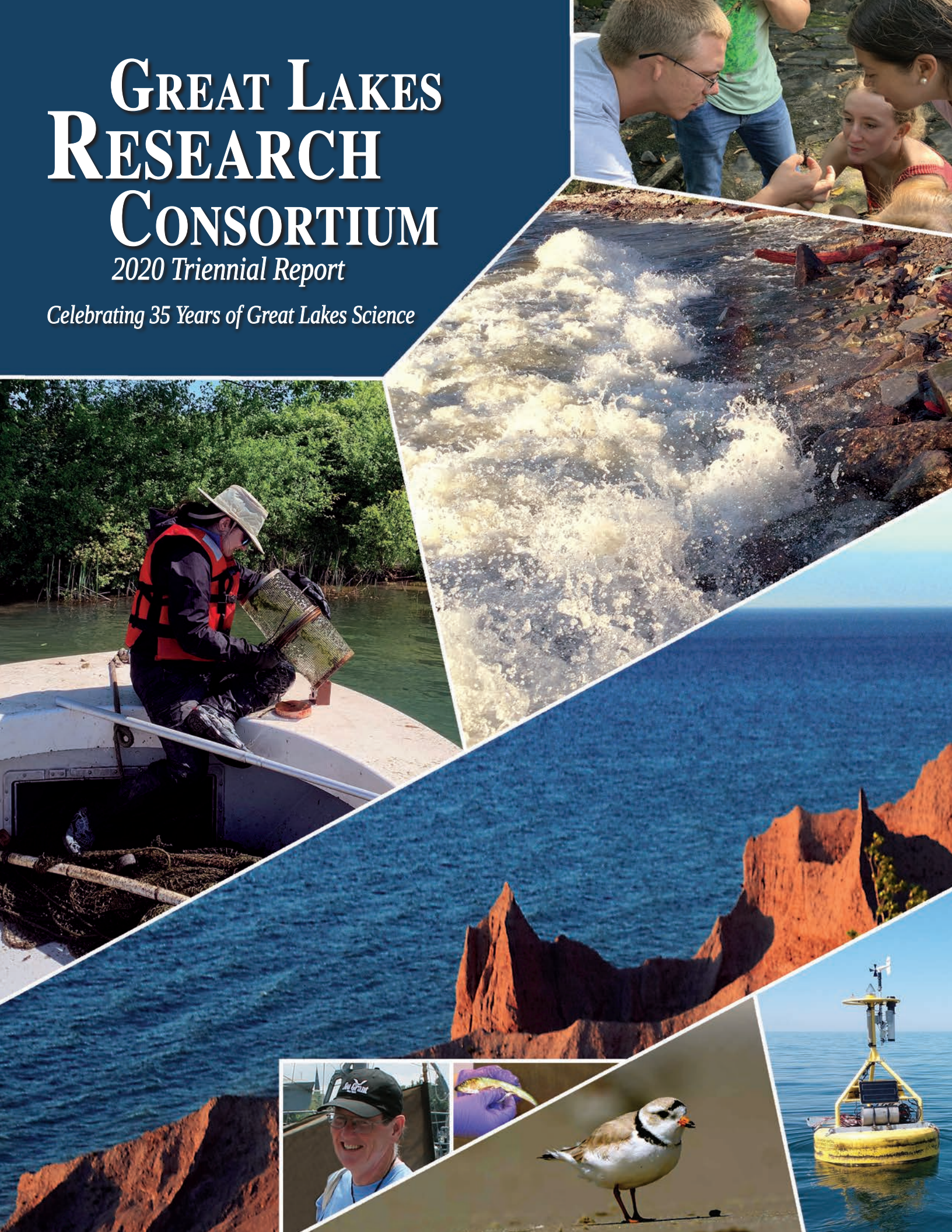
Great Lakes Research Consortium

2020 Triennial Report

Celebrating 35 Years of Great Lakes Science



Great Lakes Research Consortium
2020 Triennial Report

Great Lakes Research Consortium • 253 Baker Lab • SUNY ESF • Syracuse, NY 13210

TABLE of CONTENTS

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Great Lakes Research Consortium (GLRC)
Member Institutions & Affiliates

The GLRC's 18 colleges and universities in New York State, and nine affiliates in Ontario, Canada, are dedicated to collaborative research and education to advance Great Lakes science and understanding. A Board of Governors directs Consortium-wide policy and direction. Campus representatives network to make cutting-edge research and student involvement possible. Member institutions belonging to the State University of New York system will be identified with SUNY throughout this report.

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Associate Partner: New York Sea Grant
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Navigating New Waters

The year 2020 has been a time of transition: transition to online learning and finding new ways to conduct research while staying six feet apart and to keep in touch and share scientific findings without getting together in person. During all of this unprecedented time, the values of New York's Great Lakes Research Consortium (GLRC) remain intact.

The GLRC has three principle goals: 1) To facilitate research and scholarship on the chemical, physical, biological, and social processes that affect the Great Lakes, 2) to provide opportunities for the training and education of students, and 3) to disseminate information and research findings. These principles were described in a 2007 SUNY ESF proposal to the GLRC to continue hosting the organization. They hold true today and I am delighted to highlight some of these efforts in the pages that follow.

I became GLRC director in 2007, and will be stepping down in the next two years as I move forward in my career. I came to ESF in 1985 and still reflect fondly on the early GLRC conferences where we gathered together in Syracuse to discuss our research. One of the first grants I received as a new faculty member was a GLRC small grant to study the then-unknown occurrence of HABs within Lake Ontario and Lake Champlain. That grant was critical for shaping my research and career over these past 35 years. The GLRC continues to provide support to early-career investigators, and, over the past five years, we have used our MOU with the New York State Department of Environmental Conservation (DEC) to distribute more than $550,000 in research grants to nine campuses. This demonstrates the GLRC commitment to supporting a wide range of research at campuses, large and small.

However, I find our smaller campuses are not as involved in the GLRC as before. Perhaps this is due to changing demographics, a changed interest by students and faculty at these campuses, or if new researchers are unaware of how to get involved with the GLRC. While we can't change the first two reasons, we can address how we engage all campuses in New York State that have interest in Great Lakes research. As we look for a new director to lead the GLRC, we can investigate if structural changes in the organization are needed. All organizations evolve and the GLRC has used a similar structure since its origin 35 years ago. It may be time for a new model.

"As a charter member of the GLRC since its formation at Oswego, I have seen Greg Boyer dedicate countless hours to advancing Great Lakes research and GLRC collaborative mission to benefit faculty, students, member institutions, and New York's Great Lakes Communities." **– David G. White II, New York Sea Grant**

The GLRC was formed to help researchers across New York State to collaborate with each other. Historically, conferences were used to enable researchers to contact others outside their local institutions. With the development and evolution of new communication technologies, researchers can now interact with others across the region with a click of a mouse. This should lead to a greater understanding of our Great Lakes and the dissemination of research findings. However, many of us still miss those conversations between scientists at the conferences and over dinner. The new director will need to lead the organization as it evolves to engage a whole new generation of Great Lakes scientists. These new scientists are the future of research in New York State and for the entire Great Lakes, as well as the future of the GLRC organization itself.

I have enjoyed being GLRC director over the last 14 years. I look forward to seeing all that the GLRC will accomplish as it begins this new transition period, and wish you all the best.

— Greg Boyer

Sparking Innovative Science for Great Lakes Issues

Great Lakes Research Consortium small grants' projects produce big results. The research by faculty and students receiving GLRC grants, more often than not, forms the leading edge of science-based solutions to critical problems facing the binational Great Lakes-St. Lawrence River system and its coastal communities.

GLRC projects engage the best multi-discipline, academic minds and draw interest and support from diverse sectors, from government and municipal leaders to citizen conservation groups, as well as larger funders in support of the next steps of discovery and application.

GLRC-funded research addresses critical issues:

- **Contaminants of Emerging Concern (CEC)**: Everyday household and personal care products and medications, such as antidepressants, pesticides, PFAS, and industrial chemicals, are increasingly found in the public water supply, in treated wastewater, and bioaccumulating in the aquatic ecosystem.

- **Water Quality and Harmful Algal Blooms**: While some algal blooms are just a nuisance, impeding recreational use or waterfront access, when a bloom produces cyanobacterial toxins it becomes dangerous to human and animal health.

- **Water Quality and Shoreline Septic Systems**: Projects have applied aerial photography and tested the use of DNA tracers to identify the location of problematic systems to assist resource managers and public health officials and encourage engineering and remediation to protect the environment from septic pollution.

- **Water Quality and Microplastics Pollution:** GLRC has a longstanding interest in Great Lakes water quality as illustrated through member participation in the Cooperative Science Monitoring Initiative, funding of one of the early assessments of plastic pollution within the Great Lakes (SUNY Fredonia), and a 2020 grant to evaluate the effect of microplastics on harmful algal bloom.

- **Climate and Coastal Resiliency for the Great Lakes:** GLRC projects are empowering communities to advance their ability to anticipate, withstand, and recover from extreme weather events in any season from flooding to "Lake Effect" snow events.

- **Habitat Conservation:** Researchers have helped bring the piping plover, an indicator species of the health of sandy shoreline habitat, back to Lake Ontario. The Great Lakes form one of three distinct geographic regions for the feisty little bird that has returned to eastern Lake Ontario after a long absence and in spite of high water events in 2017 and 2019.

- **Fisheries:** GLRC research creates foundational science that contributes to Great Lakes' fisheries' health, management, and conservation. An April 2020 *New York Freshwater Fishing Digest* article, published by the NYS DEC, noted that "New York's latest statewide angler survey shows that the economic impact of freshwater fishing is more than $2 billion and supports nearly 11,000 jobs." Fisheries biodiversity is key to the Great Lakes ecological and economic health.

This report is a snapshot of the broad range of the innovative science supported by GLRC member institution faculty and students. Please read on. . .

GLRC's New Faculty Mentoring Conference

The Great Lakes Research Consortium (GLRC) mentoring conferences introduce member institutions' new faculty (<2 years) to one another and to the mission of the Consortium. GLRC Director Greg Boyer details the structure of the Consortium and its mission to advance understanding of the Great Lakes ecosystem across a broad range of singular and interconnected disciplines. He shares his enthusiasm for innovative research that establishes a basis for future in-depth studies and for the unparalleled GLRC student scholarship opportunities focused on Great Lakes issues.

Navigating the Great Lakes' sea of agencies and acronyms can be difficult, even for the established investigator. Conference attendees learn the Great Lakes "H.O.M.E.S. (Huron, Ontario, Michigan, Erie, Superior) Who's Who" from GLRC Associate Director Dave White of New York Sea Grant (NYSG).

Multiple funding agencies (federal, state, and local) support Great Lakes research. New York State (NYS) funding opportunities are described by the NYS DEC Great Lakes Program Coordinator Donald Zelazny, while federal funding through the National Oceanic and Atmospheric Administration (NOAA) is outlined by NYSG Associate Director Katherine Bunting-Howarth. Representatives from the SUNY Research Foundation discuss the mechanics of proposal preparation, budgets, and submission.

Opportunities to utilize federal and state assets are presented, including access to the U.S. EPA Research Vessel *Lake Guardian* as part of the cooperative Science and Monitoring Initiative (CSMI). The CSMI is a binational initiative instituted under the 2012 Great Lakes Water Quality Agreement to address management and monitoring priorities on each of the Great Lakes on a rolling basis. It provides excellent opportunities for Great Lakes scientists to interact with federal and state partners to address areas of joint concern. The next CSMI tour on Lake Ontario is expected in 2023 and on Lake Erie in 2024.

New faculty attending GLRC Mentoring Conferences network and explore their research ideas with experienced faculty and researchers from multiple disciplines and learn how to communicate project results to a wide audience of Great Lakes stakeholders, nonprofit organizations, and citizen stewardship groups.

EPA R/V Lake Guardian

GLRC Buoy Data Help Diverse Stakeholders

On the constantly changing Great Lakes, diverse stakeholders rely on the high-quality, real-time, and long-term water, weather, and nutrient data logged by the Great Lakes Observing System (GLOS) network of buoys. That data includes wave height; water temperature; wind speed; relative humidity; oxygen, algae, and other nutrient levels; and other datapoints.

Buoys operated by Great Lakes Research Consortium members, e.g, ESF3 Dunkirk, ESF8 Sodus, and UFI 45189 Oswego, are critical components of the GLOS system.

"Making the data public through GLOS, as many GLRC members do, makes a difference for people throughout the eastern Lake Erie and Lake Ontario area."
— GLOS CEO Kelli Paige

GLOS CEO Kelli Paige notes that, in addition to being useful to the research and management communities, more and more recreational audiences are using the buoy data every year to plan trips, find good fishing locations, and to stay safe on the water.

Stakeholders check the glbuoys.glos.org website for current conditions for navigation or to download data for research, analysis and modeling projects. User groups, freely accessing the system, include scientists, resource managers, maritime industry, recreational boaters, and anglers. Beneficiaries include state agencies on watch for HABs and the international public that relies on the Great Lakes as 20% of the world's fresh water.

Above, Buoy 45189, operated by Upstate Freshwater Institute (UFI), at Oswego, NY.

Contaminants of Emerging Concern

RESEARCH UNDERWAY:

Niagara River Project on Removing Antidepressants from Public Waters

With support from the GLRC grant, the University at Buffalo (UB) is evaluating the efficiency of advanced oxidative processes (AOP) for removing antidepressants in public wastewater. The research involves characterizing persistent AOP transformation products and chemical analysis and assessment of the ecotoxicity of the AOP-treated wastewater effluent based on fish physiological response. Earlier research has shown antidepressant medication bioaccumulation in fish brains.

Principal Investigators and Partners:
Diana S. Aga, Ph.D.; Ning Dai, Ph.D.; Alicia Perez-Fuentetaja, Ph.D., University at Buffalo; Erie County; New York Sea Grant

Onondaga Creek, a major tributary of Onondaga Lake

RESEARCH HIGHLIGHT:

GLRC Project Attracts NSF Grant

The "Screening and Risk Assessment of Contaminants of Emerging Concern (CEC) in the Onondaga Lake-Three Rivers System" conducted with GLRC grant funding by Syracuse University and the Upstate Freshwater Institute (UFI) attracted a $111,938 National Science Foundation (NSF) grant for new work. The project designed an analytical workflow to confirm and prioritize dozens of CECs, including pharmaceuticals, household/industrial chemicals, and pesticides, and their transformation products in Onondaga Lake. Twenty-eight of these CECs were detected in 100% of the lake samples. The artificial sweetener sucralose occurred at the highest concentration among all CECs detected; along with high levels of corrosion inhibitors, three human-use pharmaceuticals, and one pesticide (atrazine).

Sampling of the lake's four major tributaries showed fewer CECs with 10 detected in 100% of samples. Thirty-seven (37) CECs were also identified in the downstream Three Rivers (Seneca, Oneida, Oswego) system, indicating their ubiquitous presence in this regional lake-river system.

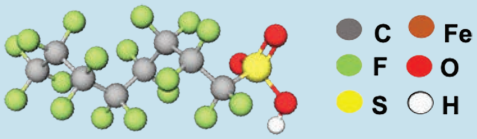
Community leaders now have a baseline dataset for monitoring and to address potential exotoxicological risks associated with CECs. The new funding from the NSF supports research to assess the occurrence patterns of CECs in more than 100 lakes with citizen participation across New York State.

Note: This project also helped attract a $499,000 USDA grant to SU for CEC-related research.

Principal Investigator: Teng Zeng, Ph.D., Engineering and Computer Science, Syracuse University

Contaminants of Emerging Concern

"Environmental contamination by PFAS has become an increasing public health concern because of the wide range of toxic effects that have been associated with exposure to these persistent chemicals."
— Nirupam Aich, Ph.D., University at Buffalo (UB)



RESEARCH UNDERWAY:
Applying Nanotechnology to PFAS Removal

PFAS are manmade per- and polyfluoroalkyl substances used to make heat, oil, grease and water-resistance coatings, food packaging, firefighting foam, and other products in the U.S. since the 1940s. The U.S. Environmental Protection Agency has identified PFAS as a priority pollutant for removal from drinking water and food sources. Of increasing public health concern, PFAS linger in the environment as they biodegrade very slowly and incompletely, and persist in water environments. In July 2020, the New York State Legislature passed legislation that bans PFAS in food packaging sold or distributed in the state as of 2023.

Based on Year 1 results, the UB team submitted a 5-year, $1.5 million project proposal for furthering this technology with the help of molecular modeling and high-resolution mass spectroscopy to achieve enhanced nano-bio-remediation of PFAS without the formation of toxic byproducts. This proposal was under review by a major federal funding agency in the fall of 2020.

Principal Investigator: Nirupam Aich, Ph.D., Civil, Structural and Environmental Engineering, University at Buffalo

RESEARCH UNDERWAY:
CEC Knowledge Gap Analysis Underway

A SUNY ESF research team with GLRC support has a Great Lakes Basin contaminants of emerging concern (CECs) gap analysis underway. The project is conducting a literature review for the "knowns" and "unknowns" of the most frequently detected CECs in the Great Lakes.

As of August 2020, the project had created surface water screening values (SV) for two CECs found in relatively high frequencies in earlier U.S. Fish and Wildlife Service water sampling at hundreds of Great Lakes Basin sites. One SV is for metformin, an anti-diabetes medication; the other for metolachlor, an herbicide.

With tens of thousands of CECs in commercial products, there is a clear need to develop SVs for CECs identified in waters worldwide. The SVs developed by this research contribute to CEC hazard characterization and assessment for ecological and public health risk in the Great Lakes Basin, and are valuable tools for Great Lakes natural resource and fisheries management. The U.S. Fish and Wildlife Service (Dan Gefell) and Abby Webster, SUNY ESF Alum 2019/2020 GLRC Intern, are project collaborators.

Principal Investigator: Roxanne Razavi, Ph.D., Environmental and Forest Biology, SUNY ESF

RESEARCH UNDERWAY:
Is this Invasive Species a Mercury Vector?

The tubenose goby (*Proterorhinus semilunaris*) population has significantly increased in NY's northeast Lake Ontario–St. Lawrence River basin. How is this invasive species likely to affect the regional fisheries?


Freshwater Tubenose Goby

A SUNY ESF project is providing data on the diet and habitat preferences of the tubenose goby and the more-established invasive round goby, using stomach content and stable isotope analyses to assess the importance of each species to the diets of predators.

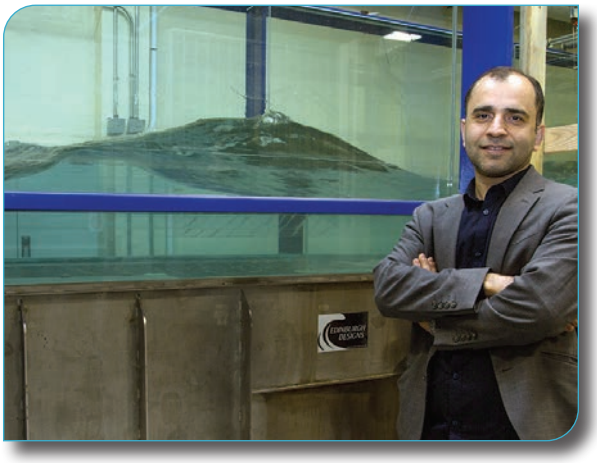
As its main objective, this GLRC-funded project is measuring mercury (Hg) bioaccumulation in the two invasive species to assess their potential to act as vectors of Hg to higher trophic level fishes.

Principal Investigators: Roxanne Razavi, Ph.D., Environmental and Forest Biology, SUNY ESF;
John M. Farrell, Ph.D., SUNY ESF, Thousand Island Biological Station Director

Cornell University graduate (2018) Iman Pakzad (seen on cover in boat) is a collaborator on this project.

Building Coastal Resiliency

Shorelines along the Great Lakes (nearly 10,000 miles in total) are experiencing increasingly high erosion rates and beach areas are threatened by water quality issues. While the impact of flooding events in 2017 and 2019 along New York's Lake Ontario shoreline (at right) captured news cycles, Lake Erie is also subject to the unique action of the Great Lakes on its shorelines. The GLRC has funded projects that are evaluating opportunities to build shoreline resiliency to erosion along New York's two Great Lakes, and to identify the sources of bacterial pollution *(p. 10)* that may impact beach access.



RESEARCH UNDERWAY:
Erosion Prediction Modeling

Stony Brook University (SBU) Civil Engineering Assistant Professor Ali Farhadzadeh, Ph.D. (*at left, with wave simulator in his SBU laboratory*) is currently using satellite imagery to validate an erosion management model he has built using seasonal climate, wave climate (wave height, period and direction averaged over time), storm surge, beach erosion, and sediment movement data along eastern Lake Erie since 1995.

Once validated, the model will be used to identify the potential for future climate change impact on Lake Erie shores and beaches. The computer modeling is also quantifying sediment transport and deposition processes following beach erosion. The SBU School of Marine and Atmospheric Sciences, New York Sea Grant, New York State Office of Parks, Recreation and Historic Preservation are project collaborators.

"Rather than spending hundreds of millions of dollars on the emergency to replace what was... let's rebuild it with a different plan and a different strategy."
— New York Governor Andrew M. Cuomo
Lake Ontario REDI webpage

RESEARCH UNDERWAY:
Managing Erosion with Biopolymers

A GLRC-funded demonstration project along the Lake Ontario shoreline is testing the use of marine-based, ecosystem-friendly biopolymers, applied with existing soil mixing techniques, to increase erosion resistance and protection. This project has been designed to achieve robust shoreline restoration with use of the biopolymers as a cost-effective solution. The demonstration site, installed by Stony Brook University (SBU) in collaboration with the Wayne County Soil and Water Conservation District (WCSWCD), is providing full-scale, four-season performance testing. Results are expected in 2021-22.

Above: at right, Principal Investigator Sherif L. Abdelaziz, Ph.D., Civil and Environment Engineering, SBU/Virginia Tech, and WCSWCD Program Specialist Drew Starkey scouting demonstration sites along Lake Ontario.

Building Coastal Resiliency


Woodlawn Beach State Park

RESEARCH UNDERWAY:
Source Tracking Contamination along NY Beaches

In early 2020 New York State announced that its' parks, campgrounds, trail systems, and historic sites saw a record number of more than 77 million visits in 2019. Beaches play a significant role in the associated economic impact for the state and the host communities. Shoreline resource managers and public health officials are increasingly interested in more precise ways to identify any public, or ecoystem, health risk identified with water quality. In 2018, the University at Buffalo received a GLRC grant to identify sources of bacterial pollution along Lake Erie, with a particular focus on *E. coli* and *Enterococci* species that can cause beach closures. The analysis involves evaluating bacterial DNA markers to help identify where the microbes originate. Enhancing prediction models will alert to when conditions warrant beach closure. Development of same day-result testing will facilitate more accurate and quicker response to protect the public health associated with beach access. The Erie County Department of Health and New York State Office of Parks, Recreation and Historic Preservation are project collaborators. Results are expected in 2021.

Principal Investigators: Lauren Sassoubre, Ph.D., University at Buffalo/University of San Francisco; Zhenduo Zhu, Ph.D., Civil, Structural and Environmental Engineering, University at Buffalo

RESEARCH HIGHLIGHT: Water Quality Monitoring with Sensors on the St. Lawrence River

"Our early GLRC grant helped prove the feasibility of conducting water quality monitoring on the river with sensors on the Canadian side, the American side, and in the middle at the Moses-Saunders Power Dam. The data opened our eyes to the binational ability to conduct long-term observation with an analytical approach. Recent data shows a potential 'early warning' notice of increased cyanobacteria levels, not high enough to demand action, but rather a call for attention to learn more about what may be influencing that increase."
— Michael Twiss, Ph.D., Clarkson University


Rachel Schultz, Ph.D. of SUNY Brockport, and graduate student Courtney Scoles collect methane emissions data in a Lake Ontario coastal wetland near Braddock Bay.

RESEARCH UNDERWAY:
Cattail Removal from Wetlands & Greenhouse Gas Management

Wetlands sequester carbon and buffer the Great Lakes shoreline from extreme weather events. They are also the largest natural source of methane, a major greenhouse gas. To better understand the role wetlands restoration might play in climate impact mitigation and carbon sequestration, SUNY Brockport is applying a GLRC grant to compare methane gas release from cattail-dominated marshes and restored marshes where cattails have been removed and replaced with native plant species that more effectively store carbon. The fieldwork in areas along Lake Ontario uses mobile technology (backpack unit) to measure greenhouse gas levels. Additionally, a log of belowground environmental conditions in the marshes will be used to model methane fluctuations over time and to estimate the carbon storage of each site.

Early data results indicate that native species restoration could lead to a decrease in methane released into the atmosphere. This work continues in 2021.

Principal Investigators: Rachel Schultz, Ph.D., graduate student Courtney Scoles, Michael Chislock, Ph.D., SUNY Brockport

Addressing Shoreline Septic Pollution Risk

"This research is a necessary first step towards addressing the question of what role septic field inputs have with stream water quality and watershed scale nutrient fluxes."
— Paul L. Richards, Ph.D., SUNY Brockport

RESEARCH HIGHLIGHT: The Grass is Greener

Using GLRC funding, SUNY Brockport conducted two proof-of-concept tests to evaluate the connectivity of leach fields to Great Lakes watersheds and embayments and to aid location of problematic septic systems.

Images captured with high resolution Pictometry Oblique Imagery showed changes, caused by nutrients in leachate, in vegetation color, and grass height and texture in septic fields in the Oak Orchard watershed of NY's Genesee and Orleans counties. Changes in soil microrelief were integrated with LIDaR (light detection and ranging) data to enhance location of raised septic fields and, in some instances, septic tanks and distribution boxes. The mapping of 1,277 septic fields was quality control checked against county geospatial databases.

Analysis of images and GIS shape files proved successful for mapping up to 61% to 81% of the systems by township. The remaining septic fields previously mapped by the county health departments were either not visible (e.g., obscured by canopy cover), were systems without leach fields, or were installed after imagery capture date.

Approximately 4.2% of the leach fields identified were within 100 feet of a tributary (< *minimum separation distance to a water body required by New York State Department of Health*). GIS shape files included data on soil types and soil characteristics. Eighty-eight percent of all of the septic fields mapped were impacted by soil issues. Watershed stakeholders in 20 townships received maps of high density septic "hot spots."

DNA Tracing Trial Shows Potential

A separate trial flushed DNA-based groundwater tracers from two residential toilets to investigate the potential for individual septic system effluent to breach into the watershed. Tracers were not located from one system; however, more than 30 days after flushing, a breakthrough curve through at least 200 meters of groundwater flow path and 1 km of stream was documented from the second site.

This initial trial showed the technology's potential utility, but identified issues for attention, including false positive outliers and the need to refine sampling interval and more accurately define the threshold of actual presence of tracers compared to data "noise." As an aside, it was noted that how much water is flushed into the septic system may also be a factor to achieve overflow push of leachate with tracers into the groundwater system.

Principal Investigators:
Paul L. Richards, Ph.D.,
Earth Sciences, SUNY Brockport;
M. Todd Walter, Ph.D.,
Biological and Environmental Engineering,
Cornell University

RESEARCH UNDERWAY:
Testing N Isotopes as Septic Pollution Indicator

Nitrogen pollution from aging and leaking septic tanks threatens the Great Lakes' water quality, encourages dense growth of aquatic weeds, and can lead to harmful algal blooms. SUNY ESF is using 2019 GLRC funding to investigate the use of nitrogen (N) isotopes as an indicator of septic pollution. The research is testing aquatic weeds in Sodus Bay for a natural biochemical signature indicating N accumulation, and developing a metrics analysis process that is expected to apply to any freshwater body, particular those with aging shoreline septic systems.

The Wayne County Soil and Water Conservation District and nonprofit Save Our Sodus are collaborating on the project.

Principal Investigator: Mark A. Teece, Chemistry, SUNY ESF

Protecting NY's Water Quality: Harmful Algal Blooms Research

RESEARCH HIGHLIGHT: Evaluating Cyanobacterial HABs

Cyanobacterial Harmful Algal Blooms (CHABs) have become an increasingly important water quality issue for New York's Great Lakes and inland waters. SUNY ESF and the Upstate Freshwater Institute (UFI) coalesced HAB data from the Citizens Statewide Lake Assessment Program (CSLAP) and from university researchers for 168 lakes for the period of 2012-2017 to identify potential factors associated with HAB formation and toxicity on those lakes.

Researchers evaluated cyanobacteria abundance and the cyanotoxin microcystin levels to identify potential variables associated with bloom and toxin formation. Cyanobacterial blooms and toxin formation were confirmed in 63% and 27% of the study lakes. Microcystis was a common genus, identified in 94% of nearshore CHABs with high levels of toxin. Blooms were most commonly found in eutrophic lakes, but also occurred in oligotrophic and mesotrophic lakes.

The presence of dreissenid mussels increased the probability of CHABs in lakes with low-to-moderate nutrient levels and in lakes with long fetches. Higher proportions of agricultural and developed land cover were also associated with increased likelihood of a HAB. Other significant predictors included total phosphorus, pH, and northwesterly lake orientation. The best overall model of predicting the occurrence of a toxic HAB included total nitrogen, pH, northwesterly lake orientation, and the interaction between lake fetch and dreissenid mussels.

Project Leads to Work on More NY Lakes

This GLRC project attracted new funding to conduct similar modeling on Owasco Lake, and for a similar effort on Skaneateles Lake. The project results are supporting additional water quality modeling related to the effect of mussel filtering and excretion on cyanobacteria and other phytoplankton groups, and research to advance understanding of hydrodynamic processes on spatial distribution of cyanobacteria.

"This project has advanced understanding of the factors associated with toxic HABs in New York lakes, encouraged a collaborative research effort with colleagues at NYSDEC and Ramboll (a Danish engineering, architecture and consultancy company), and stimulated new directions in CHABS research."
— UFI Director David Matthews, Ph.D.

Principal Investigators: David Matthews, Ph.D., Director, UFI; Kimberly L. Schulz, Ph.D., Environmental & Forest Biology, SUNY ESF

RESEARCH UNDERWAY:

Applying EBI Technology to Manage Microcystin

Microcystins are persistent toxins produced by cyanobacteria (blue-green algae), threatening public drinking water, ecosystem integrity, and freshwater recreational use. SUNY ESF is evaluating the use of electron beam irradiation (EBI) to rapidly degrade and detoxify microcystins. The work is evaluating how dissolved organic matter may shield microcystins from EBI and how EBI impacts effluent.

Principal Investigator: Mark Driscoll, Ph.D., Chemistry, SUNY ESF

RESEARCH HIGHLIGHT:

The Role of Nitrogen in HAB on Honeoye Lake

With increasing instances of Harmful Algal Blooms (HABs) in NY's 11 Finger Lakes, the Finger Lakes Institute at Hobart and William Smith (HWS) Colleges made the preliminary study of, and continues to investigate, the role of nitrogen (N), specifically the most bioavailable form of N, in the development of HAB on Honeoye Lake, as well as the influence of denitrification versus N recycling.

Principal Investigator: Lisa Cleckner, Ph.D., Director, Finger Lakes Institute at HWS

"Everyone is Upstream from Someone Else"

RESEARCH HIGHLIGHT: Engaging New York's Great Lakes Communities

Funding provided to the Environmental Finance Center at Syracuse University (SU-EFC) in 2018 was used to develop participatory models to engage Great Lakes communities in resiliency planning.


Chimney Bluffs along Lake Ontario

SU-EFC Director Khristopher Dodson notes, "Exploring targeted questions in a participatory process enables communities to identify barriers and opportunities and as a basis for advancing appropriate solutions, and creating momentum for adaptive measures to increase resiliency."

The participatory model developed for this project has directly helped communities in NY's Wayne County, and has set a standard for any watershed group to address climate adaptation and resiliency issues. Workshops engaged Wayne County stakeholders from elected officials and planners to community residents, business owners, and advocacy groups, e.g., Save Our Sodus and the Port Bay Improvement Association.

One resiliency workshop attendee noted: "Everyone is upstream from someone else."

Workshops and participatory instruments were designed to: 1) elicit factors constraining existing local plans re: shoreline resiliency, storm water management, and green infrastructure; 2) identify areas of opportunity for plan development; 3) articulate how community members, especially those in planning or decision-making roles, understand watershed issues and the Great Lakes' value; and 4) connect climate adaptation to municipal planning.

Initial findings suggest that "boundary organizations" that stabilize the science-policy interface while assisting interaction between science producers and users may help mitigate or lower procedural and communication barriers. Preliminary outcome identified the need for training and knowledge on how to communicate complicated information, such as codes and procedures, and scientific concepts. This is a gap that impartial boundary organizations might be ideally suited to fill.

"The GLRC funding for our 2018 pilot project in Wayne County created the basis from which we can now transfer the applicable success of that one project to other diverse and divergent communities."
— SU-EFC Director Khristopher Dodson

With additional funding provided through the NOAA Climate Program, SU-EFC is investigating economic resilience strategies for enhancing collaboration, engaging stakeholders county-wide, and increasing incorporation of climate science in local decision-making in Wayne County. Collaborators include the Great Lakes Integrated Sciences and Assessment Program, New York Sea Grant, Cornell University, and Genesee-Finger Lakes Regional Planning Council. This effort meets NY's Great Lakes Action Agenda goal to enhance community resiliency.


Spring thaw, March 2019

RESEARCH HIGHLIGHT: Climate Adaption: Learning from "Lake Effect"

Using a GLRC grant, University at Buffalo paleoclimatologist Elizabeth K. Thomas, Ph.D., extracted and compared thousands-of-year-old samples of leaf waxes to more recent samples from New York's "lake effect" areas (western NY and along Eastern Lake Ontario). The ancient, pre-industrial era samples reflect a warmer climate period. Thomas' baseline data on the hydrogen isotope signature unique to leaf waxes in high snowfall areas revealed spatio-temporal patterns in moisture recycling. This foundational knowledge is helping scientists better understand how a warming climate may impact future snowfall events.

RESEARCH HIGHLIGHT: The Return of the Piping Plover to Eastern Lake Ontario

***"The successful nesting of the Piping Plovers at Sandy Island Beach State Park is excellent news..."* — NYS DEC Commissioner Basil Seggos**

The Piping Plover (*Charadrius melodus)* is a North American "indicator species" reflecting the health of the open sandy coastal habitat the tiny bird prefers, but which makes it vulnerable to high water, beach erosion, predators, and human activity. In 1991, only 17 piping plover nesting sites were known in the U.S. Great Lakes (GL) region, mostly in the western GL. The birds disappeared from Lake Ontario from 1984 to 2015 until a single pair was found along the lake's eastern shore.

The GLRC has funded the SUNY ESF collaborative effort to restore this federally-endangered bird to the Lake Ontario shoreline. From 2017-2020, the research team 1) documented habitat selection during territory establishment, nesting, and brood-rearing; 2) monitored threats to nest and chick survival; 3) produced guidelines for future habitat management and actions to promote return of the birds to the region; and 4) placed exclusion protection over nests to discourage predators but allow adult plovers access.

The nesting of piping plover pairs at Sandy Island Beach State Park in 2018, 2019, and 2020 is significant, particularly in light of high water events along Lake Ontario in 2017 and 2019 that nearly expunged the habitat that remains in New York State for this unique species.

"Protection and creation of new habitat is critical to increasing the number of (piping plover) pairs nesting in New York. Based on our data, a mosaic of cover types is needed, as the use of microhabitat differed between adult and juvenile birds and by year." —Jonathan Cohen, Ph.D., SUNY ESF

A public outreach component brought the researchers the opportunity to comment on Sandy Island Beach State Park's dredging plan to suggest placement of dredge spoil to both prevent high water washover and benefit piping plovers. "*Share the Shore*" messaging through collaborator Audubon New York reached ~50,000 people. Audubon New York's update of the New York State Parks' *Great Lakes Piping Plover Factsheet* informs state legislators about the importance of this species.

This work attracted $70,000 in U.S. Fish and Wildlife Service funding for piping plover conservation. The multi-partner network supporting the GLRC project continues to work with its counterparts in the western Great Lakes.

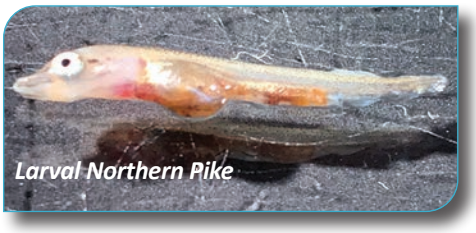
Principal Investigator:
Jonathan Cohen, Ph.D., Wildlife Ecology & Management Lab, SUNY ESF

Plover Advocate Serves as Onondaga Audubon Student-President

"The piping plover is a fiesty little avian that disappeared from NY's Great Lakes, but is now back with a successful hatch for three years," says Alison Kocek, a SUNY ESF Ph.D. candidate.

As president of the Onondaga Audubon Society, Alison recruited volunteers to help with monitoring and protecting nesting pairs as part of the GLRC-funded research.

"In Michigan, piping plovers nest on wide beaches, so the less-than-11-feet-wide beaches along NY's eastern Lake Ontario shore seemed suboptimal. It has been exciting to learn that these birds can use a variety of lake habitat and are not as limited as we thought for nesting habitat. Now we are learning all we can about what it takes to help them thrive here," says Alison. "More people using the Great Lakes creates the need for attention to habitat protection and public education. The people here have valued the (Sandy Island) beach and have taken care of it that without trying they have brought the piping plover back, proving that with care co-existence by people and plovers is possible."


Larval Northern Pike

RESEARCH HIGHLIGHT:
Fish Microbiome Research

"GLRC funding allowed us to explore the question of the microbiome effect on aquaculture-raised vs. wild freshwater fish. Fish raised on a diet of *Artemia* (shrimp) fatten faster but may not be as healthy as their wild counterparts. Does the microbiome of a natural diet provide the fish with an innate ability to fight off pathogens? "That is what we set out to learn," says SUNY ESF Professor Brian F. Leydet, Jr., MPH, Ph.D., who co-led the project with SUNY ESF Professor John Farrell, Ph.D., director of the Thousand Island Biological Field Station in Clayton, NY.

A series of articles by Leydet, Farrell, and student Ben Gallo (*p. 19*) will include note of the use of next generation sequencing to compare simple habitat and species level differences in fish gut microbiota.

"There is a lot of fruitful information yet to come as more of the work and five key points are published. The GLRC funding was essential to this baseline project that now provides a basis for new work and new, larger funding" says Leydet.

"This project allowed me, as new faculty, to work with John Farrell who is a well-regarded scientist. It has been wonderful to have the GLRC support so early in my career to pursue research, work with students, and spark new ideas for future projects." – Brian F. Leydet, Jr., MPH, Ph.D., SUNY ESF

RESEARCH HIGHLIGHT: **Student-Led Alewife Research**

Advancing understanding of alewife (*Alosa pseudoharengus*) as a dominant food source for Lake Ontario's multi-million dollar sport fishery was a focus of SUNY Brockport student Thomas "Tom" Bianchi's research. His interest was spurred by a decline in alewife abundance and variability in year-class strength. Evidence of a prolonged spawning season and the presence of multiple batches of advanced oocytes in the ovaries of alewife suggest this species displays indeterminate fecundity.

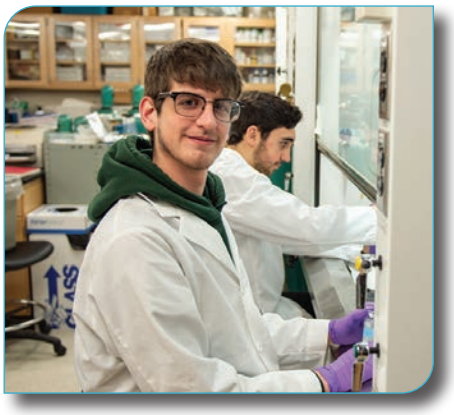
Tom's work also found that spawning potential (observed spawning and/or the presence of mature gonads) was observed in 63.9% of age-2 females and 90.4% of of age-2 males captured in June and July, indicating that age-2 alewife should be considered part of the spawning stock.

Above, Tom Bianchi (MS, 2020) at right is seen with his undergraduate advisor SUNY Brockport professor Jacques Rinchard, Ph.D. Tom was also advised by SUNY Brockport professor Michael F. Chislock, Ph.D., and U.S. Geological Survey Research Fisheries Biologist Brian C. Weidel, Ph.D.

RESEARCH HIGHLIGHT: **Journal of Great Lakes Research Publishes HWS Research on *Hemimysis Anomala***

A GLRC-funded team of researchers with Hobart and William Smith Colleges worked with high school students supported by the Poughkeepsie Day School Annual Fund over the course of four summer and fall seasons to examine the ecology of the bloody red shrimp, *H. anomala*. This work was published in the Journal of Great Lakes Research (January 2020) under the title: "*The influence of light, substrate, and fish on the habitat preferences of the invasive bloody red shrimp, Hemimysis anomala.*"

Fisheries: Fatty Acids Signature Research



RESEARCH HIGHLIGHT: **Students Assist Fisheries Research**

With GLRC support, SUNY Brockport students have worked with Professor Jacques Rinchard on the study of fatty acid signatures (FAS) to assess Lake Ontario fisheries. Fatty acids (FA) are a key component of fish survival, growth, and reproduction.

Student Robert G. Pattridge III (MS, 2016) conducted research to establish the first comprehensive FAS dataset for Lake Ontario's major prey species: alewife, rainbow smelt, round goby, and nine key predator species. Detailed analysis produced data on lipid content and FAS by season and location for each prey species, with distinguishable FAS profiles by species. This work established an initial model for the use of FAS to assess the lakewide food web.

Subsequent study by Jeremy Pike (MS, 2017) considered the effects of dietary FA on lake trout FAS. He examined the effects of mixed diets on juvenile lake trout to better understand how predators assimilate prey species' FA. His GLRC grant supported the assistance of an undergraduate and supplies for lipid extraction and FA analysis.

Kinsey Irvin (MS, 2018) received GLRC grant support to evaluate whether FAS of aquatic organisms (Genesee River and Sandy Creek) could be used to assess the river continuum concept to predict biological community response to changes from headwaters to river mouth.

SUNY Brockport and Dr. Rinchard have similarly applied GLRC and NYSDEC grants to support successive research examining the impact of thiamine (vitamin B1) deficiency syndrome in Lake Ontario salmonids, including an investigation by Matthew Futia (MS, 2018) on how diet and FA composition relate to thiamine deficiency in Lake Ontario salmonids.

Above, Cameron Snell, left, and Matthew Beers extract lipids from fish tissue in the SUNY Brockport Aquaculture Lab.

Sampling of SUNY Brockport GLRC Student Grants for Fisheries Research*

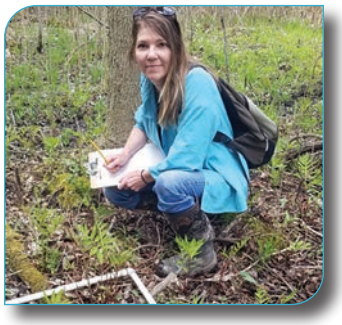
2013	Chris Hays: ***Impacts of dietary intake on round goby (Neogobious melanostomus) reproductive performance***
2013	Robert G. Pattridge III: ***Assessing nearshore-offshore linkages and spatiotemporal differences in the Lake Ontario food web using fatty acid signatures (FAS)***
2015	Pattridge and Matthew Futia present FAS signatures research at American Fisheries Society NY Meeting, Lake Placid, NY
2015	Jeremy Kraus: ***Interpreting predator-prey interaction in Cayuga Lake fish using FAS***
2015	Jeremy Pike: ***Effects of dietary FA on lake trout FAS***
2016	Matthew Futia: ***Causes and impacts of thiamine deficiency in Lake Ontario salmonids***
2016	Kinsey Irvin: ***Use of FAS to explore the river continuum concept to predict biological community response to changes from headwaters to rivermouth in the Genesee River and Sandy Creek***
2017	Futia et.al.: ***Thiamine deficiency and the effectiveness of thiamine treatments through brood stock injections and egg immersions on Lake Ontario steelhead trout***
2018	Thomas Bianchi: ***Determination of alewife (Alosa pseudopharengus) age at first spawning in Lake Ontario***
2019	Lillian Denecke: ***Interaction between dietary thiamine and lipid on survival, growth and fatty acid composition of juvenile steelhead trout***
2020	Lillian Denecke: ***Presented at the American Fisheries Society NY Meeting in February***

**Partial list*

Advancing Student Careers

Mentor-Student Relationship Key To Success

with SUNY Brockport Ph.D. Emeritus Doug Wilcox and Graduate Andie Graham



Doug Wilcox: "The fun of being a scientist is designing and working out a project. Doing so with graduate students to help them develop their own careers is exciting for faculty. Seeing Andie (Graham) now working as a full-grown research scientist makes my day."

Andie Graham: *" When searching for graduate programs, I was looking for a mentor who is friendly, accessible, and flexible to allow me to explore my interests, and an advisor who is genuine, would speak to my strengths, and develop my weaknesses. I found all these qualities in Dr. Wilcox. Although he is a well-respected, highly acclaimed, and incredibly busy wetlands scientist, he always made time for me, and made it a point to connect me with other scientists in my field and include me on other projects, which helped to expand my range of interests and knowledge of wetland ecosystems. Furthermore, the atmosphere in his lab made learning fun. Doug's excitement about wetland science is contagious."*

Wilcox: "Andie is a fine example of a bright, motivated student. She received GLRC funding for one of the first, if not the only at the time, projects to show the ecological impact of hydrofracking accidents."

Andie: *"My graduate study (2011, GLRC) with Dr. Wilcox investigated the impacts to a groundwater-fed fen in central Pennsylvania after it received contaminants as a result of nearby gas-drilling operations. Our research links Marcellus gas-drilling accidents to environmental contamination in wetland ecosystems and highlights how little is known about the potential negative impacts of hydraulic fracturing. This is a novel area of research and our first paper is due out soon."*

Wilcox: "I like to think the work Andie did on that GLRC project helped convert her to becoming a wetland scientist and a groundwater-fed fens specialist."

Today, Andie is a certified Professional Wetland Scientist, a Certified Ecological Restoration Practitioner in Training, an instructor for the SUNY Brockport Department of Environmental Science and Ecology, and a Research Scientist with the SUNY Research Foundation. Her current research is focused on Bergen Swamp in New York's Finger Lakes region.

See page 21 for GLRC student funding opportunities

"I am inspired to know we have a bright future ahead of us with these students leading the charge to protect and restore our shared waters."
— IJC U.S. Co-Chair Jane Corwin

Envisioning a Shared Future: Students Meet IJC Commissioners

In 2019, a day-long event at Clarkson University introduced 41 students (more than 30 from GLRC campuses) to representatives of the International Joint Commission. GLRC travel support enabled more than a dozen students to participate in this first-of-its-kind opportunity for students.

During "Great Lakes Futures" envisioning scenarios and a problem-solving role-playing game, groups assigned to "Ontario," "Erie," "Michigan," "Huron" or "Superior" tables, each headed by an IJC Commissioner, identified areas of threat to the Great Lakes. The agenda also included an International Association for Great Lakes Research plenary session and student presentations.

"The students and the Commissioners spoke freely about what the Great Lakes could look like 50 years from now and what it will take to get us there." **— Clarkson Professor Michael Twiss, Ph.D.**

IJC U.S.Co-Chair Jane Corwin commented, "The IJC assesses the progress that the governments of Canada and the United States have made to ensure the Great Lakes are fishable, swimmable, and drinkable, and as part of that assessment we ask both experts and the public for their input. The students' comments were valuable to us because they are training to be the next generation of experts upon whom we rely for our unbiased, science-based work, and as youth they will inherit these lakes, and so we need to have their views included in the feedback we receive, to keep us thinking about the next several generations."

Advancing Student Careers

Fredonia Fisheries Grad Now a SUNY Oswego Professor/Mentor

The smallmouth bass fishery is a big economic engine for Lake Erie shoreline communities. A 2007-2009 GLRC project evaluated the fishery that was quite possibly based on a pure, wild strain of the fish. Molecular techniques were used to genetically differentiate between fish that spawned in the lake and those that spawned in the lake tributaries.

As a SUNY Fredonia 3rd-year student, Nicholas N. "Nick" Sard earned "Best Oral Presentation" honors with fellow student Cassidy Hahn for their program on *"The Genetic Divergence and Longitudinal Variation of Smallmouth Bass Populations in Lake Erie and its Tributaries"* at the 2009 Great Lakes Research Consortium Annual Conference.

Nick continued this initial research, applying radio telemetry to determine if the fish returned to the same location to spawn year after year. With that work, he was awarded his Master's degree in 2011. He would go on to complete his Ph.D. in Fisheries Science at Oregon State University in 2016.

Today, Nick is an evolutionary ecologist and assistant professor mentoring SUNY Oswego students in the application of genetics-based and bioinformatics approaches to questions related to species of conservation concern. One of the classes he teaches is BIO 363: Great Lakes Environmental Issues.

"I had no idea that committing to that GLRC smallmouth bass project would kindle a passion in me for population genetics, but I am certainly glad it did. I am so thankful for the experiences that the GLRC support made possible for me, and I believe my research endeavors at Fredonia gave me a competitive edge when applying to Ph.D. programs," Nick says.

"Conducting undergraduate research showed me the importance of paying attention to details and perseverance. It taught me to figure out why things didn't work and to correct the issues. It aided my ability to critically think for myself, and to harness the power of population genetics to answer important ecological questions," Nick explains.

"Now, here at SUNY Oswego, I hope to inspire a passion in my students for using genetic-based tools and the cutting-edge technologies of the day to support the conservation of native species, particularly on the Great Lakes," Nick says. "Their research will help them develop the skills they will need as they look beyond graduation."

From top: Student Nick Sard with Coho salmon; SUNY Oswego Professor Nick Sard helping students collect water samples for environmental DNA testing, and with students at Rice Creek Field Station.

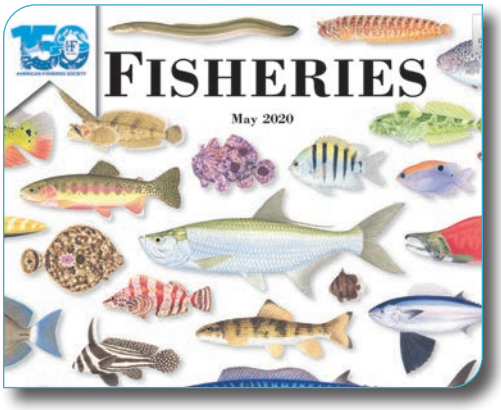
Advancing Student Careers

From Fisheries Research to COVID-19 Response Support

As a SUNY ESF student, Ben Gallo was part of the GLRC-funded research team investigating the "*Influence of Spawning and Nursery Habitat in Shaping the Northern Pike (Esox lucius) Gut Microbiome*." In 2020, he applied his fisheries' laboratory experience to the national covid-19 response. Here's a bit of his story. . .

"Ben was involved in applying a novel approach to comparing the gut microbiota between fish species in the upper St. Lawrence River using next generation sequencing technologies," says one of his mentoring professors Brian F. Leydet, Jr. MPH, Ph.D., a SUNY ESF assistant professor of epidemiology and disease ecology. "The project also included a controlled diet experiment with fish from birth, comparing an aquaculture diet of *Artemia* (microscopic brine shrimp) to a more natural diet of zooplankton for the impact on the fish microbiome and fish health, growth and development."

As of summer 2020, the first chapter of Ben's thesis —"*Fish Gut Microbiome: A Primer to an Emerging Discipline in the Fisheries Sciences*"— had been published in the peer-reviewed American Fisheries Society *Fisheries* journal. His second chapter was under review by *PeerJ, the Journal of Life and Environmental Sciences*, and he continued work on three additional manuscripts in collaboration with Leydet and SUNY ESF Professor and Thousand Island Biological Field Station Director John M. Farrell, Ph.D.



"The GLRC funding created an opportunity to see where this research could go. I was not familiar with molecular biology, but I embraced that as a challenge to develop my skills and my professors let me run with it. They allowed me the creative freedom to follow an idea. Each step morphed into more areas to investigate. As the project developed, we learned so much that it developed into quite a large thesis," Ben says.

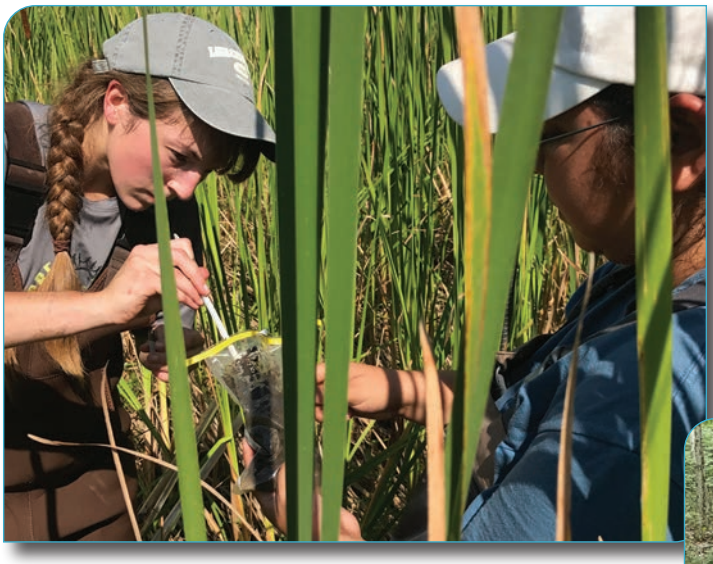
Writing his thesis to complete his Masters degree in Fish and Wildlife Biology and Management in two years, presenting at conference events including the American Microbiologists Meeting, and now publishing papers on the GLRC project helped Ben build a resume that landed him a job as a Research Associate with T2 Biosystems, Lexington, MA, a diagnostic testing laboratory that developed a test to help hospitals diagnose covid-19.

"The Great Lakes Research Consortium grant paved the way to my Master's degree. I wouldn't be where I am now, doing what I'm doing to support the public health sector, without having that multi-faceted research experience with the field and molecular laboratory sampling," Ben says.

"What I learned on the GLRC project about how to ask critical questions, how to learn a lot by listening at professional conferences, and how to develop a publishable paper helps my work now. I had no idea that I would be playing a small part in applying science to helping people during a pandemic that has become the news headline of the year for 2020."

Clockwise from above: Ben Gallo, right, with Thousand Islands Biological Station (TIBS) Lab Manager Nathan Satre on the St. Lawrence River; Ben with a walleye from a gill netting survey on Mud Bay, eastern Lake Ontario; an adult northern pike being measured and tagged as part of the TIBS annual Northern Pike Survey.

Advancing Student Careers



Student-Now-Instructor Takes River Research to Adirondack Mountains

In 2016 undergraduate Evie Brahmstedt became involved with GLRC-funded mercury (Hg) release research on the St. Lawrence River. In 2020, she took that study inland as the new co-instructor of Clarkson University's Adirondack Semester.

"The work we began to investigate the potential for mercury (Hg) mobilization from the St. Lawrence River's wetlands is now underway in the Adirondacks with an entirely new course of study," Evie's mentor and Adirondack Semester co-instructor Michael Twiss, Ph.D. explains.

Data from the River project determined that 80 kg of Hg could be released if the river returns to pre-Moses-Saunders Power Dam water levels. It also identified the significance of the wetland interface at the margin with the forest system of the Adirondacks.

"Evie developed the idea and designed the experiment to test vernal pools from the Adirondacks to the St. Lawrence River Valley to investigate how mercury is being mobilized into the food chain. This is the kind of independent thinking we like to see in graduate students," Twiss says.

Evie, a Ph.D. candidate, obtained a GLRC grant, and Clarkson added funding, to support her new work. She notes, "The results of the River project in the summer of 2019 helped me refine my project for 2020. I reshaped the work design to identify small-scale hotspots where mercury enters the food chain. Climate change with increasing temperature may increase the risk of atmospheric deposition and cycling of mercury in waters, such as the Adirondack lakes in the St. Lawrence River watershed."

In residence at Paul Smith's College, the Adirondack Semester students are participating in Evie's research. The work with vernal pools (small but critical ecosystems) considers mercury mobilization into Adirondack wildlife species, including amphibians, frogs, and wetland insects.

GLRC Support Propels Student Career

"The GLRC has been a part of my entire research career," says Evie. "A GLRC research grant supported the mercury study I worked on as an undergraduate. I received a travel grant to attend the International Association for Great Lakes Research (IAGLR) Conference at SUNY Brockport. That was a great opportunity to communicate my research, get valuable feedback, and network. The value of conferences is huge; to step back and see your project in the context of others' work is reenergizing and helps refine the scope of your work within the bigger picture of the field.

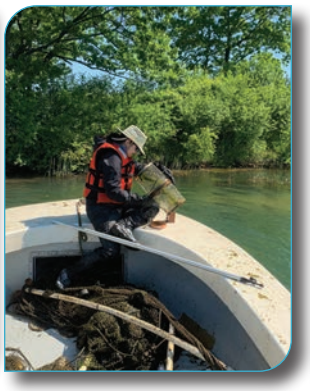
"I applied for a GLRC student research grant in October 2019 and received $1,000 that represents much more than its face value. The grant award validates your idea and the importance of your research focus. GLRC funding helps students develop an idea on your own and roll with it," Evie comments.

In June 2020, Evie was elected to the IAGLR Board of Directors as the U.S. Student Board Member.

She says, "My ultimate goal is to make a difference with impactful research for the Great Lakes Basin."

GLRC Student Support Opportunities





The Great Lakes Research Consortium helps advance students' academic and professional career goals with grants for research, travel to present their work at major scientific conference events, and internships.

"The Great Lakes Research Consortium opportunities for students are a fantastic way to support your research and data collection, and to help you contribute to science that can make a difference for imperiled ecosystems. As an undergraduate, working on a GLRC project helps you to see if a particular field of study is right for you and is an opportunity to conduct research that can make your career. And, you make great contacts for your future!"
— SUNY ESF student Alison Kocek, GLRC piping plovers restoration project

STUDENT RESEARCH GRANTS

Since 2013, the GLRC has awarded more than a dozen grants in support of student research of relevance to the Great Lakes. Up to $1,000 is available to help the student defray research-related expenses to accomplish work not otherwise possible.

More Info: https://www.esf.edu/glrc/studentgrants.htm

STUDENT TRAVEL SUPPORT

The GLRC has long supported member institutions' students through student travel grants to attend and/or make poster or oral presentations at prestigious scientific conferences. The awards subsidize travel costs up to $100 to attend a local meeting; up to $250 US to attend a national or international meeting. More than 40 student travel grants have been issued to date.

More Info/Application Form: https://www.esf.edu/glrc/students/travel.htm

STUDENT INTERNSHIPS

GLRC first partnered with the U.S. Geological Survey to support the first formal GLRC internships in 2007. Today, GLRC member faculty can receive up to 50% in matching funds (up to $3,000) from the GLRC to "hire" a student from another GLRC member institution for laboratory assistance. More than two dozen students have taken advantage of this opportunity to learn with New York's best multi-disciplinary faculty.

More Info: https://www.esf.edu/glrc/students/interns.htm

Above, from left: Student presentations at Clarkson University conference with IJC Commissioners; GLRC UAV demonstration at the Great New York State Fair; aquatic invasive species research; the Aquaculture Lab at SUNY Brockport; GLRC student intern working with U.S. Geological Survey.

2019 GLRC Interns

SUNY Brockport student Lillian Denecke received a 2019 GLRC summer internship to work with Buffalo State University's Randal Snyder, Ph.D., to determine gill enzyme (Na+/K ATPase) activity in pen-raised Chinook salmon in Lake Ontario.

Lillian is also working with SUNY Brockport's Dr. Jacques Rinchard on thiamine (vitamin B1) biomonitoring in Lake Ontario fish, supported in part by GLRC research and student grants.

Lillian's own student project is the study of the interaction between dietary thiamine and lipid content in juvenile steelhead trout.

In 2019, GLRC intern and SUNY ESF student Abby Webster began analyzing mercury levels in big brown bats in NY's Finger Lakes region as part of a Hobart William Smith College research team. Her work continues.

2018-2020 GLRC Small Grants for Great Lakes Research

Grants made available by a partnership of the GLRC and New York State Department of Environmental Conservation support projects that contribute to the protection and restoration of the health of New York's Great Lakes. These grants spark innovative investigations that advance the science-based understanding of the complexities and interactions of the Great Lakes as a unique ecosystem. This small grants program is made possible through the New York State Environmental Protection Fund's Ocean and Great Lakes Ecosystem Conservation Act.

2018

- **Assessing innovative advanced wastewater treatments in removing antidepressant drugs based on chemical analysis and fish physiological responses**
  Principal Investigator: Diana Aga, Ph.D., University at Buffalo
- **Degradation of microcystin in drinking water using EBI: electron beam irradiation**
  Principal Investigator: Mark Driscoll, Ph.D., SUNY ESF
- **Gap analysis for contaminants of emerging concern (CEC) in the Great Lakes Basin**
  Principal Investigator: Roxanne Razavi, Ph.D.; SUNY ESF
- **Participatory models for identifying barriers to climate adaptation and resiliency in NY's Great Lakes Basin**
  Principal Investigator: Khristopher Dodson, Syracuse University Environmental Finance Center
- **Use of nitrogen isotopes (15N) as an indicator of septic pollution to Sodus Bay**
  Principal Investigator: Mark Teece, Ph.D., SUNY ESF
- **Using culture-based. molecular and modeling approaches to identify point & non-point sources of fecal pollution and improve water quality predictions at Lake Erie beaches**
  Principal Investigator: Lauren Sassoubre, Ph.D., University at Buffalo

2019

- **Assessing effects of cattail treatment on methane emissions from Lake Ontario coastal wetlands**
  Principal Investigator: Rachel Schultz, Ph.D., SUNY Brockport
- **Eastern Lake Erie shore erosion, sediment transport & deposition under a changing climate**
  Principal Investigator: Ali Farhadzadeh, Ph.D., SUNY Stony Brook
- **Food web impacts and contaminant transfer by tubenose goby in the Lake Ontario-St. Lawrence River basin**
  Principal Investigator: Roxanne Razavi, Ph.D., SUNY ESF
- **Increasing shoreline erosion resiliency using marine-based biopolymers**
  Principal Investigator: Sherif Abdelaziz, Ph.D., SUNY Stony Brook/Virginia Tech
- **Towards complete removal of PFAS using a nanotechnology-assisted advanced wastewater treatment process**
  Principal Investigator: Nirupam Aich, Ph.D., University at Buffalo

2020

- **Harmful Algal Bloom: Advancing prediction and mitigation through systems modeling**
  Principal Investigators: Ian M. Bradley, Ph.D., Zhenduo Zhu, Ph.D., University at Buffalo
- **Harmful Algal Bloom: The effect of great lakes-isolated microplastics and associated microbial communities and small molecules**
  Principal Investigators: Kiyoko Yokota, Ph.D., SUNY Oneonta; Erica L. Majumder, Ph.D., SUNY ESF
- **Lake Ontario Watershed: Thiamine deficiency as a potential cause of diving and sea duck population decline**
  Principal Investigator: Jacob N. Straub, Ph.D., SUNY Brockport
- **Lake Ontario Watershed Quality and Hydrology: Impacts of 2 non-native invasive insects in Bergen Swamp**
  Principal Investigator: Andie Graham, SUNY Brockport
- **Restoring American Beachgrass Native to the Great Lakes**
  Principal Investigator: Danilo D. Fernando, Ph.D., SUNY ESF

GLRC Economic Impact Profile

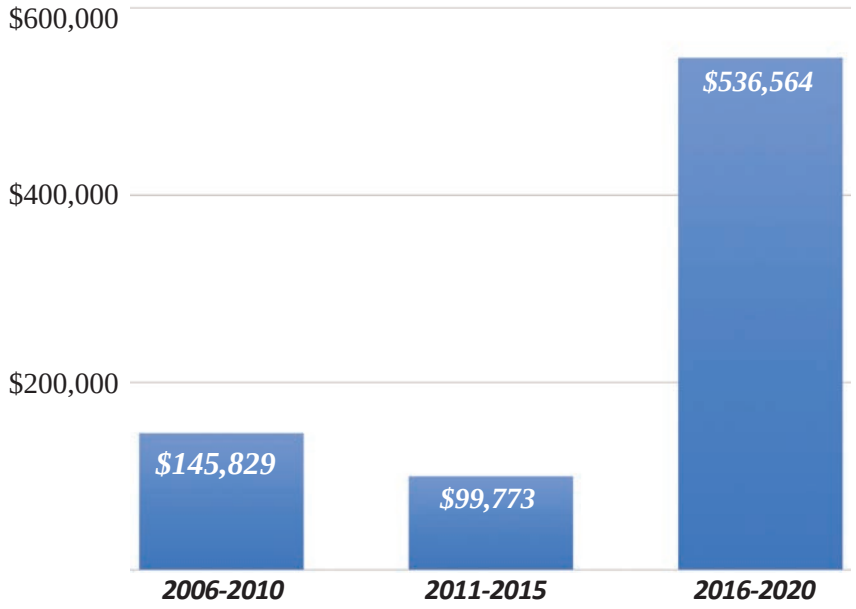
"Great Lakes Research Consortium funding supports novel research and off-the-beaten-path projects that may not have the visibility to attract larger or typical funding sources.

There is much we don't know about the Great Lakes so there is always room for new ideas.

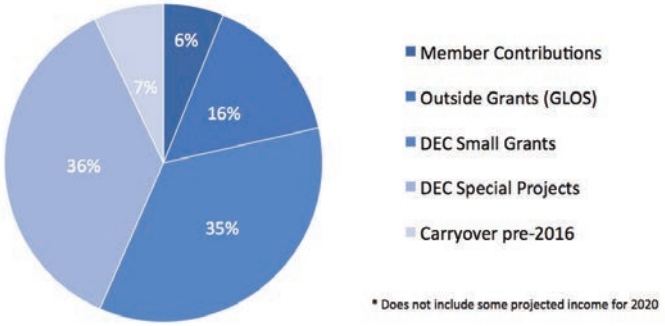
The GLRC small grants support start-up of research that may lead to follow up studies that will attract larger funding for years or decades.

— Douglas Wilcox, Ph.D., SUNY Brockport Professor Emeritus

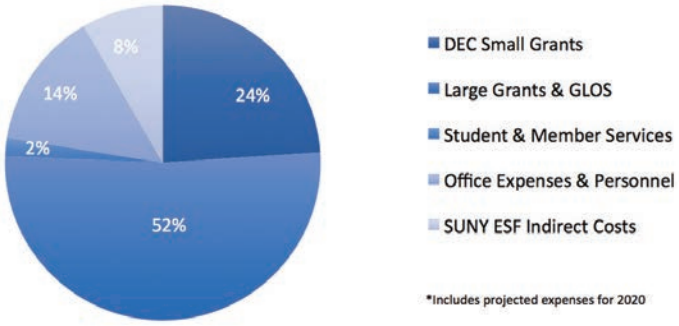
GLRC Small Grants Awarded 2006-2020: $782,166



GLRC Income 2016-2020: $2,280,803

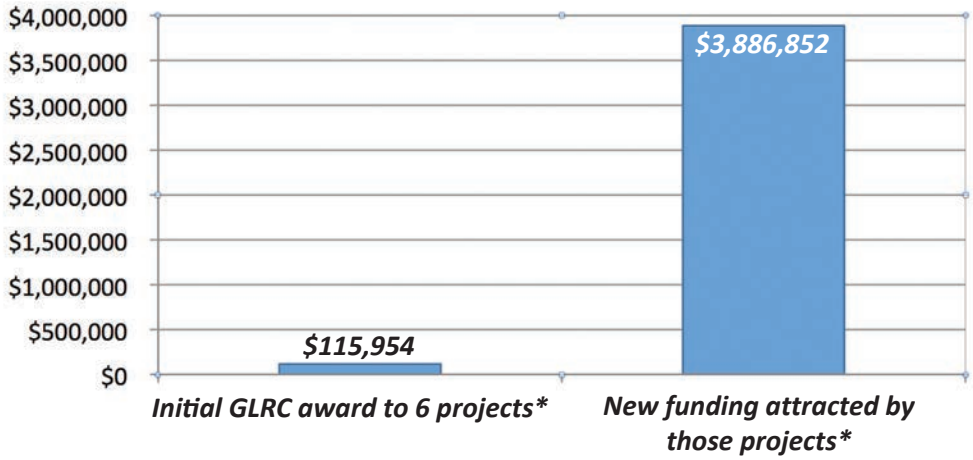


GLRC Expenditures 2016-2020: $2,280,803



GLRC Research Success Leverages New/Larger Funding

The power of GLRC small grants for proof-of-concept/baseline research leverages new and larger funding: see representative example at right.



**Plastics pollution migration into Great Lakes food web in Lake Erie, thiamine deficiency in salmonids, endangered species/ piping plover restoration along Lake Ontario, contaminants of emerging concern, engaging coastal stakeholders in climate resiliency planning, and the potential for mercury mobilization from wetlands along the Upper St. Lawrence River.*

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University at Buffalo The State University of New York

Hobart and William Smith Colleges

Cornell University

SUNY Brockport

RIT Rochester Institute of Technology

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ESF State University of New York College of Environmental Science and Forestry

St. Lawrence University