



SG

research **outreach**

Biennial Report **2014-16**

University of Wisconsin Sea Grant Institute

research_outreach

FROM THE DIRECTOR

AT WISCONSIN SEA GRANT, we are always searching and reaching for answers.

What are the questions?

Simple ones like: How do we keep people safe from rip currents and other water dangers? How do we help people avoid getting ill from swimming at beaches? How can we work with the National Weather Service to warn people about violent storms? How can we clean the Great Lakes of marine debris? How can we help prevent people's homes from eroding into Lake Michigan?

Finding answers to those questions isn't so simple. But we have some of the best minds at Wisconsin's top-notch academic institutions working on them, as I hope you'll see by looking at our accomplishments from 2014-16. And it's not only our faculty and student researchers who are outstanding, our Sea Grant staff members are too. They provide strong administrative support and get scientific results out to Wisconsin residents through communications and extension efforts.

Evidence of our success has come in the form of recent reviews of our program by teams of national experts. Their comments show recognition of our program's excellence:

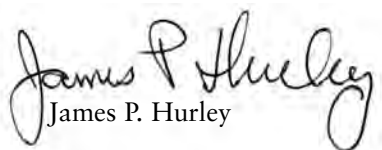
- *"The Wisconsin Idea was almost the first thing the team heard, and it came up repeatedly during the visit from many sources, and was very much in evidence in the work (Sea Grant) did and the services they provided to their Wisconsin stakeholders."*
- *"The program's work to educate and empower your researchers to become better communicators of their work with the constituents who need the information was impressive."*
- Also, our impacts and accomplishments received a national rating of "Highest Performance: exceeds expectations by an exceptional margin in most areas/aspects."

As the National Sea Grant College Program celebrated its 50th anniversary in 2016, 33 programs in coastal states followed similar paths of scientific inquiry. Our current national strategic plan focuses our network to provide integrated research, outreach and education for responsible use of coastal and Great Lakes resources and to support informed personal, policy and management decisions.

This report tells the stories of a subset of our recent efforts in Wisconsin and the Great Lakes. We're proud to be part of such an innovative network of programs and look for continued success for the next half century.

We appreciate your support in our continued quest for answers to benefit the Great Lakes and the people who live along them. I hope you find the information in this report useful and enlightening.




James P. Hurley



12



8

Annual value of
the Great Lakes
regional economy:
\$62 billion



6

From the Director	1
Searching and Reaching in Service of the Great Lakes	4
Reaching Out Over the Largest Lake	6
Searchlight on Safety, Sea Caves Project Saves Lives	8
Improved Warnings for Treacherous Weather	10
On the Beach, A Successful Search for Clean Waves and Sand	12
Budget Overview	15
Wisconsin Sea Grant Mission and Vision Statements and Core Values	16
Leadership	17
Wisconsin Sea Grant Advisory Council	18
Wisconsin Sea Grant Committee on Outreach and Education	19
Partners and Collaborators	20
Publications and Other Information Transfer Publications	25
Resources	30

Searching and Reaching in Service of the Great Lakes

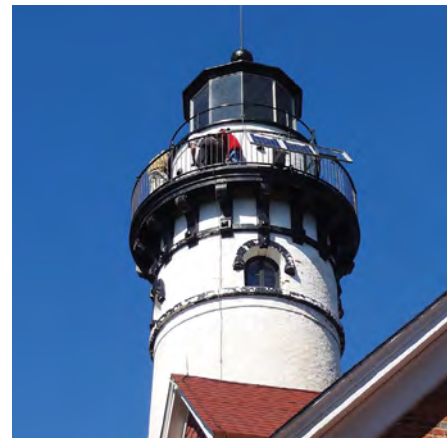
Inherent in every scientific exploration is a quest. It's research with a focus on search — for validation of a prior finding or a journey to arrive at the threshold of a whole new frontier of understanding.

When the object of scientific exploration is the Great Lakes, there is tremendous potential in what will result from the quest, whether it is restored habitat, improved public health or greater economic pay-off from the bounty of our waters.

In the Sea Grant paradigm, one result of a quest is the application of that research to real-world situations and to the benefit of coastal communities and their businesses, residents and visitors. The term of art for that process is outreach, with the emphasis on reach.

Wisconsin Sea Grant's strength is in the research projects it funds across Wisconsin, and in reaching people with that knowledge to protect and use Great Lakes' resources in wise ways. Research findings are not solely bound up in scholarly journals but rather shared with those who can most use them. The findings go to local planners, property owners, fishermen, aquaculturists, fisheries managers, teachers, students, lifelong learners and many others.

This 2014-16 biennial report is a demonstration of the search and reach that goes on for nearly 365 days a year. It happens in labs and lake basins. It involves sampling stations and classrooms. It could be on the swaying deck of a boat or within a village hall. Search and reach are in the service of the world's largest freshwater system. We are glad you are prepared to come along with us on this quest.



Statewide research and outreach clockwise from left: Researchers working atop Outer Island Lighthouse, Apostle Islands; sturgeon spawn, Wolf River; South Shore Beach gets ready for its cleanup, Milwaukee; whitefish processing, Cornucopia; diving the *Australasia* shipwreck in Lake Michigan; Great Lakes Indian Fish and Wildlife Commission



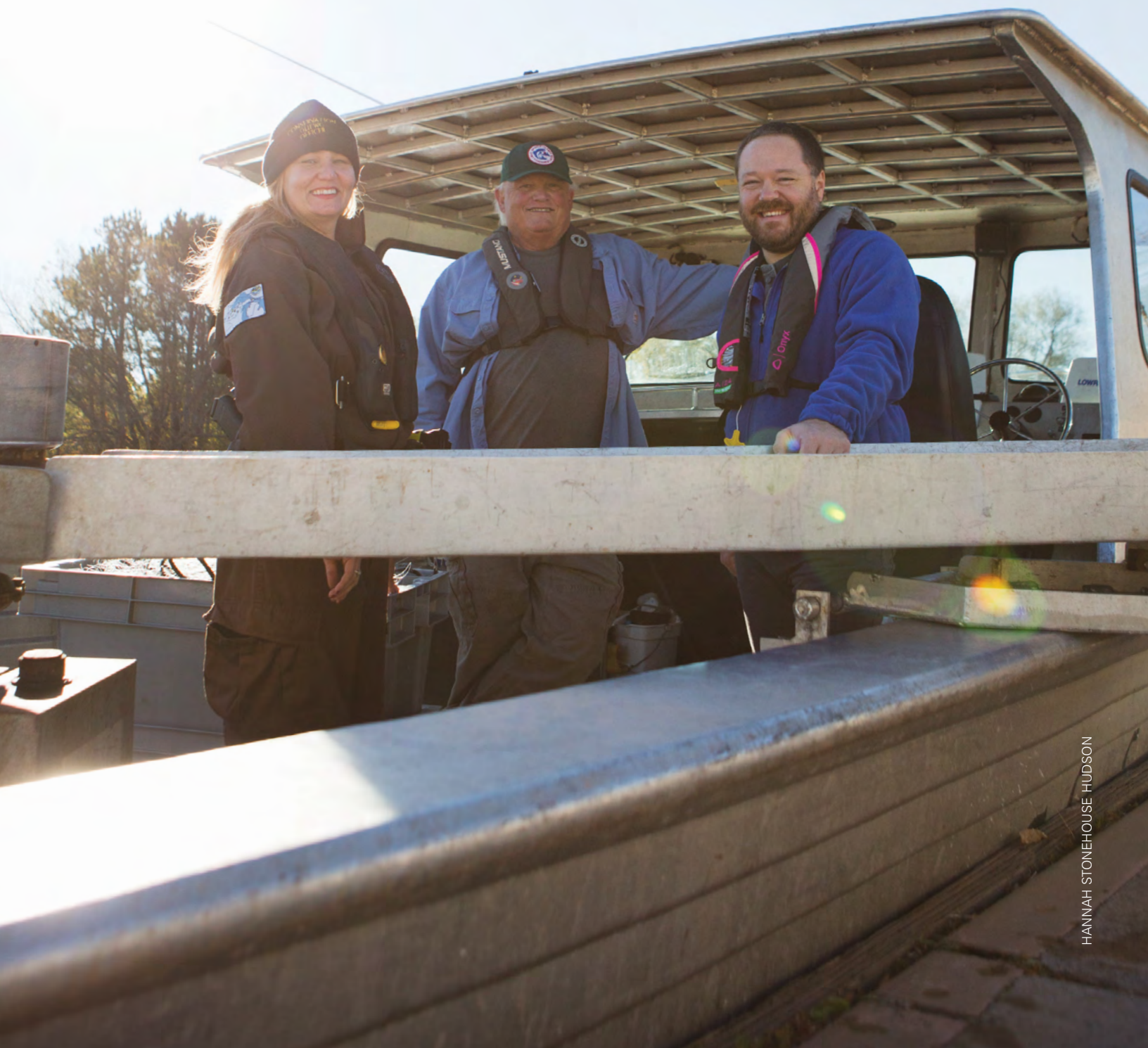
Science and
learning events:
167



partners to reduce fishing conflicts; the National Weather Service's impact-based weather forecast system gives people more time to react before severe weather events like the widespread flooding, road and structure damage in Bayfield in 2016.

Reaching Out

Over the Largest Lake



Lake Superior stretches lengthwise for 350 miles and has the largest surface area of any lake in the world. Because of that expanse, one would think Lake Superior has plenty of room to accommodate every use. Generally, that is true but when it comes to demand for the whitefish and trout that swim in its waters, the big lake can sometimes see overlapping demands from commercial, tribal and sport fishermen.

The commercial and tribal operations stretch nets to ensnare fish, but occasionally the nets break free from their anchors, drifting, rotting and picking up debris, and perhaps even fish or waterfowl. In addition to the pollution they represent, the nets pose a hazard for sport fishermen. An entangled boat or fishing gear can be damaged or cause a capsized craft.

There is a system in place to deal with these ghost nets, as they are termed. When nets are reported, the Wisconsin Department of Natural Resources or the Great Lakes Indian Fish and Wildlife Commission (GLFWIC) will collect them. The challenge has long been one of making boaters aware of ghost nets, along with ensuring cooperation from commercial, tribal and regulatory agencies.

Cooperation had been elusive until Wisconsin Sea Grant stepped in. Aided by a grant from the National Oceanic and Atmospheric Administration's Marine Debris Program, Fisheries Specialist Titus Seilheimer, GLFWIC and Sea Grant's Advisory Council Member Al House brought the parties together. House is the president of the Apostle Islands Sport Fishermen's Association. GLFWIC's Chief Warden Fred Maulson said if it wasn't for Sea Grant, these parties wouldn't even be sitting at the same table, much less reducing fishing conflicts and bringing safety to the Great Lakes.

The initiative also produced an informational video (go.wisc.edu/49084s), provided materials at regional boat shows, and created and shared a poster for boat landings and bait shops. The next step has been workshops, engaging the very people affected by the nets.

**Ghost nets
removed from
Lake Superior
since awareness
campaign began:
5,000 feet**

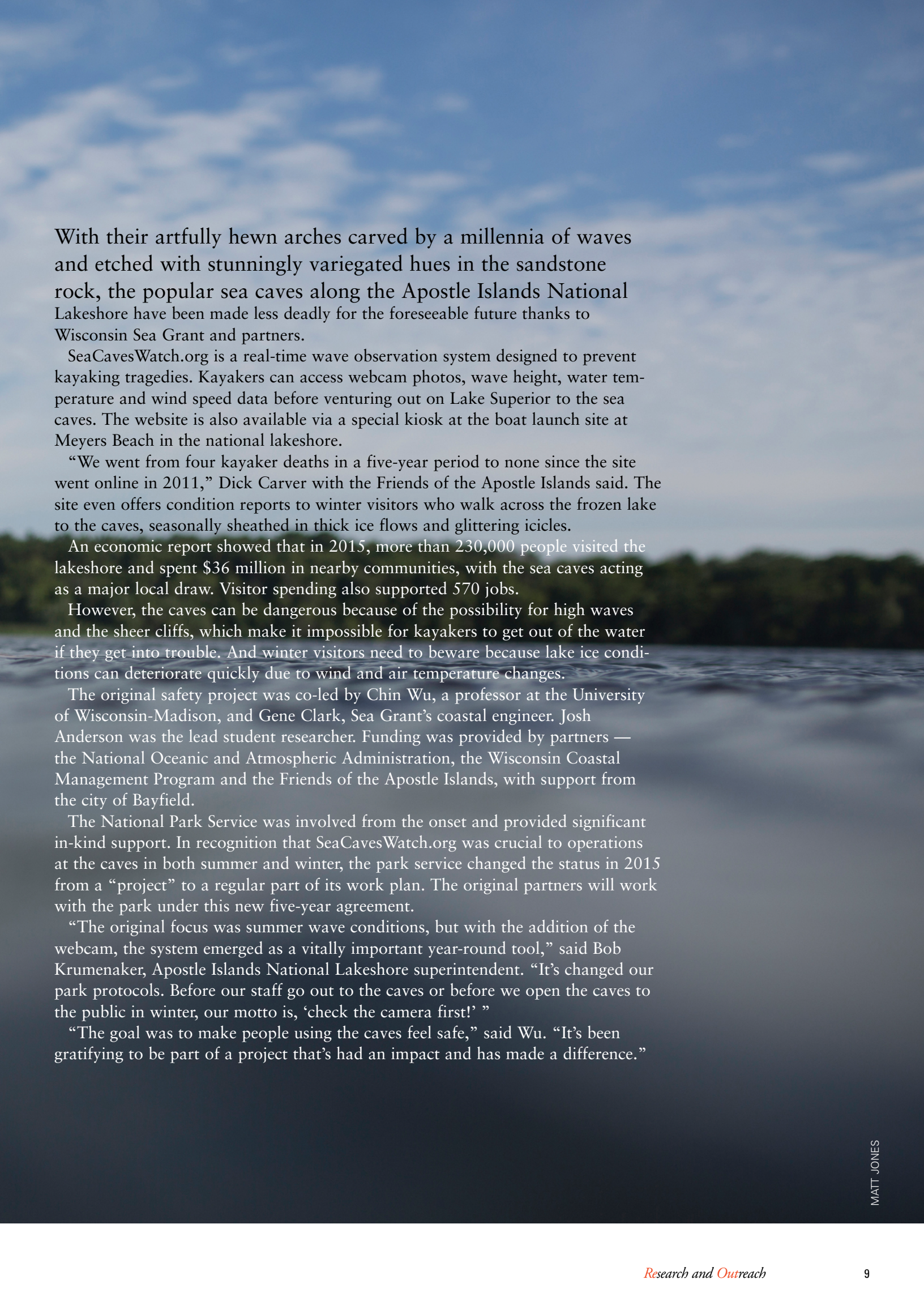
They ain't afraid of no ghost nets. Heather Bliss, outreach officer, Great Lakes Indian Fish and Wildlife Commission; Al House, president, Apostle Islands Sport Fishermen's Association; and our own fisheries specialist, Titus Seilheimer, work together to make ghost nets less of a safety hazard.



Searchlight on Safety, Sea Caves Project Saves Lives

**Deaths at sea caves since
operation of real-time
wave observation system:**

0



With their artfully hewn arches carved by a millennia of waves and etched with stunningly variegated hues in the sandstone rock, the popular sea caves along the Apostle Islands National Lakeshore have been made less deadly for the foreseeable future thanks to Wisconsin Sea Grant and partners.

SeaCavesWatch.org is a real-time wave observation system designed to prevent kayaking tragedies. Kayakers can access webcam photos, wave height, water temperature and wind speed data before venturing out on Lake Superior to the sea caves. The website is also available via a special kiosk at the boat launch site at Meyers Beach in the national lakeshore.

“We went from four kayaker deaths in a five-year period to none since the site went online in 2011,” Dick Carver with the Friends of the Apostle Islands said. The site even offers condition reports to winter visitors who walk across the frozen lake to the caves, seasonally sheathed in thick ice flows and glittering icicles.

An economic report showed that in 2015, more than 230,000 people visited the lakeshore and spent \$36 million in nearby communities, with the sea caves acting as a major local draw. Visitor spending also supported 570 jobs.

However, the caves can be dangerous because of the possibility for high waves and the sheer cliffs, which make it impossible for kayakers to get out of the water if they get into trouble. And winter visitors need to beware because lake ice conditions can deteriorate quickly due to wind and air temperature changes.

The original safety project was co-led by Chin Wu, a professor at the University of Wisconsin-Madison, and Gene Clark, Sea Grant’s coastal engineer. Josh Anderson was the lead student researcher. Funding was provided by partners — the National Oceanic and Atmospheric Administration, the Wisconsin Coastal Management Program and the Friends of the Apostle Islands, with support from the city of Bayfield.

The National Park Service was involved from the onset and provided significant in-kind support. In recognition that SeaCavesWatch.org was crucial to operations at the caves in both summer and winter, the park service changed the status in 2015 from a “project” to a regular part of its work plan. The original partners will work with the park under this new five-year agreement.

“The original focus was summer wave conditions, but with the addition of the webcam, the system emerged as a vitally important year-round tool,” said Bob Krumenaker, Apostle Islands National Lakeshore superintendent. “It’s changed our park protocols. Before our staff go out to the caves or before we open the caves to the public in winter, our motto is, ‘check the camera first!’ ”

“The goal was to make people using the caves feel safe,” said Wu. “It’s been gratifying to be part of a project that’s had an impact and has made a difference.”

Improved Warnings for Treacherous Weather

In 2011, a tornado roared through the small town of Joplin, Mo., killing 159 people and injuring more than 1,000. The extraordinary number of casualties in spite of multiple and early warnings puzzled the National Weather Service (NWS) since there have been vast improvements in warning technology and forecasting. Despite that, many sectors of the public remain vulnerable to severe weather. Just as in Joplin, weather-related devastation has come to countless communities that have been leveled, forcing people to rebuild lives, homes, schools and businesses.

The service decided to improve communication, enhancing traditional tornado watch and warning information. In 2012, the NWS piloted an impact-based weather forecast system. The premise was to use more straightforward language that would convey direct and detailed descriptions of what being in the path of a storm could mean to personal safety and property.

The NWS was interested in evaluating the efficacy of this system and whether it merited expansion nationwide to save lives, and protect infrastructure and other property. The service didn't have its own capacity to do this assessment.

The service's Central Region turned to Wisconsin Sea Grant, a fellow program within the National Oceanic and Atmospheric Administration. Sea Grant coordinated a team of social scientists from the Great Lakes Sea Grant Social Science Network to evaluate a new severe storm communication tool. The assessment included focus groups, surveys and interviews with weather forecasters, emergency managers and broadcast reporters. Following that information gathering and based on Sea Grant's analysis, the NWS modified the warning system to be more effective.

The NWS first implemented the new communication tool throughout the Midwest and Great Lakes states and in succeeding years expanded it nationally. Plus, more than 450 NWS and American Meteorology Society members have been briefed on the Sea Grant information related to the system. Sea Grant programs created a report and fact sheet that have been disseminated and are available at go.wisc.edu/gc1mf9.

A ghostly tornado skips and hops across the central Minnesota landscape as it lifts momentarily, narrowly missing this rural farmstead. Residents in the heartland, and beyond, are better protected from severe weather thanks to Wisconsin Sea Grant.



Annual value of
National Weather
Service activities
to U.S. households:
\$26.4 billion

Annual average
number of days
South Shore
Beach closed
due to poor
water quality:

50

On the Beach,



Science has led the way in the recovery of one Milwaukee beach — Bradford. A second — South Shore — is tapped for attention so they both can regain their popularity as Lake Michigan swimming spots. At South Shore, the efforts have also attracted a half-million dollar corporate donation and \$1 million from the county for cleanup.

South Shore Beach is closed from 20 to 50 percent of the swimming season due to water-quality advisories. Wisconsin Sea Grant-funded research by Sandra McLellan, a microbiologist at the University of Wisconsin-Milwaukee School of Freshwater Sciences, revealed the sources of pollution included local and regional stormwater runoff, and other regional sources such as combined sewer overflows and fecal waste from gulls and waterfowl.

The first improvements planned for South Shore Beach will be focused on the parking lot.

“We support the planned improvements at South Shore Beach,” said Cary Solberg, South Shore Park Watch. “Dr. McLellan’s research helped us determine the primary pollution sources at the beach. Her research has better positioned us to advocate for the best management practices to improve conditions.”

To raise public awareness about the beach issues, Jane Harrison, Wisconsin Sea Grant’s former social scientist, hosted information tables at the South Shore Farmers’ Market and organized community volunteers for monthly trash cleanups.

A Successful Search for Clean Waves and Sand

The research and outreach activities at the beach are modeled after past work at Bradford Beach. Bradford used to attract thousands of people in the early 1930s, but pollution and beach closures slowly made it a less-desirable place to swim. By the end of the century, Bradford was a desolate, wasted half-mile of sand in the heart of Milwaukee used by only a few diehard sunbathers and dog walkers.

McLellan’s Sea Grant-funded research found that local stormwater discharges were a major source of fecal pollution for Bradford Beach. The county and MillerCoors provided a total of \$1.5 million and worked with local partners to improve the beach’s water quality, including construction of a rain garden, a gull-deterrent program, removal of dead nuisance algae and improvements to amenities.

The project was a success and now thousands of visitors have returned to Bradford Beach, which has also earned a coveted national Blue Wave Beach designation from the Clean Beaches Coalition and has been termed one of the nation’s top 10 freshwater beaches by USA Today in 2016.

With McLellan’s findings and the continued work of local partners, it looks like South Shore Beach may be on the same path. Other project partners include Milwaukee County Parks, Friends of South Shore Park, Alliance for the Great Lakes, Milwaukee Metropolitan Sewerage District and the Wisconsin Department of Natural Resources Office of the Great Lakes.

Sandra McLellan’s research is leading to changes. Buffer strips will be planted to separate the beach from paved surfaces, and an in-ground trench drain system on the boat launch will direct runoff away from the lake to a buffer strip basin. Additional plantings will help with other stormwater issues on the site.



**Pounds of
garbage picked
up during beach
cleanup events:
200**



**Wisconsin jobs
created/retained:
5,071**

**Materials in the
Wisconsin Water Library:
30,000**



**Weather forecasts
U.S. adults obtain
each year:
300 billion**



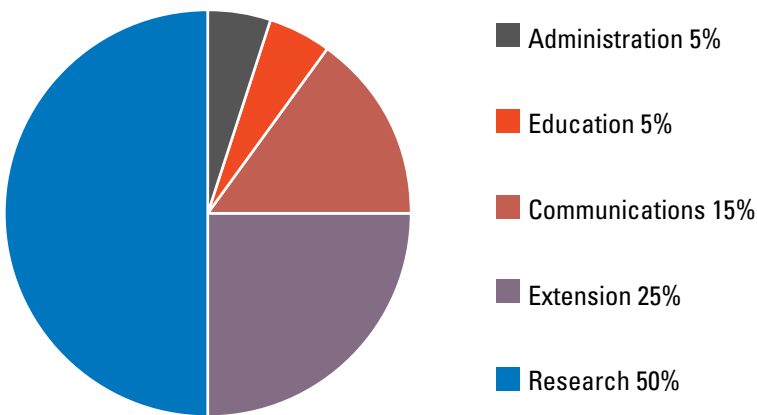
**Acres of restored
Great Lakes
coastal areas:
760**



By the Numbers

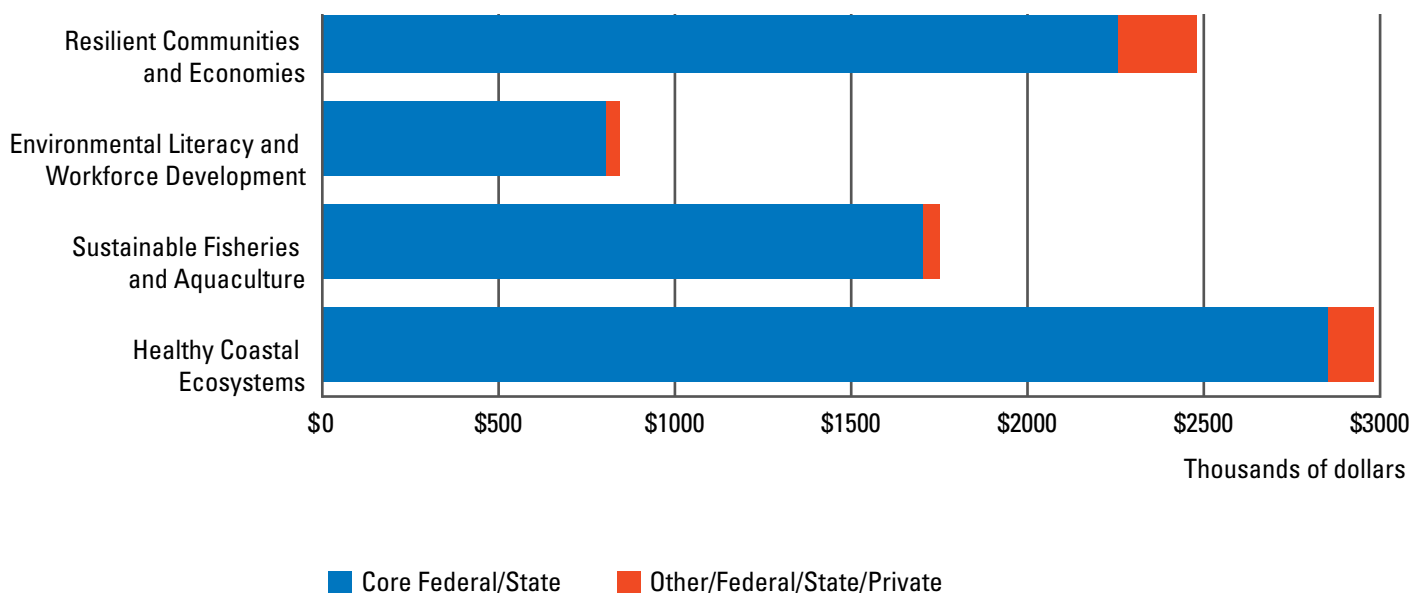
BUDGET OVERVIEW

Funding allocation 2014-16



People reached
at science and
learning events:
16,772

Focus areas 2014-16



Wisconsin Sea Grant Mission and Vision Statements and Core Values

MISSION

Promote the sustainable use of Great Lakes resources through research, education and outreach.

VISION STATEMENT

Thriving coastal ecosystems and communities.

CORE VALUES

Service, science-based, discovery to application, academically grounded, collaborative, inclusive of diversity, educational and visionary.



Addresses

Wisconsin Sea Grant Main Office
1975 Willow Drive
Madison, Wis. 53706-1177
(608) 262-0905

UW-Green Bay MAC 212
2420 Nicolet Drive
Green Bay, Wis. 54311-7001
(920) 465-2795

UW-Manitowoc
705 Viebahn St., Room F103
Manitowoc, Wis. 54220-6699
(920) 683-4697

School of Freshwater Sciences,
UW-Milwaukee
600 E. Greenfield Ave.
Milwaukee, Wis. 53204
(414) 382-1723

Lake Superior National Estuarine Research
Reserve Building
14 Marina Drive
Superior, Wis. 54880
(715) 919-2154

Leadership

Sea Grant has a five-person leadership team, and also benefits from guidance offered by two external bodies. The Sea Grant Advisory Council is appointed by the University of Wisconsin-Madison chancellor, and the Sea Grant Committee on Outreach and Education was formed to provide additional input.

SEA GRANT MANAGEMENT TEAM

Director

James P. Hurley
(608) 262-0905
hurley@aqu.wisc.edu

Assistant Director for Communications

Moira Harrington
(608) 263-5371
moira@aqu.wisc.edu

Assistant Director for Extension

David Hart
(608) 262-6515
dhart@aqu.wisc.edu

Assistant Director for Research and Student Engagement

Jennifer Hauxwell
(608) 263-4756
jennifer.hauxwell@aqu.wisc.edu

Assistant Director for Operations

Terri Liebmann
(608) 263-6747
terri@aqu.wisc.edu



Wisconsin
fishing licenses
issued annually:
1.51 million

WISCONSIN SEA GRANT ADVISORY COUNCIL

James Hurley (Ex-officio), director, UW Sea Grant, University of Wisconsin-Madison

Will Allen, farmer, founder and CEO, Growing Power Inc., Milwaukee, Wis.

Kristine Andrews, assistant vice president, federal relations, University of Wisconsin System, Madison, Wis.

Thomas J. Blewett, former program director, University of Wisconsin Cooperative Extension, Madison, Wis.

Carrie Bristol-Groll, owner of Stormwater Solutions Engineering, Milwaukee, Wis.

Sharon Cook, owner of Sharon D. Cook, LLC, Milwaukee, Wis.

Sheila Coyle, member of the Wisconsin Women Forward for Environmental Education Foundation, Bayfield and Madison, Wis.

Michael Friis, program manager, Wisconsin Coastal Management Program, Madison, Wis.

H. J. (Bud) Harris, professor emeritus, Natural and Applied Sciences, University of Wisconsin-Green Bay, Green Bay, Wis.

Al House, president, Apostle Islands Sport Fisherman's Association, Washburn, Wis.

J. Val Klump, senior director and associate dean of research, School of Freshwater Sciences, University of Wisconsin-Milwaukee, Milwaukee, Wis.

Larry J. MacDonald, former mayor, Bayfield, Wis.

Dreux Watermolen, section chief, Science Information Services, Bureau of Science Services, Wisconsin Department of Natural Resources, Madison, Wis.

Larry Wawronowicz (chair), natural resource director, Lac du Flambeau Band of Lake Superior Chippewa Indians, Lac du Flambeau, Wis.

**Undergraduate,
graduate and
post-doctoral
students
supported:
183**



WISCONSIN SEA GRANT COMMITTEE ON OUTREACH AND EDUCATION

Carmen Aguilar, associate scientist,
School of Freshwater Sciences, University of
Wisconsin-Milwaukee, Milwaukee, Wis.

Bill Brose, principal, JJR, Madison, Wis.

Bart deStasio, professor, Lawrence
University, Appleton, Wis.

Matt Eitrem, geographic information systems
coordinator, city of Ashland, Ashland, Wis.

Mary Erpenbach, president, Cherry
Street Agency, Beloit, Wis.

Denny Fox, national tournament director,
AIM Pro Walleye Series, Little Chute, Wis.

Lee Haasch, president and captain,
Haasch Guide Service, Algoma, Wis.

Vicky Harris, coordinator, Wisconsin
Clean Marina Program, De Pere, Wis.

Lynn Kurth, teacher, Prairie River
Middle School, Merrill, Wis.

Edith Leoso, tribal historic preserva-
tion officer, Bad River Band of Lake
Superior Chippewa, Odanah, Wis.

Marge Louch-Wouters, children's librar-
ian, LochWorks, La Crescent, Minn.

Travis Olson, wetland protection and habitat
restoration coordinator, Wisconsin Coastal
Management Program, Madison, Wis.

Pat Robinson, freshwater estuary
specialist, UW-Green Bay Extension

Jason Serck, economic development/planning
and port director, city of Superior, Superior, Wis.

Angie Tornes, senior planner for
rivers, trails and conservation, National
Park Service, Milwaukee, Wis.

Pat Wilborn, aquaculture farmer,
PortFish Ltd., Port Washington, Wis.



FELLOWS

Wisconsin Sea Grant is committed to fostering the next generation of water science leaders through support for fellowships. From 2014-16, a half-dozen inspiring young people participated in Sea Grant-supported fellowships.

Dean John A. Knauss Marine Policy Fellows

Shelby LaBuhn and Danielle Cloutier have been selected as fellowship finalists for 2017.

Caroline Mosley, 2015

Kristina Surfus, 2015

Catherine Simons, 2015

Sarah Wilkins, 2014

Great Lakes Commission Fellow

Michael Polich, 2016

J. Philip Keillor Fellow

Adam Bechle, 2016

NOAA Coastal Management Fellow

Joe Dwyer, 2016

Partners and Collaborators

GOVERNMENTAL

AmeriCorps
Center for Great Lakes Literacy
Department of Fisheries and Oceans Canada
Executive Office of the President
Federal Emergency Management Agency
Fond du Lac Band of Lake Superior Chippewa
Great Lakes Fishery Commission
Ho-Chunk Nation
Illinois Coastal Management Program
Illinois Department of Natural Resources
Illinois Environmental Protection Agency
Illinois Natural History Survey
Indiana Department of Natural Resources:
Lake Michigan Coastal Program
Julius Kühn-Institut, Federal Research
Centre for Cultivated Plants
Lake Superior National Estuarine
Research Reserve
Michigan Coastal Zone Management Program
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
National Oceanic and Atmospheric
Administration Office for Coastal Management
National Oceanic and Atmospheric
Administration Coastal Storms Program
National Oceanic and Atmospheric
Administration National Marine Sanctuaries
National Oceanic and Atmospheric
Administration National Sea Grant Office
National Oceanic and Atmospheric
Administration National Weather Service
National Oceanic and Atmospheric
Administration Office of Ocean
Exploration and Research
National Park Service
New York State Department of
Environmental Conservation
Ohio Department of Natural Resources
Oneida Tribe of Indians of Wisconsin
Red Cliff Band of Lake Superior Chippewa
U.S. Army Corps of Engineers
U.S. Department of the Interior
Bureau of Indian Affairs
U.S. Department of Transportation
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. Geological Survey
Wisconsin Historical Society
Wisconsin Coastal Management Program
Wisconsin Department of Health Services
Wisconsin Department of Natural Resources
Wisconsin Department of Public Instruction
Wisconsin Department of Tourism
Wisconsin Department of Transportation
Wisconsin Veterinary Diagnostic Laboratory

ACADEMIC

Arizona State University
 Bowling Green State University
 Central Michigan University
 Consortium of Universities for the
 Advancement of Hydrologic Science Inc.
 Cooperative Educational Service Area 6
 Cornell University
 East Carolina University
 Gustavus Adolphus College
 Iowa State University
 Japan Agency for Marine-Earth
 Science and Technology
 Loyola University Chicago
 Marine Biological Laboratory, Woods Hole,
 an affiliate of the University of Chicago
 Marquette University
 Medical College of Wisconsin
 Michigan State University
 Milwaukee Public Schools
 Northwestern Michigan College
 Northland College
 Ohio State
 Oregon State University
 Pennsylvania State University

Purdue University
 St. Norbert College
 Stony Brook University, New York
 University of Connecticut
 University of Illinois
 University of Miami
 University of Michigan
 University of Minnesota Duluth
 University of Minnesota Twin Cities
 University of Notre Dame
 University of St. Thomas
 University of Texas
 University of Vermont
 University of Wisconsin-Extension
 University of Wisconsin-Green Bay
 University of Wisconsin-Madison
 University of Wisconsin-Milwaukee
 University of Wisconsin-Manitowoc
 University of Wisconsin-Oshkosh
 University of Wisconsin-Stevens Point
 University of Wisconsin-Superior
 Uppsala University
 Yale University



**Partnering and
 collaborating
 organizations:
 240**





**Volunteer
hours:
4,139**

LOCAL, MUNICIPAL, COUNTY AND TRIBAL

- Bay-Lake Regional Planning Commission
- Bayfield, county
- Brown, county
- Chicago, city
- City of Milwaukee Health Department
- City of Racine Health Department
- Public Health Madison & Dane County
- Door, county
- Douglas, county
- East Central Wisconsin Regional Planning Commission
- Fox-River Valley County Land Conservation Departments
- Fox-Wolf Watershed Alliance
- Great Lakes Indian Fish and Wildlife Commission
- Marinette, city
- Metropolitan Water Reclamation District of Greater Chicago
- Milwaukee, city
- Milwaukee, county
- Milwaukee Metropolitan Sewerage District
- NEW Water
- Northwest Regional Planning Commission, Wisconsin
- Ozaukee, county
- Racine, city
- Sheboygan, city
- Sheboygan, county
- South Milwaukee, city
- Southeastern Wisconsin Regional Planning Commission
- Vilas County Land and Conservation

BUSINESSES AND NONGOVERNMENTAL ORGANIZATIONS

- 1000 Friends of Wisconsin
- Abbey Marina, Lake Geneva
- AlgaXperts, LLC
- Alliance for the Great Lakes
- AMI Consultants
- American Boat and Yacht Council
- American Planning Association
- Apostle Islands Sportfisherman's Association
- AquaTerra Farms
- Association of Public and Land-Grant Universities
- Association of State Floodplain Managers
- The Bass Federation
- Bayfield City Dock
- Birchline Planning, LLC
- Blue Iris Fish Farm, LLC
- Braise
- Cabela's Masters Walleye Circuit
- Central States Water Environment Association - Wisconsin Section
- Centro Hispano
- Chequamegon Bay Area Partnership
- Clean Bay Backers
- Clean Wisconsin
- Coolwater Farms, LLC
- David and Julia Uihlein Charitable Foundation Inc.

Door County Maritime Museum
 Ducks Unlimited
 Ecosystem-Based Management Tools Network, NatureServe
 Egg Harbor Marina
 Escuela Verde
 Esri
 FarmedHere
 Forequarter
 Fort Fremont Marine
 Fox Brothers Charter Service
 Fox-Wolf Watershed Alliance
 Friends of the Apostle Islands National Lakeshore
 Friends of the Manitowoc River Watershed
 Friends of South Shore Park
 Fund for Lake Michigan
 Gathering Waters Conservancy
 Gaslight Pointe Marina, Racine
 Great Lakes Commission
 Great Lakes Ecological Services, LLC
 Great Lakes Shipwreck Preservation Society
 Great Lakes Shipwreck Research Foundation
 Great Lakes Observing System
 Greater Milwaukee Committee
 Groundwork Milwaukee
 Growing Power Inc.
 Harbor Centre Marina, Sheboygan
 Harbor Club Marina, Sturgeon Bay
 Henriksen Fisheries
 International Coastal Atlas Network
 Jerry's Dock & Shoreline, Shawano
 Kingdom Animalia Exotic Animal Rescue
 Lakeshore Culinary Institute
 Lake Michigan Stakeholders
 Lakeshore Natural Resource Partnership
 Lakeshore Towers Marina, Racine
 Living Adventure Inc.
 Madison Area Chefs Network
 Manitowoc Marina
 McKinley Marina, Milwaukee
 Metcalfe's Market
 MillerCoors
 Milwaukee Riverkeeper Inc.
 Milwaukee Talent Dividend
 National Association of Counties
 National States Geographic Information Council
 National Professional Anglers Association
 The Nature Conservancy
 Nestegg Marine, Marinette
 Northside Enterprises
 Northwest Passage
 Oconto County 4-H
 Outpost Natural Foods
 Pet Industry Joint Advisory Council
 Pikes Bay Marina
 Port of Duluth-Superior, Twin Ports
 Port Washington Marina
 Princess Marissa Sportfishing
 Racine Riverside Marina
 Racine Yacht Club
 River Alliance of Wisconsin
 Riveredge Nature Center
 Salmon Specialist Sportfishing Charters
 Seafood Center
 Seagull Marina
 Shorebirds Powered Parachute Club
 Sixteenth Street Community Health Centers



**Average length
 of a trap net:
 2,500 feet**



- SkipperBud's marinas
- South Bay Marina
- Southeast Michigan Council of Governments
- South Shore Yacht Club
- Southport Marina
- St. Croix Marina
- Superior and Douglas County Chamber of Commerce
- Superior Public Museums
- Susie Q Fish Co.
- Sweet Water, Southeastern Wisconsin Watersheds Trust Inc.
- ThedaCare
- Urban Ecology Center
- Urban Farm Project
- Van's Catch Sport Fishing
- Washburn Marina
- The Water Council
- West Shore Marine
- Wildlife Forever
- Will Allen Farms, LLC
- Willy Street Co-op
- Wisconsin Academy of Sciences, Arts and Letters
- Wisconsin Alumni Association
- Wisconsin Commercial Ports Association
- Wisconsin Environmental Education Board
- Wisconsin Federation of Great Lakes Sport Fishing Clubs
- Wisconsin Green Industry Federation
- Wisconsin Harbor Towns Association
- Wisconsin Marina Association
- Wisconsin Maritime Museum
- Wisconsin Underwater Archaeology Association
- Wisconsin Waterfowl Association
- Wisconsin Wastewater Operators' Association
- Woodland Dunes Nature Center and Preserve



Publications and Other Information Transfer Publications

Akins, AL, MJ Hansen, and MJ Seider. Effectiveness of a Refuge for Lake Trout in Western Lake Superior II: Simulation of Future Performance *North American Journal of Fisheries Management* 35, 1003-1018 DOI:10.1080/02755947.2015.1074960 (DOI) (2015)

Anderson, JD, CH Wu and DJ Schwab. Wave Climatology in the Apostle Islands, Lake Superior *Journal of Geophysical Research-Oceans* DOI:10.1002/2014JC010278 (2015)

Althouse, B, SN Higgins and MJ Vander Zanden. Benthic and Planktonic Primary Production Along a Nutrient Gradient in Green Bay, Lake Michigan, USA *Freshwater Science* 33: 487-498 (2014)

Baker, TR, RE Peterson and WHeideman. Using Zebrafish as a Model System for Studying the Transgenerational Effects of Dioxin *Toxicological Sciences* 1-9 doi:10.1093/toxsci/kfu006 (2014)

Bechle, AJ, DAR Kristovich and CH Wu. Meteotsunami Occurrences and Causes in Lake Michigan *Journal of Geophysical Research Oceans* 120, 1-17 DOI: 10.1002/2015JC011317 (DOI) (2015)

Bocast, C, RM Bruch and RP Koenigs. Sound Production of Spawning Lake Sturgeon (*Acipenser fulvescens* Rafinesque, 1817) in the Lake Winnebago watershed, Wisconsin, USA *Journal of Applied Ichthyology* DOI:10.1111/jai.12556 (2014)

Burns, FR, KA Lanham, KM Xiong, AJ Gooding, RE Peterson, W Heideman. Analysis of the Zebrafish *sox9b* Promoter: Identification of Elements that Recapitulate Organ-specific Expression of *sox9b* Gene DOI:10.1016/j.gene.2015.12.041(DOI) (2015)

Campbell, T. Great Lakes Biotic fact sheet (2015)

Campbell, T. Clean Boats—Clean Tournaments fact sheet (2014)

Campbell, T. Clean Boats—Clean Tournaments: How About a Boat Wash Station brochure (2014) Carey, DE, DH Zitomer, KR Hristova, AD Kappell and PJ McNamara. Triclocarban Influences Antibiotic Resistance and Alters Anaerobic Digester Microbial Community Structure *Environmental Science & Technology* 50, 126-134 DOI: 10.1021/acs.est.5b03080 (2016)

Cary, TL, ME Ortiz-Santaliestra and WH Karasov. Immunomodulation in Post-Metamorphic Northern Leopard Frogs, *Lithobates pipiens*, Following Larval Exposure to Polybrominated diphenyl ether *Environmental Science and Technology* 48 (2014) 5910-5919 (2014)

Clark, G. Great Lakes Accelerated Freshwater Harbor Corrosion fact sheet (2015)

Cloutier, DD, EW Alm and SL McLellan. The Influence of Land-Use Nutrients, and Geography on Microbial Communities and Fecal Indicator Abundance at Lake Michigan Beaches *Applied and Environmental Microbiology* DOI:10.1128/AEM.00233-15 (2015)

**Value of
commercial fish
harvested from
Wisconsin's
Great Lakes:
\$23 million**



**Brand-new
science,
technology,
engineering
and math
Pre-K-4th grade
learning kits:**

3

Crawford, JT, and AG Stone. Relationships Between Soil Composition and *Spartina alterniflora* Dieback in an Atlantic Saltmarsh *Wetlands DOI 10.1007/s13157-014-0588-0* (2014)

DeVilbiss, SE, ZJ Zhengzhen, JV Klump and L Guo. Spatiotemporal Variations in the Abundance and Composition of Bulk and Chromophoric Dissolved Organic Matter in Seasonally Hypoxia-Influenced Green Bay, Lake Michigan, USA *Science of the Total Environment 565: 742-757* (2016)

Driscoll, ZG, and HA Bootsma and E Christiansen Zooplankton Trophic Structure in Lake Michigan as Revealed by Stable Carbon and Nitrogen Isotopes *Journal of Great Lakes Research DOI:10.1016/j.jglr.2015.04.012* (2015)

Ferrie, GM, VC Alfrod, J Atkinson, E Baitchman, D Barber, WS Blaner, G Crawshaw, A Daneault, M Dierenfeld, M Finke, G Fleming, R Gagliardo, EA Hoffman, WH Karasov, E Klasing, E Koutsos, J Lankton, SR Lavin, A Lentini, S Livingston, B Lock, T Mason, A McComb, C Morris, AP Pessier, F Olea-Popelka, T Probst, C Rodriguez, K Schad, K Semmen, J Sincage, MA Stamper, J Steinmetz, K Sullivan, S Terrell, N Wertan, CJ Wheaton, B Wilson and EV Valdes. Nutrition and Health in Amphibian Husbandry *Zoo Biology 33(6):485-501* (2014)

Ghylin, TW, SL Garcia, F Moya, B Oyserman, P Schwientek, KT Forest, J Mutschler, J Dwulit-Smith, L Chan, M Martinez Garcia, A Sczyrba, R Stepanauskas, H Grossart, T Woyke, F Warnecke, R Malmstrom, S Bertilsson and KD McMahon. Comparative Single-Cell Genomics Reveals Potential Ecological Niches for the Freshwater act Actinobacteria Lineage *ISME Journal 2014 Dec; 8(12):2503-16* (2014)

Gleason, SM, M Yahn and WH Karasov. Digestive Efficiency of Northern Leopard Frog (*Lithobates pipiens*) Tadpoles During Development, Reared on a Laboratory Diet *Herpetologica 72(2):107-113* (2016)

Graham, LE, JJ Knack, JM Graham and SB Zulkifyly. A Metagenome for Lacustrine Cladophora Reveals Surprising Diversity of Eukaryotic Epibionts and Genes Related to Materials Cycling *Journal of Phycology 51 (3), 408-418* (2015)

Kline, K. *Guide for Retailers, Restaurants and Culinary Schools* (2016)

Halliday, E, SL McLellan, LA Amaral-Zettler, ML Sogin and RJ Gas. Comparison of Bacterial Communities in Sands and Water at Beaches With Bacterial Water Quality Violations *PLoS One DOI:10.1371/journal.pone.0090815* (2014)

Happel, A, S Creque, J Rinchar, T Hook, H Bootsma, J Janssen, D Jude and S Czesny. Exploring Yellow Perch Diets in Lake Michigan Through Stomach Content, Fatty Acids, and Stable Isotope Ratios *Journal of Great Lakes Research DOI:10.1016/j.jglr.2015.03.025* (2015)

Harrington, M. Science for the Safeguarding and Sustainable Use of Wisconsin's Waters Fact Sheet (2014)

Harrington, M. Science for the Sustainable Use of Wisconsin's Great Lakes Resources Fact Sheet (2014)

Harrington, M, M Zhuikov and E White. UW Sea Grant Biennial Report 2012-14 (2014)

Harrington, M. Shipwrecks Website postcard (2014)

Harrison, J. Economic Impacts of Restoring Wisconsin's Sheboygan River fact sheet (2014)

Harrison, J. Social Science and Severe Weather: Evaluating a New Tornado Risk Communication Tool Report Fact Sheet (2014)

Harrison, J. Evaluation of the National Weather Service Impact-Based Warning Tool fact sheet (2014)

Higgins, SN, B Althouse, SP Devlin, Y Vadeboncoeur and MJ Vander Zanden. Large-bodied Grazers Alter the Autotrophic Structure and Total Ecosystem Productivity of Lakes *Ecology* 95(8):2257-2267 (2014)

Host, G, C Hagley, D Hart, RAxler, R Fortner, M Axler, V Smith, A Drewes, W Bartsch, N Danz, J Mathews and M Wagler. Linking Place-based Science to People Through Spatial Narratives of Coastal Stewardship Silbernagel *Journal of Coastal Conservation* 19, 181-198 DOI: 10.1007/s11852-015-0380-1 (2015)

Johnson, MJ, MJ Hansen and MJ Seider. Effectiveness of a Refuge for Lake Trout in Western Lake Superior I: Empirical Analysis of Past Performance *North American Journal of Fisheries Management* (2015) 35, 988-1002 DOI:10.1080/02755947.2015.1074959 (2015)

Kappell, AD, MS DeNies, NH Ahuja, NA Ledebor, RJ Newton and KR Hristova. Detection of Multi-Drug Resistant Escherichia coli in the Urban Waterways of Milwaukee, WI *Frontiers of Microbiology* DOI:10.3389/fmicb.2015.00336 (2015)

Karl, J, and K Kline. Educating Students of All Ages About the Great Lakes (2015)

Karl, J, and A Moser. Wisconsin Water Library (2015)

Karl, J. A Little Weather Problem (2015)

Karl, J. National Site Review Reception (2015)

Karl, J. Beautiful Waters Gardens (2015)

Karl, J. Loosestrife for Lunch (2015)

Karl, J. Avoid the Trap (2015)

Karl, J, and J Noordyk. Helping Coastal Communities (2015)

Karl, J. Clean Boats, Clean Tournaments video (2014)

Karl, J. Clean Bay Backers Cruise video (2014)

Karl, J. Mapping the Cribs (2014)

Karl, J. Mapping Davidson's Adriatic (2014)

Karl, J. A Cold Shoot on Lake Superior (2014)

Karl, J. Ghost Net Filming (2014)

Karl, J. Bad Day Fishing (2014)

Karl, J. Got Oaks? (2014)

Karl, J. Drought in Southwest Wisconsin as Told by Oaks (2014)

Kline, K. Eat Wisconsin Fish brochure (2014)





Commercial fishers in Wisconsin: 70

Kohl, KD, TL Cary, WH Karasov and MD Dearing. Larval Exposure to Polychlorinated biphenyl 126 (PCB-126) Causes Persistent Alteration of the Amphibian Gut Microbiota *Environmental Toxicology and Chemistry* DOI:10.1002/etc.2905 (2015)

Kornis, MS, BC Weidel and MJ Vander Zanden. Divergent Life Histories of Invasive Round Gobies (*Neogobius melanostomus*) in Lake Michigan and Its Tributaries *Ecology of Freshwater Fish* DOI:10.1111/eff.12300 (2016)

Kornis, MS, J Carlson, G Lehrer-Brey and MJ Vander Zanden. Experimental Evidence That Ecological Effects of an Invasive Fish Are Reduced at High Densities *Oecologia* 175:325- 334 (2014)

Koskey, A, JC Fisher, MF Fraudt, RJ Newton and SL McLellan. Analysis of the Gull Fecal Microbial Community Reveals the Dominance of *Catellibacterium marimammalium* in Relation to Culturable Enterococci *Applied and Environmental Microbiology* DOI:10.1128/AEM.02414-13 (2014)

Liao, Q, B Wang and PF Wang. In Situ Measurement of Sediment Resuspension Caused by Propeller Wash With an Underwater Particle Image Velocimetry and an Acoustic Doppler Velocimeter *Flow Measurement and Instrumentation* 41, 1-9 (2015)

Lepak, R, Y Runsheng, DP Krabbenhoft, JM Ogorek, Jf DeWild, TM Holsen and JP Hurley. Use of Stable Isotope Signatures to Determine Mercury Sources in the Great Lakes *Environmental Science and Technology Letters* 2(12), 335-341 (2015)

Lin, P, JV Klump and L Guo. Dynamics of Dissolved and Particulate Phosphorus Influenced by Seasonal Hypoxia in Green Bay, Lake Michigan *Science of the Total Environment* 541, 1070-1082 DOI:10.1016/j.scitotenv.2015.09.118 (2016)

Liu, Q, JM Spitsbergen, R Cariou, CY Huang, N Jiang, G Goetz, RJ Hutz, PJ Tonellato and MJ Carvan III. Histopathologic Alterations Associated With Global Gene Expression Due to Chronic Dietary TCDD Exposure in Juvenile Zebrafish *PLoS One* Vol 9 Issue 7 e100910 (2014)

Loken, LC and SK Oliver. Habitat Requirements and Occurrence of *Crematogaster pilosa* (Hymenoptera: Formicidae) Ants Within Intertidal Salt Marshes *Florida Entomologist* 99(1):82-88 (2016)

Magee, MR, CH Wu, DM Robertson, RC Lathrop and DP Hamilton. Trends and Abrupt Changes in 104 Years of Ice Cover and Water Temperature in a Dimictic Lake in Response to Air Temperature, Wind Speed, and Water Clarity *Hydrology and Earth Systems Sciences* 1681-1702 DOI:10.5194/hess-20-1681 (2016)

Mertes, J, T Thomsen and J Gulley. Evaluation of Structure From Motion Software to Create 3D Models of Late Nineteen Century Great Lakes Shipwrecks Using Archived Diver-Acquired Video Surveys *Journal of Maritime Archaeology* 9:173-189 (2014)

Moser, A, and E White. Jump Around With Frogs STEM kit (2015)

Moser, A, and E White. Sink or Float STEM kit (2015)

Mosley, C, and H Bootsma. Phosphorus Recycling by Profunda Quagga Mussels (*Dreissena rostriformis bugensis*) in Lake Michigan *Journal of Great Lakes Research* DOI:10.1016/j.jglr.2015.07.007 (2015)

Noordyk, J, and M Zhuikov. Nuisance Algae on Lake Michigan Shores Fact Sheet (2014)

Peng, L and L Guo. Dynamic Changes in the Abundance and Chemical Speciation of Dissolved and Particulate Phosphorous Across the River-Lake Interface in Southwest Lake Michigan *Limnology and Oceanography* 61: 771-789 (2016)

Roth, R, D Hart, R Mead and C Quinn. Wireframing for Interactive & Web-based Mapping: Designing the NOAA Lake Level Viewer *Cartography and Geographic Information Science*. DOI:10.1080/15230406.2016.1171166 (2016)

Roth, R, C Quinn and D Hart The Competitive Analysis Method for Evaluating Water Level Visualization Tools” In: A Vondrakova, J Brus, and V Vozenilek (eds) *Modern Trends in Cartography, Lecture Notes in Geoinformation and Cartography Chapter 19, pp. 241-256* (2015)

Roth, R, D Hart R Mead and C Quinn. Design Before You Code: Using Wireframes in Support of Interactive and Web-based Mapping *AutoCarto 5-7 October* (2014)

Roth, R, C Quinn and D Hart A Competitive Analysis of Web-based Water Level Visualization Tools *CartoCon Olomouc 25-28 February* (2014)

Seilheimer, T, and L Campbell. Great Lakes Fishes poster (2014)

Seilheimer, T. Commercial Trap Net Location Map (2016, '15, '14)

Sheth, NC McDermott, K Busse and G Kleinheinz. Evaluation of Enterococcus Concentration at Beaches in Door County, WI (Lake Michigan, USA) by qPCR and Defined Substrate Culture Analysis *Journal of Great Lakes Research* 42: 768-774 (2016)

Silva, MR, HR Bravo, D Cherkauer, JV Klump, W Kean and SL McLellan. Effect of Hydrological and Geophysical Factors on Formation of Standing Water and FIB Reservoirs at a Lake Michigan Beach *Journal of Great Lakes Research* 40 (2014) 778-779 (2014)

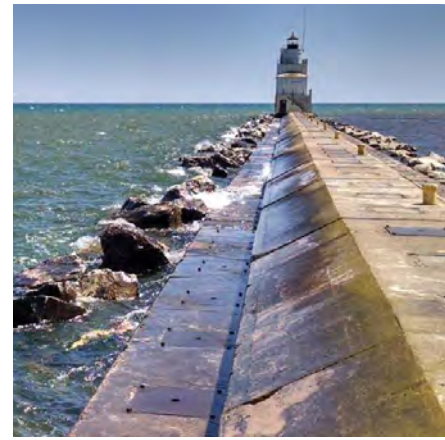
Stepien, CA, OJ Sepulveda-Villet and AE Haponski. Comparative Genetic Diversity, Population Structure, and Adaptations of Walleye and Yellow Perch Across North America 643-689 In *Biology and Culture of Percid Fishes Springer Netherlands* DOI: 10.1007/978-94-017-7227-3_25 Print ISBN 978-94-017-7226 Online ISBN 978-94-017-7227-3 (2015)

Turschak, BA, and HA Bootsma. Lake Michigan Trophic Structure as Revealed by Stable C and N Isotopes *Journal of Great Lake Research* DOI:10.1016/j.jglr.2015.04.004 (2015)

Turschak, BA, D Bunnell, S Czesny, TO Hook, J Janssen, D Warner and HA Bootsma. Nearshore Energy Subsidies Support Lake Michigan Fishes and Invertebrates Following Major Changes in Food Web Structure *Ecology* 95(5):1243-1252 (2014)

Wang, B, Q Liao, J Fillingham and HA Bootsma. On the Coefficients of Small Eddy and Surface Divergence Models for the Air-Water Gas Transfer Velocity *Journal of Geophysical Research-Oceans* DOI:10.1002/2014JC010253 (2015)

White, E, and M Harrington. UW Sea Grant Directory of Projects and People, 2016-18 booklet (2016)



White, E, and M Harrington. UW Sea Grant Directory of Projects and People, 2014-16 booklet (2014)

White, E, Savory Fish Recipes fact sheet (2014)

White, E, Home Canning of Fish fact sheet (2014)

White, E, Home Freezing of Fish fact sheet (2014)

White, E, Home Smoking of Fish fact sheet (2014)

White, E, Home Pickling of Fish fact sheet (2014)

Wilson, A, T Goldberg, S Macquenski, W Olson, F Goetz, P Hershberger, L Hart and K Toohey-Kurth. Development and Evaluation of a Blocking Enzyme-Linked Immunosorbent Assay and Virus Neutralization Assay to Detect Antibodies to Viral Hemorrhagic Septicemia Virus *Clinical and Vaccine Immunology* 21:435-442 (2014)

Wilson-Rothering, A, S Marcquenski, R Koenigs, R Bruch, K Kamke, D Isermann, A Thurman, K Toohey-Kurth and T Goldberg. Temporal Variation in Viral Hemorrhagic Septicemia Virus Antibodies in Freshwater Drum (*Aplodinotus grunniens*) Indicates Cyclic Transmission in Lake Winnebago, *Wisconsin Journal of Clinical Microbiology* DOI:10.1128/jcm.00010-15 (2015)

Yin, R, RF Lepak, DP Krabbenhoft and JP Hurley. Sedimentary Records of Mercury Stable Isotopes in Lake Michigan *Elementa: Science of the Anthropocene* 4.1:000086 (2016)

Zhuikov, M. Research to Safeguard the Quality and Supply of Our Water fact sheet (2014)



RESOURCES

The Wisconsin Sea Grant 2014-17 strategic plan and the work plan for the same period are available at go.wisc.edu/26ed50.

Fact sheets, directories of current and past research projects, posters and other material — much of it available at no cost — is found at seagrants.wisc.edu/publications.

More than 30,000 water-related materials, including new Pre-K-4th grade learning kits, are available at the Wisconsin Water Library, aqua.wisc.edu/waterlibrary.

Connect with us at seagrants.wisc.edu.



Awards

2016 INVADER CRUSADER AWARD from the Wisconsin Department of Natural Resources presented to Tim Campbell, Wisconsin Sea Grant invasive species specialist

2015 GREAT LAKES SEA GRANT NETWORK, OUTSTANDING PROGRAMMING AWARD for the St. Louis River Estuary Stories and Science project

2015 COUNCIL FOR ADVANCEMENT AND SUPPORT OF EDUCATION CIRCLE OF EXCELLENCE AWARD for the 2012-14 Wisconsin Sea Grant Biennial Report

2015 APEX GRAND AWARD for the Eat Wisconsin Fish communications campaign

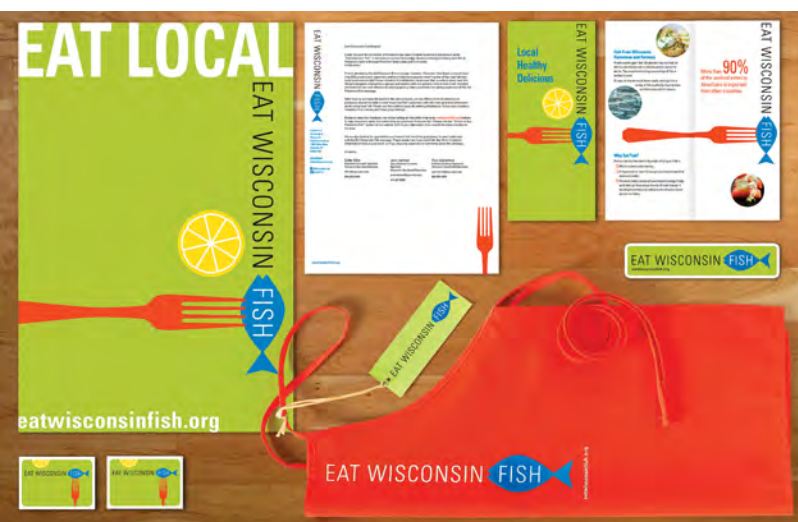
2015 UNIVERSITY OF WISCONSIN REGENTS ACADEMIC STAFF EXCELLENCE AWARD presented to Gene Clark, Wisconsin Sea Grant coastal engineer

2014 RESEARCH TO APPLICATION AWARD from the National Sea Grant Association recognizing work to understand and mitigate damage from accelerated freshwater corrosion of structures within the port of Duluth-Superior

2014 SEA GRANT ASSOCIATION PRESIDENT'S AWARD presented to James Hurley, Wisconsin Sea Grant director



Partner organizations supporting the Lake Superior real-time wave observation system:
10



Consider supporting Wisconsin Sea Grant.
Visit seagrant.wisc.edu and select the red "make a gift" button.

Wisconsin Sea Grant is a unique partnership with public and private sectors combining research, education and technology transfer for public service. Sea Grant is a national network of 33 university-based programs dedicated to enhancing the practical use and conservation of coastal, ocean and Great Lakes resources to create a sustainable economy and environment.

email: publications@aqua.wisc.edu
web: aqua.wisc.edu/publications

Editor: Moira Harrington

Contributors: Linda Campbell, Moira Harrington, Terri Liebmann, Jean Touchett, Elizabeth White and Marie Zhuikov

Art Director/Designer: Yael Gen

Photography: Yael Gen, highway 63 photo courtesy of Bayfield County (page 5), Amanda Hill, Hannah Stonehouse Hudson, Matt Jones, John Karl, Jeff Miller/UW Communications, R.J. and Linda Miller, Kevin J. Miyazaki, David Nevala, Sigrid Peterson, Bryce Richter/UW Communications, Sara Stathas and Marie Zhuikov (cover).

©2016 University of Wisconsin Sea Grant Institute/Board of Regents/
University of Wisconsin System

Publication No. WISCU-Q-16-002

Additional copies are available from:
Publications, UW Aquatic Sciences Center
226 Goodnight Hall, 1975 Willow Drive
Madison, WI 53706-1103
(608) 263-3259

Funding provided by the the National Sea Grant College Program,
National Oceanic and Atmospheric Administration, U.S. Department
of Commerce (grant no. NA10OAR4170070, Project C/C-01)

First Printing: December 2016
Printed in the USA

Breaking

Did I believe I had a clear mind?

It was like the water of a river

flowing shallow over **the ice.** And now

that the rising water has broken

the ice, I see that what I thought

was the light is part of the dark.

—Wendell Berry