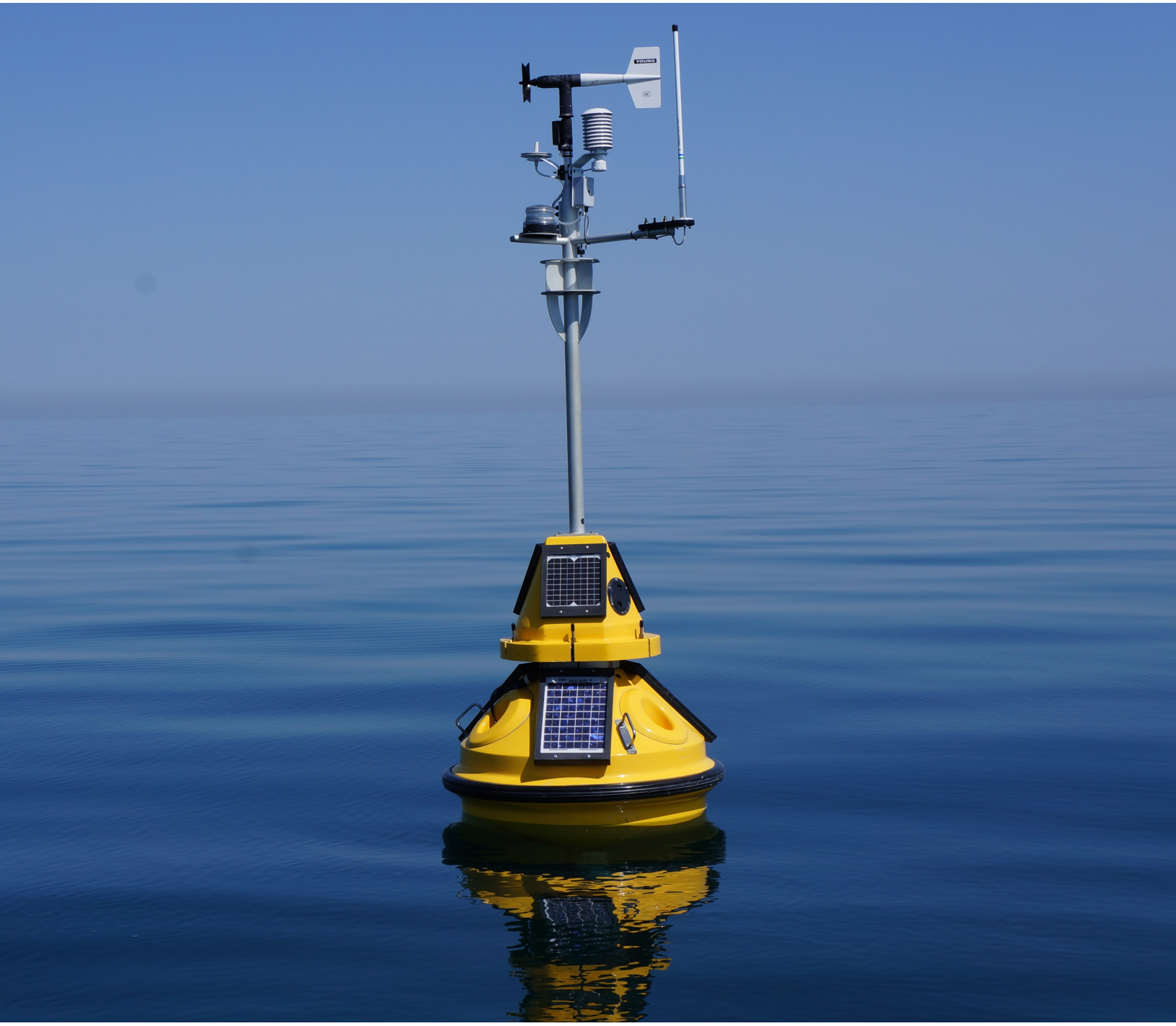
GREAT LAKES RESEARCH CONSORTIUM



Biennial Report

2012 - 2014

www.esf.edu/glrc/


GLR

CONTENTS

STAFF

ORGANIZATION

GREAT LAKES RESEARCH CONSORTIUM

WORKING TOGETHER FOR GREAT LAKES RESEARCH, OUTREACH & EDUCATION

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MESSAGE FROM THE DIRECTOR

Message from the Director: Greg Boyer

The past few years have been an interesting time of change for the Great Lakes Research Consortium (GLRC). One of our founding members, Joe Makarewicz from SUNY Brockport, retired this past year. We will miss his guiding influence on the GLRC. Another one of our founding members, Joe DePinto, formerly at Buffalo State University and currently at LimnoTech in Michigan, has come back into the fold via joint projects with SUNY-ESF and the University of Buffalo. It has been great to work with him over the past few years. We also have added an Associate Director, Dave White, New York Sea Grant (NYSG) extension specialist, joined us in 2012. He is co-funded by NYSG to help galvanize our efforts to reach out to and get better involvement from all our different campuses with the Federal and State initiatives. The Federal Government, after long years of ignoring the Great Lakes in terms of Federal funding, is entering the second half of a 10-year plan to protect the lakes. The Great Lakes Restoration Initiative was launched in 2010 to accelerate Federal efforts to restore this great resource. Now entering its second five year cycle, the initiative has already pumped hundreds of millions of dollars into Great Lakes Restoration. In 2014, the bipartisan compromise budget bill included $300 million for the Great Lakes Restoration Initiative, with $285 million allocated in 2013. Even in an era of political discord, recovery and protection of the Great Lakes is one area where all parties can agree. In June of 2014, the U.S. Fish and Wildlife Agency announced approval of more than $960,000 for grants aimed at protecting, restoring, and enhancing wetlands and wildlife habitat in Wisconsin and New York under the Great Lakes Restoration Initiative through the Joint Venture Habitat Protection and Restoration Program. Never in the history of the Great Lakes has so much financial support been available for Great Lakes efforts. Coupled with those Federal efforts, New York State has released its interim action agenda for the Great Lakes. This agenda blends the goals and objectives of the current state programs with the federal and state initiatives. The potential and need for the Great Lakes Research Consortium has never been stronger.

The year 2014 also marked a year of change for me personally. After four years of serving as the Chair of the Department of Chemistry at SUNY-ESF, I stepped down from the chair position at the end of 2014 to focus my efforts on Great Lakes research activities. GLRC has had some success tapping into GLRI funding through projects at Sodus Bay (Lake Ontario), the Oswego River and the St. Lawrence River, but we need to expand those partnerships to include more schools and more investigators. Traditional federal support of research through single investigator projects submitted to agencies such as NSF has become brutally competitive. We are in the era of interdisciplinary projects with multi investigators, and we need to incorporate our new faculty into these projects. This is a perfect scenario for the Great Lakes Research Consortium and I am excited to see what we can do in this regard in the next couple of years.

ORGANIZATION

ORGANIZATION

The Great Lakes Research Consortium is an organization of eighteen colleges and universities in New York, with nine affiliate campuses in Ontario, dedicated to collaborative research and education on the Great Lakes. We have nearly 400 member faculty, who are conducting research in every facet of Great Lakes science. The organization is run by an Executive Director with input from Campus Representatives from each member institution. Final decision-making authority rests with the Board of Governors. The Board consists of one representative from the Research Foundation of the State University of New York and one representative from each of the member colleges and universities. Each board member is appointed by the President of his/her Institution and is given the authority to commit the institution to implementing decisions of the Board of Governors.

Our mission is to improve the understanding of the Great Lakes ecosystem, including the physical, biological, and chemical processes that shape it, as well as the social and political forces that affect human impact on the lakes and their associated economic resources. We accomplish this through research, instruction, and public service.

MEMBER INSTITUTIONS

University at Albany	Cornell University	SUNY Oswego
Binghamton University	SUNY Cortland	SUNY Plattsburgh
SUNY Brockport	SUNY ESF	SUNY Potsdam
Buffalo State University	SUNY Fredonia	Rochester Institute of Technology
University at Buffalo	SUNY Geneseo	St. Lawrence University
Clarkson University	Hobart and William Smith	Syracuse University

CANADIAN AFFILIATES

Brock University	McMaster University	Queens University
Ryerson University	University of Guelph	University of Ottawa
University of Toronto	University of Waterloo	University of Windsor

ORGANIZATION

(as of December 31, 2014)

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University at Albany

Lars Rudstam
Cornell University

James Pagano
SUNY Oswego

Rich Shaker
Binghamton University

John Lombardo
SUNY Cortland

Timothy Mihuc
SUNY Plattsburgh

Joseph Makarewicz
SUNY Brockport

John Hassett
SUNY-ESF

Robert Snyder
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Alexander Karatayev
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Rochester Institute of Technology

Joseph Atkinson
University at Buffalo

Robert Simon
SUNY Geneseo

Carolyn Johns
St. Lawrence University

Michael Twiss
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Hobart and William Smith

Cliff Davidson
Syracuse University

David White
New York Sea Grant

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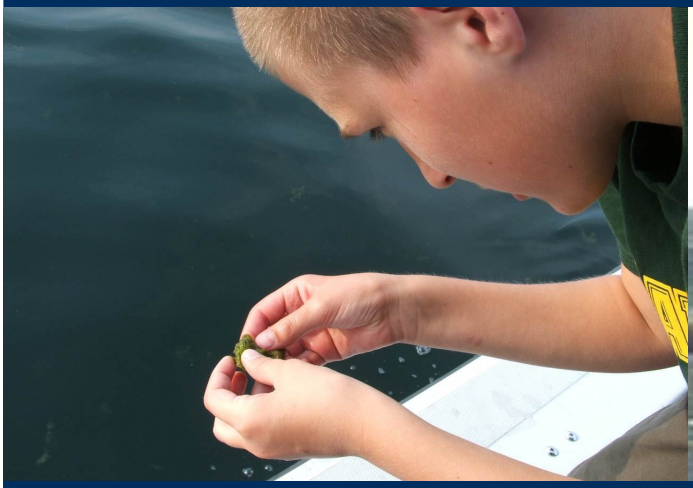
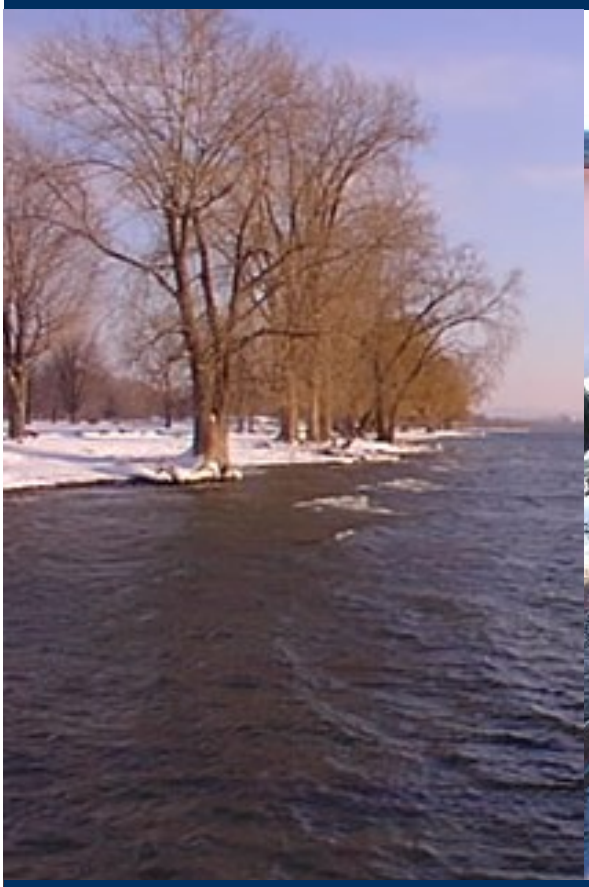


PROGRAMMATIC ACTIVITIES



SEMINAR SERIES

The GLRC is pleased to support a seminar series on a variety of topics presented by its member scientists. This is one mechanism by which we promote interactions between member schools and help foster research collaborations between scientists.

GLRC Current Offerings:

Aga, Diana; University at Buffalo. Emerging Contaminants and their Metabolities: *Analysis, Treatment, and Implications for Public Health.*

Alben, Katherine; University at Albany. *Algal pigments as biomarkers to assess diet, nutrition, and health of organisms from Lake Erie and Lake Ontario.*

Arhonditsis, George; University of Toronto. *Lessons Learned and Future Perspectives of Aquatic Biogeochemical modeling: why Bayesian inference?*

Atkinson, Joe; University at Buffalo. *Resource Sheds in the Great Lakes*

Baier, Robert; University at Buffalo. *Ballast Water Biofilms and Sediments: Suppressors of Biodiversity*

Bhavsar, Satyendra; University of Toronto. *Risk assessment of PCB in fish: How to overcome deficiency of congener-specific PCB measurement*

Bhavsar, Satyendra; University of Toronto. *Using fish as a bioindicator of aquatic contamination*

Boyer, Greg; SUNY-ESF. *Toxic Cyanobacteria in the Great Lakes: Problems, Issues and Solutions*

Boyer, Greg; SUNY-ESF. *Algal bio-diesel: Is it a solution to our current energy needs?*

Campbell, Linda; Queen's University. *Spatiotemporal trends of mercury bioaccumulation in Great Lakes and across Canada*

Dupont, Diane; Brock University. *Differences in Water Consumption Choices in Canada: the Role of Socio-demographics, Experiences, and Perceptions of Health Risks*

Gardella, Joseph; University at Buffalo. *Geospatial statistics and public service learning in community based environmental and urban brownfield science and policy*

Haynes, Jim; SUNY Brockport. *Population monitoring, trophic relationships, and levels of bioaccumulative chemicals of concern in mind, a sentinel species*

Holsen, Thomas; Clarkson University. *Mercury in the Environment: Cycling and Sources*

Holsen, Thomas; Clarkson University. *The Great Lakes Fish Monitoring and Surveillance Project: Pushing the Science*

Johnson, Glenn; SUNY Potsdam. *Conservation biology of Blanding's turtles in northern New York*

Johnson, Glenn; SUNY Potsdam. *Conservation strategies for spruce grouse at the edge of the range*

Johnson, Glenn; SUNY Potsdam. *Edge of the Range: Conservation of Blanding's turtles in northern New York*

Kettle, Anthony; SUNY Oswego. *Role of groundwater in controlling the physical dynamics of Fayetteville Green Lake*

Kettle, Anthony; SUNY Oswego. *Unexpected role of the groundwater input on the heat budget and overturning dynamics of lakes*

Kostyniak, Paul; University at Buffalo. *Mercury Exposure: Different Chemical Forms Result in Different Toxicological Effects*

Kraft, Clifford; Cornell University. *Thiamine Deficiency and Reproductive Failure in Great Lakes Fishes: New Insights Regarding an Unsolved Mystery*

Krantzberg, Gail; McMaster University. *Revitalization of Great Lakes Governance*

Langen, Tom; Clarkson University. *Locating and mitigating hotspots of road mortality of turtles and other herpetofauna along rural highway networks*

Langen, Tom; Clarkson University. *Effectiveness of wetland restoration programs for biodiversity conservation in agricultural landscapes*

Lodge, Jeffrey; Rochester Institute of Technology. *Isolation and Characterization of hydrocarbon degrading bacteria from soils from Western New York*

Makarewicz, Joseph; SUNY Brockport. *Causes of variability in coastal water quality of Lake Ontario*

Malmsheimer, Robert; SUNY-ESF. *Climate Change Mitigation benefits of Managed Forests*

McMillan, Amy; Buffalo State College. *Genetic Connections: Seasonal migration and gene flow in the common loon*

McMillan, Amy; Buffalo State College. *Conservation genetics of Eastern Hellbenders in the Alleghany Drainage*

O'Neill, Charles; New York Sea Grant. *Aquatic Invasive Species of the Great Lakes Basin: Introductions, Impacts, and Management*

Pennuto, Chris; Buffalo State College. *Round gobies in tributary streams: seasonal abundance, community effects, and energy consumption*

Perez-Fuentetaja, Alicia; Buffalo State College. *Type E Botulism in the Great Lakes: a Widespread Concern*

Regenstein, Joe; Cornell University. *Fish Gelatin: A use for skin, scales and bones?*

Regenstein, Joe; Cornell University. *Slaughtering Aquacultured Fish – the Animal Welfare Issues*

Regenstein, Joe; Cornell University. *Why I Support Factory Farming*

Riessen, Howard; Buffalo State College. *Changes in water chemistry can disable plankton prey defenses*

Rinchard, Jacques; SUNY Brockport. *Application of Fatty Acid analysis in Aquatic Ecology Trophic tracers and Essential Nutrients*

Romeu, Jorge Luis; Syracuse University. *Design of Experiments in Ecological and Environmental Problems: Methods and Issues*

GLRC Current Offerings (cont.)

Rudstam, Lars; Cornell University. *Regime shifts in the Great Lakes – the coupling between productivity and fisheries*

Smardon, Richard; SUNY-ESF. *Sustaining the Worlds Wetlands: Story of GL Wetlands Policy Consortium*

Smardon, Richard; SUNY-ESF. *Facilitation of Revitalization of Onondaga Creek: An Urban Creek with multiple stakeholders*

Twiss, Michael; Clarkson University. *Winter Limnology of the Great Lakes and Climate Change Resiliency*

Walcek, Chris; University at Albany. *Air Pollution Dispersion, the effects of Shear on plumes from point sources*

Walcek, Chris; University at Albany. *An overview of the skeptical scientific evidence surrounding the role of humans in climate change*

Walcek, Chris; University at Albany. *New interpretations of pioneering Upstate NY cloud seeding experiments*

Wilcox, Doug; SUNY Brockport. *Water-Level Variability in the Great Lakes: Natural Cycles, Human Impacts, Wetlands and Human Responses*

Buffalo State University

In order to facilitate collaboration between the Great Lakes Center personnel and leading experts in aquatic ecology and related sciences and increase visibility of the Center in 2013-2014 eight speakers were invited to present talks, including:

Sarah Delavan, University at Buffalo. "Predator Avoidance Behavior? Patterns in Clam Excurrent Siphon Velocity According to External Environmental Cues". November 14, 2013.

Jason D. Fridley, Syracuse University. "The Modern Invasive Species Problem: A World Darwin Envisioned?" November 22, 2013.

Knut Mehler, Desert Research Institute, Las Vegas. "Understanding effects of changes in land use, environmental parameters, and habitat characteristics on the benthic macroinvertebrates in the Walker River, Nevada". December 4, 2013.

Dimitry Gorsky, U.S. Fish and Wildlife Service. "Restoring Lake Sturgeon in the Great Lakes: A U.S Fish and Wildlife Perspective"

Ronald Griffiths, Oregon State University. "Benthos Powers Lake Dynamics". February 27, 2013.

Martin A. Stapanian, U.S. Geological Survey, Lake Erie Biological Station. "Soil and vegetation indices for wetland quality: A predictive modeling approach". April 10, 2014.

Zy Biesinger, "Habitat effects on the space use and growth of reef-oriented fish in the Gulf of Mexico". March 20, 2014.

Frances Lucy, Centre for Environment Research Innovation and Sustainability (CERIS), Department of Environmental Science, Institute of Technology, Sligo, Ireland. "Freshwater Invasives Networking for Strategy". June 3, 2014.

SUNY Fredonia

Presentations by Dr. Sherri A. Mason:

International Association of Great Lakes Researchers (IAGLR) 57th Annual Meeting, 'Great Lakes Plastic Pollution Survey,' Sherri A. Mason, Marcus Eriksen & William Edwards, May 2014 (invited, oral).

The Walrus Talks Water, 'Beads of Destruction,' May 2014.

Alliance for the Great Lakes Webinar, 'Great Lakes Plastic Pollution Survey,' April 2014

NYC Sierra Club, 'Beads of Destruction,' April 2014.

Rochester Committee for Scientific Information, 'Great Lakes Plastic Pollution Survey,' April 2014.

Sustainability Speakers Series, SUNY Oswego, 'Addicted to Plastic,' March 2014.

First Friday, Jamestown Audubon Society, 'Great Lakes Plastic Pollution Survey,' March 2014.

Save the River, 'Great Lakes Plastic Pollution Survey,' February 2014.

NY GREAT LAKES PROTECTION FUND SMALL GRANTS

The **Great Lakes Protection Fund Small Grants Program** is administered by the Great Lakes Research Consortium, in cooperation with the New York Department of Environmental Conservation and the New York Great Lakes Basin Advisory Council, with earnings that accrue from New York State's investment in the regional Great Lakes Protection Fund. The protection fund (NYGLPF) small grants program was developed to provide "seed" money for new, cooperative approaches to researching and protecting the environmental quality of the Great Lakes.

NYGLPF Awarded Project - 2011 Funding Cycle

Hydrofracking the Marcellus Shale: The Impact of a Gas Drilling Accident on Wallace Mine Fen, Moshannon State Forest, PA

Principal Investigator: Douglas A. Wilcox
Department of Environmental Science and Biology, SUNY Brockport
Collaborator: Andie Graham

In 2009, Marcellus Shale gas-drilling company, EOG Resources, was fined $30,000 by the Pennsylvania Department of Environmental Protection (PA DEP) after several violations occurred at two well sites located on private land adjacent to Mashannon State Forest in Clearfield County, PA. Of these violations, there were three separate accidents that resulted in the deposition of flowback water and frack fluids into Alex Branch, a small, sandy-bottom steam that flows through Wallace Mine Fen. Contaminated water also infiltrated the ground upslope from the fen. Water testing conducted by the PA DEP indicated elevated levels of barium, strontium, manganese, chloride, total dissolved solids, and specific conductance, all of which are typical of Marcellus well discharge water. At the time of the accident, no research was conducted to evaluate the potential impacts to the Wallace Mine Fen.

In 2012, we initiated a study to determine the ecological impacts of the accidents on Wallace Mine Fen. We used a nearby wetland, Crystal Spring Bog (actually a fen), as a control and sampled amphibians, birds, vegetation, fish, aquatic macroinvertebrates, and water quality (pH and specific conductance) at both sites.

Crystal Spring Bog and Wallace Mine Fen are very similar wetlands. Both have similar underlying geology that is dominated by sandstone, shale, clay, and coal. Both have similar hydrology; they are fens with similar groundwater and surface water chemistry. There are also similarities in taxa composition; no major differences were detected in birds, aquatic invertebrates, fish, or vegetation between the two wetlands. There were, however, significant differences in amphibians between the two wetlands, despite both wetlands providing ample suitable habitat for amphibians. Therefore, results suggest that the accidents at EOG well 8H and 9H may have decreased amphibian species richness at Wallace Mine Fen. Not knowing the exact date of the gas well drilling accidents or the exact chemical composition of the fracking fluids used a the wells make it difficult to determine how amphibians were affected. This study underscores the importance of collecting baseline data in areas where hydrofracking is anticipated so that impacts of any future accidents can be evaluated more thoroughly.

NY GREAT LAKES PROTECTION FUND SMALL GRANTS

NYGLPF Awarded Project - 2014 Funding Cycle

Understanding the synergistic impact of aquatic invasive species, global climate change, and harmful algal bloom dynamics on Lake Erie

Principal Investigator: Sarah Delavan
Department of Civil, Structural and Environmental Engineering,
State University of New York at Buffalo
Collaborators: Joseph Atkinson, William Edwards

The specific objective of this project is to quantify water quality and velocity characteristics near the sediments in relatively shallow sites in Lake Erie that have been colonized by invasive quagga mussels and to compare them to non-colonized sites. This summer Drs. Edwards, Delavan, and Atkinson, along with UB PhD student, Brandon Sansom, and NU undergraduate student, Kimberly Alexander were able to sample multiple sites in Lake Erie in both the eastern and western basins. During the month of July, the team collected water samples and water velocity measurements at several heights above the sediment in the western basin of Lake Erie near the Buffalo Outer Harbor and the mouth of the Niagara River. The team was also able to collect similar measurements in the eastern basin of Lake Erie during the historic Harmful Algal Bloom outbreak of August 2014 that negatively affected the drinking water of millions of people along the shoreline of Lake Erie. The team was able to capture samples to determine water velocities, dissolved and particulate phosphorus concentrations, nitrogen concentration, chlorophyll concentrations, turbidity, density, conductivity, depth measurements, and sediment type. Over the next few months, the team members will be analyzing the data to be used in Kimberly Alexander's senior undergraduate thesis and potentially used in a MS thesis at UB. The team will also be creating a sampling plan for the summer 2015 field season.

Two New Techniques for Evaluating Connectivity of Septic Fields to Great Lake Watersheds and Embayments

Principal Investigator: Paul Richards
Department of Earth Sciences, SUNY Brockport
Collaborators: David Whitcroft, Brian Beha, Andrew Mendola

Our project, Two New Techniques for Evaluating Connectivity of Septic Fields to Great Lake Watersheds and Embayments, tests whether Pictometry True Color Oblique Imagery can be used to map septic fields in watersheds. We have started the project and have focused our efforts in Oakfield Township, located within the Upper Oak Orchard Creek Watershed. Of the 37 septic fields mapped by the Genesee Orleans County Department of Health, 49% were able to be identified with LiDAR and oblique imagery. The sites that were not identifiable tended to be located underneath tree canopies or were indicated as simply "septic

NYGLPF Awarded Project - 2014 Funding Cycle *(continued)*

tanks" according to Genesee County DOH Records. Imagery taken in the late spring (April) seemed to be more useful for identifying the leach fields. Leach fields were identifiable as a set of dark lines where it appeared the grass was longer and darker (Figures A-C). Some septic fields appear to have dark discolorations that appear to be related to drainage (see A). Raised septic fields were also sometimes identifiable from hill shades developed from 1 meter DEMs (LiDAR). So far we have mapped 117 septic fields that predate the available mapping. In the second part of the project, we are testing whether a new DNA groundwater tracer can be used to determine the time it takes for septic leachate to reach a water body. To date we have been preparing new groundwater tracers and

Figure Caption

Pictometry Oblique Imagery views of septic fields:

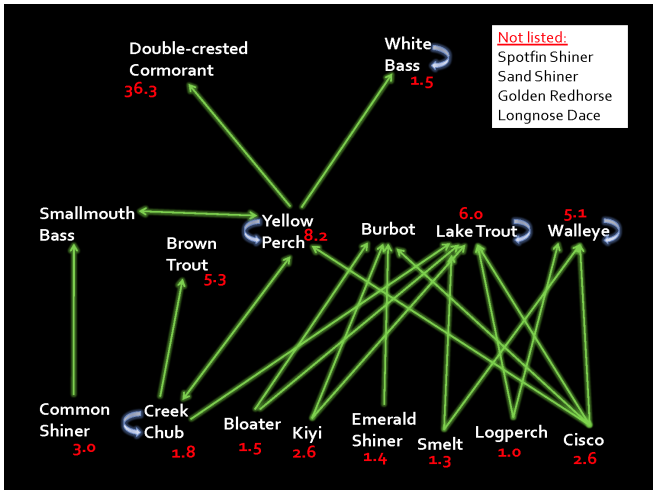
A: Septic field showing dark discoloration presumably caused by drainage from the leach field.

B-C: Two views of the same leach field taken in March (B) and April (C). Septic fields were easier to spot in the April Imagery after the grass started growing.

Assessment of Plastic Pollution Migration into the Great Lakes Food Web

Principal Investigator: Sherri Mason
Department of Chemistry, SUNY Fredonia
Collaborators: Jason P. Lewis, Donald Einhouse

The intention of this project was to examine the gastrointestinal tracts of a wide variety of Lake Erie fish species, as well as the Double-Crested Cormorant, a primarily fish-eating waterfowl, in order to assess the potential migration and bioaccumulation of plastic pollution into the Great Lakes food web. To-date we have analyzed 18 species (17 fish species and the cormorant) from multiple trophic levels and have eight more fish species awaiting analysis. Every species analyzed thus far has contained some amount of plastic, though some individual specimens have not. Depending upon the species anywhere from 75-100% of specimens contained microplastic particles. Counts per specimen and per species are highly variable, as could be expected given differing size, trophic level and feeding habitats. It does appear that lower trophic level organisms have smaller counts, which increase with the trophic level, but this might simply be due to the larger size of the organisms, rather than bi-omagnification. More in depth data analysis will be required to fully glean a complete understanding of the preliminary results obtained thus far (in addition to those which are still in process).



CHUBSUCKER PROJECT

Population Genetics of *Erimyzon oblongus* Across a Drainage Divide in Central New York

Madeline J. Clark, Kimberly L. Schulz, Donald J. Stewart and Christopher M. Whipps

INTRODUCTION

The Creek Chubsucker, *Erimyzon oblongus*, is freshwater catostomid seen in the waterways of central New York. A closely related species, the lake chubsucker, *Erimyzon sucetta*, has been extirpated for almost sixty years. In 2011, specimens were collected from Song Lake (Figure 1), located south of Syracuse, that appeared to exhibit features intermediate between *E. oblongus* and *E. sucetta*.

Song Lake is an endorheic lake, isolated by the last glaciation period (Kappel, 2001). It sits in between the Oswego and Susquehanna drainage basins. Thus, the Song Lake chubsucker population may be either:

1. An isolated population of *E. oblongus* which was trapped after glaciation
2. A population of the extirpated *E. sucetta*
3. A previously unrecognized evolutionarily significant unit (ESU) undergoing allopatric speciation.

CONCLUSIONS

1. Song Lake population is not an ESU of conservation concern. There were no significant differences in morphology.
2. There are differences in color pattern. Song Lake fish were similar to Susquehanna fish. These both differ from Oswego basin fish, which were more strongly banded vertically.
3. Mitochondrial and ribosomal DNA analysis shows no DNA sequence variation.
4. Song Lake chubsucker population is not *E. Sucetta* as DNA sequences match creek chubsuckers, not lake chubsuckers.

Though there were no mitochondrial or ribosomal DNA indications of genotypic variation, future studies might explore other areas of the mitochondrial or nuclear genome. This would determine if variation in color patterns correlates with intra-specific genetic differences that indicate population vicariance across the drainage divide.

This project opens opportunities to investigate the existence of evolutionary timeline in which allopatric vicariance of the Song Lake population is occurring. It is thought that glacial periods such as the last one that isolated this body of water have been major sources of speciation (April et al, 2013).

CITATIONS

April, J., Hanner, R. H., Dione-Cote, A. & Bernatchez, L. (2013). Glacial cycles as an allopatric speciation pump in north-eastern American freshwater fishes. *Molecular Ecology*, *22*, 409-422

Kappel, William M. (2001). *Hydrogeology of the Tully Lakes area in southern Onondaga and northern Cortland counties, New York.* Ithaca, N.Y.: U.S. Dept. of the Interior, U.S. Geological Survey.

GREAT LAKES OBSERVING SYSTEM (GLOS) BUOY PROGRAM

Buffalo State College Eastern Lake Erie Great Lakes Observing System Buoy

Buffalo State College, in collaboration with SUNY College of Environmental Science and Forestry and the Great Lakes Research Consortium, has been participating in the Great Lakes Observing System (GLOS) by operating and maintaining a GLOS buoy in the eastern basin of Lake Erie. The 4.8 meter long, 1.2 meter diameter buoy weighs a little over 650 pounds and is deployed annually in Lake Erie at a station five miles NNW of Dunkirk, NY in 30 meters of water. The buoy collects meteorological information including solar radiation, barometric pressure, wind speed and direction, and relative humidity. It also collects wave height, direction and period information as well as measuring water temperature from the surface to 25 meters at 2 meter increments along with dissolved oxygen and conductivity at 25 meters. Data collected are logged and transmitted via a cellular link back to the Great Lakes Center and onto the GLOS network. The information collected from this buoy, and from the whole GLOS system, can be used for climate modeling, lake current and energy budget modeling, as well as for the study of nutrient dynamics and fisheries research. The system is also useful for commercial and recreational navigation by providing real time information regarding wind and wave conditions.

Sodus Bay Great Lakes Observing System Buoy

The Great Lakes Research Consortium operates and maintains six seasonal buoys and three year-round weather stations across the upstate New York region. All of these units provide near-real-time data on meteorological and/or lake-specific parameters. Data from these stations is collected and transmitted every 30 minutes. Within 15 minutes of the data being collected, it is published on the GLRC website and available for anyone to view. The stations serve both as test beds for new instrumentation and as a source of weather and water data for teaching purposes.

The buoys range from those with oceanographic capabilities (deployed in the open waters of Lakes Ontario and Erie) which record additional data on wave heights and directions, to smaller inland water buoys (deployed in Sodus Bay and Oneida Lake). Some buoys are equipped with additional sensors which are capable of detecting pigments produced in algae and cyanobacteria. This allows the monitoring of the relative abundance of these organisms in the water at any given point in time, which in turn, allows us to make decisions regarding the potential toxicity of the cyanobacteria present. Data from the weather stations, in addition to being available to the general public, is also used by GLRC scientists to model water movement in Sodus Bay.

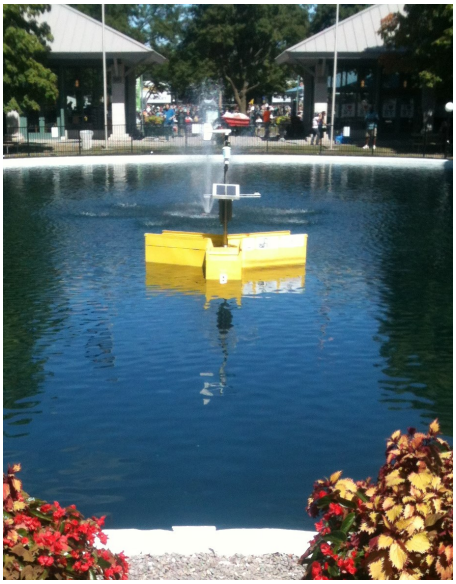
NEW YORK STATE FAIR SHIPWRECK DISPLAY

NEW YORK STATE FAIR EXHIBIT

The Great Shipwrecks of NY's 'Great' Lakes Signature Exhibit at the 2014 Great New York State Fair had several components in the permanent reflecting pool at the 375-acre Syracuse, NY, fairgrounds. The 'cement pond' is part of the State Park, operated by the New York State Office of Parks, Recreation and Historic Preservation at the Fair.

Twice daily, at 2pm and 4pm, the Great Lakes Research Consortium demonstrated the use of a remotely-operated underwater vehicle/ROV in the pool. Information was presented on how the high-tech equipment is used to further a science-based understanding of the Great Lakes.

Throughout the 12-day, August 21-September 1, fair, a weather buoy equipped with a real-time, 24/7 weather station also broadcast current weather conditions from the pool. With funding from the Great Lakes Observing System, the U.S. EPA Great Lakes Restoration Initiative and others, the Great Lakes Research Consortium has a series of these real-time monitoring stations located across New York State.

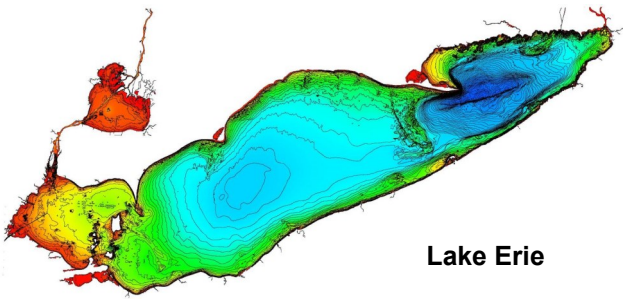


On Wednesday, August 27, the Great Lakes Research Consortium expanded its ROV demonstrations in the pool as part of "ROV Day at the Fair". Visitors were able to watch a 36-inch monitor as the equipment located underwater items.

Also as part of "ROV Day", a SeaPerch ROV, developed in partnership with the Office of Naval Research, was built on site in The Great Shipwrecks 60-foot exhibit tent throughout the day and put into the pool for a test run.

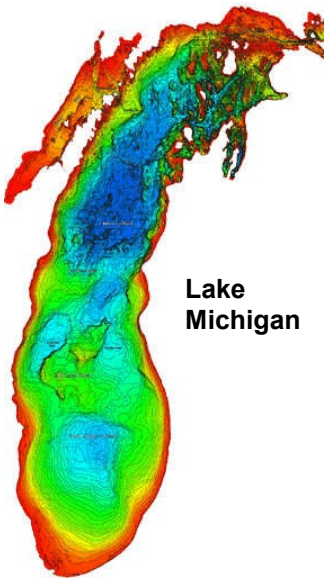
New York Sea Grant and the Great New York State Fair developed the "Great Shipwrecks of NY's "Great" Lakes" Signature Exhibit in partnership with the Great Lakes Research Consortium, Lake Champlain Sea Grant, Lake Champlain Maritime Museum, H. Lee White Marine Museum, Great Lakes Seaway Trail, and U.S. Coast Guard Auxiliary.

CONVERSATIONS IN THE DISCIPLINES



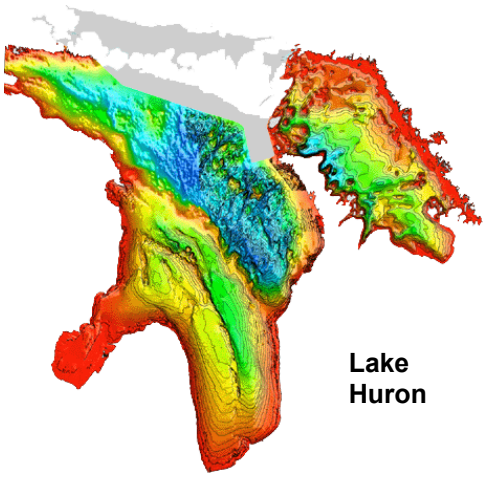
Lake Erie

With recent extreme weather events, climate change and public awareness now provide us with a unique opportunity to formulate a research agenda addressing these issues for the Great Lakes. To this end, the GLRC received funding to host a SUNY Conversations in Disciplines Conference entitled "Resiliency of the Great Lakes to Climate and Storm Events". This conference was held at SUNY-ESF on May 22nd-23rd, 2013.



Lake Michigan

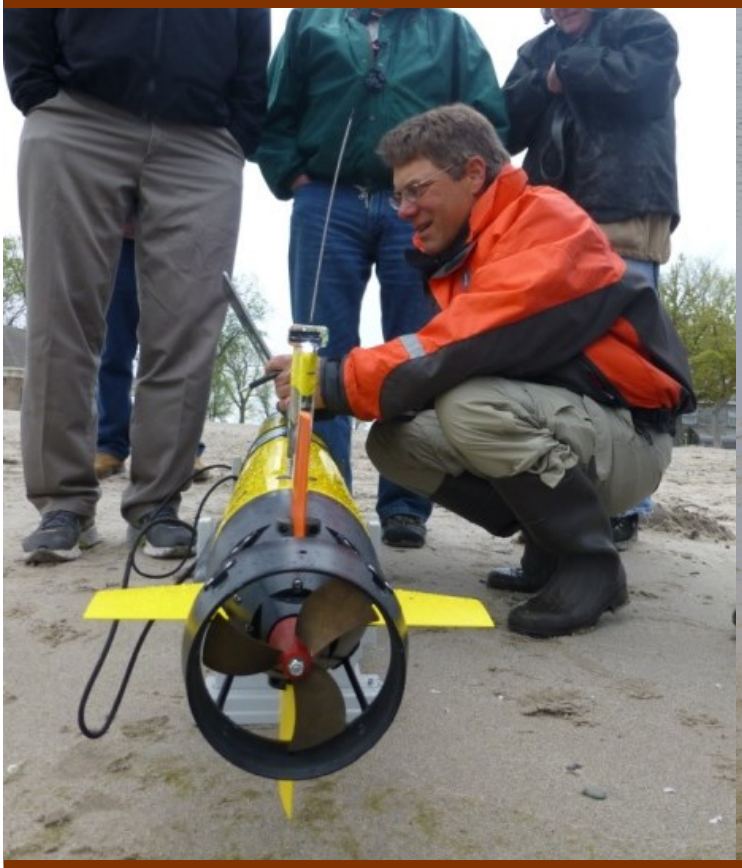
The conference addressed how the Great Lakes respond to storm and climate events. Along with the Great Lakes Research Consortium the conference was co-organized by New York Sea Grant, New York State Department of Environmental Conservation and New York State Department of State. The conference identified key research needs that should be addressed as the State moves forward in its response to coastal hazards and climate change. The first day consisted of plenary talks by Tim Killeen (SUNY-Research Foundation) on the "*NYS 2100 Commission and the role of SUNY"*, Art DeGaetano (Northeast Regional Climate Center) on "*CLIMAID and predicting NYS's Climate Future"*, and by Kathy Bunting-Howarth (New York Sea Grant) on "*Lessons learned from Hurricane Sandy"*. This plenary session was followed by the real work of the conference; breakout sessions to allow different groups to evaluate the State of the Science in the areas of Air (atmospheric modeling and climatology), Water (aquatic biology, limnology, aquatic chemistry), Land (hydrodynamic modeling, watershed sciences, soft engineering solutions, etc.), and the People (social sciences, economics and the human dimension). The following morning, we identified areas of overlap amongst and between disciplines followed by the development of a set of recommendations for future research.



Lake Huron

This was a truly interdisciplinary undertaking, requiring scholarly contributions in meteorology, lake ecology, physical limnology, shoreline engineering processes, coastal design and planning of the human environment, as well as the social sciences. In an effort to promote networking opportunities, we also invited all participants to bring along a poster describing their Great Lakes work or interests.

STUDENT ACTIVITIES



STUDENT ACTIVITIES

In 2013, the **Great Lakes Research Consortium** initiated a very small grants program to facilitate student research at its member institutions. We recognize that often small amounts of research support can be critical to the success of a student research project. Modeled after the Phycological Society of America (PSA) Grants-in-Aid of Research Program, this program is designed to aid undergraduate and graduate students interested in conducting research of relevance to the Great Lakes.

AWARDED STUDENT RESEARCH PROJECTS

Impacts of dietary intake on round goby (Neogobius melanostomus) reproductive performances

Student Researcher: Chris Hays
Department of Environmental Science and Biology, SUNY Brockport

The main objective of this research is to evaluate the effect of dietary intake on reproductive performance (i.e. fecundity, egg size, gonad size) of round goby. To achieve this objective, both field and lab experiments were conducted. In the lab, round goby were fed different diets to mimic the diet found naturally in both Lake Ontario proper (Mysis shrimp) and in a local tributary: Sandy Creek (blood worm). How these diets affected goby productive performance and lipid/fatty acid profiles was evaluated. In the field, the Sandy Creed goby were sampled using backpack electroshockers, and both stomach content and reproductive factors were analyzed to compare to the lab data. The data is still being compiled, therefore, there is no preliminary data to report at this time.

Assessing nearshore – offshore linkages and spatiotemporal differences in the Lake Ontario food web using fatty acid analysis

Student Researcher: Robert Pattridge
Department of Environmental Science and Biology, SUNY Brockport

Fatty acid signatures (FAS) are currently used in food web studies to provide insights into long term feeding habits of predators based on the degree of similarity between their FAS and that of their prey. To date, FAS data of fish from Lake Ontario are limited and are required to better understand possible energy connections between nearshore and offshore environments. This research project focuses on these food web dynamics in Lake Ontario and involves a rigorous multi-phase process

which will ultimately yield data revealing the feeding habits of predatory fish in the lake. Sampling for prey (alewife, round goby, and rainbow smelt) and predator species (lake trout, brown trout, northern pike, coho salmon, chinook salmon, steelhead, and yellow perch) has been conducted in two different sampling seasons (spring and fall of 2013). Prey species were captured by bottom trawling (cooperation with the USGS) at three different transects along the south shore of Lake Ontario (Olcott, Rochester, and Oswego). Predator species were sampled in areas along the south shore of Lake Ontario by use of gill nets and cooperation with anglers at tournaments and cleaning stations. The fatty acid signatures of both prey and predator fish are currently being analyzed and will yield important information about the Lake Ontario food web.

STUDENT TRAVEL SUPPORT

Starting in 2008, the GLRC instituted student travel awards. Since that time, many students have received support to attend and present their research at national and international conferences and meetings. Student participation at such conferences is integral to the students' education and the student is expected to attend the entire conference to take advantage of the many educational opportunities afforded by these meetings. More information on the student travel support program is available on the GLRC website at www.esf.edu/glrc/students/travel.htm

Since 2011, the GLRC has sponsored the following students to attend the following meetings:

2011:

Kevin Cudney	International Association for Great Lakes Research
Katherine Perri	Northeast Algal Symposium
Dale Pettenski	International Association for Great Lakes Research
Evan Rea	International Association for Great Lakes Research
Justine Schmidt	Northeast Algal Symposium
Melissa Winslow	International Association for Great Lakes Research

2012:

Derek Crane	American Fisheries Society Annual Meeting
Brian Henning	American Fisheries Society Annual Meeting
Christine Killouhy	American Fisheries Society Annual Meeting

2013:

Vadim Karatayev	International Association for Great Lakes Research

2014:

Shannon Beston	Joint Aquatic Sciences Meeting
Samuel Byrne	Central & Eastern European Conference, Romania
Vadim Karatayev	International Association for Great Lakes Research
Justin Mycheck-Londer	American Fisheries Society Annual Meeting
Katherine Perri	International Association for Great Lakes Research

STUDENT ACTIVITIES

INTERNSHIPS

Development of student scientists remains one of the core missions of the Great Lakes Research Consortium. To facilitate this process, the GLRC instituted its internship program in 2007. Initial funding came from the USGS to support fisheries research done in conjunction with scientists working at the USGS Lake Ontario Biological Station or at the Tunnison labs. In 2008, this program was expanded using funds generously provided by New York State Senator John DeFrancisco to provide matching support for students working in any area of Great Lakes science. Traditionally, matching internship positions must be filled by a student from a GLRC member school other than that of the faculty mentor's home campus and provide some more mechanism to focus collaborations across campuses. More information on the internship program is available on the GLRC website at www.esf.edu/glrc/students/interns.htm

USGS and Matching GLRC Internships

Ian Harding (2011; SUNY-ESF) Determining preparation techniques for round goby age and growth.
Mentor: Brian Weidel (USGS).

Chris Legard (2011; SUNY-ESF) Brown Trout Survival in the Salmon River.
Mentor: Neil Ringler (SUNY-ESF).

Christopher Nack (2011; SUNY-ESF) A study on fallfish diets in the Salmon River.
Mentor: Karin Limburg (SUNY-ESF) and Jim Johnson (USGS).

Margaret Pavlac (2011; SUNY-ESF) GLOS Internship at Michigan Technical University.
Mentor: Robert Shuchman (MTU).

Kean Clifford (2012; SUNY-ESF) Trout Interactions and Model Validation.
Mentor: James McKenna (USGS).

Colby Fisher (2012; SUNY-ESF) Adaptation and Implementation of the CADA-ECM Model for Sodus Bay.
Mentor: Gregory Boyer (SUNY-ESF).

Stacey Furgal (2012; SUNY-Oswego) Alewife diets. Mentor: Maureen Walsh (USGS).

Andrea Graham (2012; SUNY Brockport) Studies related to restoration of sedge/grass wetlands.
Mentor: Douglas A. Wilcox (SUNY Brockport)

Emily Ogburn (2012; SUNY-ESF) Non-native mussels in the Oswego Basin NY Canal System.
Mentors: Dawn Dittman (USGS), Jim Johnson (USGS), Karin Limburg (SUNY-ESF).

Seyed Mohammad Ghaneeizad (2013; SUNY Buffalo) The Vertical Connection: Restructuring of Lake Ontario's Offshore. Mentor: Joseph F. Atkinson (SUNY Buffalo).

Imran Khalid (2013; SUNY-ESF) GLRC Graduate Student Intern. Mentor: Gregory Boyer (SUNY-ESF).

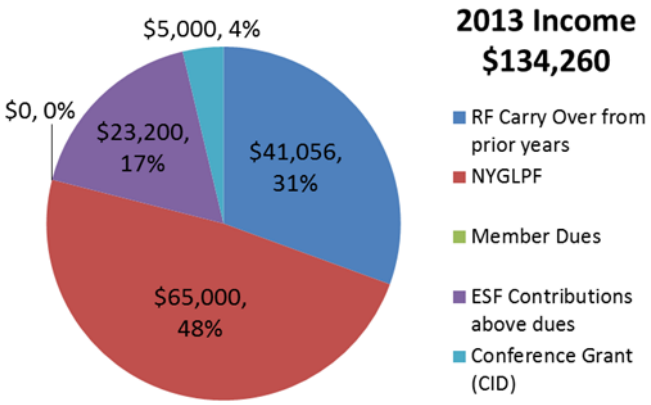
Marissa White (2013; Cornell University) Development of education and outreach programs for Lake Ontario and Its Watershed. Mentor: Lars Rudstam (Cornell University).

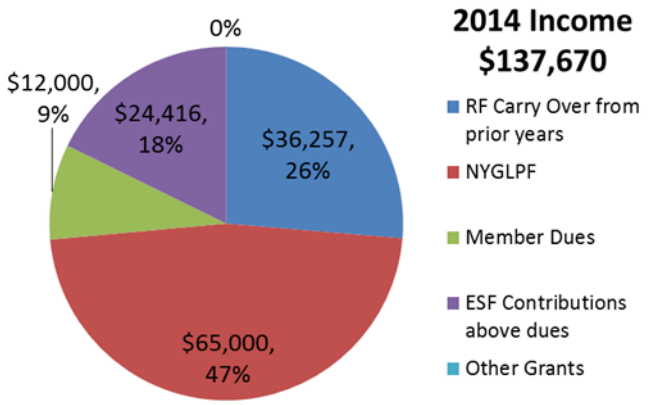
FINANCIAL OVERVIEW

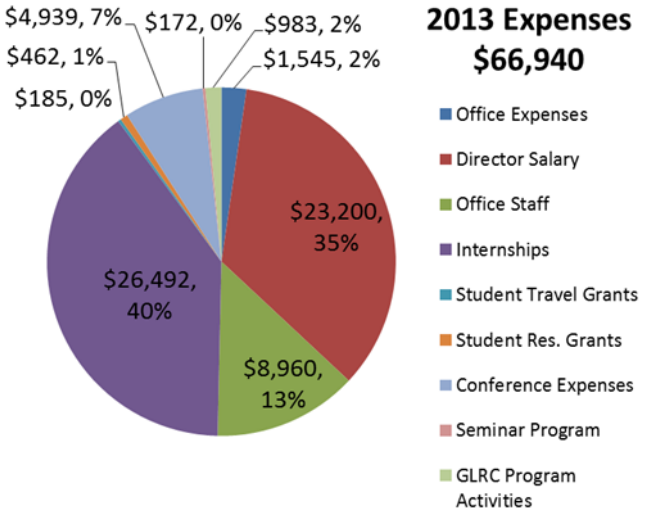
FINANCIAL OVERVIEW

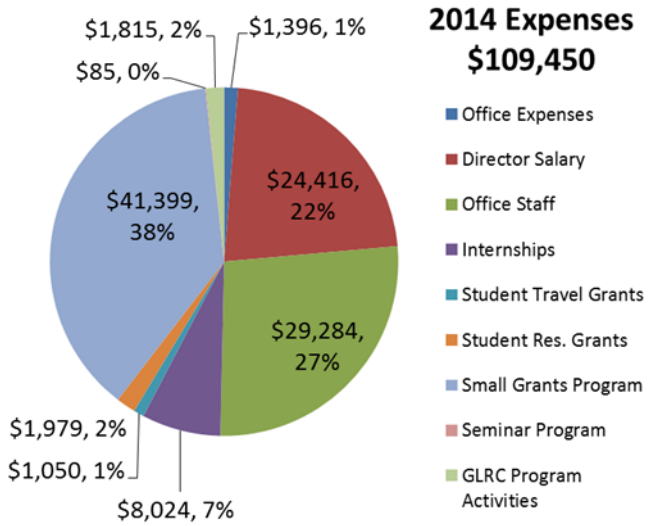
2013 - 2014 FINANCIAL SUMMARY

2013 marked another year of change for the GLRC. We switched from State fiscal year reporting to calendar year reporting. This allows us to make a more realistic estimation of our NYS support of the small grants program and our income and expenditures associated with the summer field season. We added an Associate Director to the office staff in 2012 and an Administrative Assistant in 2014. 2014 also saw the return of the small grants program, the implementation of the student small grant program as well as the return of our request for membership dues. Details of our income and expenditures for 2013 and 2014 are summarized below.









FINANCIAL OVERVIEW

GRANTS AND FUNDING

The Great Lakes Research Consortium is a diverse and active group of institutions. Below is a selection of funded proposals from our GLRC member schools. This list is by no means meant to be inclusive of all the research activities currently underway at the participating institutions.

Clarkson University. Fish Monitoring and Surveillance. U.S. EPA. **$3,828,503**. 2010-2015.

Cornell University. Biological and social impacts of aquatic invasive species in the Great Lakes: development of scenarios through expert judgment and assessment of impacts on recreational angling. Great Lakes Fisheries Commission. **$103,000**. 2014-2017.

Cornell University. Biogeochemical and ecological impacts of amphipod circoviruses in benthic habitats. National Science Foundation. **$620,000**. 2014-2017.

Cornell University. Rehabilitation of cisco in Lake Ontario. The Nature Conservancy. **$105,000**. 2013-2015.

Cornell University. The vertical connection: restructuring of Lake Ontario's offshore. Great Lakes Fisheries Commission. **$101,000**. 2013-2015.

Cornell University. Reducing Exposure to Toxics in Urban Anglers. U.S. EPA. **$632,235**. 2013-2015.

Cornell University. Great Lakes Long-term Biological Monitoring Program. U.S. EPA. **$3,850,000**. 2012-2017.

Cornell University. Lake Ontario Biomonitoring Program. NYS Department of Environmental Conservation. **$120,000**. 2012-2017.

Great Lakes Center. Survey of Texas Hornshell populations in Texas. U.S. Fish and Wildlife Service, and Texas Parks and Wildlife Department, Traditional Section 6, Bilateral species conservation effort in New Mexico and Texas. **$143,000**. 2011-2014.

Great Lakes Center. Effects of multiple acoustic scattering from realistic oceanic bubble and fish assemblages. **$151,468**. 2011-2013.

Great Lakes Center. Investigating lake sturgeon habitat use, feeding ecology, and benthic resource availability in the lower Niagara River. Greenway Ecological Standing Committee. **$835,829**. 2014-2017.

Great Lakes Center. Implementation of the Great Lakes Observing System. US Department of Commerce. **$87,678**. 2011-2014.

Great Lakes Center. Alcohol and PAH-induced carcinogenesis. National Institutes of Health. **$147,000**. 2012-2014.

Great Lakes Center. The Lake Erie Nearshore and Offshore Nutrient Study (LENONS). U.S. EPA Great Lakes Restoration Initiative 2010. **$615,813**. (**$365,101** for Buffalo State). 2010-2013.

Great Lakes Center. Administration of the Western New York PRISM (Partnership for Regional Invasive Species Management). Department of Environmental Conservation, New York State. **$1,100,768**. 2012-2017.

Great Lakes Center. Administration of the Western New York PRISM (Partnership for Regional Invasive Species Management). Department of Environmental Conservation, New York State. **$1,100,768**. 2012-2017.

Great Lakes Center. Emerald shiner habitat conservation and restoration study in the upper Niagara River: importance for sport fish, common terns and public education. Niagara Greenway Ecological Fund. **$766,488**. 2014-2016.

GRANTS AND FUNDING *(continued)*

Great Lakes Center. Emerald shiner habitat conservation and restoration study in the upper Niagara River: importance for sport fish, common terns and public education. Great Lakes Remedial Action Plan. US Army Corps of Engineers. **$1,331,247** (Funds are in-kind). 2014-2016.

Great Lakes Center. Great Lakes Long-term Biological Monitoring Program. U.S. EPA. **$3,867,525** (**$1,094,726** for Buffalo State). 2012-2017.

Great Lakes Center. Enhanced early detection of invasive Ponto-Caspian fishes in the Great Lakes. U.S. EPA Great Lakes Restoration Initiative. **$99,756**. 2012-2013.

Great Lakes Center. Collaborators: M. Schlesinger, R. Haas, T. Crail, P. Badra, N. Welte, and L. Holst. Conservation of native freshwater mussel refuges in Great Lakes coastal zones. Great Lakes Fish and Wildlife Restoration Act FY 2010. **$327,363** (**$71,054** for Buffalo State). 2010-2013.

SUNY Brockport. Wetland Monitoring for Lake Ontario Adaptive Management. U.S. EPA. **$176,313**. 2014-2015.

SUNY-ESF. Implementation of the Great Lakes Observing System (GLOS). National Oceanic and Atmospheric Administration. **$448,400**. 2011-2016.

SUNY-ESF. GLOS Enhanced Tributary Monitoring to Support AOCs and LaMPs. University of Michigan. **$217,113**. 2013-2015.

SUNY-ESF and University at Buffalo. Contribution of Marina Activities to the Algal Growth to Sodus Bay, Lake Ontario. New York Sea Grant Institute. **$294,222**. 2012-2015.

SUNY-ESF. The Integrated Water-System of the Great Lakes Region: Its Condition and Changes for the Future. Research Foundation for SUNY. **$149,978**. 2014-2015.

SUNY-ESF. Direct Mitigation of a Harmful Algal Bloom in Sodus Bay. U.S. EPA. **$397,147**. 2011-2016.

SUNY Fredonia. Assessment of Plastic Pollution Migration into the Great Lakes Food Web. New York Great Lakes Protection Fund Small Grants Program. **$14,000**. 2014-2015.

SELECTED PUBLICATIONS

Allan, J. D., P. B. McIntyre, S. D. P. Smith, B. S. Halpern, G. L. Boyer, A. Buchsbaum, A. Burton, L. Campbell, L. Chadderton, J. Ciborowski, P. Doran, T. Eder, D. M. Infante, L. B. Johnson, C. G. Joseph, A. L. Marino, A. Prusevich, J. Read, J. Rose, E. Rutherford, S. Sowa, and A. Steinman (2013) Joint analysis of stressors and ecosystems services to enhance restoration effectiveness. Proc. Natl Acad. Sci (USA). 110(1) 372-377.

Kapuscinski, K. L., J. M. Farrell, S. V. Stehman, G. L. Boyer, D..D. Fernando, M. A. Teece and T. J. Tschaplinski (2014) Selective herbivory by a non-native cyprinid, the Rudd *Scardiniuserythrophthalmus*. Freshwater Biology, 59:2315–2327

Kapuscinski, K. L., J. M. Farrell, G. Paterson, M.A. Wilkinson, L.C. Skinner, W. Richter, A. J. Gudlewski, (2014) Low Concentrations of Contaminants in an Invasive Cyprinid, the Rudd, in a Great Lakes Area of Concern, Bulletin of Environmental Contamination and Toxicology, 93 (5)567-573

Karatayev, V. A., A. Y. Karatayev, L. E. Burlakova, and D. K. Padilla. 2013. Lakewide dominance does not predict the potential for spread of dreissenids. *Journal of Great Lakes Research* 39: 622-629.

Karatayev, A. Y., L. E. Burlakova, and D. K. Padilla. 2014. General overview of zebra and quagga mussels: what we do and do not know. In T. F. Nalepa and D. W. Schloesser (eds.) Quagga and Zebra Mussels: Biology, Impacts, and Control. 2nd Edition. CRC Press, Boca Raton, FL. pp. 695-703.

SELECTED PUBLICATIONS

Lehman, P. W., C. Kendall, M. A. Guerin, M. B. Young, S. R. Silva, G. L. Boyer and S. J. Teh.(2014) Characterization of the *Microcystis* bloom and its nitrogen supply in San Francisco Estuary using stable isotopes. Estuaries and Coasts, 58 (1) 165-178.

Manning, N. G., J. M. Bossenbroek, C. M. Mayer, D. B. Bunnell, L. G. Rudstam, and J. R. Jackson. 2014. Modeling plumes and blooms: turbidity type and intensity effects on the growth and starvation mortality of yellow perch. Can. J. Fish.Aquat. Sci. 71:1544-1553.

Mastitsky, S. E., A. Y. Karatayev, and L. E. Burlakova. 2014. Parasites of aquatic exotic invertebrates: identification of hazards posed to the Great Lakes. *Human and Ecological Risk Assessment* 20: 743-763.

Mayer, C. M., L. E. Burlakova, P. Eklöv, D. Fitzgerald, A. Y. Karatayev, S. A. Ludsin, S. Millard, E. L. Mills, A. P. Ostapenya, L. G. Rudstam, B. Zhu, and T. V. Zhukova. 2014. Benthification of freshwater lakes: exotic mussels turning ecosystems upside down. In T. F. Nalepa and D. W. Schloesser (eds.) Quagga and Zebra Mussels: Biology, Impacts, and Control. 2nd Edition. CRC Press, Boca Raton, FL. pp. 575-586.

Mukherjee, J. J. and S. Kumar. 2013. DNA synthesis inhibition in response to benzo[a]pyrene dihydrodiol epoxide is associated with attenuation of p34cdc2: Role of p53. *Mutation Research* 755: 61-67.

Naddafi, R. and L. G. Rudstam. 2014. Does differential predation explain the replacement of zebra by quagga mussels? Freshw. Sci. 33:895-903.

Naddafi, R. and L.G. Rudstam, 2014. Predator-induced morphological defenses in two invasive dreissenid mussels: implications for species replacement. Freshw. Biol. 59:703-713.

Naddafi, R. and L. G. Rudstam. 2014. Predation on invasive zebra mussel, *Dreissenapolymorpha*, by pumpkinseed sunfish, rusty crayfish, and round goby. Hydrobiologia 721:107-115.

Pérez-Fuentetaja, A. and J. Wuerstle. 2014. Prey size selection and feeding ecology of an omnivorous invader: *Hemimysis anomala*. *Journal of Great Lakes Research* 40(2): 257–264.

Pérez-Fuentetaja, A., M. D. Clapsadl, and W. T. Lee. 2014. Comparative role of dreissenids and other benthic invertebrates as links for type-E botulism transmission in the Great Lakes. In T. F. Nalepa and D. W. Schloesser (eds.) Quagga and Zebra Mussels: Biology, Impacts, and Control. 2nd Edition. CRC Press, Boca Raton, FL. pp. 705-712.

Randklev, C. R., E. T. Tsakiris, M. S. Johnson, J. Skorupski, L. E. Burlakova, J. Groce, and N. Wilkins. 2013. Is False Spike, *Quadrula mitchelli* (Bivalvia: Unionidae), extinct? First account of a very recently deceased individual in over thirty years. *The Southwestern Naturalist* 58: 247-259.

Schmidt, J.R., M. Shaskus, F, F. Estenik, C. Oesch, R. Khidekel, and G. L. Boyer (2013) Variations in the microcystin content of different fish species collected from a eutrophic lake. Toxins 5:992-1009

Snyder, R. J., L. E. Burlakova, A.Y. Karatayev, and D. B. MacNeill. 2014. Updated invasion risk assessment for Ponto-Caspian fishes to the Great Lakes. *Journal of Great Lakes Research* 40: 360-369. http://dx.doi.org/10.1016/j.jglr.2014.03.009

Watson, L. C., Stewart,D. J., and Teece, M. A. (2013) Trophic ecology of *Arapaima* in Guyana: giant omnivores in Neotropical floodplains. Neotropical Ichthyology 11(2), 341-349.

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