoxicology to Understand the Distribution and Effects of Microplastics in the Great Lakes Ecosystem

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Caren Ackley, Great Lakes Indian Fish and Wildlife Commission
Gavin Dehnert, Wisconsin Sea Grant

Global plastic production has increased dramatically over the past century and contamination of aquatic ecosystems with microplastics is a widespread issue. Yet our understanding of the distribution and ecological impact of microplastics in Great Lakes ecosystems (GLE) remains limited. This project will expand microplastic sampling efforts, especially in areas supporting traditionally underserved communities. In collaboration with tribal partners, researchers will develop a community science program that engages youth from tribal communities to help determine environmentally relevant levels of microplastic contamination in the GLE. Next, researchers will use standard toxicity studies to evaluate the effects of microplastics on nine common wetland organisms and generate artificial pond mesocosms to evaluate how microplastics alter food web interactions. This project intends to not only develop a better understanding of the distribution and ecological effects of microplastic pollution in the GLE but also develop a program that works to connect traditional ecological knowledge with Western science. R/HCE-55

Tracing Sources of Per- and Polyfluoroalkyl Substances (PFAS) to the Great Lakes

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Per- and polyfluoroalkyl substances (PFAS) are used in multiple products, including consumer products and fire-fighting foams. Many PFAS are toxic, resist degradation and are highly mobile in the environment. It is important to identify the exact source of PFAS contamination in order to decrease further release and inform remediation efforts. PFAS forensics techniques may be useful in source identification but can be challenging to implement because some PFAS undergo transformation in the environment. This project will compare two different non-target mass spectrometry approaches in an effort to develop PFAS forensics techniques. The project will also investigate how PFAS fingerprints change during environmental processes such as groundwater transport and atmospheric processing. This project provides a unique opportunity to study PFAS fate and transformation in aquatic systems in the Great Lakes region. R/HCE-50

OUTREACH PROJECTS

Wisconsin Aquatic Invasive Species Partnership Coordination (Campbell, McComb) – This partnership consists of approximately 50 aquatic invasive species (AIS) 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-21.07

Aquatic Invasive Species Prevention in Southeastern Wisconsin (McComb) – In cooperation with the Wisconsin Department of Natural Resources, Sea Grant coordinates AIS prevention and monitoring activities on lakes and streams in Milwaukee, Racine and Kenosha counties. Activities focus on preventing and reducing the spread of AIS through community engagement, outreach and education. A/AS-21.07

Great Lakes Sea Grant Network Organisms in Trade (OIT) Coordination (Campbell) – OIT invasion pathways cover a large set of activities that involve buying and selling 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. A/AS-21.07

Closing Aquatic Invasive Species Pathways (Campbell) – AIS 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-21.07

Refining Aquatic Invasive Species Communication Techniques (Campbell) – With new invasions there will be gaps in Wisconsin's AIS 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 AIS professionals to communicate effectively. A/AS-21.07

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 regional and national issues. A/AS-21.07

PFAS Actionable Science (Dehnert) – Sea Grant connects with state agencies, tribal nations and other partners addressing per- and polyfluoroalkyl substances (PFAS) in the Great Lakes ecosystem. This project forges understanding of the fate and transport of PFAS in aquatic ecosystems and what impacts PFAS has on wildlife. It is building a network across the region and disciplines and conducting PFAS research. A/AS-21.06

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-21.06

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-21.06

Wisconsin Clean Marina Program (Noordyk) – The operation, maintenance 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-21.11

Promote, Create and Restore Coastal and Nearshore Habitats (Seilheimer) – Habitats in coastal zones of the Great Lakes, as well as in small watersheds that drain directly to the lakes, have been understudied and underappreciated. Large swings in water levels in recent years have resulted in opportunities for coastal restoration in areas formerly covered with nonnative vegetation. Wild rice (manoomin) is a culturally and ecologically important species that can be seeded in these areas to provide submergent habitat and food. This project will also work to understand the habitat value of small Lake Michigan tributaries. Several small streams in northeast Wisconsin have been targeted for restoration. A/AS-21.12

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. 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-21.13

Sustainable Fisheries and Aquaculture

> **GOAL:** Wisconsin fisheries and aquaculture supply food, jobs and economic and cultural benefits.

Harvest and Processing Techniques

- Promote and support harvesting, culturing and processing techniques that lead to safe, sustainable, high-quality food as well as economic, social and ecosystem benefits.
- 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, outreach and communications 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 value-added product development and processing to maximize value from wildcaught and farm-raised seafood.

Fisheries and Aquaculture Workforce

- Support development of a trained workforce and enhance technology transfer in a manner that recognizes a variety of methodologies and approaches, including those based on traditional and local knowledge.
- 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 new sources of workforce for aquaculture and commercial fisheries, as well as develop training frameworks to build that pool.

Consumer Science/Perceptions

- Support research that leads to a better understanding of the benefits and risks of consuming Wisconsin-produced and Great Lakes region 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, outreach and communications that encourage 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.

New Aquaculture Species/Markets

- Investigate emerging species and new technologies suitable for aquaculture in Wisconsin.
- Support development of urban aquaculture in new markets and provide knowledge resources to existing operations.

> **GOAL:** Natural resources are sustainably managed to support coastal communities and working waterfronts, including commercial, recreational, subsistence fisheries and aquaculture.

Fisheries and Food Webs

- Support research, outreach and communications to better understand 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, outreach and communications to advance an environmentally sustainable and robust recreational, commercial and subsistence Great Lakes fishery.

- Better understand threats to Great Lakes fisheries, including, but not limited to, food web changes, invasive species, nutrient enrichment, contaminants, and genetics as well as effective responses to build resilience, facilitate and accept change.
- Support research to improve understanding of the impacts of food web change and other stressors on early life history and interaction of valuable sport and commercial species and develop management actions to mitigate impacts

RESEARCH PROJECTS

Enhancing Walleye (*Sander vitreus*) Fingerling Production in Recirculating Aquaculture Systems Through Advanced Nutrition and Feed Management

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Michael Preul, Mole Lake Sokaogon Chippewa Community
Patrick Blaufuss, UW-Milwaukee

Walleye are valuable in the Great Lakes region; high demands cannot be met by local wild harvest and farming, which is mainly in pond systems. This research focuses on developing new feed formulations and establishing an optimal feeding strategy for walleye production in recirculating aquaculture systems. Researchers will replace corn oil in the control diet with insect (black soldier fly) oil at different percentages (0, 25, 50, 75 and 100%) in a 12-week feeding trial. They will then evaluate the test diets based on fish growth rate, nutrient retention and tolerance to hypoxia and heat shock, as well as the effects on feeding, water quality control and nutritional content of the resulting fish product. Findings will be validated through extension research and provided to industry partners. Additionally, the project includes engagement with K-12 students through outreach and educational activities and the promotion of aquaculture through public education events. R/SFA-28

Enhancing Ice Safety Among Green Bay Ice Anglers and the Great Lakes Community

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Bret Shaw, UW–Madison
Titus Seilheimer, Wisconsin Sea Grant
Tim Campbell, Wisconsin Sea Grant

Recent rescues of anglers from large ice floes have highlighted the need for improved safety outreach materials. Researchers will use a participatory approach to engage ice anglers, collaborative organizations and other stakeholders in co-creating and testing the safety materials for relevance and usability. Research will entail in-depth interviews with Green Bay ice anglers, a controlled experiment with ice anglers and social media analytics to verify the validity of experimental findings. Multimodal materials, such as infographics, posters, social media posts and an ice safety card will be created. The project will include collaborations with the Wisconsin Department of Natural Resources, Extension Lakes, local first responders and fishing groups and will also be used as a case study for approximately 250 students at UW–Madison. R/SFA-29

Understanding Angler Behavior and Values Among Urban Anglers of the Lake Michigan Shoreline

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Olaf Jensen, UW–Madison
Amy Schultz, UW–Madison
Kari Fenske, Wisconsin Department of Natural Resources
Laura Schmidt, Wisconsin Department of Natural Resources
Iyob Tsehaye, Wisconsin Department of Natural Resources
Titus Seilheimer, Wisconsin Sea Grant

Great Lakes anglers generate billions of dollars of economic activity and serve a critical role in fisheries management. This group includes multiple ethnicities, genders, incomes and languages. However, much of our understanding of Great Lakes anglers is based on boat anglers. This group is likely not representative of the attitudes and values of shore anglers, who target different species and local communities. This project will implement in-person surveys along the Lake Michigan shoreline in the greater Milwaukee area, focusing on shore

anglers to understand what species they fish for, why they fish and their views about fisheries management. Researchers will compare agency research priorities and investments to the priorities of each angling community, working closely with shore angling communities to strengthen their engagement with management entities – leading to an improved relationship between shore anglers and fisheries managers while providing managers with information critical to ensuring equitable, sustainable Lake Michigan fisheries. R/SFA-30

OUTREACH PROJECTS

Advancing the Eat Wisconsin Fish Initiative (Moen) – This initiative provides consumers, grocers, chefs and others with 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 support to address industry challenges, build networks 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-21.09

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 mapping activities, Sea Grant 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 portals. A/AS-21.09

Working With Third-Party Seafood Ratings Organizations to Support the Great Lakes Commercial Fishing Industry (Moen) – Complicated access to information has prompted third-party seafood rating and ranking organizations to levy poor sustainability scores on some Great Lakes fisheries. Unfavorable ratings damage the sale of 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 government officials, non-profit organizations and buyers for domestic and international markets can understand how Great Lakes fisheries are sustainably managed by a network of agencies that span two countries, eight states, one province and 10 tribes. A/AS-21.09

Supporting the Needs of Interested Parties to Respond to Changing Great Lakes Food Webs and Climate (Seilheimer) – The Great Lakes waters of Wisconsin support jobs and economic benefits through the harvest of fish by commercial, charter and recreational fishers. The food webs that support these fisheries are dynamic systems and are influenced by factors such as invasive species and nutrient loading. This project provides outreach to interested parties about the current state of science and Sea Grant-funded work on changing food webs. A/AS-21.12

Supporting a Sustainable Great Lakes Commercial Fishing Industry (Seilheimer, Moen) – Wisconsin's commercial fisheries in lakes Superior and Michigan provide jobs, economic impacts and food for Wisconsin's residents. Freshwater fishes are a healthy source of protein and a sustainable industry. The primary commercial catch in Lake Michigan is lake whitefish, while Lake Superior harvests are a combination of cisco and lake whitefish. This project will attempt to reduce conflicts between commercial fishers and anglers, increase efficiency of fishing methods and deepen understanding of the dynamics of bycatch. The project will also address industry needs, such as recruitment of deckhands and the aging of the fleet. Safety of fishers will also be a priority and supported through drill conductor training as part of an apprenticeship program. A/AS-21.09, A/AS-21.12

Wisconsin Support for the Great Lakes Aquaculture Collaborative (Hauser, Moen, Seilheimer) – 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 effort will also support networking and engagement within Wisconsin's aquaculture industry. A/AS-21.15, A/AS-21.09, A/AS-21.12

Recirculating Systems Raising Walleye (Deng) – This project will assist walleye hatcheries in adapting indoor recirculating aquaculture systems (RAS) for the rearing of walleye destined for stocking. There will be a particular focus on feeding and feed management. A/AS-21.14

Outreach and Education on Aquaculture Topics (Deng) – Sea Grant will engage with farmers who cultivate yellow perch to provide them with updated technologies for fish culture and feed nutrition. In addition, there will be educational tours for the public and high school students and participation in events like the Sturgeon Bowl, Milwaukee City Open Day and summer camp tours. Finally, this effort will provide hands-on experiences to both undergraduate and high school students, fostering a greater understanding of aquaculture research and its impact. A/AS-21.14

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, demonstrations and technical assistance, K-12 education, web content, articles, reports and other publications, presentations and videos. A/AS-21.15

Resilient Communities and Economies

> **GOAL:** Great Lakes coastal communities have the capability and resources to prepare for and adapt to extreme and chronic weather and coastal hazards, economic disruptions and other threats to community health and well-being.

Coastal Processes

- Support research, outreach and communications 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.

Ports, Harbors and Marinas

- Promote research, outreach and communications for sustainable and resilient ports, harbors and marinas.
- Encourage adoption of best-management practices by marinas and boaters that keep Wisconsin's waterways clean and safe.

Nature-Based Shorelines

- Support research, outreach and communications 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.

Coastal Planning

- Work with coastal communities to advance collaborative planning, including incorporation of natural hazards resilience principles into community plans.

Maritime History and Culture

- Support research, outreach and communications that document and preserve cultural and historical resources in coastal and marine areas.

Coastal Economy

- Work with communities to explore and support diversification, strengthening, sustainability and social equity within coastal economic sectors and the blue economy.
- Support research to document the socioeconomic contributions of water-dependent industries.

Sustainable Tourism and Recreation

- Support research, outreach and communications to understand the value of and opportunities for subsistence, tourism, commerce and recreation activities in coastal communities.
- Build collaborative networks to promote sustainable tourism and outdoor recreation.

> **GOAL:** Water resources are enhanced, sustained and protected to meet existing and emerging needs of the communities and economies that depend on them.

Water Quality, Quantity and Availability

- Support research, outreach and communications 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.

Water Resource Management

- Collaborate with diverse partners and interested parties to advance plans and management practices for protecting and managing water resources.
- Support research, outreach and communications to promote the development and implementation of green stormwater infrastructure practices.

RESEARCH PROJECTS

Underwater Archaeological Surveys of Shipwrecks in the Bay of Green Bay

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Kendra Kennedy, Wisconsin Historical Society
Jordan Ciesielczyk-Gibson, Wisconsin Historical Society

Investigators will conduct two underwater archaeological surveys of shipwrecks located in the bay of Green Bay in Door County. The first year will focus on a pristine, unidentified historic steam-launch discovered during a NOAA bathymetric survey of the bay of Green Bay near Little Harbor. In the second year, a survey will be conducted on the Civil War-era schooner "Jennibel," a popular recreational dive site located south of Chambers Island. Both surveys will include opportunities for volunteer divers and avocational archaeologists. Complete service histories of these vessels will be researched, and a National Register of Historical Places nomination prepared, if appropriate. Data collected will be used for presentations, updates to museum kiosks, field reports, and print and web content, including an update of the popular wisconsinshipwrecks.org website to include information about historic use of Wisconsin's riverways by commercial vessels, fur trading routes and waterway usage by Native communities. R/RCE-21

Analysis of Socioeconomic Drivers in Flood Resilience

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James Price, UW-Milwaukee
Sergey Kravtsov, UW-Milwaukee

The Great Lakes region in Wisconsin is vulnerable to flooding, yet only around 30% of homeowners within the FEMA floodplain have insurance coverage. A lack of flood insurance, and resulting property losses, might unequally affect Great Lakes communities with different socioeconomic statuses. This project will address several research questions with data-driven models. 1) In Wisconsin, how is social vulnerability manifested in flood vulnerability, and does this manifestation increase social vulnerability? 2) Can we reduce

flood vulnerability by leveraging tools such as insurance price and federal buyout and improving homeowners' flood risk awareness? Researchers will develop artificial intelligence tools to predict property insurance claims and coverage for every flood event in Wisconsin, and they will investigate the fundamental inequity issues causing insufficient insurance penetration. Optimizing financial planning and educational tools and identifying future hotspots will assist in resolving inequities. These models and data sets will remain free and accessible to the public. R/RCE-22

OUTREACH PROJECTS

Coastal Geographic Information Systems (Hart) – Over the past three decades, Sea Grant has collaborated with many partners to apply geospatial technologies to better understand coastal management issues facing the Great Lakes. This activity will build on that investment to enhance the Wisconsin Coastal Atlas by including additional interactive maps, decision tools, geospatial data and place-based learning resources, specifically about coastal adaptation and resilience, green stormwater infrastructure and marine debris. Additional planned changes include integrating coastal access inventory data, photography, cartography and place-based learning resources through interactive story maps and a coastal access guidebook to encourage cultural and natural heritage tourism along the Great Lakes coasts of Wisconsin. A/AS-21.01

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, regional and statewide agencies with natural coastal hazard awareness, permit review assistance, grant proposal reviews, coastal engineering guidance, education opportunities and shoreline management tools. In particular, a "Coastal Resilience Self-Assessment" tool can help local governments consider planning and mitigation opportunities. For private landowners, a "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/21.5

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-21.05

Support Coastal Resilience Networks (Bechle, Noordyk, Chin, 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 and the Collaborative Action for Lake Michigan Coastal Resilience. Sea Grant will continue serving in leadership roles, facilitating activities and providing technical support to these networks. A/AS-21.05, A/AS-20.08, A/AS-21.11, A/AS-21.10

Increase Flood Resilience in Wisconsin's Coastal Communities (Bechle) – Many of Wisconsin's coastal areas suffer flooding caused by extreme rainfall, high lake levels, coastal storms, and in some cases, a combination of these factors. Sea Grant provides coordination, outreach, data and technical assistance that flood-affected communities use to plan, design and implement flood mitigation strategies. A.AS/21.5

Accessibility in Coastal Spaces (Chin) – Sea Grant will work with partners to increase the accessibility of coastal spaces by working with local communities to inventory accessibility features at public access points around the state and host events focused on reducing barriers to the outdoors with local partners. The outcomes of this work will be used to identify gaps in existing resources and future research project opportunities. Sea Grant will also participate in statewide and national efforts around diversity, equity, accessibility and inclusion (DEAI) and coastal spaces, including serving on the Wisconsin Department of Tourism's and National Extension Tourism network's DEAI committees. A/AS-21.10

Advance Sustainable Tourism in the Great Lakes Region (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-21.10

Support Coastal Adaptation (Chin) – Sea Grant will continue to 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-21.10

Climate Migration in Wisconsin (Chin) – Sea Grant has joined and will continue to participate in statewide efforts through the Wisconsin Initiative on Climate Change Impacts to better understand the issues around climate migration for Wisconsin and the Great Lakes. A/AS-21.10

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-21.11

Nature-Based Solutions for Increasing Flood Resilience in the East River Watershed, Green Bay (Noordyk, Bechle) – 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-21.11, A-AS-21.5

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, a nation-wide lifeguard shortage and issues with accessibility to water activities on Lake Michigan. The Beach Ambassador Program, organized by Sea Grant and several Milwaukee-based partners, uses a face-to-face approach to communicate Lake Michigan beach conditions and increase awareness and knowledge among the general public to prevent further drownings. A/AS-21.13

Rising Voices, Changing Coasts Hub (Peroff) – The goal of this project is to create a platform for Western environmental and social scientists and Indigenous knowledge-holders to center diverse ways of knowing by working closely together to understand impacts on coastal regions and to provide information to coastal communities to protect their livelihoods and traditional ways of life. A/AS-21.13

Environmental Literacy and Workforce Development

> **GOAL:** An environmentally literate public participates in lifelong formal and nonformal learning opportunities aligned to the Great Lakes literacy principles.

Environmental Literacy

- Provide financial support for Great Lakes education projects that incorporate innovative practices or technologies and multicultural perspectives developed through engagement with community leaders.

- Develop Pre-K-12 resources that address the Great Lakes literacy principles and support state, tribal and national educational standards.
- Support professional learning opportunities that engage and train educators about Great Lakes literacy principles.
- Promote place-based learning as a way to engage communities in local stewardship and commitment to preserving and protecting the environment.
- Promote the intersection of the arts, humanities, sciences and traditional and local knowledge to inspire an environmentally literate society.

> **GOAL:** A skilled and environmentally literate workforce that is engaged and able to build prosperous lives and livelihoods in a changing world through traditional and innovative careers.

Workforce Development

- Identify, promote and expose students, working professionals and the unemployed to Great Lakes-related career pathways to build a skilled Wisconsin workforce.
- Develop and carry out programs that help people discover, create and grow within careers that support the current and future needs of coastal communities and ecosystems and to adapt and thrive in changing conditions.
- Support a graduate student and post-graduate fellows program to provide emerging professionals with opportunities to practice community engagement and actionable science and to connect them with the full range of Sea Grant activities and Great Lakes-related employment opportunities.
- Increase opportunities for students at all levels (Pre-K-12, undergraduate, graduate, technical and vocational) to gain knowledge and experience addressing issues that are important to the Great Lakes and its watersheds.

EDUCATION PROJECT

Engaging Youth in Monitoring Aquatic Species Using Environmental DNA (eDNA)

Amy Workman, UW–Madison, (608) 264-3485, amy.workman@wisc.edu
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Tim Campbell, Wisconsin Sea Grant
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Hands-on field and laboratory investigations benefit student learning and improve science literacy. Even as community-based science plays an increasingly important role in monitoring species diversity in aquatic ecosystems, opportunities for students to practice conservation work are lacking. This project will engage a diverse set of partners (the Upham Woods Outdoor Learning Center, the UW–Madison Biotechnology Center, the U.S. Geological Survey and Water Action Volunteers) in conjunction with Sea Grant scientists to develop, pilot and refine field and laboratory experiences that engage high school students in detecting, identifying and tracking the existence of common, rare or harmful species in the Wisconsin River using environmental DNA sampling and analysis. The evaluation developed for participating students, staff and teachers will not only collect feedback to shape program contents and implementation but also measure changes in environmental literacy, experience gained and interest in careers that support the current and future needs of coastal communities and ecosystems. E/ELWD-28

OUTREACH PROJECTS

Developing a Workforce for Food-Fish Production in Wisconsin (Moen, Deng, Hauser, Seilheimer) – Wisconsin's food-fish production industry has prioritized the need to identify a workforce and the next generation of commercial fishers, fish farmers and fish processors. Responding, Sea Grant is partnering with other Great Lakes Sea Grant programs and the food-fish production industry

– including state and tribal commercial fishers, fish farmers, 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-21.09, A/AS-21.12, A/AS-21.14, A/AS-21.15

Innovative Approaches in Great Lakes Literacy (Moser, Carlton) – Great Lakes education has been successful with traditional Great Lakes-science topics such as water quality, fisheries, weather and invasive species. Now, it must expand to address emerging problems like per- and polyfluoroalkyl substances (PFAS), marine debris and other topics beyond the traditional science realm such as maritime history, shipwrecks and coastal engineering. It must also take into consideration visual, performance and literature perspectives. A/AS-20.03

Great Lakes Education in the Wisconsin Idea (Moser, Carlton, Seilheimer) – Sea Grant advances Great Lakes literacy principles in formal and informal learning environments to produce an engaged and skilled workforce able to address regional needs. Sea Grant participates in or leads education and outreach activities for educators, students and community members throughout the state. It also provides Wisconsin educators with professional learning opportunities through activities hosted by partner organizations. A/AS-21.03, A/AS-21.12

Wisconsin Participation in the Center for Great Lakes Literacy (Moser, Carlton) – 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 R/V Neeskay, land-based in-person and virtual professional learning opportunities, a mentor program, loanable education kits and a "Students Ask Scientists" webinar series. A/AS-21.03

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. In particular, staff will promote and seek opportunities to facilitate productions of "Me and Debry," a whimsical, audience-participation theatrical performance related to marine debris prevention. A/AS-21.03

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. 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-21.04

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 students and help develop the next generation of scientists. A/AS-21.06

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 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-21.11

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 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-21.13

Plastic-Free Cities (Peroff) – Single-use plastics are a critical threat to Great Lakes water quality, human health, fish and wildlife. Working with K-12 students and Milwaukee Public Schools, this project will facilitate civic engagement and educate Milwaukee's youth on marine debris and plastic pollution and help launch a Plastic-Free Cleveland initiative modeled on Plastic-Free MKE, a volunteer and partner-lead initiative designed to reduce plastic pollution in Milwaukee. A/AS-21.13

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 full-semester aquaponic course. A skilled and educated workforce in aquaculture is a major bottleneck to the sustainable expansion of the current aquaculture industry. This initiative also assists in training interns and technicians to foster workforce development in aquaculture, leading to nearly 100% job placement. A/AS-21.15

ADDITIONAL PROJECTS

In addition to the research, education and extension projects on these pages, Sea Grant leverages the expertise of its people to secure funding other than Sea Grant base funding. It is an efficient use of dollars and broadens the reach of freshwater science. The list of projects and funding sources is fluid, as projects wind down and new ones begin. Here is a snapshot of projects at the time of publication of this directory.

Association of State Floodplain Managers

- Strengthening Coastal Communities Resilience in the Great Lakes Region

Freshwater Collaborative of Wisconsin

- Summer Research Opportunities Program
- Partnering to Boost Aquaculture Workforce Development in Wisconsin
- Pilot Project: Development of an In Vivo Method to Assess the Innate Immune Response in Fathead Minnow Larvae

National Fish and Wildlife Foundation

- East River Resilience Collaborative: Partnership and Action for Nature-Based and Community-Driven Solutions

National Oceanic and Atmospheric Administration Marine Debris Program

- Plastic-Free Cleveland: An Expansion of Coalition-Based Efforts to Reduce Marine Debris Throughout the Great Lakes Region

National Oceanic and Atmospheric Administration National Sea Grant Office

- Applying Research on Advice Communication to Environmental Settings

U.S. EPA

- Training the Next Generation

Wisconsin Rural Partnership Initiative, University of Wisconsin–Madison

- Connecting Cultural Values and Indigenous Research Towards Food System Resilience

INDEX

SEA GRANT FELLOWSHIPS/SCHOLARSHIPS

Dean John A. Knauss Marine Policy Fellowship

seagrant.noaa.gov/knauss

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

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.

J. Philip Keillor Wisconsin Coastal Management – Sea Grant Fellowship

go.wisc.edu/9ec36w

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

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@aqua.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 Outreach Internships

go.wisc.edu/1a23fv

Opportunities for undergraduates to be mentored in extension activities.

Freshwater@UW Summer Research Opportunities Program

go.wisc.edu/ae70mk

Contact: Alison Mikulyuk, Water@UW–Madison research program coordinator, (608) 263-3296, alison.mikulyuk@aqua.wisc.edu

Opportunities for undergraduates to be mentored by freshwater researchers.

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 downloadable resources such as fact sheets and booklets.

Social Media Channels

seagrant.wisc.edu

Visit the Sea Grant home page and look for the links to many social media channels, including Instagram; X, formerly called Twitter; Flickr; Facebook; YouTube; and the blog Unsalted. 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

waterlibrary.aqua.wisc.edu

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.

USEFUL WEBSITES

University of Wisconsin Sea Grant Institute

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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