



2020-22 DIRECTORY OF PROJECTS AND PEOPLE

University of Wisconsin Sea Grant Institute



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INSIDE:

2 From the Director

5 Participating Organizations 2020-22

Program Focus Areas

6 Healthy Coastal Ecosystems

17 Sustainable Fisheries and Aquaculture

25 Resilient Communities and Economies

37 Environmental Literacy and Workforce Development

46 Additional Projects

47 Index

48 Sea Grant Fellowships/Scholarships

50 Useful Websites

51 Program Resources

52 Key Contacts

From the Director

Rigor. That is the primary driver in grant-funding decisions. Just as a researcher employs rigor in planning a field season and lab protocols, so too does Wisconsin Sea Grant in establishing a call for research proposals.

A panel of scientific experts reviews proposals and encourages those with a strong scientific basis and a link to our strategic priorities. We then secure at least three external reviewers from all corners of the world for every encouraged full proposal. A second panel of technical experts is convened to assess each hypothesis, method, objective, rationale and budget, along with letters of support.

Next, Sea Grant taps into the insights of a statewide advisory council to ensure relevance to Wisconsin-specific needs. Further, the entire funding package is evaluated by the National Sea Grant College Program, National Oceanic and Atmospheric Administration (NOAA).

Outreach staff develop work plans that are consistent with our program's priorities. Staff work closely to craft plans with members of the Committee on Outreach and Education, as well as individual and groups of specific stakeholders in the fields of resilience planning, aquaculture, resource management, education and more. Outreach staff also apply for external project funding, where peer review is a key component of award success.

The full Wisconsin Sea Grant program is evaluated every four years by a NOAA-structured panel of national and international Great Lakes leaders to ensure performance and grant management are top-notch.

That all adds up to the rigor contained within these pages. There are details on 11 new research projects, four continuing ones, three education initiatives and 32 extension undertakings for 2020-22.

For the coming two years, just as in our program's preceding 52 years, our extension activities and funded research will go forward on the basis of scientific integrity and relevance, which are nonnegotiable under our model of operation.

I would welcome any discussion about how we determine which projects to fund to ensure we are deepening our understanding of the Great Lakes and its coastal communities. Please feel free to get in touch about our standards and follow along as we share the results of these projects to convert rigorous research into actionable science.



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 Organizations 2020-22

University of Wisconsin Sea Grant Institute

Bird Studies Canada	University of British Columbia
Center for Great Lakes Literacy	University of Illinois
Great Lakes Fishery Commission	University of Michigan
Hokkaido University	University of Minnesota Duluth
Lakeshore Natural Resource Partnership	University of Vermont
Michigan Department of Natural Resources	University of Wisconsin-Green Bay
Michigan State University	University of Wisconsin-Green Bay, Manitowoc Campus
Michigan Technological University	University of Wisconsin-Green Bay, Marinette Campus
National Weather Service	University of Wisconsin-Madison
Northwest Passage	University of Wisconsin-Milwaukee
Pennsylvania State University	University of Wisconsin-Stevens Point
Purdue University	University of Wisconsin-Superior
Southeast Wisconsin Watershed Trust	University of Wyoming
Superior Rivers Watershed Association	Wisconsin Coastal Management Program
St. Norbert College	Wisconsin Department of Natural Resources
Texas A & M University	Wisconsin Historical Society
The Ohio State University	Wisconsin Marine Association
U.S. Department of Agriculture	Wisconsin Maritime Museum
U.S. Environmental Protection Agency	
U.S. Fish and Wildlife Service	
U.S. Geological Survey	

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 services 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. 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.

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 action-able 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.

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.

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- Ecosystem science and conservation priorities for Wisconsin are those that are developed through stakeholder participation.
 - Greater awareness and understanding of freshwater ecosystem functions and services they provide improve stewardship efforts among resource managers, communities and tribal entities.
 - 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.
 - Citizen science initiatives are engaged and contribute to improving our knowledge with respect to coastal communities and ecosystems.
 - Wisconsin communities have access to information and understand projected changes within coastal ecosystems and how changes will impact coastal ecosystems.
 - Wisconsin communities 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.

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- Support research and outreach to understand the environmental and socioeconomic effects of current and emerging challenges to 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.
 - Support research and outreach to improve Great Lakes ecosystem health through innovations in measurement, predictive modeling and potential treatment or management approaches.
 - 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.

Projects

Transitioning Science to Management: Developing Models and Tools to Restore the Health of the Green Bay Ecosystem

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Hypereutrophic conditions are a persistent problem in Green Bay and a principal criteria for the southern bay's designation as an Area of Concern by the U.S. EPA. Ecosystem restoration requires a significant and sustained effort to reduce nutrient inputs. Many new efforts are taking place in the region, but success requires the cooperation of the whole watershed and resource agencies armed with science-based predictive tools. Such tools are essential in an ecosystem that is witnessing massive alterations in agriculture and development and a changing climate. Researchers have assembled a comprehensive set of linked models of watershed loading, biogeochemical cycling and hydrodynamics that are informed by downscaled climate scenarios. Effective implementation requires translating that information into a form that is useable by stakeholders. Key outcomes are the refinement of a set of management analysis tools to help guide resource management and the engagement of those involved in land and water use across all sectors. [R/HCE-35](#)

A New Phosphorous Model for Lake Michigan

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Previous research has shown that the relationship between external phosphorus loading and algal production in Lake Michigan has changed — phytoplankton production in offshore waters has decreased while the production of nuisance benthic algae in the nearshore zone has increased. As a result, previous phosphorus loading targets may no longer be valid, and managers are uncertain as to whether there is an ideal loading rate that will result in minimal growth of nuisance algae in the nearshore while sustaining the pelagic plankton and fish community. Researchers will develop a whole-lake phosphorus model that couples nearshore and pelagic models they have recently constructed. The project goal is to produce a model that can be used to determine how both the pelagic and nearshore communities will respond to external phosphorus loads. The researchers will work closely with the Wisconsin Department of Natural Resources to ensure that products specifically address this agency's management needs. R/HCE-36

Spatial and Temporal Distribution of Benthic Macro-Invertebrate Community of Lower Green Bay, 1938-Present

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Benthic macro-invertebrate communities often have a disproportionate effect on Great Lakes aquatic communities. The benthic community of Green Bay has been surveyed periodically from the late 1930s through the 1990s. However, many sources of uncertainty regarding the benthic invertebrate community remain, and that limits understanding of the ecology of the system as a whole. The main objective of this project is to evaluate the current density and distribution of the entire benthic

macro-invertebrate community in lower Green Bay and place this distribution in the context of historic records. Researchers will also attempt to develop spatially explicit predictive models that can determine associations with surrounding abiotic and biotic features of the overlying waters that may influence observed macro-invertebrate distribution. The proposed research will have application to broader management objectives (e.g., U.S. EPA Area of Concern delisting), ongoing hydrodynamic and phosphorus modeling, and research seeking to better understand fish foraging ecology and population dynamics. [R/HCE-37](#)

Sources and Fate of Per- and Polyfluoroalkyl Substances (PFAS) in Green Bay and Lake Michigan

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The presence of per- and polyfluoroalkyl substances (PFAS) in the watersheds of the Great Lakes is a topic of emerging concern. Elevated PFAS concentrations have been reported in industrial and municipal wastewaters and private drinking water wells near Marinette, Wisconsin. However, little is known about the extent of PFAS contamination in the Menominee River and nearby Green Bay, as well as the broader extent of contamination across Lake Michigan. This project will test the hypothesis that tributaries around Green Bay are hotspots of PFAS contamination and attempt to identify other potential PFAS hotspots. Researchers will partner with the Wisconsin Department of Natural Resources in implementing the project and sharing results. Furthermore, results will be of interest to the coastal communities around Green Bay, and researchers will share these results at both the local and state levels. [R/HCE-40](#)

Characterization of the Basis for Survival of Naturalized *E. coli* in the Beach Environment

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Beach managers use *E. coli* as an indicator of the presence of pathogens, and elevated levels trigger beach water-quality warnings. However, growing evidence shows these fecal indicators can survive for long periods outside the host, diminishing their usefulness in evaluating human health risk. The goal of this project is to increase our understanding of the basis for long-term survival of *E. coli* in the sand and develop tools for beach managers that can be used to distinguish a beach with chronic *E. coli* reservoirs from one that has new fecal pollution inputs. Researchers have created *E. coli* collections from hosts and endpoint microcosm studies that represent long-term survivors. These collections, along with isolates collected at beaches, will be used to characterize the genotypic profiles of long-surviving strains. This project will yield immediate information on the study site beaches and establish trends useful for managing *E. coli*-contaminated beaches.

R/HCE-41

Assessing and Improving Policy and Practice Interventions to Reduce Nutrient Runoff Into the Great Lakes

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Excessive runoff and leaching of nutrients from upstream watersheds is negatively impacting coastal Wisconsin shorelines and communities. Excessive phosphorus is the primary driver of surface water impairment in Wisconsin, while excessive nitrogen — in the form of nitrate — is the main cause of groundwater contamination. One barrier to addressing these problems is a disconnect between local ecological and social conditions and the policies and programs meant to address them. How well these elements work together is called “institutional fit.” This project will analyze institutional fit in the

watersheds along Wisconsin's northeast lakeshore draining directly into Lake Michigan. This area is near the beginning of its water quality remediation planning process, has significant nutrient runoff concerns and contains counties with varying policies and implementation approaches. Publications and other data resulting from this project will inform the implementation plan and also assist people in other locations seeking to do this type of analysis. [R/HCE-42](#)

The Significance of Piscivorous Birds in the Lower Green Bay Ecosystem

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Piscivorous (fish-eating) birds such as cormorants, pelicans, herons, gulls and terns are highly visible elements of freshwater ecosystems, but their significance in aquatic food webs is often ignored or overlooked. A particularly striking increase in piscivorous bird populations is occurring in lower Green Bay (Lake Michigan). Both theoretical models and empirical research at other sites suggest that predators like piscivorous birds clearly are capable of profoundly altering aquatic food webs when their numbers are high. Yet little is known about the impact of avian piscivores on lower Green Bay's fish community, including both economically important species and undesirable invasive species. This project will use state-of-the-art telemetry and molecular tools to evaluate the numbers, diet and movements of piscivorous birds within the lower and middle portions of Green Bay and the Fox River. Results will provide a foundation for informed resource management and public outreach in the lower Green Bay ecosystem. [R/HCE-43](#)

Outreach

Restoring the Health of the Lower Fox River and Green Bay (Noordyk) – Lower Green Bay and 14 tributaries in the Lower Fox River Basin do not meet Wisconsin water-quality standards due to low dissolved oxygen. Excessive suspended solids and phosphorus cause nuisance and harmful algal blooms that have led to a dead zone in lower Green Bay. With partners, Sea Grant is working to address the challenges and improve water quality. [A/AS-1](#)

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 promotes and celebrates the voluntary adoption of measures to reduce pollution. The program is administered by Sea Grant with support from the Wisconsin Marine Association, Wisconsin Coastal Management Program, Wisconsin Department of Natural Resources and Fund for Lake Michigan. [A/AS-1](#)

Wisconsin Aquatic Invasive Species Partnership Coordination (Campbell) – The Wisconsin Aquatic Invasive Species 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, investigates information gaps and creates new outreach materials. [A/AS-1](#)

Great Lakes Sea Grant Network Habitattitude Surrender Collaborative (Campbell) – People purchase animals and plants for their aquarium or water garden. Or, people purchase animals as pets. Problems for the environment arise if these animals or plants are accidentally or intentionally released. Wisconsin Sea Grant participates in a Great Lakes Sea Grant Network Habitattitude campaign, offering people the option to surrender a pet or plant for future rehoming versus releasing it. [A/AS-1](#)

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 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-1](#)

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 remaining stakeholders with prevention messages, and little work is being done currently to determine what techniques are effective. Sea Grant will contribute to this examination of effectiveness. [A/AS-1](#)

Great Lakes and Mississippi River Regional 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. [A/AS-1](#)

Implementing Coastal Aquatic Invasive Species Outreach (Campbell) – With the help of the Wisconsin Department of Natural Resources, Sea Grant is implementing statewide aquatic invasive species (AIS) programs in coastal counties. Sea Grant coordinates a watercraft inspection program that covers lakes Michigan and Superior landings and increases access to statewide AIS programs in southeast Wisconsin. [A/AS-1](#)

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 percent of what is consumed, leading to a seafood trade deficit of more than \$11.2 billion per year. With global wild fisheries harvests at a plateau of around 185 million tonnes, further increases in seafood production will have to come from aquaculture. Currently, more than 50 percent of seafood consumed globally is now produced from aquaculture. Since 2013, global seafood production has surpassed global beef production. There are no projected increases in wild-capture fisheries, but global aquaculture is predicted to increase by 33 percent 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 percent comes from aquaculture operations in the region.

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 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.

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.
- 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.

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- 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.
- 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.
- 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.

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- Collaborate in identifying Great Lakes regional aquaculture opportunities and best-management practices.
 - Support research that leads to a better understanding of the benefits and risks of consuming Wisconsin-produced fish.
 - 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 and outreach to develop and improve economically viable and environmentally sustainable aquaponics operations, with an emphasis on business planning, risks and socioeconomics.
 - 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.
 - Support development of urban aquaculture in new markets and provide knowledge resources to existing operations.
 - Investigate emerging species suitable for aquaculture in Wisconsin.

Projects

Commercial Application of Out-of-Season Spawning of Walleye (*Sander vitreum*)

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The University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility's research has allowed the aquaculture industry in the Midwest to become a viable commercial producer of controlled-environment walleye. A final domestication step is to make walleye eggs, fry and juveniles available year-round. Recent scientific advances in percid out-of-season spawning can be used to manipulate the reproductive cycle and produce multiple crops of walleye throughout the year. This project will 1) compare out-of-season spawning cycles with in-season spawning cycles for the production of viable walleye eggs in incubation systems to achieve optimal fecundity, development and survival, 2) investigate the influence of photoperiod, thermal and hormonal manipulation on spawning walleye to optimize the production of viable eggs and fry and 3) compare the continued grow-out of out-of-season produced walleye with in-season produced walleye under controlled environment conditions (recirculating aquaculture system) while demonstrating and transferring information to Wisconsin's aquaculture industry through outreach activities. [R/SEA-19](#)

Virulence Factors and Control of the Fish Pathogen *Flavobacterium columnare*

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Flavobacterium columnare is a common fish pathogen that causes columnaris disease in wild and farmed freshwater fishes. Most if not all species of freshwater fish are susceptible

to columnaris disease, which causes large losses in aquaculture. The virulence mechanisms are not known and protective measures are inadequate. Researchers sequenced the genomes of two virulent *F. columnare* strains and deleted genes involved in protein secretion to construct mutant variants of the bacteria. These mutants failed to secrete the toxins that the wild-type strains produce and did not cause disease among zebrafish, yellow perch, rainbow trout and channel catfish. This project will identify the specific *F. columnare*-secreted proteins that are required for virulence in zebrafish and yellow perch. Once avirulent mutants are developed, they will be tested as vaccine strains to protect against wild type *F. columnare*. [R/SFA-20](#)

Diversity of Great Lakes Coregonines and the Implications for Great Lakes Fisheries Management and Restoration

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Randy Eshenroder, Great Lakes Fisheries Commission

Willie Fetzer, University of Wyoming

Andrew Muir, Great Lakes Fisheries Commission

Chris Olds, U.S. Fish and Wildlife Service

Wendylee Stott, U.S. Geological Survey

Historically, coregonine fishes were critical players in Great Lakes food webs and ecosystems, exhibiting a remarkable degree of diversity in physical forms, known as morphological diversity. This diversity in Lake Michigan (and to a lesser degree Lake Superior) has been lost over the past century as a result of anthropogenic changes. This project will assess both historical and present-day morphological diversity of Great Lakes coregonines, and, in parallel, estimate trophic position (place in the food web) and assess trophic niche breadth and niche overlap among coregonine and non-coregonine forage fishes. In bringing these data sets together, researchers will directly assess the hypothesized linkage between morphological and trophic niche diversity. The results will have

notable Great Lakes fisheries management implications, potentially showing that restoration of morphological diversity would contribute towards rebuilding trophic diversity, conferring food web stability and the delivery of ecosystem services. [R/SFA-21](#)

Outreach

Aquaculture Outreach and Education: Continuous Activities (Wiermaa) – 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. These species are then commercially scaled, allowing research and development transfer to the industry. Outreach and education include webpage development, articles, reports and other publications, presentations and video production. [A/AS-1](#)

Aquaculture Technical Bulletins (Binkowski) – With the growing interest in recirculating aquaculture system technology and its application to cool-water species such as yellow perch, bluegill and walleye, Sea Grant will produce technical bulletins that will serve as a guide for the biological, physical and chemical production parameters. This information will support commercial aquaculture practitioners and agricultural education science programs, along with on-site technical assistance. [A/AS-1](#)

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 that are influenced by factors such as invasive species, watershed activities and resource management. This effort will support outreach, education and research in Wisconsin's Great Lakes ecosystems. [A/AS-1](#)

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. The lake whitefish fishery in southern Green Bay will be a focus in 2020-22. [A/AS-1](#)

Resilient Communities and Economies

Coastal communities provide crucial economic, subsistence, social and recreational opportunities for millions of people within the Great Lakes basin. A 2011 study completed by the University of Michigan reported that more than 1.5 million jobs, generating \$62 billion in wages, are tied to the inland seas. The job breakdown is 994,879 in manufacturing; 217,635 in tourism; 118,550 in shipping; 118,430 in agriculture, fishing and food production; 38,085 in science and engineering; 10,980 in utilities; and 10,003 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 in applying the best-available scientific knowledge to address increased resource demands and vulnerability. 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 use their knowledge of changing conditions and risks to become resilient to extreme events, economic disruptions and other threats to community well-being.

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- Water resources are sustained and protected to meet existing and emerging needs of the communities, economies and ecosystems that depend on them.

Anticipated Outcomes for Wisconsin and the Great Lakes Region

- Members of the community, including the underserved, are aware of and understand changing conditions and hazards and the implications to their Wisconsin 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.
- Wisconsin communities have access to information needed to understand the factors impacting ecosystems and participate in adaptive management planning. Wisconsin communities employ adaptive management strategies and apply tools to engage diverse members of the community to improve resilience and community sustainability.
- Members of the community, including the underserved, have access to information needed to understand how Wisconsin coastal economic activities and trends will impact environmental and community well-being.
- Communities have access to tools, services and technologies to adapt and grow resilient Wisconsin economies.
- Leaders in Wisconsin's coastal economic sectors understand how they can become more resilient through diversification and through conservation of ecosystem services.

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- Community members throughout Wisconsin understand watershed functions and the services those watersheds provide to support communities and economies.
 - Community members understand how actions will impact water quantity and quality and are able to make informed decisions.
 - Wisconsin communities have access to sound science, data, tools and services to understand and anticipate changes in water quantity and quality.
 - Wisconsin communities have diverse, sustainable economies and industries that support existing and emerging water-resource needs.
 - Wisconsin communities have 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 entities 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.
 - 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.

Projects

Risk-based Assessment and Management (RAMAN) Online Visualization Tools for Health of Bluff, Beach and Nearshore Environments on Wisconsin's Coast

Chin H. Wu, UW-Madison, (608) 263-3078, chinwu@enr.wisc.edu

Qunying Huang, UW-Madison

Adam Bechle, Wisconsin Sea Grant

Risks from coastal bluff and shoreline erosion threaten personal safety, property and infrastructure along Great Lakes coastlines. Researchers will identify hazards near coastal structures on bluffed and sandy coasts through measurements of bluff and shoreline recession, bluff profiles, nearshore sediment thickness and nearshore sediment transport. Assessments of hazards will be conducted using observed data and models of bluff stability, shoreline change and sediment budgets to predict bluff/shoreline positions. The outcomes of the hazard assessment will be intersected with socioeconomic indexes to provide direct and indirect risk assessments — the first estimates in Wisconsin of expected damages to property from coastal erosion. Risks will be communicated to management, planners and stakeholders through a spatial web portal and 3-D interactive bluff erosion visualization. Overall, this project will provide managers and stakeholders with the information needed to take targeted actions along the coast and understand potential positive and negative impacts of coastal protection measures. [R/RCE-11](#)

Mitigating Flooding, Extreme Heat and Heavy Rainfall in Urban Coastal Communities by "Greening"

Steve Lobeide, UW-Madison, (608) 265-5277, lobeide@wisc.edu

Daniel Wright, UW-Madison

Carolyn Voter, UW-Madison

Transformation of the landscape from green, transpiring surfaces to buildings and paved surfaces disrupts the water and energy balance and causes phenomena such as

urban stream syndrome, the urban heat island and urban rainfall modification. The risk of heavy rainfall is especially high in coastal cities like Milwaukee, where moisture-laden urban sea/lake breezes can amplify urban rainfall modification. To mitigate these hazards, many cities are turning to “green” interventions such as increased urban tree canopy, depaving and green roofs. This project will explore the potential for widespread greening to mitigate urban hazards in the Milwaukee area using a coupled land surface-atmospheric model. Ultimately, this research will provide local agencies, engineers and public works departments with quantitative information about where, when and how widespread greening can reduce the risk of flooding, extreme heat and heavy rainfall.

R/RCE-12

Model Analysis of the Effect of Reduced Ice Coverage on Great Lakes Marine Transportation

Richard Stewart, UW-Superior, (715) 394-8547, rstewart@uwsuper.edu

Daniel L. Rust, UW-Superior

This project will examine how reduced ice coverage resulting from climate variability will impact commercial marine transportation, ports and shippers. Researchers will model the changes in marine transportation from reduced ice cover, and the results will provide data and models that can be used by commercial ports. Three major cargoes, taconite, coal and limestone, will be modeled first for a vessel and then for a fleet of vessels. The study will also examine and model examples of “new” cargoes or the expansion of existing cargoes that can make a modal shift to marine transportation when an extended shipping season provides new supply chain opportunities. The transfer of cargo from rail and/or truck to more energy-efficient marine vessels can be beneficial for ports and states surrounding the Great Lakes. R/RCE-13

Boatloads of Lumber: Expanding the Reach of Wisconsin's Maritime Resource Education

Caitlin Zant, Wisconsin Historical Society, (608) 221-5909, caitlin.zant@wisconsinhistory.org

Tamara Thomsen, Wisconsin Historical Society

Victoria Kiefer, Wisconsin Historical Society

Anne Moser, Wisconsin Sea Grant

Lumber was vital to small communities around the upper Great Lakes in the late 19th century, allowing them to develop as profitable lumber ports. The schooner-barge Sidney O. Neff (1891) carried freight and pulpwood until it was laid up in Menominee, Michigan, in 1933. The vessel was scuttled outside the harbor after having sunk at its mooring. Today the wreckage lies in the bay of Green Bay, Wisconsin, off the Marinette Lighthouse. Five other lumber schooners remain undiscovered within Whitefish Bay, Door County, Wisconsin. Archaeologists will use the process of documenting the wreck of the Sidney O. Neff and locating the other wrecks to train volunteers and as an opportunity for public outreach and education. An important facet of this project is a collaboration with educators at maritime museums and teachers throughout Wisconsin to create an educational package to be used by Wisconsin Historical Society staff, museum educators, teachers and others. [R/RCE-14](#)

An Integrated Physical-Social-Community (PSC) Approach for Sustainable Shore Protection, Beach Integrity, and Bluff/Dune Stabilization Along Lake Michigan

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Adam Bechle, Wisconsin Sea Grant

Deidre Peroff, Wisconsin Sea Grant

Todd Breiby, Wisconsin Coastal Management Program

Kate Angel, Wisconsin Coastal Management Program

Guy Meadows, Michigan Technological University

Cary Troy, Purdue University

Pengfei Xue, Michigan Technological University

Sean Vitousek, University of Illinois-Chicago and the U.S. Geological Survey, Pacific Coastal & Marine Science Center

Stuart Carlton, Purdue University and Illinois-Indiana Sea Grant

Aaron Thompson, Purdue University

Mark Breederland, Michigan Sea Grant

Private landowners, communities and public officials along the Lake Michigan coast face many challenges — climate and weather hazards, shore and beach erosion, bluff and dune recession, and failing coastal protection structures — and protecting one property can cause problems for adjacent properties. In addition, complex human-coastal environment interactions and human-human interactions combined with coastal shore protection options often prompt conflict among stakeholders. Previously, there have been no readily available techniques to resolve these conflicts. This project will work to improve resilience in coastal communities on the Lake Michigan coast through a science-based, integrated physical-social-community approach that helps to build sustainable shore protection, understand attitudes and perceptions related to behavior change or adoption of shore protection options, employ just and forgiving community practices to enhance community social resilience and establish multi-way communications within and between coastal communities for all of Lake Michigan. **R/RCE-15**

Outreach

Coastal Engineering Outreach and Grant Proposal Review (Bechle) – Great Lakes shoreline and coastal regions, some fragile, receive pressure from weekend vacationers, as well as year-round property owners and development. 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, 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” is under development. [A/AS-1](#)

Great Lakes Nature-Based (Green) Coastal Shoreline Protection, Coastal Engineering Outreach and Promotion of Appropriate Use in Great Lakes Applications (Bechle) – Nature-based coastal shoreline protection methods use a range of nature-based stabilization techniques combined with traditional “gray” methods to provide a proven and cost-effective alternative. Gray solutions involve concrete, steel and stone shoreline protection. This work will continue efforts that partner with stakeholders, learn from successful nature-based demonstration projects, identify locations and provide outreach. An upcoming publication, “Nature-Based Shorelines for Wisconsin’s Great Lakes Coasts,” will summarize the current status. [A/AS-1](#)

Wisconsin Coastal Atlas (Hart) – Sea Grant collaborates with partners to apply geospatial technologies to better understand Great Lakes coastal management. The Wisconsin Coastal Atlas is a part of the coastal spatial data infrastructure for Wisconsin and the Great Lakes region. Sea Grant will: 1) partner with the Wisconsin State Cartographer’s Office and the Robinson Map Library at the University of Wisconsin-Madison to add

coastal data to [GeoData@Wisconsin](mailto:GeoData@Wisconsin.gov), 2) include additional decision tools and learning resources to the atlas and 3) collaborate with the International Coastal Atlas Network.

A/AS-1

Wisconsin Coastal Guide (Hart) – Travel can both sustain local economies and promote stewardship of scenic and cultural resources. The Wisconsin Coastal Guide is an interactive web-mapping site promoting coastal heritage tourism along Great Lakes Circle Tour routes. Sea Grant will: 1) leverage innovative story map technology to enhance the guide, 2) use coastal photography to attract new visitors to the coast and 3) include place-based learning activities to promote discovery and exploration of cultural heritage and scenic resources. A/AS-1

Weather-Ready Nation (Peroff) – Sea Grant has partnered with the National Weather Service to assess how severe and routine weather information is communicated to Wisconsin’s socially and economically disadvantaged communities, which may lack the technological or financial means to adequately prepare and recover from severe events. Alternative mechanisms will be identified to ensure equitable access to weather information. A/AS-1

Tackling Barriers to Green Infrastructure Through Policy (Noordyk) – Extreme rainfall events are expected to continue to increase in the Great Lakes region, causing more frequent and intense flooding and water-quality problems. Green infrastructure is a proven and effective means to improve water quality and habitat. It can reduce flooding damage and stormwater pollution and volume, but there remain critical barriers to its implementation. Based on the work of 1000 Friends of Wisconsin, Sea Grant developed “Tackling Barriers to Green Infrastructure: An Audit of Local Codes and Ordinances,” a workbook to help communities audit, revise and prioritize codes to increase the adoption of green infrastructure. A/AS-1

Building Resilient Coastal Communities (Noordyk) – Increasing frequency and severity of storms has led to flooding in many of Wisconsin’s coastal communities. Green infrastructure can help communities alleviate flooding and provides additional community benefits in water quality, open space and public health. This effort will focus on planning and implementation of green infrastructure practices to reduce the impacts of storms and increase coastal community resilience. [A/AS-1](#)

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 will work 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-1](#)

Climate Change Impacts on Lake Superior (Chin) – With renewed state of Wisconsin-sponsored Wisconsin Initiative on Climate Change Impacts activities, 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-1](#)

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-1](#)

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 his/her watershed; and is able to make informed and responsible decisions regarding Great Lakes and watershed resources. Wisconsin Sea Grant advances these 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.

The efforts build on a 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 all state citizens. Geographically, Wisconsin is situated in the nation's heartland with its shifting economy — from traditional manufacturing sectors to a diversified economy. Technology and jobs resulting from the freshwater resources of the state provide a solid platform for potential growth.

National and Wisconsin Sea Grant Goals

- An environmentally literate public that is informed by lifelong formal and informal 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 communities are knowledgeable and equipped with the best available science and technology in order to contribute to adaptive management planning processes and stewardship.
- Teachers and students are better informed in science, technology, engineering and mathematics fields and can employ their knowledge to support sustainable practices within their communities throughout Wisconsin.
- 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 informal science education.
- 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.

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- The existing and future workforce is able to adapt and thrive in changing environmental, social and economic conditions.

Wisconsin Strategies

- Support research that will provide robust data about the current level of Great Lakes and water literacy in Wisconsin students to serve as a foundation for future education efforts in the state.
- Work with education partners to promote Great Lakes literacy principles within formal and informal learning environments.
- Develop Pre-K-12 resources that address the Great Lakes literacy principles and support state and national educational standards.
- Support education projects that incorporate innovative technologies or practices in 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 citizens in local stewardship.
- Identify and promote Great Lakes-related career pathways in Wisconsin.

Projects

A Systems Thinking Approach to Building Great Lakes-Related Career Pathways and Improving Great Lakes Literacy Messaging

Rebecca Abler, UW-Green Bay, (920) 683-4700, ablerr@uwgb.edu

Richard Hein, UW-Green Bay

James Kettler, Lakeshore Natural Resource Partnership

Kendra Kelling, Lakeshore Natural Resource Partnership

Jacob Fincher, Southeast Wisconsin Watersheds Trust

Deidre Peroff, Wisconsin Sea Grant

Engaging undergraduate students in research supports recruitment and retention in STEM fields and connects them to their community. In this project, students supervised by faculty and a graduate student will collect water quality data on Lake Michigan tributaries during a summer internship, providing them real-world research experience. In turn, the interns will work with project investigators to communicate information to a secondary audience — local citizens, decision-makers, government agencies, land managers, regional water organizations and peers — as well as presenting their results at the Lakeshore Water Summit and other forums. Engaging students early is crucial for success, so during the academic year, faculty and interns will work with area high schools to integrate water research activities into their curriculum, discuss post-secondary and career opportunities, and develop relationships with students. This project will also support the creation of the Lakeshore Water Educators Network to encourage collaboration at the secondary level. [E/ELWD-16](#)

Rivers2Lake: A Superior Connection

Deanna Erickson, Lake Superior National Estuarine Research Reserve, (715) 399-4086, deanna.erickson@wisc.edu

Ryan Feldbrugge, Lake Superior National Estuarine Research Reserve

Melissa Kjelvik, Superior Rivers Watershed Association

Over the past six years, the Rivers2Lake program has built a community of educators dedicated to sharing the Great Lakes with their students. Since 2012, Rivers2Lake staff have worked with 77 teachers and 2,640 students in their classrooms, spending a year providing support in the classroom as they integrate Lake Superior science, history, research and stewardship into the curriculum. The effects have been transformative. Teachers report increased student scientific literacy in their classrooms, and evaluation results demonstrate significantly increased student engagement. This project will broaden support for Lake Superior-focused place-based learning at the school district and regional level by working directly with curriculum coaches employed in the curriculum development office at the Superior School District. It extends training opportunities along the south shore of Lake Superior by partnering with the Superior Rivers Watershed Association. [E/ELWD-17](#)

Teaching Under the Surface: Underwater Photography Joining Arts, Ecosystem Exploration and Scientific Knowledge to Unite Current and Future Environmental Leaders

Toben Lafrançois, Northwest Passage, (715) 209-7452, toben@lakewolves.org

Ian Karl, Northwest Passage

Most people do not directly experience aquatic systems from the inside, presenting a challenge for fostering aquatic stewardship. This project opens up the freshwater world first by providing access to immersive experiences for teens from underserved populations and secondly sharing that experience publicly through underwater photography. Northwest Passage is a treatment facility that pioneered the use of outdoor experiences

as mental health treatment alongside traditional counseling and psychiatric care. Under the Surface is a signature program that blends arts, ecology and underwater photography with mental health. Students' photographs are displayed in exhibits, reigniting each viewer's sense of stewardship. An extension of this program (Zaaga'igan Ma'iinganag / Lakewolves) serves teens from coastal communities with photography expeditions through the lens of ecological science and Ojibwe cultural history. This project will broaden our educational and therapeutic impact to more teachers, elders and conservation leaders while continuing to deliver our truly immersive educational experience.

E/ELWD-18

Outreach

Great Lakes Education in the Wisconsin Idea (Moser, Carlton) – The foundation of Wisconsin's public university system is the "Wisconsin Idea," the premise that knowledge gained on state campuses should be shared with all state citizens to improve their quality of life. Sea Grant partners with a wide variety of University of Wisconsin and other education and outreach programs to support K-12 and public enrichment programs in both formal and informal learning environments. A/AS-1

Wisconsin Participation in the Center for Great Lakes Literacy (Moser, Carlton, Gen) – The Center for Great Lakes Literacy builds upon the framework of the Great Lakes Literacy Principles, with a vision to develop a Great Lakes-literate public capable of effectively contributing to the environmental, economic and social sustainability of the Great Lakes. Opportunities include an annual Great Lakes shipboard science workshop aboard the U.S. Environmental Protection Agency's R/V Lake Guardian, a science sail workshop on the replica tall ship S/V Denis Sullivan, land-based watershed workshops, Great Lakes

Awareness Day events for the public in partnership with local communities, an educational kit loan program, Educator Day at the International Association for Great Lakes Research Conference, and support for citizen science and other activities spurring adult and youth involvement in watershed restoration. [A/AS-1](#)

Great Lakes Education Projects in Wisconsin (Moser, Carlton) – Sea Grant’s education coordinator manages peer-reviewed project grant funding as part of Sea Grant’s biennial requests for research proposals in support of the goals of the education and workforce development focus area that track closely with other National Oceanic and Atmospheric Administration (NOAA) and state education partners. Education staff also provide outreach support to those projects to amplify their reach. [A/AS-1](#)

Arts, Sciences and Humanities (Moser) – Sea Grant fosters interdisciplinary collaborations among professionals in science, arts and the humanities by sponsoring and participating in events intersecting the disciplines. These collaborations are an innovative way to communicate the challenges facing the Great Lakes and provide opportunities to reach wider and more diverse audiences. [A/AS-1](#)

Library Collections and Outreach (Moser) – The Wisconsin Water Library preserves water-related publications in both print and digital format and seeks ways to leverage the collection for Great Lakes science communication. Historical materials maintained by libraries are vital in order to preserve past research, data and trends that contribute to sound decision-making. [A/AS-1](#)

Manoomin Education and Outreach Toolkit (Peroff) – Manoomin (wild rice) is essential to the identity of the Ojibwe people. With coordination among the Michigan,

Minnesota and Wisconsin Sea Grant programs and Native American nations across the Lake Superior region, education and outreach materials are being developed to demonstrate manoomin's ecological and cultural significance. [A/AS-1](#)

Promote Environmental Justice in Wisconsin's Coastal Communities (Peroff) –

Sea Grant is initiating projects to increase access to and responsible use of coastal resources and opportunities among disenfranchised communities — ensuring water-related risks do not negatively affect one group over another. Social science tools and theory will be applied to local or regional environmental justice projects and may involve risk communication and resiliency, water safety and swimming proficiency, tourism/recreation, water quality, traditional ecological knowledge and other topics. [A/AS-1](#)

Aquaculture K-12 and Beyond (Wiermaa) – 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, including thousands of students and educators annually through interactive facility tours, classroom visits, educator workshops, student 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, leading to high job placement. [A/AS-1](#)

Watershed and Great Lakes Education Experiences (Seilheimer) – Wisconsin's Great Lakes coast is unique, but it can be underappreciated by residents. Working with partners at the Wisconsin Maritime Museum and local school districts, this project will

continue successful NOAA Bay Watershed and Education Training Program teacher professional development while also expanding to specifically increase watershed accessibility and engagement for students with disabilities and their instructors. [A/AS-1](#)

Additional Projects

In addition to the research and outreach 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 Sea Grant Office National Strategic Initiative in Aquaculture

- Great Lakes Sea Grant Aquaculture Collaborative
- Nanobubble Oxygenation of Recirculating Aquaculture Systems to Increase Fish Production
- Building Capacity of Land-Based Atlantic Salmon Aquaculture in the U.S.

National Sea Grant Office National Strategic Initiative in Visioning

NOAA Coastal Resilience Southeast Wisconsin Coastal Resilience

Great Lakes Protection Fund Advancing Stormwater Management at Marinas in the Great Lakes

Great Lakes Protection Fund for Lake Michigan Wisconsin Clean Marina Program for Sustainable Water Resources

U.S. EPA Training the Next Generation

- Abler, Rebecca 40
Angel, Kate 33
Baumgart, Paul 10
Bechle, Adam 30, 33, 34
Binkowski, Fred 23
Booth, Eric 13
Bootsma, Harvey 11
Bravo, Hector 10
Breederland, Mark 33
Breiby, Todd 33
Bunnell, David (Bo) 22
Campbell, Tim 15, 16
Carlton, Ginny 42, 43
Carlton, Stuart 33
Chin, Natalie 36
Cook, Chad 10
Enright, Robert 33
Erickson, Deanna 41
Eshenroder, Randy 22
Feldbrugge, Ryan 41
Fermanich, Kevin 10
Fetzer, Willie 22
Fincher, Jacob 40
Fischer, Gregory 21
Forsythe, Patrick 11
Fowler, Drew 14
Gen, Yael 42
Giese, Erin E. G. 14
Hart, David 34, 35
Hartleb, Christopher 21
Hein, Richard 40
Holmes, Kendall 21
Houghton, Christopher 11
Howe, Robert 14
Huang, Qunying 30
Hunnicutt, David 21
Karl, Ian 41
Kaster, Jerry 10
Kelling, Kendra 40
Kettler, James 40
Kiefer, Victoria 32
Kjelvik, Melissa 41
Klump, J. Val 10, 11
Lafrançois, Toben 41
Liao, Qian 11
Loheide, Steve 30
MacKenzie, Stuart 14
Martinez, Joshua 14
Matteson, Sumner W. 14
McBride, Mark 21
McLellan, Sandra 13
Meadows, Guy 33
Moser, Anne 32, 42, 43
Muir, Andrew 22
Noordyk, Julia 15, 35, 36
Olds, Chris 22
Patrick, Christopher 11
Peroff, Deidre 33, 35, 40, 43, 44
Remucal, Christy 12
Rissman, Adena 13
Rust, Daniel L. 31
Seilheimer, Titus 23, 24, 44
Sepulveda-Villet, Osvaldo J. 21
Smith, Brad 14
Stewart, Richard 31
Stott, Wendylee 22
Thompson, Aaron 33
Thomsen, Tamara 32
Troy, Cary 33
Vander Zanden, Jake 22
Vitousek, Sean 33
Voter, Carolyn 30
Wiermaa, Emma 21, 23, 44
Wolf, Amy T. 14
Wright, Daniel 30
Wu, Chin H. 30, 33
Xue, Pengfei 33
Zant, Caitlin 32

Sea Grant Fellowships/Scholarships

Dean John A. Knauss Marine Policy Fellowship

seagrant.noaa.gov/Knauss-Fellowship-Program

Contact: Jennifer Hauxwell, associate director, University of Wisconsin Sea Grant Institute, (608) 263-4756, jennifer.hauxwell@aqu.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. Twenty-five Wisconsin students have been among those selected for Knauss fellowships since 1982.

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.

Great Lakes Commission/Sea Grant Fellowship

glc.org/about/scholarships-fellowships

Contact: Jennifer Hauxwell, associate director, University of Wisconsin Sea Grant Institute, (608) 263-4756, jennifer.hauxwell@aqu.wisc.edu

A successful fellow will work with members of the Great Lakes' science, policy and information/education communities to advance the environmental quality and sustainable development goals of the Great Lakes states.

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) 263-4756, jennifer.hauxwell@aqu.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.

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

Designed for undergraduates to pursue an in-depth Great Lakes topic under the mentorship of a career professional. This is a 10-week experience and includes a stipend.

Carl J. Weston Memorial Scholarship

go.wisc.edu/9ec36w

Contact: Jennifer Hauxwell, associate director, University of Wisconsin Sea Grant Institute, (608) 263-4756, 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.

Useful Websites

University of Wisconsin Sea Grant Institute

seagrant.wisc.edu

Strategic and Work Plans

seagrant.wisc.edu/about/plans

Funding Opportunities

seagrant.wisc.edu/research

Current and Past Projects

go.wisc.edu/8pezp3

NOAA National Sea Grant College Program

seagrant.noaa.gov

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

Wisconsin 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.

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