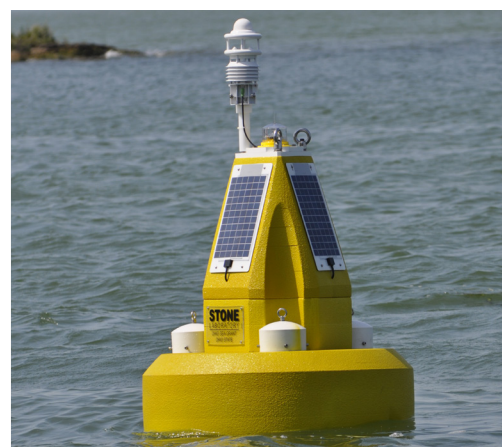


Briefing Book

# OHIO SEA GRANT

## COLLEGE PROGRAM

NOAA Sea Grant Site Visit  
May 7-9, 2019



# PROGRAM MANAGEMENT AND ORGANIZATION

## ORGANIZATION

### Description of Governance within the University

Dr. Chris Winslow is the Director of the Center for Lake Erie Area Research (CLEAR) at The Ohio State University, which includes the Ohio Sea Grant College Program (OHSG) and Stone Laboratory (Lake Erie island campus and field station). Stone Laboratory is the base of operations for many of OHSG's research, education and outreach efforts. Dr. Winslow reports to two Vice Presidents at Ohio State: Dr. Morley Stone, Vice President for Research, and Dr. Cathann Kress, Vice President for Agricultural Administration and Dean of the College of Food, Agricultural and Environmental Sciences (CFAES). CFAES is home to OSU Cooperative Extension and The Ohio State University is a land-grant institution.

**Major changes during the 2014-2018 Strategic Plan:** During the last 13 months of Director Emeritus Reutter's tenure and Winslow's time as both Interim Director (20 months) and Director (last 11 months of strategic plan) the CFAES vice president role was occupied by four different individuals; two in an interim capacity. This turnover influenced OHSG's ability to modify/update the MOU that governs its relationship with university leadership, how the program is funded and how major decisions are vetted and made. The current CFAES Vice President, Dr. Cathann Kress, has been in her position for ~2 years and has begun working with OHSG to formalize a new MOU. In December of 2017 the Vice President for Research, Dr. Carol Whitacre, announced her retirement and her replacement, Dr. Morley Stone, was officially named in June 2018.

### Management Team Composition and Responsibilities

**Dr. Jeffrey M. Reutter, Director (November 1987 – March 2015)**

**Dr. Chris Winslow, Director (Interim April 2015 – January 2017; Director February 2017)**

Oversees all aspects of the program including developing goals, objectives and policies for the program; hiring and managing staff; maintaining facilities and equipment; overseeing fundraising and budgets; writing proposals and serving as principal investigator; awarding grants and scholarships; public speaking; donor development; overseeing development of Stone Lab curriculum; hiring faculty; coordinating legislative/congressional interactions; and leading/serving on state, regional and national boards, task forces, committees and groups.

**Dr. Kristen Fussell, Assistant Director of Administration and Research (July 2014)**

Acts as the Director in the director's absence, serves as research coordinator and liaison for principal investigators (PIs). Responsibilities include coordinating reporting to national office and omnibus submission; coordinating project funding with Ohio State Office of Sponsored Programs; providing university approvals on travel and expenditures; writing proposals and serving as principal investigator on grants; teaching at Stone Lab; developing partnerships with agencies/stakeholders and collaborative proposal development.

**Frank Lichtkoppler, Extension Program Leader (retired September 2014)**

**Tory Gabriel, Extension Program Leader (effective October 2014)**

Responsibilities include Extension program leadership; Extension grant writing, budget development and grant management; assisting in overall Extension outreach programming; and mentoring junior Extension faculty and staff. Responsible for conducting education and outreach programming in Northwest Ohio and the Ohio shoreline relating to fisheries. Supervises four full-time employees.

**Jill Jentes Banicki, Assistant Director of Communications (October 1997)**

Serves as the Communications Manager and Media and University Relations Liaison for the program. Responsibilities include analyzing and developing strategies to increase program visibility and student

recruitment; creating educational and marketing publications, displays and web sites to broaden audience exposure; producing merchandise to increase fundraising efforts; generating grant proposals to expand outreach opportunities; and developing partnerships and collaborative projects at university, state and regional levels.

**Bryan Ford, Business Manager (November 2010)**

Manages fiscal and HR matters for OHSG and Stone Lab. Responsibilities include developing and monitoring budgets and fees; approving expenditures; developing strategies to enhance revenue and reduce expenses; developing and maintaining effective internal controls to ensure compliance with university, state and federal policies; and overseeing all personnel concerns, including appointments, salaries and timekeeping.

**Dr. Kristin Stanford, Education and Outreach Coordinator (July 2012)**

Responsibilities include oversight of all program logistics at Stone Laboratory; develops and implements education and outreach workshops, curricula and courses; maintains and creates new partnerships for the program; develops research, education, outreach and facility proposals; serves as principal investigator on grants; leads tours of Stone Lab; conducts research related to Lake Erie ecology; oversees all vertebrate collection activities, protocols and permitting for the laboratory; and represents Stone Lab at annual conferences and community events.

**Dr. Justin Chaffin, Research Coordinator (July 2012)**

Responsibilities include developing a research program focused on algal blooms and other issues facing Lake Erie; coordinates visiting scientists' research activities at Stone Lab; works to create new partnerships and research funding with other university researchers, federal and state agencies and private sector groups; coordinates Stone Laboratory's undergraduate research experience; teaches courses; speaks at outreach events at Stone Lab; and represents Stone Lab and Ohio Sea Grant at annual conferences and community events.

**Advisory Boards and Seeking External Advice**

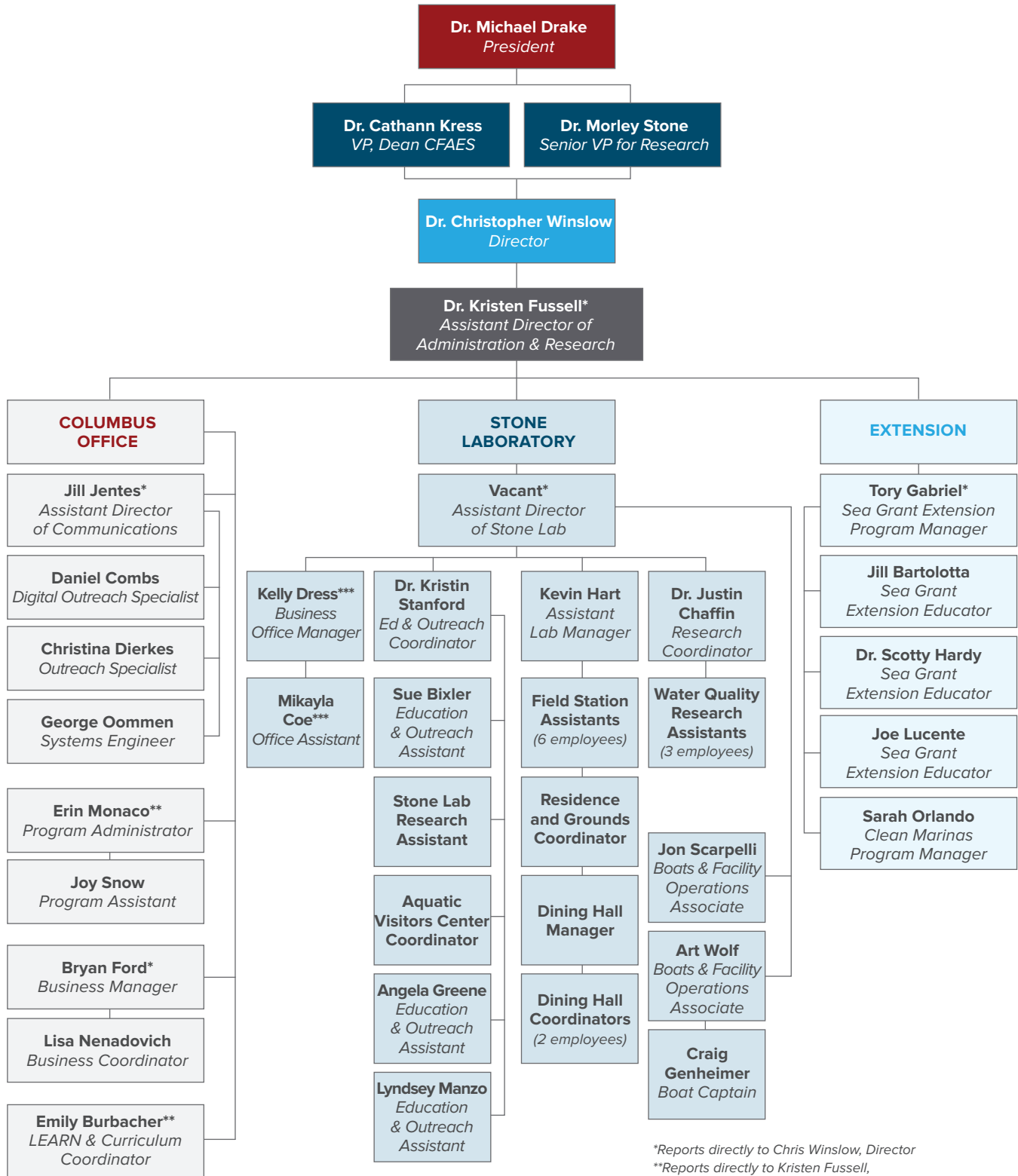
OHSG has worked hard to establish active partnerships with the Ohio Environmental Protection Agency (OEPA), Ohio Department of Natural Resources (ODNR), Ohio Department of Health (ODH), Ohio Department of Agriculture (ODA), Ohio Lake Erie Commission (OLEC), Old Woman Creek National Estuarine Research Reserve (NERR), the International Joint Commission (IJC) and many more. During the execution of the 2014-2018 Strategic Plan, with university leadership in transition, these programs have served as the director's advisory network. Dr. Winslow has submitted for approval a list of candidates for both an internal and external advisory board. These lists have yet to be approved by university leadership but this has not affected OHSG's ability to solicit the research, education and outreach needs of stakeholders.

OHSG staff are active members of numerous boards and committees (highlighted below), providing ample opportunities to identify and understand the needs of stakeholders.

Each extension educator has an external advisory committee. Each educator has selected their committee members to best represent their programmatic areas, which has resulted in a variety of backgrounds and viewpoints for OHSG, e.g., anglers; educators; private sector businesses; non-governmental organizations; and local, state and national government agencies. Some of these committees have bylaws and a regular schedule of meetings while others are more loosely structured and meet on an as-needed basis.

Efforts at Stone Laboratory are guided by board members of the Friends of Stone Lab (FOSL). Members have knowledge relevant to the mission of Stone Laboratory and OHSG and foster connections between the program and Lake Erie stakeholders. The FOSL board is asked to promote visibility of the program, fundraise, build new partnerships and recommend general program direction.

## PROGRAM ORGANIZATIONAL CHART OHIO SEA GRANT AND STONE LABORATORY



\*Reports directly to Chris Winslow, Director  
 \*\*Reports directly to Kristen Fussell,  
 Assistant Director of Administration & Research  
 \*\*\*Reports to Bryan Ford, Business Manager

## PROGRAM TEAM APPROACH

### Strategic Communication, Planning and Recruiting Research Talent

OHSG works hard to ensure that research, education and outreach efforts are strategic and that the entire team is in regular communication. This communication begins with weekly leadership calls between the director, assistant director of administration and research, Extension program leader, assistant director of communications and Stone Lab leadership. Calls discuss upcoming deadlines, new initiatives, recent conversations with stakeholders and needs (e.g., communication products, staff time, grant budgets, etc.).

Calls with education and Extension leads, Dr. Kristin Stanford (education and outreach coordinator at Stone Lab) and Tory Gabriel (Extension program leader), take place quarterly. These calls guide future efforts and make sure everyone is up-to-date on current projects and initiatives. The assistant director of communications is part of these calls to hear updates and discuss needs and ideas, e.g., identification of possible social media and newsletter topics and requests for publication products.

As Stone Lab is the base of many research, education and outreach efforts, the team holds annual end-of-season meetings to discuss what did and did not work that season. Topics include: modifying or creating new programming, designing new displays for the Aquatic Visitors Center and possible staffing changes.

The strategic planning process includes numerous e-mails, conference calls, leadership meetings and a face-to-face meeting in Columbus with full program staff. Each person brings priorities they have identified with the help of their various committees and boards.

An additional component of this Program Team Approach is an annual Action Plan Meeting. Recognizing that a strategic plan is a long-term guidance document, staff meet annually to assess progress toward four-year performance measure and metric targets. This meeting helps OHSG adjust programming quickly to stay on task and meet the changing needs of its stakeholders.

Finally, the research, education, communications and Extension leads participate in all Great Lakes Regional Network activities, with many taking leadership roles. This engagement ensures that no emerging issues or key partnership opportunities are missed.

## SUPPORT

### Diversity of Matching Funds (% of budget indicated)

**Ohio State University General and Program Operations/Management Funds:** OHSG receives funding from the Office of Research to support administrative staff and Columbus office operations (14%). CFAES provides financial support for the operations of Stone Laboratory (15%).

**Earnings:** Annual revenue from services provided at Stone Laboratory (19%). These services include field trips, workshops, courses, tours, conferences and research ventures.

**Development and Endowment Income:** OHSG currently has 27 Development and Endowment funds; total principal balance of >\$1.5 million (9%). Funds support scholarships, outreach and facility needs.

**State Support:** Line item with the governor's biennial budget (10%).

**Extension Funds:** In addition to CFAES support for operations OHSG also receives funding for Extension operations (e.g., travel) and salaries (12%).

**Office of Sponsored Programs (Grants; salary and benefits only):** OHSG staff serve as principal investigators and actively seek external funding for research, education and outreach initiatives (5%).

**Omnibus (salary and benefits only):** OHSG, as part of the National Sea Grant College Program, receives grant support from NOAA (16%).

## RECRUITING TALENT

### RFP Priorities and Planning Process

#### Ohio Sea Grant Research Priority Setting

OHSG takes a two-pronged approach to research priority setting to address both large thematic areas discussed at the national level and specific state-level needs regarding Lake Erie and its watershed. The research priorities outlined in the request for proposals are developed using the OHSG Strategic Plan and staff's knowledge of current research needs from interactions with stakeholders and through serving on boards and committees for many organizations. The director of OHSG also reaches out to each state agency for a list of their current research needs. The Large Grant RFP includes research priorities from both the OHSG strategic plan and state level agencies to be confident it addresses the most pressing needs of the state, region and nation.

#### Ohio Sea Grant Proposal Submission and Technical Review Panel

Since 2014, approximately 40% of OHSG's core budget has been dedicated to competitively funded research projects. Proposals for small grants (up to \$10,000) from development funds can be submitted at any time through the OHSG website. Small grant proposals are sent to at least two external reviewers for evaluation. If the proposal receives positive remarks, fits into the OHSG strategic plan and funding is available, the project will be funded. These grants are typically pilot studies and are used to leverage additional grant dollars.

Proposals for large research grants (up to \$60,000/year for two years) are requested through a biennial request for proposals disseminated to a list of over 900 principal investigators located at colleges and universities in Ohio and neighboring states. The RFP is also located on the OHSG webpage under "Funding" and is solicited through various communications platforms.



Under this strategic plan OHSG was awarded 47 grants totaling about \$8.5 million dollars from 15 funding sources.

Both preproposals and full proposals submitted for the biennial large grant cycle are reviewed by a panel of expert professionals and scientists from agencies, academia, industry and non-governmental organizations at both the preproposal and full proposal stages. In recent years, the panels have included representatives from the OLEC, OEPA, ODH, ODA, ODNR, The Nature Conservancy, National Wildlife Federation and many academic institutions. In addition to being highly-trained scientists, the agency and non-governmental organizations bring a clear understanding of management and local stakeholder needs. Their participation has also created opportunities to leverage Sea Grant funds by co-funding projects with these organizations.

OHSG staff leads the proposal review process but do not rate or score the proposals. Panel members are asked to keep the following five evaluation criteria (approximately equal weighting for each) in mind: (1) Impact of Proposed Project and the Significance of

the Problem/Issue, (2) Scientific or Professional Merit, (3) User Relationships, (4) Innovativeness, and (5) Qualifications and Past Record of Investigators.

At the preproposal level, submitters are either encouraged or discouraged to submit a full proposal; however, no preproposal is rejected based solely on these evaluations. OHSG offers a webinar prior to the full proposal submission date to further discuss the funding opportunity, what reviewers are looking for in a successful submission and answer any questions. Full proposals submitted to the large grant cycle are initially all subject to external, written peer review using the form outlined in the Best Practices document developed by the Sea Grant research coordinator network, and investigators are permitted to submit written responses to the blinded peer reviews.

At the full proposal level, the panel members review the proposal document along with the written reviews and investigator comments. A representative from the National Sea Grant Office attends the technical review panel meeting to ensure fairness and the absence of conflicts of interest. The technical review panel reviews proposals as outlined above. The director of OHSG rarely deviates from the recommendations of the panel when deciding which proposals to include in the biennial omnibus submission to the National Sea Grant College Program. Projects chosen for funding are included in a press release from OHSG's communications team and featured in the program's *Twine Line* magazine, e-newsletter and social media.

OHSG's ability to attract state-of-the-art research; hold a rigorous, unbiased and transparent research competition to address the most pressing needs of the state; and deliver high quality outreach materials from the research conducted has led to OHSG being a go-to entity for research competition and grants management. Since 2014, OHSG received 60 preproposal submissions from 15 different institutions for two large grant RFP cycles with 21 of those preproposals coming from the program's home institution Ohio State. Full proposal submissions include both large grant full proposals and small grant proposals. Since 2014, OHSG has received 89 full proposal submissions from 19 different institutions and funded 57. OHSG received 30 full proposals from principal investigators at The Ohio State University and funded 20.

### **Project Reporting and Management**

Projects are managed within OHSG by the director, assistant director of administration and research, business manager and the program's assigned Ohio State sponsored programs officer. Both large and small grant investigators are required to submit a report annually. The annual report includes information on personnel, students supported, partners, leveraged funds, awards, media generated, publications, presentations and relevant findings and/or progress toward objectives. The investigators also work alongside the OHSG communications team to submit their annual 4R statement and to develop articles and other media coverage of their research.



Stone Lab, Ohio Sea Grant's research station, hosts more than 30 research projects every year, studying everything from water quality to the health of the Lake Erie fishery. An average of 29 scientists from 21 institutions and four countries spend time working at the lab every year and often share their research with students and visitors during special events.

# STAKEHOLDER ENGAGEMENT / PARTNERSHIPS

## RELEVANCE TO LOCAL, STATE, REGIONAL, OR NATIONAL OPPORTUNITIES/PROBLEMS

### International Partnerships

- International Joint Commission: Member of Science Advisory Board; Research Coordination Committee
- Great Lakes Commission:
  - Crude Move Oil Transport Working Group
  - Panel on Aquatic Nuisance Species: Ohio's alternate and Grass Carp Ad-Hoc committee
- Great Lakes Fishery Commission: Lake Erie Percid Management Advisory Group

### National Partnerships

- NOAA Marine Debris Program: Developed the Great Lakes Marine Debris Action Plan
- National Park Service: Partnered to include clean boating education in *Lake Erie Water Trails Guide*
- NOAA Coastal Storms Program: Managed the NOAA Coastal Storms Grants Program
- Ottawa National Wildlife Refuge: Partner on wetland sampling and restoration grants
- Sea Grant Law Center:
  - Co-developed memo on plastic bag legislation
  - Produced a Guidance Document on municipal response to plastic marine debris
- Audubon Society: Climate Explorations 4-H Curriculum
- The Nature Conservancy (TNC): Developed nutrient certification program for agricultural retailers
- U.S. Geological Survey: Partnered on tagging study to assess yellow perch populations
- Old Woman Creek National Estuarine Research Reserve: Collaborated on projects covering marine debris, stormwater and nonpoint source pollution with marinas
- Cedar Fair (Cedar Point Amusement Park): Partner in marine debris PSA competition

### Regional Partnerships (excluding efforts with Great Lakes Sea Grant Programs)

- Cooperative Extension across Great Lakes: Regional Water Program Climate Outreach
- Great Lakes Restoration Initiative (U.S. EPA): Grant partner to increase number of certified marinas and teach boaters about environmental practices
- Maritime Archaeological Survey Team, Inc. (MAST): Developed Lake Erie shipwrecks website and brochure

### State Partnerships

- Climate Explorations 4-H Curriculum (includes Ohio State 4-H Program, Byrd Polar and Climate Research Center, Columbus Zoo, Franklin Park Conservatory, and Columbus Metro Parks)
- Boating Association of Ohio: Provide marinas with regulatory updates and environmental education
- Lake Erie Charter Boat Association: Plan/host Charter Captains Conferences (2 times/year)
- Lake Erie Marine Trades Association: Part of Ohio Clean Marinas Program Advisory Board
- Lake Erie Nature and Science Center: Partner to advance Lake Erie education
- Mondo Polymer Technologies: Coordinated shrink-wrap recycling collection in Ohio
- Ohio Aquatic Invasive Species Committee: Co-development of Ohio Field Guide to AIS
- Ohio Coastal Management Program: Partners to coordinate the Ohio Clean Marinas Program
- Ohio Environmental Protection Agency: Partner to provide marinas with update on regulations
- Toledo Area Sanitary District, Toledo Zoo: Partnered on mosquito control

### Local Partnerships

- University Communicators: Offered professional development conferences at Stone Lab
- City of Cleveland Office of Sustainability:
  - Year of Clean Water working group (Adopt-a-Beach)
  - Plastic Reduction Working Group
  - Climate action for marinas
- Cleveland-Cuyahoga County Port Authority: Assess waste removal on Cuyahoga River
- Toledo Zoo: Assist with purchasing/operating a marine debris removal vessel
- City of Cleveland: Partner on NOAA Marine Debris Program and Climate Action Advisory Council



- Ashtabula: Partner on Ashtabula River Remedial Action Plan and AOC Advisory Committee
- Chagrin River Watershed Partners, Inc.: Grant-funded program on stormwater and wastewater at marinas and best practices and long-term maintenance guidance on green infrastructure
- Ohio cities: Completed Business Retention and Expansion Program (Fremont, Medina, Mentor, Oregon, Perrysburg, Lake County Soil and Water)
- Cleveland Metroparks: Cuyahoga River AOC Advisory Committee
- Cleveland Museum of Natural History: Partnered on a range of education and outreach programs
- Erie County Soil and Water Conservation District: Partner on green infrastructure projects at marinas
- Gilson Gardens, Inc.: Sustainable options for shrink-wrap recycling
- Lake Erie College: Advisory Committee for newly established Environmental Science degree
- Lake Erie Islands Nature and Wildlife Center: Develop curriculum lessons, offer public summer programming (Wild Tuesdays)
- Ohio cities: Local Government Leadership Academy (Lucas County)
- Northeast Ohio Regional Sewer District: Partner on Cuyahoga River AOC Advisory Committee
- Ottawa County Soil and Water Conservation District: Partners in youth education and outreach
- Jet Express Ferry, Miller Boat Line and Put-in-Bay Township Park District: Partnered on “Talking with Tourists” marine debris education program

## INFORMATION, TECHNIQUES, AND RESEARCH COMMUNICATED TO AND UTILIZED BY USER

Providing information to Lake Erie stakeholders is key. Because research findings published only in scientific journals are often of little value to stakeholders, outreach through extension and communications is intertwined in all aspects of the program.

As such, OHSG has five extension educators spread across Lake Erie’s shore to interact with stakeholders and answer their questions about Lake Erie water quality, fishing, economic development and marine debris through presentations and training workshops. Across this strategic plan, OHSG staff gave 2,870 public and professional presentations to just under 170,000 individuals. Using ~73 communications-developed resources, OHSG’s outreach and engagement initiatives bring program resources to approximately 265 external partners. The program’s quarterly magazine of 40 years, *Twine Line*, provides up-to-date research information and highlights education and outreach opportunities. Across the four years of this strategic plan, *Twine Line* was accessed by >16,200 viewers. In addition, OHSG’s monthly e-newsletter delivers program information and updates to ~6,000 subscribers.

Media releases and social media posts keep the program’s stakeholders informed of OHSG’s activities. Additionally, these releases and posts highlight key program events and research results. OHSG has more than 3,500 Facebook followers, more than 6,300 Twitter followers and more than 1,100 Instagram followers.

Annual events such as the Mayors and County Commissioners Days (two one-day events per year) and Science Writers Workshops (2-day event) also facilitate the communication of research findings to stakeholders. Created more than 10 years ago, the Science Writers Workshop brings writers from across the region to Stone Lab to learn about key Lake Erie issues from experts. As a result, dozens of stories by these writers have broadened Ohio Sea Grant’s reach. [go.osu.edu/legislaturedays](http://go.osu.edu/legislaturedays)

Webinar hosting is another way to connect with non-academic audiences. Over this four-year period, OHSG led the hosting of two impactful webinar series: “Crude Move” and “Global Change, Local Impact.”

- “Crude Move”: Exploring the transport of crude oil across the Great Lakes Basin. Included efforts to understand the issue, risks and options for moving crude oil through the basin.
- “Global Change, Local Impact”: >45 webinars highlighting climate change impacts on ecosystem health, infrastructure and water quality/quantity and providing updates on public policy and education materials.

# COLLABORATIVE NETWORK ACTIVITIES: COORDINATED PLANNING AND COOPERATIVE WORK WITH LOCAL, STATE, REGIONAL AND FEDERAL AGENCIES

**Engaging Ohio Academic Institutions:** OHSG established, with National Science Foundation (NSF) funding, the formation of the Lake Erie Area Research Network (LEARN), a consortium of field stations, scientific equipment and diverse researchers to address the major challenges facing Lake Erie. LEARN is enhancing collaboration on grants, sharing of equipment and vessel time, increasing communication across Ohio universities and reducing duplicative efforts in Lake Erie research. Over 50 researchers from 17 Ohio institutions have invested their time into the development of this new Lake Erie consortium.

**Asian Carp Regional Coordinating Committee (ACRCC):** The ACRCC is a Great Lakes Restoration Initiative funded committee of 36 U.S. and Canadian local, state, provincial and federal entities with a shared desire to protect the waterways of the U.S. and Canada from invasive Asian carp under the ACRCC. OHSG led efforts to increase education and awareness of Asian carp in the Great Lakes. All Great Lakes Sea Grant programs received funding to collaboratively develop a bibliography of existing education and outreach materials, summarize existing education and outreach materials, develop a regional PowerPoint to be used for education and outreach, compile a regional network of speakers capable of disseminating accurate Asian carp information and survey current research being conducted to summarize projects and identify information gaps.

**Charter Captains Conference:** The long-running Ohio Charter Captains Conference organized by OHSG has been the unofficial kickoff of the fishing season for over 30 years. A large part of the program's success is due to the collaboration and involvement of key partners coming together to maintain Ohio's charter industry as one of the best in the nation. Major partners are the Lake Erie Charter Boat Association (LECBA) and the Ohio Department of Natural Resources-Division of Wildlife (ODNR-DOW). Other important regulatory agencies provide annual speakers, including U.S. Customs and Border Protection and U.S. Coast Guard. Many local business partners attend annually as vendors. While the main stakeholders are charter captains and anglers, OHSG also reaches fishing-related businesses (bait and tackle shops, marinas, etc.), outdoor writers, coastal residents and natural resource agency personnel.

**NOAA Great Lakes Coastal Storms Program:** To help the Great Lakes better prepare for severe storms, the NOAA Coastal Storms Program (CSP) approached OHSG to manage a competitive grants program for the region to reduce and mitigate risks. With guidance from the Great Lakes Sea Grant Network and CSP, ten projects were funded that help Great Lakes coastal communities plan for, respond to and recover from coastal storms. Results include increased climate resiliency using green infrastructure, improved dissemination of beach hazard information, a sustainable nearshore buoy network (427,000 individual requests), a marina planning tool for adaptation and response to coastal storms, a forecasting and warning system for rip currents and an evaluation of flood hazard identification tools.

**Nutrient Loading and Harmful Algal Blooms (HABs):** OHSG's Director Emeritus, Dr. Reutter, served on the Ohio Phosphorus Task Force I & II that determined the load reductions needed to solve the HABs issue in Lake Erie. He also served on Annexes II (LaMPs) and IV (Nutrients) of the Great Lakes Water Quality Agreement (U.S. and Canada) and was the U.S. Co-Chair of the Objectives and Loadings Task Team to develop appropriate nutrient loads to address the problem on all five Great Lakes. OHSG is one of the most visible leaders addressing this problem at the state, regional and national level.

**NOAA HABs Forecast:** Since 2012, OHSG has hosted the annual NOAA Harmful Algal Bloom Forecast. OHSG works with NOAA to create publications and visuals to help the general public better understand the issue and organizes HABs experts to deliver the science. The event gathers government and academic researchers to engage with industry representatives affected by blooms (e.g., charter captains, small businesses, tourism bureaus, farming community). Annually, OHSG is the bridge to >20 media outlets and >300 people on the event's webinar.

**Marine Debris:** OHSG has conducted research on consumer plastics use (bags, bottles, cigar tips) in Northeast Ohio in partnership with the NOAA Marine Debris Program (NOAA MDP), City of Cleveland Mayor's Office of Sustainability, and thunder::tech. This research has informed a social marketing campaign, a plastic levy proposal and spurred cigar tips research. OHSG, funded by NOAA MDP, has also partnered with numerous businesses, marinas and the ODNR to conduct a plastic reduction awareness campaign on South Bass Island. OHSG staff, under the 2014-2018 Strategic Plan, have conducted 209 outreach events; educated 23,657 coastal residents, students, educators and businesses; and developed 15 displays reaching 266,606 people. OHSG also promotes recycling of fishing line and marine debris awareness in its Ohio Clean Marinas and Boater Programs and leads a partnership with NOAA MDP, the Boat US Foundation and others to generate a website, database and tracking system for monofilament recycling bins in Ohio.

**Research at Stone Lab:** Since 2013, Stone Laboratory has hosted a yearly average of 33 research projects led by 29 PIs from 21 institutions, 10 states and four countries. The efforts address harmful algal blooms, aquatic invasive species, endangered species, fisheries management and pollutants in the atmosphere and the water.

**Center for Great Lakes Literacy (CGLL):** Developed in 2011, CGLL is a collaborative effort led by Sea Grant educators throughout the Great Lakes watershed and supported through Great Lakes Restoration Initiative (GLRI) funding. The center fosters informed decisions that advance basin-wide stewardship by providing hands-on experiences, educational resources and networking opportunities that promote Great Lakes literacy in educators. OHSG plays key roles in facilitating teacher professional development, developing regional curriculum and designing program evaluation tools for CGLL.

**Great Lakes Clean Marina Network:** In 2016, OHSG joined as co-chair of the Great Lakes Clean Marina Network (GLCMN) to assist in advancing the network's Clean Marina efforts. This network consists of representatives from private industry, government agencies, universities and non-profit organizations. OHSG contributed to the revision of the GLCMN BMP guide and biannual webinars. Since 2011, the GLCMN has obtained five Great Lakes Restoration Initiative grants to advance the network's mission and over 2,000 new best management practices were adopted by certified marinas in the Great Lakes. In Ohio, the Clean Marinas Program has expanded statewide.



Since 2012, Ohio Sea Grant and Stone Lab have hosted NOAA's annual harmful algal bloom forecast for western Lake Erie, bringing together researchers, agency experts and the media to prepare Ohio businesses and residents for the season. OHSG staff create publications specific to NOAA and attendee needs, and host a 300-person outreach webinar that helps experts address questions coming directly from Lake Erie residents.



In the last five years, Ohio Sea Grant has provided \$70,000 in workshops, courses and stipends to teachers through funding from the Center for Great Lakes Literacy. Many have taken Lake Erie information back to their classrooms, reaching more than 20,000 K-12 students since 2009.

**4R Nutrient Stewardship Certification Program:** In 2013, the Ohio Clean Marinas Program was invited to partner with 41 other agency, industry and university representatives to develop a voluntary certification program for agricultural retailers in the western Lake Erie Basin. The goal of the 4R Nutrient Stewardship Certification Program is to acknowledge farmer efforts to implement nutrient management principles by modeling the Ohio Clean Marinas Certification. After being launched in 2014 in the western Lake Erie Basin 45 agricultural retailers servicing 2.77 million acres are certified.

**Local Government Leadership Academy:** Created in 2002, the leadership academy helps public officials understand how their decisions can affect the Lake Erie watershed and coastal communities, with the goal to encourage sustainable decision-making. OHSG continues to co-lead a partnership with OSU Extension, the Toledo Chamber of Commerce and the Greater Medina Chamber of Commerce to teach a ten-week curriculum for local government officials that was developed under a previous strategic plan. In 2014, 140 public officials representing 40 coastal communities participated in ten-week training sessions in Medina and Lucas counties. Because of this training, local leaders are better informed about the economic, social and environmental impacts of their decisions about land use and the environment.

**Cuyahoga River Area of Concern:** The Cuyahoga River is one of 43 Great Lakes Areas of Concern (AOC) that have experienced environmental degradation, fail to meet Great Lakes Water Quality Agreement (GLWQA) standards and are impaired in their ability to support aquatic life or beneficial uses. The GLWQA requires that each AOC identify Beneficial Use Impairments (BUIs) and their causes, develop restoration criteria, implement and monitor remedial measures and confirm that restoration is achieved. OHSG plays a significant role in the AOC Advisory Committee by providing guidance on education and outreach activities associated with the de-listing process. OHSG also directs the AOC's Public Outreach Subcommittee to interpret and relay scientific information about the AOC to the public and to bring the needs of the public to the attention of the advisory committee. In 2017 the U.S. EPA approved the removal of the first BUIs associated with the Cuyahoga AOC - "Degradation of Aesthetics" and "Access and Recreation Impairments."



Ohio Sea Grant staff are part of three AOC committees along the Lake Erie shore, working to restore these major Ohio rivers to sustainable health. The Ashtabula group recently took the last major step to removing the river from the list of Areas of Concern, having addressed its remaining beneficial use impairments. [go.osu.edu/ashtabula](http://go.osu.edu/ashtabula)

**NOAA ECOHAB:** A seasonal HAB forecast for Lake Erie is released every spring. Although HAB size and location can be predicted, fundamental questions remain about what controls toxin production. The study proposed in 2017, currently funded, aims to correlate environmental variables and toxicity to improve the annual forecast by linking size, location *and* toxicity. Research products include presentations, publications, tools to inform stakeholders and guidance to NOAA and drinking water utilities. Partners on this grant include five universities and one private business.

**The Harmful Algal Bloom Research Initiative (HABRI):** This initiative funded by the Ohio Department of Higher Education (ODHE), is a statewide response to the threat of harmful algal blooms and one of multiple external grant programs OHSG is managing. HABRI was born out of the 2014 Toledo algal toxin crisis that threatened drinking water for over 500,000 individuals. To better position the state to prevent and manage future algal issues, the Chancellor of ODHE worked with OHSG, The Ohio State University, and The University of Toledo to manage research efforts across 10 Ohio universities to address critical technology needs and knowledge gaps identified by state agencies. HABRI funds have resulted in changes in land use behavior, water treatment, and agency rules and sampling. Along with managing projects, OHSG creates annual synthesis reports and coordinates research information dissemination to university partners through communication channels.

# PERFORMANCE

## STAFF LEADERSHIP ON BOARDS AND COMMITTEES

OHSG provides science-based information, without bias, throughout the Great Lakes Region. Program staff hold a broad range of leadership positions with partners representing numerous sectors and disciplines.

### Chris Winslow

- Member, 2014-present, International Joint Commission's Science Advisory Board, Great Lakes Research Coordinating Committee
- Executive Director, 2016-present, Lake Erie Area Research Network
- Advisory Board, 2015-present, Ohio Water Research Center
- Member, 2016-present, Great Lakes Water Quality Agreement, Annex II Lakewide Management Extended Subcommittee
- Member, 2016-present, Great Lakes Water Quality Agreement, Annex IV Objectives and Targets Task Team (Nutrients)
- Secretary, 2017-present, Sea Grant Association Executive Board
- Advisory Board, 2016-present, Cleveland Water Alliance
- Agency Partner, 2015-present, Ohio Lake Erie Commission
- Council member (Ex-officio), 2016-present, Old Woman Creek NERR Advisory Board
- President, 2014, Ohio Chapter of American Fisheries Society

### Kristen Fussell

- Chair, Communications Team, 2018-present, American Fisheries Society 2020 Annual Conference
- Treasurer, 2016-present, Lake Erie Area Research Network
- Member, 2008-present, International Association for Great Lakes Research Communications and Outreach Committee
- Faculty Co-Advisor, 2015-present, Buckeye Friends of Stone Laboratory
- Member, 2016, National Sea Grant College Program Knauss selection committee
- Citizen Science Research Project Scientist, 2014-2018, National Science Foundation (NSF) award with Bowling Green State University

### Jill Jentes Banicki

- Member, 2007-present, Ohio State Outreach and Engagement Council
- Member, 2017-present, Ohio State Crisis Communications Group
- Member, 2018-present, NOAA HABs Communications Working Group
- Chair, 2015-2018, Great Lakes Sea Grant Network Communicators
- Member, 2015-2018, NOAA Great Lakes Communications Working Group
- Member, 2015-2018, Great Lakes Sea Grant/NOAA GLERL Regional Outreach Advisory Committee
- Member, 2010-2018, Great Lakes Commission Sea Grant Fellow Application Review Team
- Member, 2012-present, Ohio State Communicators Council
- Chair, 2006-2015, Outreach and Education Committee, Great Lakes Regional Research Information Network
- Chair, 2011-2016, Ohio State Climate Change Outreach Team
- Member, 2007-2014, Marketing Committee, Great Lakes Observing System

### Tory Gabriel

- Member, 2018-present, Great Lakes Fishery Commission Lake Erie Percid Management Advisory Group
- Member, 2017-present, Old Woman Creek Collaborative Learning Group
- Member, 2016-present, Great Lakes Panel Grass Carp Ad Hoc Committee
- Ohio Alternate, 2013-present, Great Lakes Panel of Aquatic Nuisance Species Task Force
- Member, 2012-present, ODNR Division of Wildlife Ohio Aquatic Invasive Species Committee
- Member, 2012-present, Ohio Sea Grant Education Committee
- Member, 2008-present, Planning Committee, Ohio 4-H Sea Camp
- Member, 2008-present, Education Committee, Ohio Chapter of American Fisheries Society
- President Elect, President, and Past President, 2014-2017, Ohio Chapter of American Fisheries Society
- Member, 2017, Pennsylvania Sea Grant Research Review Panel
- Member, 2016, ODNR Ohio Envirothon Test Writing Committee

#### Jill Bartolotta

- Board Member, 2015-present, Mentor Marsh Board of Management
- Member, 2015-present, Grand, Ashtabula, and Conneaut Rivers Partnership
- Member, 2015-present, Ohio Joint Council of Extension Professionals
- Member, 2015-present, Epsilon Sigma Phi, Alpha Eta Chapter, National Extension Organization
- Board Member, 2016-present, Great Lakes Water Safety Consortium Advisory Council
- Board Member, 2016-present, Lake Erie College Environmental Science Advisory Board
- Member, 2015-present, National Marine Educators Association, Great Lakes Educators of Aquatic and Marine Sciences Chapter
- Member, 2016-present, Northeast Ohio Plastics Reduction Working Group
- Member, 2016-present, Great Lakes Land-Based Marine Debris Action Plan
- Conference Coordinator, 2016-2017, Great Lakes Sea Grant Network Meeting in Cleveland, OH
- Member, 2018-present, Ohio Joint Council of Extension Professionals, Global Relations Committee
- Member, 2018, National Association of Community Development Extension Professionals
- Member, 2018, Conference Planning Committee, National Association of CD Extension Professionals

#### Scott Hardy

- Member, 2017-present, Cleveland Climate Action Advisory Council
- Member, 2017-present, Crude Move Oil Transportation Safety Group
- Chair, Public Outreach, 2016-present, Cuyahoga River Area of Concern Advisory Committee
- Member, 2016-present, Cleveland Water Alliance Program Committee
- Member, 2016-present, Lake Erie Area Research Network
- Member, 2016-present, Sea Grant Network Social Science Community of Practice

#### Joe Lucente

- Elected Member, 2017-2019, Ohio State University Faculty Promotion and Tenure Committee
- President-Elect and President, 2014-2015, Ohio Epsilon Sigma Phi Chapter, National Extension
- Member, 2014-present, Ohio Joint Council of Extension Professionals Excellence in Extension Award Selection Committee
- Member, 2013-present, National Working Waterfronts Network, Education and Outreach Committee
- Member, 2013-present, Ohio Joint Council of Extension Professionals Personnel Committee
- Appointed Member, 2011-present, Ohio State Community Access to Resources and Educational Services Grant Committee
- Appointed Member, 2010-present, Maumee Valley Extension Education Research Area Regional Grants Committee
- Member, 2010-present, OSU Extension Signature Program Review Committee
- Member, 2005-present, Marketing/Membership Service Committee, National Association of Community Development Extension Professionals
- Member, 2005-present, Recognition Committee, National Association of Community Development Extension Professionals
- Member, 2002-present, Great Lakes Sustainable Coastal Community Development Committee
- Member, 2003-present, Toledo Area Chamber of Commerce's Economic Development and Infrastructure Committees

#### Sarah Orlando

- Member, 2011-present, Association of Marina Industries
- Member, 2012-present, Ohio Epsilon Sigma Phi Chapter, National Extension Fraternal Organization
- Member, 2012-present, Ohio Joint Council of Extension Professionals
- Co-Chair, 2012-present, Great Lakes Clean Marina Network
- Board Member, 2012-present, Advisory Committee, 4R Nutrient Stewardship Certification Program
- Non-Voting Member, 2014-present, Northeast Ohio Region Area Maritime Security Subcommittee
- Member, 2015-present, Ohio Aquatic Invasive Species Committee
- Affiliate Member, 2015-present, States Organization for Boating Access
- Member, 2016-present, Association of Natural Resource Extension Professionals
- Member, 2016-present, Water Management Association of Ohio
- Member, 2016-present, National Working Waterfronts Network
- Member, 2017-present, Lake Erie Area Research Network
- Board Member, 2017-present, Friends of Stone Laboratory
- Member, 2017-present, National Association of Community Development Extension Professionals
- Member, 2012-2018, International Association of Great Lakes Research

- Board Member, 2012-2014, Steering Committee, Cleveland Water Alliance
- Member, 2012-2014, Clean Water Coalition, Erie County Soil & Water Conservation District
- Member, 2013-2015, Year of Water Working Group, Cleveland Water Alliance
- Member, 2013-2014, Stormwater Working Group, Cleveland Water Alliance
- Member, 2013-2014, Cleveland Climate Change Adaptation Working Group, City of Cleveland Office of Sustainability

#### Lyndsey Manzo

- Secretary, 2019, Sea Grant Education Network
- Grant Reviewer, 2018-present, Ohio EPA Office of Environmental Education
- Member, 2016-present, State of Ohio Science Supervisors Committee
- Member, 2016-present, Central Ohio Teaching and Learning Collaborative
- Coordinator, 2015-present, Westerville City Schools Science Curriculum
- Member, 2005-present, Environmental Education Council of Ohio
- Member, 2000-present, Science Education Council of Ohio
- Member, 2018, Ohio Department of Education Science Model Curriculum Committee
- Member, 2017, Ohio Department of Education Biology Assessment Rubric Validation Committee
- Member, 2017, Ohio Department of Education State Standards Revision Advisory Committee
- Member At-large, 2016-2018, Sea Grant Education Network Executive Committee
- Member, 2016, Columbus Metro Parks Education Advisory Committee
- Member, 2014-2015, NOAA Education Collective Impact Regional Work Group
- President, 2010-2015, Great Lakes Educators of Aquatic and Marine Science
- Board Member, 2009-2015, National Marine Educators Association
- Member, 2012-2014, Ohio Department of Education Biology Performance Based Assessment Range Finding Committee

#### Justin Chaffin

- Member, 2018-present, Lake Erie Center for Fresh Waters and Human Health
- Member, 2018-present, Ohio State CFAES Water Quality Task Team
- Member, 2017-present, *Harmful Algae* Editorial Board
- Coordinator, 2013-present, Charter Boat Captain Sampling Program
- Coordinator, 2013-present, Stone Laboratory Research Experience for Undergraduates Program
- Member, 2014-present, Great Lakes Water Quality Agreement Annex IV

#### Kristin Stanford

- National Executive Committee Member and Co-Chair, 2016-2018, Partners in Amphibian and Reptile Conservation
- Graduate Faculty Scholar, 2012-2017, Northern Illinois University
- Board Member, 2003-present, Lake Erie Islands Chapter of the Black Swamp Conservancy
- Board Member and Co-Chair, 2010-present, Lake Erie Islands Nature and Wildlife Center
- Member, 2017-present, Ohio Partners in Amphibian and Reptile Conservation
- Member, 2012-present, Midwest Partners in Amphibian and Reptile Conservation
- Member, 2007-present, Lake Erie Islands Historical Society
- Member, 2004-present, The Snake Ecology Group
- Member, 2006-present, Teaming With Wildlife

### **PROGRAM RECOGNIZED AS PRACTICAL LEADER**

The program ensures its relevance by regularly engaging the four state agencies primarily responsible for managing Lake Erie and its watershed (OEPA, ODNR, ODA and ODH). This engagement includes soliciting research priorities for the biennial request for research proposals. Additionally, these agencies assign staff to participate in the review panel. This collaborative effort has resulted in the OEPA regularly asking OHSG to bring together academic researchers to address pressing issues that agency staff are not able to address. Recently OHSG convened Ohio researchers to help the OEPA develop criteria needed to determine if Lake Erie should be declared impaired for recreational use because of harmful algal blooms. This group's efforts resulted in a new state criteria that was submitted to the U.S. EPA. OHSG is now convening panels to assess the potential of using dredge material for beneficial uses and to develop a Lake Erie Aquatic Life Use metric for fish and benthic invertebrates.

OHSG is also an agency partner to the Ohio Lake Erie Commission (OLEC). This allows OHSG to send representation to each quarterly meeting to update all commissioners of the OLEC. OLEC is composed of six agency directors and six key Lake Erie stakeholders. Its mission is to preserve Lake Erie's natural resources, protect water quality and promote economic development. The commission staff advises the governor on policies and use of Great Lakes Restoration funds and facilitates compliance with the Great Lakes Water Quality Agreement.

Because of OHSG's success running research competitions (see "Recruiting Talent" section) the program now also manages grant funding for the state. Additionally, this request is a testament to OHSG's wide reach when disseminating research findings to decision-makers and impacted lake residents.

- Ohio Department of Higher Education Harmful Algal Bloom Research Initiative (HABRI): HABRI is a statewide response to the threat of HABs, born out of the 2014 Toledo drinking water crisis. OHSG and The University of Toledo, since 2015, have been managing \$2 million in research efforts annually for Ohio's universities to address needs and knowledge gaps identified by state agencies to: (1) reduce nutrient loads; (2) assess health impacts; (3) develop water treatment methods; and (4) ensure these solutions are disseminated to agencies, elected officials, urban planners and the agricultural community. With consistent input from state agencies, HABRI projects have been extremely successful at providing quick and reliable answers.
- Lake Erie Protection Fund: Established by the OLEC to finance research and on-the-ground projects aimed at protecting, preserving and restoring Lake Erie and its watershed. In 2017, OHSG was approached to manage this fund and leverage it against NOAA funding.
- Sandusky Bay Research Initiative: Since 2017, OHSG has managed research funds for the ODNR Office of Coastal Management (ODNR-OCM). The ODNR-OCM is working on an initiative funded by multiple state and federal agencies to decrease the severity and duration of HABs in Sandusky Bay while also increasing the aesthetics of the region's shoreline.

## **PROGRAM'S PROGRESS TOWARD PERFORMANCE MEASURES AND METRICS**

OHSG worked as a team to reach its performance measures and metrics as outlined in the 2014-2018 Strategic Plan. For Healthy Coastal Ecosystems, as a result of OHSG activities, **1,944** resource managers used ecosystem-based approaches to manage land, water and living resources in coastal areas and **5,982** acres of coastal habitat were protected, enhanced or restored. As a result of OHSG activities in Sustainable Fisheries and Aquaculture, **17,518** seafood processors and aquaculture industry personnel modified their practices using knowledge gained in fisheries sustainability and seafood safety. OHSG's work to create Resilient Communities and Economies impacted **88** communities that implemented sustainable economic and environmental development practices and policies and **18** communities will have implemented hazard resiliency practices to prepare for, respond to or minimize coastal hazardous events. Environmental Literacy and Workforce Development is a key component of OHSG's work, and as a result, an average of **73** products were used or developed each year that advance environmental literacy and workforce development, **154,263** people were engaged in OHSG-supported informal education programs, **263** OHSG-supported graduates were employed in a career related to their degree within two years of graduation and **20,922** professionals received continuing education and/or training from OHSG that helped them keep their jobs or advance professionally. OHSG supported **375** undergraduates, **200** M.S. and **88** Ph.D. students. Over this strategic plan, **2,483** P-12 educators participated in Sea Grant education programs and **115,334** P-12 students were reached through Sea Grant-trained educators or directly through education programs. OHSG has had immense impact on Ohio's local coastal economies. Over the course of this strategic plan, OHSG activities created **\$83,164,838** in total economic (market and non-market) benefits, **426** businesses were retained, **243** jobs were created and **3,624** jobs were retained. OHSG sponsored/organized **1,174** events attended by **11,397** individuals. OHSG staff also gave **2,870** public or professional presentations attended by **169,613** individuals. OHSG certified **45** Clean Marinas and **13** people received HACCP certifications.



# PROGRESS TOWARD STATE STRATEGIC PLAN

## HEALTHY COASTAL ECOSYSTEMS

**Healthy Coastal Ecosystems represents 38% of OHSG's efforts without leveraged funds.**

The Healthy Coastal Ecosystems section highlights OHSG efforts related to (1) Biotechnology, Engineering and Dredging; (2) Nutrient Dynamics and Harmful Algal Blooms; and (3) Research Addressing Ecosystem Functioning. Many of the examples in this section are a result of OHSG-funded researchers, so examples are brief and showcase specific projects. As many of these research projects are crosscutting, they are highlighted only within their primary focus area. Impacts related to aquatic invasive species are presented within Sustainable Fisheries and Aquaculture. Further, those efforts associated with climate change and sustainable coastal development are included in Resilient Communities and Economies.

**Healthy Coastal Ecosystems Performance Measure**

**1,944** resource managers have used ecosystem-based approaches to manage land, water and living resources in coastal areas.

### Biotechnology, Engineering and Dredging:

Lake Erie as a resource contributes \$11.7 billion dollars to the regional economy and employs approximately 120,000 people. Maintenance of shipping lanes is required to support this economy but dredging can't come at the expense of recreation and tourism. Open-lake disposal of dredged material is in direct opposition to water quality, affecting suspended sediments, nutrients and contaminants. In order to discontinue open-lake disposal, the U.S. Army Corps of Engineers needs a cost-effective sediment management alternative. An OHSG-funded large-scale demonstration site revealed that Toledo Harbor annual dredge load can be placed on agricultural land and still grow crops.

Photochemical methods have been used for the degradation of cyanotoxins, but conventional germicidal UV lamps require high energy and well-trained personnel. An OHSG researcher was the first to test low energy UV-LEDs with different wavelengths. Microcystin, specifically MC-LR, was efficiently degraded in both pure and natural samples. Since UV-LED technology has been developing very fast in recent years, these processes are quite promising for the destruction of other algal toxins.

With harmful algal blooms, advance warning is power in terms of producing safe drinking water. Two new integrated monitoring networks for Lake Erie's western basin alert plant operators about bloom activity near water treatment intake zones. These buoys now stream data to an online

NOAA-funded database, the Great Lakes Observing System. Researchers also send weekly emails to water utility managers and stakeholders to report on weekly sampling cruises in the area of intakes. This warning system has already notified treatment plants on two separate occasions, providing enough time for plants to adjust treatment.

Currently, quantification of algal toxins requires experienced personnel to run highly sophisticated analytical machines (HPLC-MS/MS and ELISA methods). OHSG-funded researchers are developing biosensors to easily monitor cyanotoxins in water samples. To date, MC-LR, the most common form of microcystin toxin, was efficiently detected in ultrapure water samples using this device. This rapid and accurate detection method is a significant advancement for water treatment.

### Nutrient Dynamics and Harmful Algal Blooms:

Nutrients provide the foundation of Lake Erie's food web and the right balance of nutrients is essential to ensuring a healthy Lake Erie. When nutrient levels become too high, harmful algal blooms emerge and can contribute to an expanded area of anoxic waters in the lake's central basin. This results in public health risks, tainted drinking water and economic losses. Phosphorus, a key ingredient in many fertilizers and weed killers, has been targeted as a leading contributor to HABs. OHSG has been a leader in identifying causes and solutions for this nutrient loading problem.

The Lake Erie harmful algal blooms are dominated by cyanobacteria that cannot fix nitrogen, meaning they rely on river inputs of nitrogen and/or recycled nitrogen to grow and make toxins. Unfortunately, the mechanisms and process rates of nitrogen are not well understood. In an OHSG-funded project, researchers used stable isotope tracers to measure rates of nitrification and recycling of ammonium through the microbial community. Data suggests that microbes are very good at recycling nitrogen and may be able to sustain early summer bloom growth without additional nitrogen input from land. However, the bloom becomes limited by nitrogen late in the summer, which may lead to cell death and subsequent toxin release. In addition to these nitrogen efforts, OHSG is also funding work to explore which microbes, by using genetic techniques, are responsible for mobilizing this nutrient.

The bulk of cyanobacterial bloom research is concentrated in the western basin of Lake Erie. However, cyanobacterial blooms also occur in the relatively nutrient-poor waters of the

**Cross-Cutting Metric**  
OHSG sponsored or organized **1,174** events attended by **11,397** individuals.

central basin. Currently, it is unknown why the blooms occur there, and researchers were unsure if they could produce harmful toxins. As a result, Stone Lab researchers began measuring the environmental factors that promote blooms to determine if these blooms are capable of producing toxins. For this work, researchers partnered with NOAA and examined the bloom satellite data. They found that this cyanobacteria strain is different than in the western basin, that water clarity is likely an indicator of potential bloom size and that these blooms do not contain microcystin-producing genes but have genes for saxitoxin production.

Urban runoff and increased imperviousness have been suggested as sources of nutrients that may contribute to the formation of harmful algal blooms in Lake Erie (contaminants include nutrients, suspended solids and coliform bacteria). Unfortunately, the significance of urban stormwater contaminants is currently not well characterized. An OHSG-funded researcher used a hydrologic model (SWMM) to quantify the load of stormwater pollutants delivered seasonally to the western Lake Erie Basin. Researchers have been able to identify “hotspots” for urban runoff and results are being communicated to local and regional stormwater and surface water stakeholders.

There continues to be a need to quickly identify the composition of algae and cyanobacteria growing in Lake Erie and other inland waters to differentiate harmless from harmful algal blooms. As a result, OHSG-funded researchers are collecting water samples to ground-truth satellite data. The pairing of water samples and satellite data have resulted in a robust algal pigment library, new analytical protocols for plankton pigment analysis and have informed a new algorithm to differentiate non-toxic from toxic algae using satellites.



Ohio Sea Grant researchers take projects from the lab bench to practical applications that improve the lives of Ohio residents. Dr. John Lenhart's research into using activated carbon to remove algal toxins from drinking water is now informing water treatment decisions at the Ottawa County Regional Water Treatment Plant, saving on treatment costs and providing peace of mind for drinking water customers. [go.osu.edu/habrivideo](http://go.osu.edu/habrivideo)

#### Healthy Coastal Ecosystems Performance Measure

**5,982** acres of coastal habitat were protected, enhanced or restored.

Glyphosate, the active ingredient in Roundup®, has been a previously unexamined source of phosphorus that is commonly used in agriculture and has the potential to move phosphorus from soils to the lake. OHSG-funded researchers examined numerous soil samples to determine how much phosphorus could be released when glyphosate was applied at different concentrations. Coupled with modeling efforts, it is possible that up to 53% of the dissolved phosphorus entering Lake Erie annually could be tied to glyphosate use.

To reduce phosphorus loads into Lake Erie, best management practices (BMPs) capable of meeting these reductions must be identified and applied to watersheds. OHSG researchers are developing models to evaluate individual and bundled BMPs to reduce nutrient inputs. Efforts have identified subsurface application of phosphorus as the management practice with the greatest potential.

There are thousands of agricultural fields in the Lake Erie watershed that are tile drained. In addition, prior research has found that 65% of dissolved reactive phosphorus entering Lake Erie from agricultural fields comes through tile drains. Not knowing where these tiles are located, an OHSG-funded researcher developed automated software to map tile lines over large areas. Researchers are recognizing that knowing where tiles are located in the watershed can help determine what actions need to be taken to help reduce nutrient runoff.

New methods for degrading toxins are being developed to keep drinking water safe, but it's largely unknown how organic matter like leaf debris in the water affects these methods. An OHSG-funded partnership between scientists and a local water treatment plant is studying the effects of water chemistry on the degradation of cyanobacterial toxins. Laboratory experiments showed that a combination of ultrasound and ultraviolet light can be used to degrade algal toxins, especially if hydrogen peroxide is added to the water. However, the addition of compounds often present in leaf debris significantly reduced the effectiveness of these treatments to below 45%. This work has highlighted the need to filter water before using UV and ultrasound.

Recent increased bioavailability of human-contributed phosphorus has focused attention on specific phosphorus sources. One source that OHSG-funded researchers are examining is the phosphorus contained in lake sediments, which if released into the water could contribute to algal blooms regardless of efforts to reduce landscape runoff. Data has shown that the amount of phosphorus available for algal growth in surface sediments has increased over the past decades but still only contributes 3-7% of total phosphorus

entering the lake. Different OHSF-funded researchers working on Sandusky Bay sediments are showing that phosphorus is securely stored as long as the water above it is oxygen-rich.

While the largest harmful algal blooms in Ohio are generally made up of *Microcystis*, many sites such as Lake Erie's Sandusky Bay are affected by toxic *Planktothrix* blooms (routinely exceeding EPA advisory levels). Research has indicated that strategies to manage *Microcystis* blooms will not work on *Planktothrix*. To determine the factors that contribute to *Planktothrix* blooms, researchers combined measurements of water chemistry, water quality and nitrogen availability with genetic analysis. Results show that *Planktothrix* does not fix nitrogen, can store nitrogen, is adapted to low light conditions and tolerates a range of water temperatures.

#### Research Affecting Ecosystem Functioning:

Algae attached to the bottom of streams draw nutrients from the water and convert them into food for insects and other invertebrates, but they're rarely studied. As such, these small streams have the capacity to regulate nutrients moving from the land to the lakes, and understanding that process can help researchers better understand algal blooms. OHSF-funded researchers have monitored attached algae using natural tracer compounds and enzyme analysis. Results highlight that nutrients in the water column rarely predict the amount of attached algae on river beds. The best predictor of algal biomass was the amount of sediment deposited on the river rocks.

Most people in Ohio are familiar with harmful algal blooms in Lake Erie, but not necessarily with what happens after the algae die and sink to the bottom of the lake. Researchers have suspected that hypoxia caused by decomposing algae using up dissolved oxygen may contribute to greenhouse gas emissions. This question was addressed by an OHSF researcher who found the highest rates of methane emissions occurring in August, at the height of harmful algal blooms, when dissolved oxygen in the water is lowest. This finding indicates a strong connection between the decomposing algae and greenhouse gas emissions.

Wetlands are known to filter nutrients and other pollutants out of the water before they reach the lake, but exactly which kinds of pollutants are filtered, how, when and where isn't well understood yet. Using Old Woman Creek NERR in Huron, Ohio as a study site, OHSF-funded researchers conducted a comprehensive soil characterization throughout the wetland. On-site measurements show that OWC acts as a sink for most nutrients and pollutants of concern, including phosphorus and nitrogen. Sediments within the wetland trap more nutrients when not continuously flooded, which could be of concern given predicted heavy rainfall and wetland water level increases under a changing climate.

## SUSTAINABLE FISHERIES & AQUACULTURE

**Sustainable Fisheries and Aquaculture represents 19% of OHSF's efforts without leveraged funds.**

Lake Erie's fishery is part of the fabric of Ohio's coastal communities. It contributes to community economics, cultural traditions and pride. In particular, sport fishing is a major component of Lake Erie tourism, contributing an economic impact of more than \$1 billion annually. Generations of residents have earned a living through the fishery, and events like local fishing tournaments, fish-related festivals and fish fries are common venues for bringing communities together. Protecting this cultural tradition and economic force is important for preserving jobs, income and tax revenues at the federal, state and local levels.

OHSF has exceeded projections for reaching the public with information about the fishery. The following sections will highlight efforts to promote fisheries and aquaculture: (1) Enhanced, Healthy Wild Fishery, (2) Improved Productivity and Profitability, (3) Mitigation of Aquatic Invasive Species, and (4) New Ways to Reach Visitors with Fishery Information. These sections will highlight the numerous research endeavors OHSF has supported through its grants portfolio and research and outreach efforts led by A/EP-001-supported Extension staff.

#### Enhanced, Healthy Wild Fishery:

Great Lakes wetlands are important habitats for many fishes. Over 40% of Great Lakes fish species are wetland-dependent, while more than 70% benefit from wetlands periodically. However, only around 10% of the historic wetlands that existed along the Ohio portion of Lake Erie currently remain. Because this habitat has been removed, many beneficial wetland services are no longer occurring. State and federal resource management agencies have responded by restoring some agricultural lands back into wetlands and reconnecting current managed wetlands to the lake. OHSF received funding to conduct the fish sampling required to determine if restoration projects initiated by TNC, Ducks Unlimited and the Ottawa National Wildlife Refuge have been successful.

As the critical role these wetlands play in the life cycles of Great Lakes fish is better understood, the rate of restoration and rehabilitation of Great Lakes coastal wetlands has increased dramatically. This necessitates a balance among varied management objectives, including fish passage. The presence of water control structures commonly found on diked and managed wetlands can limit fish passage. OHSF (in partnership with ODNR staff and students participating in Stone Lab's REU Program) sampled three diked Lake Erie coastal wetlands to assess how different structures affect fish passage. Findings from this project show that pool-and-weir structures do not assist fish passage as well as less cost-effective hydrologic structures, but they do not provide a means for managing wetland water levels.

In part due to wetland loss, Lake Erie often experiences an influx of nutrients and sediment runoff during rain events leading to algal blooms or stirred-up sediments that reduce water clarity. OHSG researchers focused on walleye, which hunt primarily by vision, to see if this can keep them from finding food and mates. Lab experiments showed that walleye and a common prey species, emerald shiners, have compromised vision when algal blooms are present, compared to when murky waters are caused by sediments. In addition, the researchers developed a phone app and recruited Lake Erie charter boat captains in a citizen science project aimed at gathering fishing success information under different water conditions, helping to examine the extent to which these could affect Ohio's billion-dollar sport fishing industry.

#### Sustainable Fisheries and Aquaculture Performance Measure

**17,518** fishers, seafood processors and aquaculture industry personnel have modified their practices using knowledge gained in fisheries sustainability and seafood safety.

#### Improved Productivity and Profitability:

Ohio has one of the world's largest charter fishing fleets, yet its vibrancy and value is at risk due to socioeconomic and environmental changes. Around 700 charter captains do business along Lake Erie. Keeping up with new fishing techniques, business practices and the latest information on Lake Erie environmental issues is easier for these Ohio businesses thanks to OHSG's annual Charter Captains Conference. More than half of all captains attending 2017's conference reported an increase in their bottom line due to what they learned. With 85% of these captains reporting they've changed their way of doing business as a result, OHSG's Charter Captains Conferences continue to help these local businesses succeed.

#### Cross-Cutting Metric

OHSG staff gave **2,870** public or professional presentations attended by **169,613** individuals.

OHSG often works with fisheries managers on projects related to the Lake Erie fishery. Unfortunately, budget cuts at the state level have reduced and impaired the ability of both the OEPA and the ODNR-DOW to monitor the fishery. Further, budget cuts also reduce the ability of these agencies to train new staff in management techniques. To fill this gap, OHSG and Stone Laboratory have offered fish sampling workshops since 2007 to ensure a better-trained workforce. It also saves state agencies money by allowing new hires to work more quickly and spend less time training.

OHSG is also involved in the enhancement of aquaculture. Demand for yellow perch is high, as this is the traditional fish used in local restaurants and by consumers in many Great Lakes states. Ohio ranks first in pounds of yellow perch sold in the nation. Despite this economic opportunity, expansion of the yellow perch aquaculture industry has not occurred.

One reason is the relatively slow growth of cultured fish populations. OHSG researchers developed a broodstock of fast-growing yellow perch that are almost exclusively female and grow 26.3% faster than mixed-sex groups on the same feed, reaching market size more quickly. This has the potential to increase profit margins and make yellow perch farming a more achievable industry for Ohio.



Ohio Sea Grant research addresses the demand for yellow perch in Ohio by supporting research into faster-growing fish for aquaculture operations. Dr. Hanping Wang has bred yellow perch that grow 26.3% faster than mixed-sex groups on the same amount of feed, reaching market size more quickly and potentially making yellow perch aquaculture a more profitable Ohio industry.

#### Mitigation of Aquatic Invasive Species:

Aquatic Invasive Species (AIS) threaten inland lakes, rivers, wetlands, estuaries and oceans. Over 180 AIS are documented in the Great Lakes, carrying tremendous economic costs to the region. They can be spread by a number of vectors including currents, recreational boats and ships containing ballast water. Unfortunately many people don't realize individual activities remain a major vector, and addressing AIS within the Lake Erie watershed involves a multi-pronged approach with various audiences to stop the transport of AIS.

The Great Lakes Sea Grant Network programs have collaborated on AIS issues for years, and in 2014-2017 OHSG partnered on four different network-wide grants. These grants focused on different pathways, including fishing tournaments, aquarium trade and recreational activities. Programs use existing and effective "Stop Aquatic Hitchhikers!" and Habitattitude™ campaigns to relay project messages, including to "Clean, Drain, Dry" all equipment used in water and never release aquatic pets and plants in the wild. OHSG has reached over 71,000 individuals since 2010 with information on AIS and methods to stop them from spreading. Additional education and outreach strategies have been developed to reach participants in the Ohio Clean Marinas and Ohio Clean Boater programs as well as launch ramp users and others who can use best practices to reduce fishery risks.

One species of the Asian carp complex, the grass carp, poses an immediate concern for Lake Erie because they could cause extensive damage to existing and recently re-established

wetlands. Recent studies indicate that fertile grass carp are present in the Sandusky River, and any actions to suppress or eliminate an invading population requires early rapid identification of where the fish came from. OHSG researchers are using trace metal signatures in Asian carp ear bones (otoliths) to track their spawning grounds. Knowing where potentially invading populations came from and focusing management efforts there could help address and prevent another dangerous Lake Erie invasion by non-native species.

Historically, ballast water from shipping vessels has been a major vector for the introduction of new AIS. In response, OHSG researchers created a user-friendly model that can be used in ArcGIS to predict the spread of invasive species via ballast water throughout the Great Lakes to aid managers in determining locations for monitoring and to better understand risk of future spread. The model has been used to predict the spread of Eurasian ruffe and the fish disease VHSv. The Nature Conservancy used the model to strategically search for eDNA and found ruffe DNA in several predicted locations.

#### **New Ways to Reach Visitors with Fishery Information:**

When people experience fishing and learn about Lake Erie, they gain a deeper understanding of the importance of stewardship. Sport fishing provides a unique opportunity to experience the outdoors, is a major economic driver in Ohio and provides dietary health benefits when catch is consumed. Yet Ohio natural resource managers are concerned about lack of recruitment and retention of anglers in the state. In response to this, Ohio's youth experience fishing first-hand during several OHSG programs which provide fishing opportunities, create lifelong anglers and address the disconnect between Ohioans and Lake Erie. Programming provides information on fishing gear, fishing skills, organism identification, regulations and healthy seafood consumption. Since 2008, over 66 programs have reached more than 2,188 people, predominantly youth ages 13-18. One example is 4-H Sea Camp on Kelleys Island. This annual 5-day event is designed to instill a sense of stewardship for Lake Erie and intertwines science and popular recreational activities. Campers learn lure making, sport fishing basics, aquatic biology and sampling methods, techniques for filleting and preparing fish, and how to operate power boats and personal watercraft. Between 2010 and 2017, 532 teens attended Sea Camp.

Additional fishing education opportunities led by OHSG include Family Fishing Day, Boy Scout/Girl Scout programs, a 3-day workshop and 1-week college-credit course at Stone Laboratory. These programs often provide children with their very first fishing experience. Conservative estimates based on observation and verbal feedback indicate 75% of participants had positive outdoor experiences during these events and learned new sport fishing skills. Surveys show 44% of respondents will modify fish consumption practices based on knowledge gained in fisheries sustainability and seafood safety.

## **RESILIENT COMMUNITIES & ECONOMIES**

### **Resilient Communities and Economies represents 26% of OHSG's efforts without leveraged funds.**

Building sustainable coastal communities means increasing awareness of the resources upon which these economies grow as well as sharing the importance of ecosystem health to long-term economic vibrancy. Given the \$15.1 billion impact of Lake Erie tourism within Ohio's eight coastal counties, OHSG recognizes the importance of developing strategies to boost local economies while protecting those intrinsic qualities that attract visitors and their dollars. This section will highlight the numerous research endeavors OHSG has supported, outreach opportunities OHSG has initiated, and partnerships that OHSG has been associated with to reach the Resilient Communities and Economies goals as outlined in the strategic plan. OHSG work in this area focuses on (1) Building Strong Local Economies and Leaders, (2) Ohio Clean Marinas and Clean Boater Programs, (3) Coastal Storm Resiliency and Stormwater Management, (4) Restoring Critical Habitat, and (5) Assessing Value and Enhancing Tourism Opportunities. OHSG considers climate change efforts a main component of Resilient Communities and Economies, but it is a cross-cutting theme woven throughout the four focus areas.

#### **Building Strong Local Economies and Leaders:**

OHSG and OSU Extension lead business retention and expansion programs with Lake Erie coastal cities. The cities all desired to learn of local business concerns and perceptions as a means of forming an economic development strategy to retain and expand current business operations. For example, officials in the City of Oregon have learned that the retail and service sectors in the city plan to retain up to 857 full-time equivalent jobs and create up to 19 new full-time equivalent jobs, which could create additional income tax revenue of up to \$13,127 and up to \$583,433 in personal income. Similarly, officials in the city of Fremont learned that the industrial business sector plans to retain up to 260 jobs and create up to 19 new jobs which could create additional income tax revenue of up to \$10,403 and up to \$693,538 in personal income. OHSG and the City of Perrysburg learned that 116 businesses will retain 1,721-2,880 jobs and 40 of 116 businesses reported plans to expand, modernize or renovate. The number of new employees is estimated to represent 58-177 new full-time equivalent jobs with an estimated value of \$33,117-\$101,063 in additional income tax revenue and an estimated \$2.2-\$6.7 million in personal income to Perrysburg's local economy.

OHSG also worked with coastal partners to lead business retention and expansion programs. In partnership with Lake County Soil and Water Conservation District, Lake County Development Council and Lake County Farm Bureau, OHSG surveyed existing agricultural businesses in Lake County to assess job retention, creation and business expansion activities. OHSG and agency partners learned that 36



Ohio Sea Grant and Stone Lab were essential to the recovery of the formerly threatened Lake Erie Watersnake, only the 23rd species to ever be removed from the list of federally threatened species. Dr. Kristin Stanford continues to lead education and outreach efforts that have reached more than 20 million people with information about the native snake since 2003. [go.osu.edu/nerodio](http://go.osu.edu/nerodio)

businesses will retain 690-1,034 jobs and 23 of 36 businesses reported plans to expand, modernize or renovate. The number of new employees is estimated to represent 53-150 new full-time equivalent jobs with an estimated value of \$54,961-\$155,551 in additional income tax revenue and an estimated \$1.5-\$4.1 million in personal income to Lake County's local economy. Similarly, OHSG in partnership with the Lake Erie Marine Trades Association (LEMTA) and the ODNR-OCM surveyed existing marina businesses along Ohio's Lake Erie coastline. They learned that 51 businesses will retain 566-1,011 jobs and that 30 of 51 businesses reported plans to expand, modernize or renovate their businesses, with six of these firms planning to add jobs within the next 12 months. The number of new employees is estimated to represent 26-41 new full-time equivalent jobs with an estimated value of \$33,134-\$52,250 in additional income tax revenue to Ohio's coastal communities and an estimated \$790,790-\$1.2 million in personal income to Ohio's Lake Erie coastal counties.

**Resilient Communities and Economies Performance Measure**

**88** communities have implemented sustainable economic and environmental development practices and policies.

**Ohio Clean Marinas and Clean Boater Programs:**

Marinas, like many industries, generate pollution. But because of their nearshore location, marinas also serve as a chance to address nonpoint pollution before it enters Lake Erie. In 2004, OHSG, LEMTA and ODNR partnered to develop the Ohio Clean Marinas Program. Initially limited to marinas in the Lake Erie watershed, OHSG and the ODNR Division of Parks & Watercraft supported the expansion of the program in 2015 to a statewide certification effort. In response to marina industry demand for environmental education and professional development, the 1st Annual Ohio Clean Marinas Program Conference and Awards Ceremony was held in February 2017 with over 50 marina professionals participating. In 2018, a new, tiered certification program was launched to reinvigorate the 10-year-old program and provide opportunities for continued growth and improvement for the marina industry in Ohio to benefit water quality.

The Ohio Clean Marinas Program is working to implement ecosystem-based best management practices that reduce nonpoint source pollution while improving compliance with regulations and providing critical professional development and environmental education to the marine trades industry. From 2014-2018, the Ohio Clean Marinas Program provided in-person training and educational outreach to over 343 marina managers and staff and certified over 41 marinas in both Lake Erie and Ohio River watersheds. To date, there are 79 certified Clean Marinas implementing 5,609 best management practices to improve air and water quality.

Ohio has over 500,000 registered boaters, ranking among the top ten states in the country. The Ohio Clean Boater Program was created in 2006 to educate boaters and promote clean boating throughout Ohio.

OHSG staff promote Best Boater Practices at outreach events, and the Clean Marinas Program has a broader impact through both industry and

**Cross-Cutting Metric**  
OHSG certified **45** Clean Marinas and **13** people received HACCP certifications.

individual boater participation. Also since 2006, OHSG has helped coordinate a boat shrink-wrap recycling collection in Ohio that keeps the protective plastic wrap for vessels out of landfills and reduces dumpster costs at marinas. From 2014-2018, over 1,000 boaters took the pledge to help improve Lake Erie water quality, and over 24,500 pounds of shrink-wrap have been kept out of landfills. To date, there are over 2,700 Ohio Clean Boaters, and over 2.3 million pounds of shrink wrap have been recycled. Over 333,000 highway guardrail spacer blocks have been produced from the recycled plastic, protecting over 416 miles of highway.

**Coastal Storm Resiliency and Stormwater Management:**

Coastal storms and floods have historically been the most destructive natural hazards in northeast Ohio, resulting in nine of eleven presidential declarations of disaster in Cuyahoga County that cost over \$650 million in damages from 1950 through 2010. Climatic changes are predicted to worsen these hazards by producing increased precipitation and more frequent severe storms. OHSG and partners identified the Northeast Ohio coastal communities most vulnerable to severe storms, while helping municipal officials and local residents build capacity for resiliency by identifying at-risk locations and populations; providing guidance on planning, zoning, and development of local codes and ordinances; and prioritizing implementation of conservation and green stormwater infrastructure. OHSG and partners designed four unique outreach tools and published one journal article to educate stakeholders.

The damage inflicted by Superstorm Sandy in 2012 caused many marinas in the Great Lakes to reconsider their vulnerability to coastal storms. OHSG led a project that used marina owner input to directly inform the development of a

local coastal storms Preparedness, Adaptation and Response Tool (PART) for Great Lakes marinas. OHSG obtained a NOAA Coastal Storms Grant in partnership with The Ohio State University, Pennsylvania Sea Grant and Wisconsin Sea Grant in 2014. This project sought to understand the needs, drivers and barriers to preparing for weather hazards and to develop a tool that will help marina owners now and in the future. The PART was developed based on marina owners' input and presented to 20 stakeholders at a marina resiliency workshop and webinar. Four marinas used the PART in a pilot study; all participants agreed that PART was an important and useful tool that would help prepare them for storms.

### Restoring Critical Habitat:

OHSG creates clean and healthy watersheds through participation on Areas of Concern (AOC) projects, restoring wetlands and reclaiming critical habitat thanks to OHSG expertise and assistance. Many of these initiatives are outlined below; however, much of the work restoring Lake Erie wetlands is discussed in the sustainable fisheries and aquaculture section.

OHSG is involved in four AOCs in the Lake Erie region (Maumee, Cuyahoga, Black and Ashtabula Rivers). During this strategic plan, OHSG greatly increased its representation within the Cuyahoga River AOC. The Cuyahoga River is one of 43 Great Lakes AOCs that have experienced environmental degradation, fail to meet Great Lakes Water Quality Agreement (GLWQA) standards and are impaired in their ability to support aquatic life or beneficial uses. To help lead the restoration efforts, OHSG accepted an invitation to serve on the Cuyahoga River AOC Advisory Committee in January 2016. OHSG plays a significant role in the AOC Advisory Committee by providing guidance on education and outreach activities associated with the de-listing process, and OHSG staff directs the AOCs Public Outreach Subcommittee, helping to interpret and relay scientific information to the public and bringing the needs of the public to the attention of the advisory committee.

After an intensive 10-year effort, the Lake Erie Watersnake became the 23rd species removed from the list of federally threatened species in 2011. Due to the snakes' limited distribution and endangered status in Ohio, monitoring and outreach remains an important component of their conservation. Led by Stone Lab staff, research continues to monitor the population of this endemic snake and conduct an intensive outreach campaign, educating local residents, transient boaters and tourists about the species (over 9,000 people reached). In 2017, population monitoring, which processed more than 2,000 snakes on five islands, focused on assessing a newly emerging threat, Snake Fungal Disease. Of 393 snakes, 75.4% may be harboring this fungus. Other monitoring showed stable reproduction and analysis of diet samples showed round gobies as the dominant prey item.

### Resilient Communities and Economies Performance Measure

**18** communities have implemented hazard resiliency practices to prepare for, respond to or minimize coastal hazardous events.

Plastic in Great Lakes waters affects water quality, human and animal safety and shoreline aesthetics. With 87% of items on Great Lakes beach cleanups found being single-use plastic, there is a need to educate the public to decrease use. OHSG has greatly expanded its research and outreach in the area of marine debris and single-use plastic consumption during this strategic plan. In 2017, OHSG partnered with the City of Cleveland Mayor's Office Sustainability and thundertech::inc with funding from the NOAA Marine Debris Program, to conduct a study to understand consumer behavior in regards to three single-use plastic items: water bottles, shopping bags and cigar tips. Results from this study have been used to inform the social marketing campaign "Don't Break the Lake" and have been published in *Marine Pollution Bulletin*. The plastic bag results have also been instrumental in providing Cuyahoga County legislators with scientific data on consumer opinion for a plastic bag levy which is currently in development and led to the hire of a new communication and education position for the Cleveland Water Department.

### Assessing Value and Enhancing Tourism Opportunities:

Many small towns along the coast of Lake Erie suffered some level of economic downturn due to the manufacturing recession in the last century. Tourism and special events have been recognized across the country as powerful tools to reshape community economies. OHSG supported an investigator to assess the impacts of a walleye festival to local communities in Ottawa County. The research resulted in 519 surveys collected from festival goers. The findings revealed the impact of the festival was tremendous; generating 67 jobs, \$1.8 million in labor income, \$2.1 million in value added income (GDP) and \$3.8 million of total economic output.

Birding continues to be an increasing area within nature tourism in Ohio with more than 3.2 million birding enthusiasts and an economic driver of \$750 million annually for the state. To help increase birding awareness and participation, OHSG partnered with the ODNR Division of Wildlife, Ohio Department of Transportation and Old Woman Creek NERR to create and distribute a 232-page reference book outlining 88 birding sites across the Ohio Lake Erie counties.

### Cross-Cutting Metric

OHSG activities created **\$83,164,838** in total economic (market and non-market) benefits, with **426** businesses and **3,624** jobs retained, and **243** jobs created.

OHSG-funded researchers are combining survey data with housing market information to create a comprehensive model of how algal blooms affect the Lake Erie economy. The model will also be applicable to other areas that experience similar

issues. Researchers found that housing values decrease by 7-16% when algal blooms surpass levels designated as safe for drinking. Surveys at popular recreation spots also showed that anglers and beachgoers tended to substitute locations not affected by algal blooms when their favorite spots were closed but that some people also decided to visit Lake Erie less often because algal blooms forced them to change their plans in the past.

## ENVIRONMENTAL LITERACY & WORKFORCE DEVELOPMENT

Environmental Literacy and Workforce Development represents 18% of OHSG's efforts without leveraged funds.

Since funding its very first research project in education 40 years ago, OHSG has been committed to the development of science curriculum and programming to educate its citizens about Lake Erie and Great Lakes issues. Recognizing that a more environmentally-literate citizen is potentially a more Lake Erie-educated voter, OHSG has brought aquatic science education to more than 120,000 people from children to adults since 2014 through its youth field trip program, college science courses, professional development workshops and environmental interpretive programming. The following sections outline the formal and informal educational programming that OHSG (with its educational arm, Stone Laboratory) has created over the 2014-2018 Strategic Plan period to teach STEM education and provide Great Lakes citizens with a lifetime of Lake Erie literacy and learning.

### Teaching Lake Science Early through Field Trips:

OHSG has realized that in order for youths to understand and appreciate aquatic science, students should experience firsthand Ohio's most important aquatic resource, Lake Erie. Since 1973, OHSG's Stone Laboratory has provided hands-on science learning opportunities for students across Ohio and beyond that may be unavailable to them in traditional classroom settings. Stone Lab offers students the chance to be a scientist for a day, participating in activities such as fish trawling and seining, fish identification and dissection, plankton identification, water quality monitoring and much more to show them real-world science applications outside the classroom. From 2014-2017, more than 22,992 participants (715 groups) enjoyed place-based field trip programs and tours at Stone Laboratory. The lab's hands-on outdoor field trip program alone provided opportunities for middle and high school students (8,228) and adults (6,695) to not only understand but participate in ongoing studies concerning current Lake Erie issues (e.g., harmful algal blooms). These participants gained both awareness and understanding of Lake Erie's natural,

#### Environmental Literacy and Workforce Performance Measure

An average of **73** Ohio Sea Grant products advance environmental literacy and workforce development annually.

cultural, environmental and economic importance to Ohio and the U.S. through this interactive learning opportunity.

### Producing STEM Curriculum for Classrooms and Beyond:

Encouraging renewable energy use is critical, yet there is a void of locally relevant, inquiry-based lessons accessible to educators. Therefore, OHSG developed the Solar Energy Curriculum Consortium (SECC) by bringing together Ohio State's Office of Energy and Environment; Department of Facilities, Operations, and Development; and Energize Ohio, an OSU Extension signature program. Solar thermal and photovoltaic systems currently supply hot water and power to Stone Laboratory. With its solar energy infrastructure and support from the Center for Great Lakes Literacy (CGLL) and OSU Cares grant program, OHSG led the group in developing a solar technology curriculum consisting of four hands-on lessons and three interactive web-based modules and facilitated two teacher workshops. Twelve informal and 68 formal educators from Ohio, Indiana and Michigan were trained to implement the four data-driven lessons supported by three content-driven presentations using the Nearpod interactive digital learning platform. With lessons freely accessible online (Nearpod or OHSG website), educators have greater awareness of and access to exemplary solar technology lessons. Based on immediate post-workshop evaluations, educators plan to implement lessons with 5400 learners, and informal educators with the Ohio Energy Project now incorporate lessons into their programming, reaching more than 200 educators annually.

#### Cross-Cutting Metric

OHSG supported **375** undergraduates, **200** M.S. and **88** Ph.D. students.

There are documented needs for lessons that are pedagogically sound and ready for use in K-12 classrooms as well as educator professional development for integrating Great Lakes science and fostering environmental literacy. Likewise informal educators across the basin are looking for engaging activities to promote a Great Lakes literate public. OHSG updated existing lessons on Great Lakes geography and pollution impacts on water quality, including updating science content and data sets, restructuring lessons around the 5E's of inquiry learning and adding technology components. OHSG trained 35 formal and informal educators to access and use an extensive collection of lessons and support materials, and they now have the necessary knowledge and skills to facilitate hands-on learning about Great Lakes topics. 94% of participants intended to integrate one or more lessons with their educational audience, potentially reaching over 3,000 learners. OHSG Education Specialists also used state and regional conferences as opportunities to provide resources to educators, train them to use the lessons with diverse audiences and introduce the numerous supplementary resources available at [greatlakesliteracy.net](http://greatlakesliteracy.net).





Stone Lab's Lake Erie Science Field Trip program has brought hands-on science and discovery to 282,000 participants since 1973, an experience many could not have had in a traditional classroom setting. Middle and high school students and adults not only learn about current Lake Erie research, but participate in data collection for ongoing studies, deepening their understanding of the lake's importance to Ohio and the region. [go.osu.edu/ieldtripvid](http://go.osu.edu/ieldtripvid)

Science educators not only seek opportunities to improve content knowledge, but also to develop pedagogical strategies and instructional technology skills; they also desire place-based education that adds relevance and authenticity to learning. Since 2014, the Center for Great Lakes Literacy (CGLL) has supported professional learning opportunities spanning from one-day workshops at Stone Lab to seven-day immersive courses on a U.S. EPA research vessel. As a result, innovative lessons, strategies and skills have been used with more than 11,800 learners. A partnership with OEPA's Office of Environmental Education and ODNR-DOW resulted in 33 educators (reaching 5,600 learners annually) certified to teach five sets of Project Wild and Project Wet curricula. On six-month follow-up surveys, 95% of participants have already incorporated multiple workshop lessons with more than 450 students and 300 members of the public. All participants shared resources with colleagues, reported an increase in the use of instructional technology to engage students with science content and indicated greater cognizance of consistently incorporating Great Lakes topics throughout lessons and programs in order to foster Great Lakes literacy among learners of all ages.

#### Environmental Literacy and Workforce Performance Measure

**154,263** people have been engaged in Ohio Sea Grant-supported informal education programs.

In addition, OHSG was a partner on a five-year (2012-2017) National Science Foundation grant to Bowling Green State University to be lead scientists on citizen-science research projects. Research shows a declining state of STEM education in the United States and Ohio. Further, research has suggested that classroom participation in citizen science research projects has the potential to improve motivation, engagement and achievement in students, thereby increasing student success

in STEM disciplines. OHSG designed a stream-based citizen science project to educate students in grades 4-7 from northern Ohio. The project was designed to evaluate the health of streams that pass through their community and influence Lake Erie system health. OHSG educated 12 teachers and over 300 students per year from 2014-2017 in general stream ecology; ways to assess stream health; and data collection methods, analysis and interpretation.

#### Cross-Cutting Metric

**2,483** P-12 educators participated in Sea Grant education programs.

But Great Lakes learning doesn't have to be on the lake or in the classroom. In 2014, OHSG became the first Sea Grant program to develop an e-learning iTunes U course, teaching more than 77,000 people worldwide about the impacts the Great Lakes face under a changing climate. In 2017, the Lake Erie Nature and Science Center became the first informal education facility to develop their own climate change walk and interactive exhibits modeled after OHSG's original 2013 Climate Expedition program. As the original developers of the 2010 Great Lakes Literacy Principles, OHSG has distributed more than 25,000 brochures outlining what it means to be a Great Lakes literate citizen.

#### Creating an Educated Workforce:

The goal of college courses and workshops offered at Stone Laboratory is to provide individuals interested in aquatic sciences access to cutting-edge curricula and exposure to researchers conducting research projects relevant to the Great Lakes Region. Since 2014, OHSG and Stone Laboratory have offered 89 courses for college credit and 18 non-credit workshops available to high school, college, graduate students and professionals. These efforts reached 746 students: 280 college-level students, 233 advanced high school students and 233 in non-credit workshops. A recent survey sent to 1,516 students that took courses and workshops at Stone Lab since 2012 highlight the success of the program. Of the 299 individuals that responded to the survey, 79 had graduated and were employed in a career related to their degree within two years of graduation.

OHSG collaborated with water managers from three coastal municipalities, agency scientists from NOAA and OEPA and researchers from two universities to offer workshops at Stone Lab focused on (1) algal identification and (2) treatment technology for toxins and taste/odor compounds, educating 179 professionals and students from 2014-2017. When both phosphorus concentrations and temperature are elevated, certain types of cyanobacteria can grow in excess in Lake Erie and are capable of producing toxins. Resource managers working in Lake Erie need the skills required to identify cyanobacteria and also the ability to assess toxin concentrations. They also need to know how to use this

**Environmental Literacy and Workforce Performance Measure**

**263** Ohio Sea Grant-supported graduates were employed in a career related to their degree within two years of graduation.

information to inform water treatment options and to mobilize actions to protect those that recreate on Lake Erie. This need to train experts was punctuated by the city of Toledo's 2014 drinking water crisis, which left more than 500,000 people without safe water.

**Cross-Cutting Metric**

**115,334** P-12 students were reached through Sea Grant-trained educators or directly through education programs.

As the world continues to rely more and more

on science to guide political and personal decisions, training future scientists to provide the information needed is essential to maintaining and raising quality of life across the globe. Offering hands-on training to college students gives students the experience they need to begin a career in science. To train the next generation of scientists, in 2005 Stone Lab initiated a Research Experience for Undergraduates scholarship program (REU) that allows undergraduate students to conduct an original research project under the guidance of a university or government agency scientist. During this strategic plan (2014-2018), Stone Lab educated 38 REU students and awarded more than \$160,000 in REU scholarships thanks to three of OHSG's

endowments. Of the REU students the program has maintained contact with, 69% have pursued graduate degrees and 24% began a career in a science-based field.

**Sparkling Lifelong Learning and the Importance of Lake Erie Stewardship:**

The Lake Erie island region, specifically South Bass Island, is a flourishing summer travel hot spot within Ohio, attracting more than 10,000 daily tourists. Interested visitors seek knowledge on Lake Erie topics and issues. Through its free educational center, OHSG provides a broader understanding and increases visitors' knowledge of current topics concerning the Great Lakes. Through a partnership with the ODNR-DOW, OHSG has expanded programming at the Aquatic Visitors Center (AVC) in Put-in-Bay, Ohio. The AVC provides a hands-on fishing experience for children and free tours of the facility highlighting information on the historic fish hatchery, Lake Erie fishes and food webs, aquatic invasive species, sustainable sport fishing practices and other issues facing Lake Erie. Between 2014 and 2017, more than 65,000 visitors experienced historic hatchery tours.

**Environmental Literacy and Workforce Performance Measure**

**20,922** professionals received continuing education and/or training from Ohio Sea Grant that helps them keep their jobs or advance professionally in their career.

## PROGRAM CHANGES RESULTING FROM PREVIOUS SITE REVIEW VISIT

The 2014 Site Review Team report listed zero recommendations; formally prescribed courses of action for which the Sea Grant program is accountable. The report did list two suggestions. Suggestions are presented for consideration but the program is not accountable for responding to suggestions.

- **“Look for opportunities to publish the results and impacts of Ohio Sea Grant’s education and outreach programs in professional journals.”** Since the departure of Dr. Rosanne Fortner, professor within the School of Environment and Natural Resources and Associate Director of Stone Laboratory at The Ohio State University, the program has been unable to establish a new relationship with a faculty member within Ohio State to help staff publish their efforts. This is despite three separate attempts. Within this reporting cycle, OHSG supported one education & outreach specialist to begin a Ph.D. program, with the goal being that her dissertation would include evaluation and publishing of education and outreach efforts. She ultimately decided to delay this move. The program also engaged two different Ohio State educators to replace the Sea Grant education coordinator. Their existing portfolios didn't allow time to develop this new partnership. Despite these failed attempts, OHSG has still produced five publications in professional journals over the course of the reporting period.
- **“Look for opportunities to expand some of the Stone Lab Education Programs to underserved communities.”** OHSG actively sought and received foundation support to provide free Stone Lab Field Trips to underserved communities in Northwest Ohio (First Solar and the Andrews Foundation). This support covers registration for field trips, meals and transportation to the island and substitute teachers if needed. Without this support these students would never have had access to this hands-on learning opportunity.