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Annual Report 2022–2023

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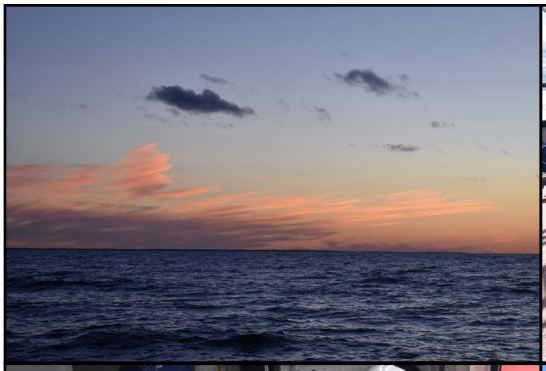
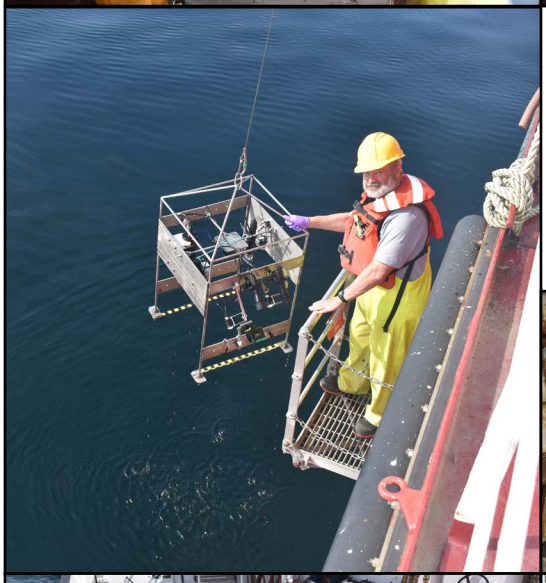






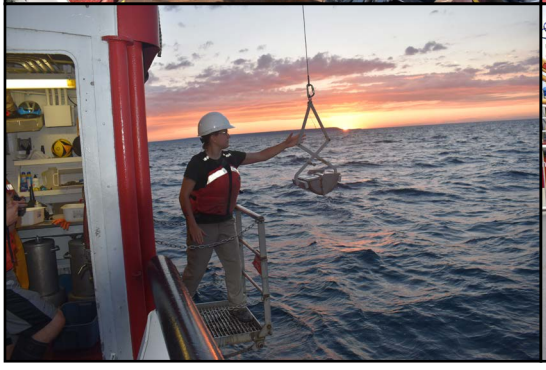
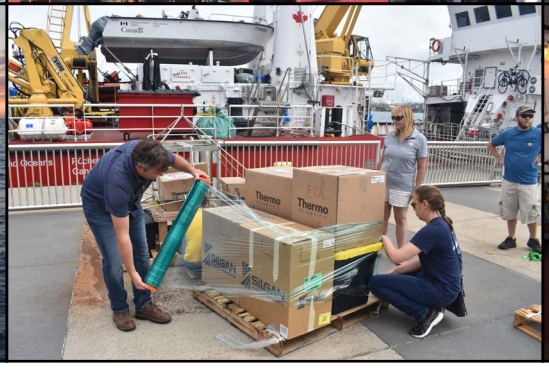


Lake Huron CSMI

July 2022






CONTENTS

MISSION

The Great Lakes Center (GLC) mission is to improve the quality of the environment by providing the best possible science to decision-makers concerned with the health and sustainability of resources, with a primary focus within the Great Lakes and their watersheds. This is accomplished through high quality research, informed and current graduate and undergraduate education, and dissemination of information to the public through outreach. The Center is committed to improving human-environment interactions in the Great Lakes ecosystem guided, in part, by an understanding of the evolutionary and ecological processes and patterns acting on the system. Although the main focus of the research in the GLC concentrates on the Great Lakes basin, nation-wide and international projects are also considered of high priority as they expose GLC scientists to the cutting edge of modern science, facilitate collaboration, and greatly increase visibility of the Center's activity in the scientific community.

HIGHLIGHTS

Over the last year, the Great Lakes Center saw sustained activity and productivity in research, education, and service. We continued our excellence in research conducted by GLC personnel and in collaboration with other faculty from Buffalo State University, as well as other institutions in North America, Europe, and South America.

- Over the last year our researchers have published **11 peer-reviewed papers**, and **6 papers** were submitted for publication.
- We presented **20 talks**, including: 14 at national/international/regional conferences and 6 invited talks.
- Nine projects for research and education are currently funded in the GLC totaling **$17,021,894**, including **$9,672,516** for Buffalo State.
- **Thirteen students** were enrolled in Great Lakes Environmental Science M.A. and M.S. programs.
- **Two issues** of GLC newsletters were produced over the last year.
- WNY PRISM conducted invasive species surveys across 82 sites, including 200 miles and 10,000 acres, uploading 3,507 records to iMapInvasives; treated over 2,000 acres, and removed 150 bags of plant material and 4,000 lbs. of water chestnut from management sites; inspected 12,063 watercraft; and held the first WNY PRISM Invasive Species Management Symposium.

GLC staff and guests at the GLC Open House at the Field Station on September 16, 2022.

I. Staff

GLC Personnel

Director:	Alexander Karatayev
Research Scientists:	Lyubov Burlakova Mark Clapsadl (Field Station Manager) Susan Daniel Allison Hrycik Christopher Pennuto Alicia Pérez-Fuentetaja
Research Technicians:	Lillian Denecke Shawn Geary Brian Haas Erik Hartnett Kit Hastings Nataliia Mikulska Angela Tulumello Brianne Tulumello
Administrative Assistant:	Susan Dickinson
WNY PRISM Coordinator:	Andrea Locke
Program Managers:	Brittany Hernon, Terrestrial Program Manager Amanda Cooper, Aquatic Program Manager Rachel Taylor, Community Science and Engagement Program Manager Douglas Knoph, Field Operations Manager
Student Research Assistants:	Kifaya Albayed, Undergraduate Student, Buffalo State University Matthew Basista, Graduate Student, Buffalo State University Theo Berenson, Graduate Student, Buffalo State University Martens Dorcely, Graduate Student, Buffalo State University Ben Gallivan, Graduate Student, Buffalo State University Kyle Glenn, Graduate Student, Buffalo State University Alexander Krest, Graduate Student, Buffalo State University Yevheniia Mikulska, Undergraduate Student, University at Buffalo Kylie Wirebach, Graduate Student, Buffalo State University Kira Yerofeev, Graduate Student, Buffalo State University

WNY PRISM Seasonal Employees

Invasive Species Management Assistants:

Alicia Addams, Canisius College (2023)
Melanie Donofrio, University at Buffalo (2022)
Tina Ni, University at Buffalo (2023)
Brianna Saylor, Buffalo State University (2022–2023)
William Walston, University of North Carolina at Asheville (2022)

Education and Outreach Assistants:
Tyler Burgess, University at Buffalo (2023)
John Montgomery, Ohio University (2021–2022)

GIS Technician: Megan Kresse, Allegheny College (2022)

Survey and Monitoring Technicians:
Diana Chaburka, University at Buffalo (2022)
Jason Kappan, Buffalo State University (2019–2023)
Lindsay Piotrowski, Buffalo State University (2023)

Lead Boat Stewards: Jessica Castellan, SUNY Environmental Science and Forestry (2023)
Tyler Harrington, University at Buffalo (2021–2022)
Vincent Manuela, University at Buffalo (2020–2022)
Rebekah Meyers, Humboldt University of Berlin (2023)

Boat Steward/Environmental Educators:

- William Brown, SUNY Morrisville State College (2023)
- Alec Cimini, Clarkson University (2023)
- Bryan Cirbus, Erie County Community College (2023)
- Emma Clay, Paul Smith's College (2023)
- Jennifer Crane, Buffalo State University (2023)
- Ashley Daneau, Niagara County Community College (2022)
- Zachary Day, University at Buffalo (2023)
- William DesJardin, University at Buffalo (2023)
- Rachel Donner, University at Buffalo (2022)
- Nathan Emery, St. Bonaventure University (2023)
- Oishee Ghosh, SUNY Fredonia (2022)
- David Kramp, Buffalo State University (2023)
- Andrew LaDuca, St. Bonaventure University (2023)
- Jade LaRock, Buffalo State University (2022)
- Alexis Long, University at Buffalo (2022)
- Bethany Mangioni, Niagara University (2023)
- Henry Meeder, SUNY Cobleskill (2023)
- Abigail Minnekine, SUNY Geneseo (2022)
- Zachary Nyhart, SUNY Cortland (2022)
- Austin Oare, University at Buffalo (2022)
- Samuel Palmieri, Jamestown Community College (2023)
- Jenna Pecky, University at Buffalo (2022)
- Imani Stephens Ibrahim, Buffalo State University (2022)
- Luke Thompson, Jamestown Community College (2022)
- Emily Townsend, University at Buffalo (2023)
- Lynnie Wallen, University at Buffalo (2022)
- Charles Weaver III, University at Buffalo (2023)
- Logan Wray, SUNY Brockport (2023)

GLC Affiliates (at Buffalo State University)

- Kelly Frothingham, Associate Dean, School of Arts and Sciences
- Susan McCartney, Director, Small Business Development Center
- Mary Perrelli, GIS Lab Supervisor, Geosciences Department
- Daniel L. Potts, Chair and Professor, Biology Department
- Randal Snyder, Professor, Biology Department
- Yola M. Stockton, Assistant Professor, Art and Design Department
- Tao Tang, Professor, Geosciences Department
- Stephen Vermette, Professor, Geosciences Department
- Robert J. Warren II, Professor, Biology Department

Adjunct Research Scientists

- Richard Barbiero, Chicago, Illinois
- Thomas Hahn, Buffalo, New York

- Vadim Karatayev, NSF Postdoctoral fellow, University of Kansas, Lawrence, Kansas
- Knut Mehler, Research Scientist at the Lower Saxony State Office for Water Economy, Coastal and Environmental Protection, Department of Water Management and River Basin Management, Germany
- Daniel Molloy, Scientist Emeritus, NY State Museum, Molloy & Associates, LLC

Collaborators in New York State

- Connie Adams, NYS Department of Environmental Conservation
- Diana Aga, Chemistry Department, University at Buffalo
- Gregory Boyer, SUNY Environmental Science and Forestry, Syracuse
- Mike Goehle, U.S. Fish and Wildlife Service
- Andrew Hannes, U.S. Army Corps of Engineers
- Kristen Holeck, Cornell Biological Field Station, Cornell University
- James Jackson, Cornell Biological Field Station, Cornell University
- Brian Lantry, U.S. Geological Survey, Lake Ontario Biological Station, Oswego
- Dianna Padilla, Department of Ecology and Evolution, Stony Brook University
- Isabel Porto Hannes, University at Buffalo
- Erin Redding, NYS Department of Environmental Conservation
- Lars Rudstam, College of Agriculture and Life Sciences, Department of Natural Resources, Cornell Biological Field Station, Cornell University
- James Watkins, Cornell Biological Field Station, Cornell University
- Brian Weidel, U.S. Geological Survey, Lake Ontario Biological Station, Oswego

Collaborators at other U.S. Institutions

- Theodore Angradi, U.S. EPA Mid-Continent Ecological Division, Duluth, Minnesota
- Jacob Boehler, National Center for Water Quality Research, Heidelberg University, Tiffin, Ohio
- Valerie Brady, Natural Resources Research Institute, University of Minnesota Duluth, Duluth, Minnesota
- David Bunnell, U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, Michigan
- Paris Collingsworth, Illinois-Indiana Sea Grant and Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana
- Peter Esselman, U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, Michigan
- Mary Ann Evans, U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, Michigan
- Elizabeth Hinchey Malloy, U.S. EPA Great Lakes National Program Office, Chicago, Illinois
- Joel Hoffman, U.S. EPA, National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division, Duluth, Minnesota
- Leon Katona, University of Nevada Reno, Nevada
- Sergei Katsev, Large Lakes Observatory, University of Minnesota Duluth, Duluth, Minnesota
- Richard Kraus, U.S. Geological Survey, Lake Erie Biological Station, Huron, Ohio
- Katya Kovalenko, Natural Resources Research Institute, University of Minnesota Duluth, Duluth, Minnesota
- Barry Lesht, Department of Earth and Environmental Sciences, University of Illinois at Chicago; CSRA, Chicago, Illinois
- Charles Madenjian, U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, Michigan
- Janet Nestlerode, U.S. EPA, National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, Florida
- Euan Reavie, Natural Resources Research Institute, University of Minnesota Duluth, Duluth, Minnesota
- Mark Rowe, Great Lakes Environmental Research Laboratory, NOAA, Ann Arbor, Michigan
- Ed Rutherford, Great Lakes Environmental Research Laboratory, NOAA, Ann Arbor, Michigan
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- Jill Scharold, U.S. EPA, National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division, Duluth, Minnesota
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- Robert Shuchman, Michigan Technological Research Institute, MTU, Ann Arbor, Michigan
- Anett Trebitz, U.S. EPA Office of Research & Development, Mid-Continent Ecology Division, Duluth, Minnesota

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- Jake Vander Zanden, Center for Limnology, University of Wisconsin-Madison, Madison, Wisconsin
- Daelyn Woolnough, Biology Department, Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, Michigan
- David Zanatta, Biology Department, Institute for Great Lakes Research, Central Michigan University, Mount Pleasant, Michigan

International Collaborators

- Boris Adamovich, Research Laboratory of Aquatic Ecology, Belarusian State University, Minsk, Belarus
- Csilla Balogh, Balaton Limnological Research Institute, Hungary
- Yulia Bespalaja, Federal Center for Integrated Arctic Research, Russian Academy of Sciences, Arkhangelsk, Russia
- Ivan Bolotov, Federal Center for Integrated Arctic Research, Russian Academy of Sciences, Arkhangelsk, Russia
- Demetrio Boltovskoy, University of Buenos Aires, Argentina
- Frank Collas, Radboud University, Nijmegen, The Netherlands
- Nancy Correra, Sede Educativa Universitaria, UNDEF, Buenos Aires, Argentina
- Ronald Dermott, Alumnus, Fisheries and Oceans Canada, Burlington, Canada
- Maria Dittrich, University of Toronto Scarborough, Toronto, Ontario, Canada
- Elsa Froufe, CIIMAR - Interdisciplinary Centre of Marine and Environmental Research, and University of Porto, Porto, Portugal
- Jürgen Geist, TU München, Munich, Germany
- Ron Griffiths, Aquatic Ecostudies Limited, Canada
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- Manuel Lopes-Lima, ICBAS - Abel Salazar Biomedical Sciences Institute, CIIMAR, University of Porto, Porto, Portugal
- Frances Lucy, Institute of Technology Sligo, Sligo, Ireland
- Oleg Makarevich, Belarusian State University, Minsk, Belarus
- Tamara Makarevich, Belarusian State University, Minsk, Belarus
- Olesya Makhutova, Institute of Biophysics, Siberian Branch, Russian Academy of Sciences, Krasnoyarsk, Russia
- Zoltán Serfőző, Balaton Limnological Research Institute, Hungary
- Ronaldo Sousa, CIIMAR and Minho University, Braga, Portugal
- Piet Spaak, EAWAG, Dübendorf, Switzerland
- Ilya Vikhrev, Federal Center for Integrated Arctic Research, Northern (Arctic) Federal University, Arkhangelsk, Russia
- Hanna Zhukava, Belarusian State University, Minsk, Belarus
- Alexandra Zieritz, University of Nottingham Malaysia Campus, Semenyih, Malaysia

Ronald Dermott and Lyuba Burlakova during his visit in September 2022.

II. Research Activities

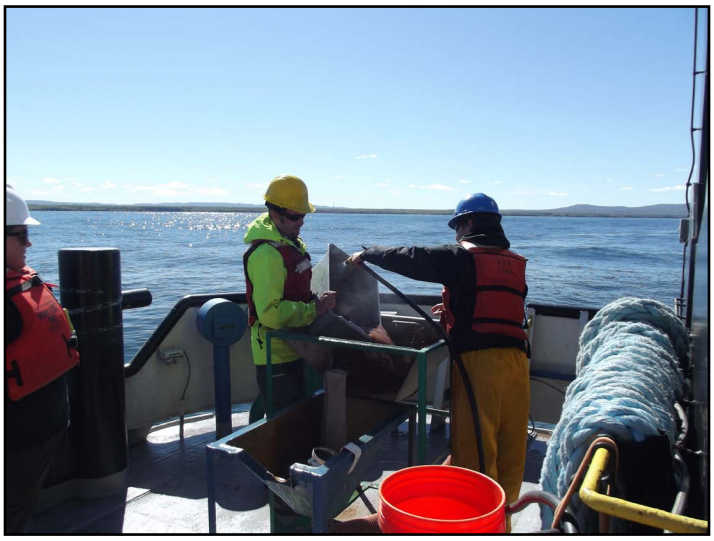
Current Projects

Monitoring of benthic invertebrates in Great Lakes

PIs Lyubov Burlakova and Alexander Karatayev. The GLC, in collaboration with Cornell University, was awarded U.S. EPA Great Lakes Long-term Biological Monitoring grants (LTM) for 2012–2017, 2017–2022, and for 2022–2028. The EPA Monitoring Program is designed to provide managers access to biological data on zooplankton and benthos to support decision-making. Within this project, we collect benthos (Buffalo State) and zooplankton data (Cornell University) across the five Great Lakes, analyze this data, and make it available to environmental and fisheries managers. Additional research projects include the impact of dreissenids on the lower food web, and development of remote sensing methods. We identified benthic samples collected onboard the EPA R/V *Lake Guardian* from all the Great Lakes in 2012–2022 and submitted the data to the Great Lakes National Program Office (GLNPO). These data are the basis for individual lake reports as well as reports for the State of the Great Lakes. Thus far, the results of the study have been published in 27 papers and presented at multiple talks at regional and international meetings. (LTM photo page.)

Cooperative Science and Monitoring Initiative

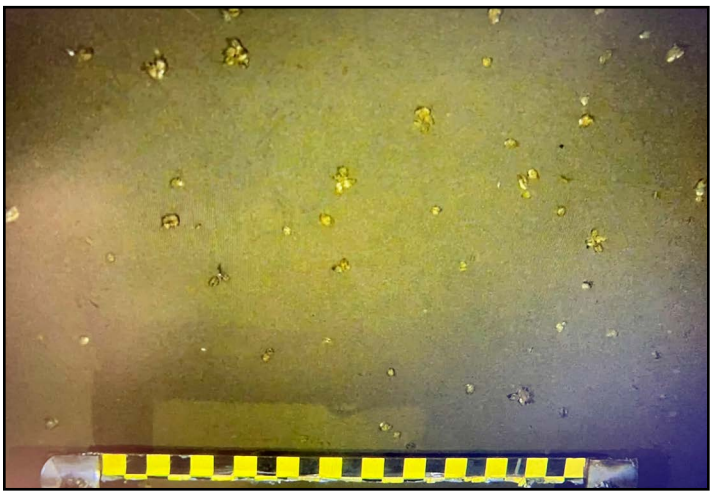
PIs Lyubov Burlakova and Alexander Karatayev. The Great Lakes Monitoring Program by the Great Lakes National Program Office includes both the collection of samples from 57 long-term stations sampled every year and a much more detailed survey conducted on each lake every 5 years within the Coordinated Science and Monitoring Initiative (CSMI). We participated in these surveys in 2014 (Lake Erie), 2015 (Lake Michigan), 2016 (Lake Superior), 2017 (Lake Huron), 2018 (Lake Ontario), 2019 (Lake Erie), 2021 (Lake Michigan), and 2022 (Lake Huron). (CSMI photo page.)



Erik Hartnett collecting benthos aboard the R/V *Lake Guardian* during CSMI Superior sampling in September 2022. Credit: Sebastian Paczuski

New method for rapid assessment of dreissenid mussels populations

PIs Alexander Karatayev and Lyubov Burlakova. The Great Lakes Center, in collaboration with the U.S. Environmental Protection Agency's Great Lakes Biology Monitoring Program and Office of Research and Development-Great Lakes Toxicology and Ecology Division, has developed a new method for rapid assessment of dreissenid mussel populations in lakes. The method uses a Benthic Imaging System (BIS) to estimate population size of these invaders in near-real time. The BIS consists of Go-Pro cameras and lights mounted to a steel frame that is lowered to the lakebed from a ship. The resulting bottom images are analyzed via imaging software to estimate mussel density and percent coverage. The new method substantially reduces the time required to map distributions of dreissenid mussels across large spatial scales compared to traditional sediment collection methods. This



An image from the BIS with sparse clusters of dreissenid mussels.

increase in spatial resolution and reporting times of monitoring is especially important considering that the quagga mussel is now the primary regulator of phosphorus cycling in the lower four Great Lakes and their tissues and shells now contain nearly as much phosphorus as the entire water columns of the impacted Great Lakes (Li et. al., 2021). The resulting research paper "Rapid assessment of *Dreissena* population in Lake Erie using underwater videography" is published online with @SpringerNature in *Hydrobiologia*. This method for *Dreissena* rapid assessment was applied in Lake Michigan in 2021, Lake Huron in 2022, and will be applied to other Great Lakes in the future as a valuable addition to conventional bottom grab monitoring. This method is now used for quagga mussel monitoring in deep Swiss lakes Constance and Biel (Haltiner et al., 2022).

Benthoscapes

PIs Lyubov Burlakova and Alexander Karatayev. Images from side-looking BIS cameras used for rapid assessment of dreissenid populations during CSMI surveys are also used to assess spatial distribution of benthos and *Mysis*. Communities of benthic macroinvertebrates are among the most useful indicators for biological assessment of environmental and anthropogenic stressors, but both sample processing and species identification are time-intensive, often requiring several years to identify all samples from a large-scale survey. Mapping benthic landscape or "benthoscape" structure and dynamics using underwater video can provide valuable and cost-effective assessment of bottom habitats on large spatial scales with minimal habitat disturbance. In 2019, during the CSMI benthic survey in Lake Erie, we used this approach to characterize benthic habitats, and then tested whether visual classification could serve as an indicator of hypoxia (Burlakova et al., 2023). We identified four habitat types that differed significantly in near-bottom dissolved oxygen concentration and confirmed that video analysis can provide a quick and reliable method to detect habitats affected by periodic hypoxia. Video identification of benthoscapes may be important for regional monitoring of over 20 hypoxic zones documented in the Great Lakes where the extent and magnitude of hypoxia currently represent a major knowledge gap. We used this method to detect hypoxic habitats in 2022 on Saginaw Bay of Lake Huron, and this year we are planning to apply it in Hamilton Bay of Lake Ontario.

Alexander Karatayev sampling Oneida Lake on a rainy day in August 2022.

Long-term changes in the mollusc community of Oneida Lake

PIs Alexander Karatayev and Lyubov Burlakova. Oneida Lake is the largest and best studied inland lake in New York State, with a strong regional, economic, and recreational importance. Frank Collins Baker, a prominent malacologist, conducted one of the world's first quantitative benthic studies in 1915–1917, finding that Oneida supported the most diverse molluscan communities in the state. Baker provided a very thorough description of his study in two books (Baker 1916, 1918) and several papers. Subsequent studies replicating Baker's sampling design were conducted in 1967 (Harman and Forney 1970) at the peak of eutrophication, and in 1992–95, shortly after the invasion of *Dreissena* in 1991 (Harman 2000). This produced a unique historical dataset enabling a rigorous assessment of changes in the structure and species richness of the molluscs. In 2012, we

Alexander Karatayev and Alexander Kovtun, a researcher from the Center for Computational and Integrative Biology, Massachusetts General Hospital, sorting benthic samples at Cornell Biological Field Station.

conducted a detailed historical analysis of the mollusc community of Oneida Lake based on our comprehensive lake-wide study that year and previous surveys dating back to 1915 (Karatayev et al., 2014). In the early 20th century, the lake had high water clarity, abundant macrophytes and benthic algae, supporting diverse molluscan community with 32 gastropod and 9 unionid species. By the 1960s, lake turbidity increased due to anthropogenic eutrophication, resulting in a 38% decline in species richness and a 95% reduction in abundance of native gastropods grazing on benthic algae. Following the invasion of *Dreissena* spp. in 1991 and subsequent increases in water clarity, gastropods in the lake dramatically increased, and by 2012, their species richness and abundance reached levels similar to reported in 1915–1917. In contrast, filter-feeding unionids were extirpated by dreissenids. In 2014, another exotic species was found in Oneida Lake. The round goby is a bottom-feeder fish from Eurasia known to feed on molluscs and may change their community composition, abundance, and distribution. To investigate their impacts on Oneida Lake molluscs, in August 2022 we conducted a detailed survey of molluscs at historic stations of the lower South Bay, the best studied part of Oneida Lake, and we collected and identified over a hundred samples. In July through August 2023, we are planning to expand our survey to the whole lake.

Benthos of Laurentian Great Lakes: Inventory of lake-wide surveys

PIs Alexander Karatayev and Lyubov Burlakova. Over 110 lake-wide benthic surveys were conducted on the Laurentian Great Lakes since 1929. However, these studies often are not readily available, and have never been combined in one dataset to preserve historic data. According to our estimations, primary data for at least 20% of all surveys are incomplete or have already been lost. For over three years, the Great Lakes Center has been conducting inventory of benthic surveys for all Great Lakes to create a database with all the available information on species composition, distribution, density, and biomass of benthic invertebrates. Considering the rarity of long-term benthic studies in lake ecosystems, these data set could be useful to explore effects of different environmental factors and exotic species on community organization, for monitoring of water quality, biodiversity, exotic species introduction, fish food base assessment, and other ecosystem services provided by benthic community. Our first complete dataset on the Lake Ontario benthic community includes taxonomic data to the species level for 11 of the surveys and data to the group level for another two surveys covering the last 54 years and was published as a data paper in *Ecology* (Burlakova et al., 2022). Our second paper summarizing 90 years of benthic research in Lake Erie has been recently published in the *Journal of Great Lakes Research*, and the database is in preparation for publication.

Interactions of benthic invertebrates with the Benthic Nepheloid Layer

PIs Lyubov Burlakova and Alexander Karatayev. Benthic nepheloid layers (BNLs) are areas of high turbidity and suspended solids that form near the benthos during summer stratification. BNLs can be several meters thick and are common in the Great Lakes. The suspended sediment and other material that build BNLs can come from a variety of sources, including sediment resuspension, entrainment of spring runoff in the hypolimnion, settling of particles from the epilimnion, and from density currents. Together with Richard Barbiero and James Watkins, we are analyzing GLNPO long-term data to examine relationships between BNL intensity/thickness and benthic invertebrate production, and to compare current BNL intensity and thickness to historical data from studies prior to *Dreissena* invasion.

Partnership for Regional Invasive Species Management (WNY PRISM)

PI Christopher Pennuto. The Western New York Partnership for Regional Invasive Species Management (WNY PRISM) works to address invasive species priorities using a coordinated partnership for which we provide leadership, technical assistance, and opportunities for collaboration. Our goal is to improve, restore, and protect local aquatic and terrestrial resources by improving the effectiveness of invasive species management. This partnership is supported by a NYS DEC Environmental Protection Award through December 2023. For more information on Western New York PRISM Activities, see section VI.

Invasive fish effects on stream drift and potential for aquatic terrestrial subsidy disruption

PI Christopher Pennuto. This project is investigating stream drift across an array of streams with or without round goby populations. Seasonal drift collections, benthic invertebrate abundances, and fish community structure are being investigated to assess drift response to goby presence. This project also will examine emergence patterns and riparian spider abundance. Emergence specialist spiders (Tetragnathidae) are known to adjust their feeding locations based, in part, on emergence density. We are exploring whether this behavior is evident in stream sections dominated by round gobies.

The response of red swamp crayfish to intensive trapping

PI Christopher Pennuto. Recently, a small pond in the region was invaded by red swamp crayfish (*Procambarus clarkii*). This invasive crayfish has had significant food web impacts in other locations it has invaded, leading to loss of littoral macrophyte beds and changes in fish communities. We are attempting an intensive trapping campaign to assess changes in population size structure and reproductive phenology.

Red swamp crayfish.

Bioaccumulation of flame retardants and emerging contaminants in wild birds and their eggs in the Niagara Region

PI Alicia Pérez-Fuentetaja. Halogenated compounds and pharmaceuticals in eggs from piscivorous birds nesting in the Niagara and St. Lawrence Rivers. We measured bioaccumulation and potential impacts to future avian predator populations nesting in the Lower Great Lakes region. We have collected eggs of eight species of nesting piscivorous birds and we are analyzing them to map the prevalence of halogenated contaminants and food web biomagnification in the region.

Biological and metabolic responses of aquatic organisms to mixtures of municipal treated effluent

PI Alicia Pérez-Fuentetaja. Egg development, hatching success, behavioral responses, and metabolomics of fathead minnows (*Pimephales promelas*) exposed to ambient Niagara River water and urban effluent purified by advanced oxidation products (H_2O_2, peracetic acid, UV light). Fish at various developmental stages are affected by contaminants not removed by wastewater treatment plants from the effluent and also by the cleansing and purification methods proposed to further increase effluent quality before it enters the Niagara River.

Implementation of the Great Lakes Observing System

PI Mark Clapsadl. We received another year of funding to operate the eastern Lake Erie Buffalo State/Great Lakes Observing System (GLOS) buoy, including $5100 for salary recovery and associated fringe costs. This funding comes despite decreased funding opportunities on the heels of a successful 2022 season. Continued success in funding is a result of the fact that we have reliably operated buoys for the GLOS network since 2012. Our contribution to the GLOS has been made by operating an observation buoy five miles offshore of Dunkirk, New York. This buoy records and transmits real time measurements of water temperature, wind speed, wave height, dissolved oxygen, and several other parameters. It is the only GLOS buoy operating in eastern Lake Erie, making it an important source of information for a variety of stakeholders. The GLOS buoy is gaining in popularity and, once again, we expect over 20,000 visits to the GLOS website by users looking to see lake conditions and our buoy data are regularly included on Channel 4 Television News weather reports.

Grants and Funding

Ongoing grants, including one newly received in 2022–2023 (total $17,021,894, including $9,672,516 for Buffalo State)

1. Clapsadl, M., and B. Haas. Buffalo State University Eastern Lake Erie Buoy. National Atmospheric and Oceanographic Administration. **$8,636**. 2023.
2. Burlakova, L. E., and A. Y. Karatayev. EPA-R5-GL2017-ZBC Great Lakes Long-Term Biology Monitoring Program: Zooplankton, Benthos, *Mysis*, and Chlorophyll-a Components. Additional 2022–2023 funding. **$287,676**.
3. Drake, R., and A. Locke. Invasive Species Management to Protect Rare Habitats at Alexander and Houghton Preserve, Nature Sanctuary Society of Western New York, Inc., U.S. Forest Service Great Lakes Restoration Initiative Cooperative Weed Management Areas. **$31,320.00 ($12,118 for Buffalo State)**. 2021–2023.
4. Goodrich, Z. Mosquito Junction Swamp Restoration at Tifft Nature Preserve, Buffalo Museum of Science. Niagara River Greenway Commission Greenway Ecological Standing Committee. **$344,754 ($25,700 for Buffalo State)**. 2019–2022.
5. Locke, A., and B. Hernon. Western New York Japanese Stiltgrass (*Microstegium vimineum*) Early Detection and Rapid Response Project, The Research Foundation for Buffalo State University, WNY PRISM. U.S. Forest Service Great Lakes Restoration Initiative Cooperative Weed Management Areas. **$35,193**. 2021–2024.
6. Molloy, D., and L. Burlakova. The Natural Enemies of Dreissenid mussels: An update of the seminal monograph published in 1997. Hudson River Foundation. **$65,200**. 2017–2023.
7. Pennuto, C. Administration of the Western NY PRISM: Partnership for Regional Invasive Species Management. NY DEC. **$3,499,212**. 2019–2023.
8. Rudstam, L., L. E. Burlakova, A. Y. Karatayev, and J. Watkins. Great Lakes Long-term Biological Monitoring Program. GLRI, U.S. EPA. **$5,999,903 ($2,700,000 for Buffalo State)**. 2017–2023.
9. Watkins J., L. Rudstam, L. E. Burlakova, A. Y. Karatayev, and A. Hrycik. Great Lakes Biology Monitoring Program: Zooplankton, Mysis, and Benthic Components. GLRI, U.S. EPA. **$6,750,000 ($3,038,781 for Buffalo State)**. 2022–2028.

Submitted Grant proposals

1. Clapsadl, M., and B. Haas. Buffalo State University Eastern Lake Erie Buoy. National Atmospheric and Oceanographic Administration. **$8,636**. 2023.
2. Ercoli, F., L. Burlakova, M. Lopes-Lima, M. Zagars, A. Karatayev, S. Capinha, and F. Collas. Development of Pan European management strategies for the conservation and restoration of ecosystems invaded by dreissenid mussels. Pre-proposal submitted to European Commission, BiodivERsA+ 2022 Call for Proposals "Improved transitional monitoring of biodiversity and ecosystem change for science and society (BiodivMon) on "Conservation and restoration of degraded ecosystems and their biodiversity, including a focus on aquatic systems". **€645,687** (not funded).
3. Pennuto, C. M. Efficacy of predatory fish introductions for control of invasive crayfish. U.S. Fish and Wildlife Service, Lower Great Lakes Fisheries Office. **$75,000**. 2023–2025.
4. Spaak, P., H. Hetzenauer, A. Brinker, D. Straile, M. Möst, U. Lang, K. Schmieder, H. Stibor, M. Speckle, R. Ebersbach, R. Schick, O. Köster, and A. Karatayev. BODENSEE in STRESS - Modelling the consequences of climate change and invasive species for the Lake Constance ecosystem as a basis for integral management: BOiSMo. Submitted to Interreg VI (Switzerland). **€4,910,438** (pending).

Publications and Presentations

Last year the researchers of the GLC were very active in publishing papers and presenting their results at international and national meetings and conferences. Eleven manuscripts were published, another 6 were submitted to peer-reviewed journals. A total of 20 presentations were made by the GLC researchers, including: 14 presentations at national, international, and regional conferences; and 6 invited talks.

Refereed Journal Publications (published/accepted)

1. Boltovskoy, D., R. C. Guiaş, L. Burlakova, A. Karatayev, M. A. Schlaepfer, and N. Correa. 2022. Aquatic invasive species: the economic cost-benefit balance of human-made infrastructure. *Anales de la Academia Nacional de Ciencias Exactas, Físicas y Naturales Argentina* 73: 122-132.
2. Brunelle, L. D., B. Szczygiel, L. S. Running, L. Su, K. M. Naas, N. Dai, A. Pérez-Fuentetaja, and D. S. Aga. 2023. Effects of advanced oxidation on wastewater effluent ecotoxicity: A novel assessment through the life history and lipidomics analysis of *Daphnia magna*. *ACS ES&T Water* 3(2), 438-447.
3. Burlakova, L. E., A. Y. Karatayev, D. Boltovskoy, and N. M. Correa. 2023. Ecosystem services provided by the exotic bivalves *Dreissena polymorpha*, *D. rostriformis bugensis*, and *Limnoperna fortunei*. *Hydrobiologia* 850:2811-2854.
4. Burlakova, L., A. Karatayev, L. Rudstam, V. Karatayev, B. Adamovich, H. Zhukava, K. Holeck, A. Hetherington, L. Jackson, C. Balogh, Z. Serfőző, T. Zhukova, T. Mikheyeva, R. Kovalevskaya, O. Makarevich, and D. Kruk. 2022. Time scales of ecosystem impacts and recovery under individual and serial invasions. *Dryad, Dataset*.
5. Eifert, R. A., L. E. Burlakova, A. Y. Karatayev, S. E. Daniel, A. E. Scofield, E. K. Hinchey. 2023. Could quagga mussels impact offshore benthic community and surface sediment-bound nutrients in the Laurentian Great Lakes? *Hydrobiologia*.
6. Haines, A. D., and C. M. Pennuto. Seasonal diet and body condition changes in the Common Mudpuppy (*Necturus maculosus* Rafinesque, 1818) in Western New York. *Journal of Herpetology* 56: 324-335.
7. Haltiner, L., J. Alexander, L. Baehn, L. E. Burlakova, S. Dennis, P. Feulner, S. Flämig, A. Karatayev, V. Karatayev, B. Kraemer, S. Rossbacher, R. Stöckli, and P. Spaak. 2023. Quagga mussels threaten pre-alpine lakes. *Aqua & Gas* 6: 61-65. (Published in German: Quaggamuscheln bedrohen voralpine seen. *Aqua & Gas* 6: 61-65).
8. Karatayev, A. Y., L. E. Burlakova, A. R. Hrycik, S. E. Daniel, K. Mehler, E. K. Hinchey, R. Dermott, G. W. Kennedy, and R. Griffiths. 2022. Long-term dynamics of Lake Erie benthos: One lake, three distinct communities. *Journal of Great Lakes Research* 48(6): 1599-1617.
9. Karatayev, A. Y., and L. E. Burlakova. 2022. *Dreissena* in the Great Lakes: What have we learned in 30 years of invasion. *Hydrobiologia*.
10. Karatayev, A. Y., and L. E. Burlakova. 2022. What we know and don't know about the invasive zebra (*Dreissena polymorpha*) and quagga (*Dreissena rostriformis bugensis*) mussels. *Hydrobiologia*.
11. Karatayev, V. A., L. G. Rudstam, A. Y. Karatayev, L. E. Burlakova, B. V. Adamovich, H. A. Zhukava, K. T. Holeck, A. L. Hetherington, J. R. Jackson, C. Balogh, Z. Serfőző, C. W. Hotaling, T. V. Zhukova, T. M. Mikheyeva, R. Z. Kovalevskaya, O. A. Makarevich, and D. V. Kruk. 2023. Time scales of ecosystem impacts and recovery under individual and serial invasions. *Ecosystems*.

Refereed Journal Publications Submitted (in review)

1. Adamovich, B. V., O. A. Makarevich, A. Y. Karatayev, L. G. Rudstam, R. Z. Kavalevskaya, M. A. Baturina, and T. V. Zhukova. Temporal and spatial distribution of macrozoobenthos in three polymictic lakes of different trophic state: a case study of the Narochianskie Lakes (Belarus). *Hydrobiologia*.
2. Glenn, K., and C. M. Pennuto. Stream energy dynamics are disrupted by a non-native fish: effects on drift and emergence subsidies to riparian spiders. *Freshwater Biology*.
3. Glenn, K., and C. M. Pennuto. Winter residency and foraging of non-native round goby populations in

Great Lakes tributary streams. *Journal of Fish Biology*.

4. Karatayev, A. Y., D. P. Molloy, and L. E. Burlakova. Natural enemies of *Dreissena*: predators, parasites, and ecological competitors – an update. *Fisheries Science and Aquaculture*.
5. Kraemer, B. M., S. Boudet, L. E. Burlakova, L. Haltiner, B. W. Ibelings, A. Y. Karatayev, V. Karatayev, S. Rossbacher, R. Stöckli, D. Straile, and P. Spaak. An abundant future for quagga mussels in deep European lakes. *Environmental Research Letters*.
6. Qiao, J., S. J. Bennett, J. F. Atkinson, P. A. Cocca, S. K. Delavan, A. R. Hannes, B. A. Hinterberger, T. W. Noon, T. J. Pede, and A. Pérez-Fuentetaja. Unconfined Fishway Design, Implementation, and Assessment for the Emerald Shiner (Notropis atherinoides) in the Upper Niagara River, New York. *Ecological Engineering*.

Published Reports

1. Burlakova, L. E., and A. Y. Karatayev. 2023. Lake Michigan Benthos Survey Cooperative Science and Monitoring Initiative 2021. Technical Report. USEPA-GLRI GL00E02254. Great Lakes Center, SUNY Buffalo State University, Buffalo, NY.

International/National/Regional Conference Presentations

1. Burlakova, L. E., A. Y. Karatayev, D. Boltovskoy, and N. M. Correa. Ecosystem services provided by the exotic bivalves *Dreissena polymorpha*, *D. rostriformis bugensis*, and *Limnoperna fortunei*. 13th Biennial Freshwater Mollusk Conservation Society Symposium. Portland, Oregon. April 10–14, 2023.
2. Burlakova, L., and A. Y. Karatayev. Rapid assessment of *Dreissena* populations in Great Lakes. 66th Annual Conference on Great Lakes Research, Toronto, Canada. May 8–12, 2023.
3. Burlakova, L. E. and Karatayev A. Y. Plenary lecture. Natural enemies of *Dreissena* and ecosystem services provided by dreissenids. SeeWandel Scientific Symposium. Constance, Germany. June 13, 2023.
4. Burlakova, L. E. and Karatayev A. Y. Natural enemies of *Dreissena* and ecosystem services provided by dreissenids. SeeWandel Exchange with practice representatives. Constance, Germany. June 14, 2023.
5. Daniel, S. E., and L. E. Denecke. Status of the New Zealand Mud Snail (*Potamopyrgus antipodarum*) in the Laurentian Great Lakes. 66th Annual Conference on Great Lakes Research, Toronto, Canada. May 8–12, 2023.
6. Feagley, R., B. Roth, T. Berenson, C. Pennuto, P. Siwula, L. Tanner, R. Stroess, C. Blanke, C. Dindorf, and W. Budnick. 2023. Evaluating the prevalence of crayfish species and owner knowledge in the pet retail trade throughout the Great Lake Basin. Ecological Society of America (ESA). 2023.

Alexander Karatayev at the 13th Biennial Freshwater Mollusk Conservation Society Symposim in Portland, Oregon on April 10-14, 2023.

Lyubov Burlakova presenting at SeeWandel Scientific Symposium in Constance, Germany on June 13, 2023.

7. Feagley, R., B. Roth, W. Budnick, T. Berenson, C. M. Pennuto, T. Fitzgerald, and P. Siwula. Buying your new (potentially invasive) best friend: evaluating the prevalence of crayfish species available for purchase in the pet retail trade throughout the Great Lake States. Midwest Fish & Wildlife Conference. 2023.
8. Gernold, Z. A., J. S. Wallace, A. Pérez-Fuentetaja, and D. Aga. Improving confidence: Suspect-screening identification of per- and polyfluoroalkyl substances (PFAS) in abandoned eggs using ion mobility and time-of-flight mass spectrometry. Poster presentation. ASMS. Huston, TX. 2023.
9. Herne, T. N., S. D. Lawhun, L. E. Burlakova, A. Y. Karatayev, P. V. Boynton, J. M. Watkins, and L. G. Rudstam. Shrimp on film - utilization of benthic habitat by *Mysis diluviana* in Lake Michigan. 66th Annual Conference on Great Lakes Research, Toronto, Canada. May 8–12, 2023 (poster).
10. Karatayev, A. Y., and L. E. Burlakova. *Dreissena* in the Great Lakes: What have we learned in 35 years of invasion. 13th Biennial Freshwater Mollusk Conservation Society Symposium. Portland, Oregon. April 10–14th, 2023.
11. Karatayev, A. Y., and L. E. Burlakova. *Dreissena* in the Great Lakes: What have we learned in 35 years of invasion. 66th Annual Conference on Great Lakes Research. Toronto, Canada. May 8–12, 2023.
12. Karatayev, A. Y., and L. E. Burlakova. Plenary lecture. Quagga mussels in the Great Lakes: What have we learned in 35 years of invasion. SeeWandel Scientific Symposium. Constance, Germany. June 13, 2023.
13. Karatayev, A. Y., and L. E. Burlakova. Quagga mussels in the Great Lakes: What have we learned in 35 years of invasion. SeeWandel Exchange with practice representatives. Constance, Germany. June 14, 2023.
14. Kraemer, B. M., S. Boudet, L. E. Burlakova, L. Haltiner, B. W. Ibelings, A. Y. Karatayev, V. Karatayev, S. Rossbacher, R. Stöckli, D. Straile, and P. Spaak. An abundant future for quagga mussels in deep European lakes: SeeWandel synthesis. SeeWandel Exchange with practice representatives. Constance, Germany. June 14, 2023.

Invited Talks

1. Burlakova, L. E. and A. Y. Karatayev. Natural enemies of *Dreissena* and ecosystem services provided by dreissenids. Invited talk presented at EAWAG Aquatic Ecology Seminar. Zurich, Switzerland. June 12, 2023.
2. Karatayev, A. *Dreissena* in Lake Ontario 30 years after the invasion. State of Lake Ontario Conference. Invited talk presented at Interagency Ecological Restoration Quality Committee. Virtual. October 27, 2022.
3. Karatayev, A. *Dreissena* population assessment in lakes Michigan & Huron. Invited talk presented at EPA Great Lakes National Program Office, Chicago. October 17, 2022.
4. Karatayev, A. Y., and L. E. Burlakova. Video *Dreissena* assessment. Invited talk presented at Cooperative Science and Monitoring Initiative Lake Michigan Sampling Prospectus. Virtual. February 22, 2023.
5. Karatayev, A. Y., and L. E. Burlakova. *Dreissena* in the Great Lakes: What have we learned in 35 years of invasion. Invited talk presented at Invasive Mussel Collaborative Webinar. May 30, 2023.
6. Karatayev, A. Y. and L. E. Burlakova. Quagga mussels in the Great Lakes: what have we learned in 35 years of invasion. Invited talk presented at EAWAG Aquatic Ecology Seminar. Zurich, Switzerland. June 12, 2023.

III. Education

The GLC fulfills its educational mission directly through the classes its researchers teach, through its Master of Arts and Master of Science graduate programs in Great Lakes Environmental Science, through the support we offer to faculty teaching classes pertaining to environmental sciences, through the seminar speakers we sponsor, and through our educational activities in the community.

Great Lakes Center M.S. and M.A. Graduate Programs

The GLC administers two interdisciplinary applied environmental science programs in Great Lakes Environmental Science (GLES). The GLES programs provide an opportunity for students to pursue graduate studies through a thesis-based Master of Arts (M.A.) and an internship-based Master of Science (M.S.). Both programs provide students with the opportunity to attain a broad understanding of the physical, chemical, biological, and social factors that comprise the Great Lakes ecosystems. GLES graduates are prepared to provide a leadership role as they address a broad range of problems and issues related to the management of resources within the Great Lakes and surrounding watersheds.

Students enrolled in GLES Administered by the GLC in 2022–2023

Master of Art:
Matthew Basista (graduated in 2023)
Lara Hargrave (graduated in 2023)
Amanda Jacobs
Alexander Krest (graduated in 2022)

Master of Science:
Theo Berenson (graduated in 2022)
Margaret Bilquin
Zachary Colling
Jade LaRock (graduated in 2023)
Michael Kalinka
Jason Kappan
Skyler Paternostro
Lindsay Piotrowski
Lisa Yaeger

Advising Undergraduate and Graduate Students

- Lyubov Burlakova was the thesis co-advisor for one GLES M.A. student.
- Allison Hrycik was the thesis co-advisor for one GLES M.A. student.
- Chris Pennuto was the advisor of 5 graduate students, a committee member for four graduate students, the advisor for 8 GLES non-thesis PSM students, and Internship Coordinator for 2 GLES graduate students.
- Alicia Pérez-Fuentetaja was an M.S. committee member for one student at Buffalo State University and served as a PhD committee member for one student in the Chemistry Department at the University at Buffalo.

IV. Outreach, Service, and Professional Development

All members of the GLC have been actively involved in outreach and service to the profession, to the University, and to the community.

Lyubov Burlakova:

- Faculty Mentor/Advisor (together with Allison Hrycik), Lara Hargrave, M.A. student, Great Lakes Environmental Science (2020–2023).
- Completed course "Culture of Civility: Creating Harassment-Free Workspace (New York)." November 9, 2022.
- Initiated preparation of educational course in Great Lakes Invertebrate Monitoring for our student technicians.
- Member of Ruth Huppuch Research and Education Award Fund Committee.
- Helped to organize 2022 GLC Open House.
- Participated in preparation of the Great Lakes Center 2021–2022 Annual Report.
- Committee member for Great Lakes Center Goals 2030.
- Participated in establishment of two Graduate Scholarships per year funded by the Ruth Huppuch Foundation.
- Wrote articles for GLC Newsletter series.
- Associate Editor of the *Journal of Great Lakes Research* and *Hydrobiological Journal*.
- Guest Editor, Special Issue "Biology and impacts of invasive freshwater molluscs" in *Hydrobiologia*.
- Participated in multiple Lake Huron CSMI 2022 survey planning workshops.
- Participated in collaboration between Great Lakes Center and the Swiss Federal Institute of Aquatic Science and Technology (Dr. Piet Spaak).
- Participating in Lake Michigan Data Meeting, every month since October 2021.
- Member of Aquatic Life Use Metrics - Benthic Invertebrate subgroup led by Ohio Sea Grant and Ohio EPA to develop aquatic indicators for Lake Erie.
- Participated in preparation of the State of the Great Lakes Report.
- Participated in multiple phone conferences with EPA, NOAA, USGS, etc. about current research and potential future projects.
- Participated in meetings with our partners from Cornell University on the Great Lakes Long-term Biological Monitoring Program.
- Member of the International Planning Committee for the Joint meeting of European Large Lakes Society and International Association for Great Lakes Research in Petrozavodsk in 2022.
- Member of the Freshwater Molluscs Conservation Society *ad hoc* International Committee.
- Member of the Association for the Sciences of Limnology and Oceanography.
- Member of the International Association for Great Lakes Research.
- Member of the Ecological Society of America.
- Member of Buffalo State's "The Friends of the Maud Gordon Holmes Arboretum."
- Reviewed a draft of the National Strategy for USGS Native Freshwater Mollusk Research.

- Reviewed manuscripts for *Diversity*, *Hydrobiologia*, *Freshwater Science*, and *Limnologica*.

Mark Clapsadl:

- Oversaw Field Station operations and provided assistance with multiple research projects (both funded and unfunded) and provided for field trip experiences for Buffalo State University classes.
- Installed and operated a weather buoy in eastern Lake Erie that provides a direct service to boaters in the lake by providing information on conditions on the lake (waves, wind etc.) that are not available from any other source and that can be used for making safe boating decisions. Once again, we have had over 20,000 views of the web site that provides this information. In addition, these data are being used by climate modelling researchers and fishery management professionals.
- With the recent modifications of our most important research vessel, the *John J. Freidhoff*, it became apparent the original boat trailer was no longer appropriate for the vessel. A new trailer was identified and fitted to the *John J.* and now we can once again resume safe trailering.
- Initiated a project to extend the boat ramp, therefore reducing the damage and debris build-up from severe fall and winter seiche events.

Amanda Cooper:

- Participated in a NYS Department of Environmental Conservation Press Event at the Gratwick Riverside Park Boat Launch kicking off the State's many Watercraft Inspection Steward Programs. May 2023.
- Facilitated WNY PRISM's Southern Tier Water Chestnut Working Group.
- Attended the Rural Landowners Workshop, CCE Allegany County, Yorkshire, New York. March 2023.
- Participated as member of the New York State *Hydrilla* Task Force.

Susan Daniel:

- Completed course "Culture of Civility: Creating Harassment-Free Workspace (New York)." October 23, 2022.
- Wrote articles for GLC Newsletter series.
- Chemical and Biological Safety officer for the Great Lakes Center (2014–present).
- Member of Aquatic Life Use Metrics - Benthic Invertebrate subgroup led by Ohio Sea Grant and Ohio EPA to develop aquatic indicators for Lake Erie.
- Participated in multiple phone conferences with EPA about current research and potential future projects.
- Participated in meetings with our partners from Cornell University on the Great Lakes Long-term Biological Monitoring Program.
- Member and Regular U.S. Board Member of the International Association for Great Lakes Research.
- Chair of the Membership Committee for the International Association for Great Lakes Research.
- Member of the Justice, Equality, Diversity, and Inclusion Committee for the International Association for Great Lakes Research.
- Member of the Awards Committee for the International Association for Great Lakes Research.
- Member of Buffalo State's "The Friends of the Maud Gordon Holmes Arboretum."
- Mentor as part of the NY Chapter Aquatic Fisheries Society Women in Fisheries Mentoring program.

Susan Dickinson:

- Execute daily operations of the GLC including purchases of supplies and equipment, travel paperwork, and maintaining multiple budgets (all with State, Research Foundation and College Foundation monies); update departmental bulletin boards and website.
- Proof-read multiple research papers, reports, and flyers/brochures for GLC and WNY PRISM.

- Scheduled and organized annual Open House, staff retreat, and staff meetings.
- Maintained or disposed of departmental files in accordance with NYS and SUNY schedules for records management.
- Assist with GLES program functions: scheduling of thesis proposal/defense meetings, Banner course input, distribution and collection of annual Performance and Evaluation forms.
- CSEA Local 640 Treasurer beginning July 2021 (4-year term).
- Member of Local 640's Veterans Committee, and chair of Budget and Audit Committees.
- Professional development: Sexual Harassment Prevention Training (10/11/22); Microsoft Teams training (webinar, 11/4/22); Microsoft Accessibility training (webinar, 12/22/22); Microsoft Forms training (webinar, 1/17/23); AHA Basic Life Support (CPR and AED) Program (1/24/23); Microsoft OneNote training (webinar, 1/25/23).
- Attended President Search Open Forum session. April 28, 2023.

Brian Haas:

- Aided in the setup, launching, and retrieval of the GLOS buoy in Lake Erie.
- Provided vessel field trips and lectures for numerous classes and school groups.
- Helped graduate and undergraduate students from Buffalo State University with research projects that were conducted in the field station labs.
- Provided general assistance to WNY PRISM at the field station.
- Installed additional plantings in the field station's migratory bird garden.
- Supported local agencies, including the NYS DEC and US FWS, through general assistance and the use of the field station grounds and boat launch.
- Made strategic purchases and installations that enhanced the field station's operational and research capacity.
- Worked with Buffalo State Property Control and the SUNY Research Foundation to manage both state-owned and grant-awarded assets.
- Ensured boats, vehicles, and equipment were properly stored and cared for.
- Helped various departments on campus when our resources were requested.
- Worked with field station neighbors, including the West Side Rowing Club and the Navy Operational Support Center, and provided assistance when possible.

Kit Hastings:

- Played a key role in producing two issues of GLC Newsletter (editor).
- Wrote an article on accessibility for the GLC Newsletter series.
- Prepared the GLC Annual Report for publication.
- Managed the GLC website.
- Set up a Digital Commons repository for GLC staff to self-archive their papers.
- Resolved accessibility audit issues for the Emerald Shiner Project website.
- Improved the accessibility of the GLC website, Annual Report, and Newsletters, in compliance with Buffalo State Guidelines for Accessibility.
- Assisted with the Great Lakes Long-term Biological Monitoring Program's Summer 2021 and Summer 2022 projects, and Lakes Michigan, Superior, and Huron CSMI projects (oligochaete taxonomy).
- Proofread and made accessibility edits to the Lake Michigan Benthos Survey CSMI 2021 Final Report before posting it on the GLC website.

- Compiled a species addition proposal for *Pristina jenkinae* to the GLNPO database.
- Continued to work on the Great Lakes Benthic Oligochaete Guide.
- Made a slideshow of GLC activities for the 2022 GLC Open House.
- Participated in webinars that pertain to my field of study, including Great Lakes research and website and document accessibility.
- Attended axe-con 2023, a virtual accessibility conference.
- Attended 14th Annual CUNY Accessibility Conference.
- Volunteered with Civic and Community Engagement at Winterim 2023: Craft an Encouragement Card and Touch a Heart, and No-Sew Blankets Service for Compass House.
- Member of the Buffalo State Institutional Animal Care and Use Committee.
- Member of WNY GIS User Group and NYS GIS Association.
- Member of oSTEM.
- Member of Buffalo State Bengal Allies and LGBTQ+ Resource Center.

Brittany Hernon:

- Hosted 8 invasive species volunteer removal workdays to help community members to learn about and participate in invasive species management.
- Participated in WNY Forest Pest Taskforce Meetings.
- Coordinated with Erie County and the Hemlock Initiative to analyze samples and collect data to drive the release of hemlock woolly adelgid biocontrol agents.
- Coordinated WNY PRISM's early detection, survey, and forest pest management efforts.
- Attended the NYS Invasive Species In-Service at Cornell University, Ithaca, New York. November 2022.
- Completed CPR/AED Training and Certification at Buffalo State, Buffalo, New York. January 2023.

Alexander Karatayev:

- 2023 recipient of the President's Award for Excellence in Research and Creativity.
- Organized the Great Lakes Center Open House on September 16, 2022.
- Published Great Lakes Center 2021–2022 Annual Report.
- Completed GLC part for 2023/24 Buffalo State University Strategic Recourse Planning Three Year Plan Workbook.
- Initiated creation of two Graduate Scholarships per year funded by the Ruth Huppuch Foundation.
- Wrote articles for GLC Newsletter series.
- Completed SUNY Sexual Harassment Prevention Training. October 2022.
- Campus Representative for the Great Lakes Research Consortium.
- Member of three Search Committees for technicians and a research scientist. August 2022 – February 2023.
- Associate Editor of *Hydrobiological Journal* (Ukraine).
- Participated in multiple Lake Ontario CSMI 2023 survey planning workshops.
- Prepared reports for International Union for Conservation of Nature's Red List of Threatened Species (IUCN) for zebra and quagga mussels.
- Invited by Dr. Piet Spaak to present our research and take part in workshop in Switzerland, and to discuss collaboration between the Great Lakes Center and the Swiss Federal Institute of Aquatic Science and Technology, including writing publications and grant proposals. June 2023.

- Participated in multiple phone conferences with EPA, NOAA, USGS, Sea Grant, etc. about current research and potential future projects.
- Participated in meetings with our partners from Cornell University on the Great Lakes Long-term Biological Monitoring Program.
- Member of the Dissertation Council established for the defense of the doctoral dissertation Igor Y. Popov "Rediscovery of the southern populations of *Margaritifera margaritifera* (L.) in Russia as a model of research of distribution and abundance of threatened animals."
- Reviewed Doctoral Dissertation of E. Anufriieva, A.O. Kovalevsky Institute of Biology of the Southern Seas of RAS of hypersaline ecosystems.
- Reviewed Doctoral Dissertation of Nikolai V. Barulin "The fish biology substantiation of application of laser radiation in technology of sturgeon aquaculture (*Acipenser*)," Scientific and Applied Center NAN Belarus for Animal Husbandry.
- Member of Aquatic Life Use Metrics - Benthic Invertebrate subgroup led by Ohio Sea Grant and Ohio EPA to develop aquatic indicators for Lake Erie.
- Member of Freshwater Mollusk Conservation Society.
- Member of the Association for the Sciences of Limnology and Oceanography.
- Member of the International Association for Great Lakes Research.
- Reviewed manuscripts for the *Journal of Great Lakes Research*.

Douglas Knoph:

- Participated in the Orleans County Fair, Genesee County Farmers Market, and PlantWNY Certified Nursery and Landscape Professionals Day Trade Show to provide education and outreach materials.
- Coordinated Crew Assistance Program, working with partners across the region to assist with invasive species removal and survey projects.
- Attended the NYS Invasive Species In-Service at Cornell University, Ithaca, New York. November 2022.
- Completed the Compeer Mental Health First Aid Certification training, Buffalo State University, Buffalo, New York. October 2022.

Andrea Locke:

- Participated in Tonawanda Creek/Erie Canal *Hydrilla* Demonstration Project Collaborative as part of Advisory Committee and as part of the New York State *Hydrilla* Task Force.
- Presented at Watercraft Inspection Stewardship Program/*Hydrilla* Kick-Off Press Conference in partnership with DEC.
- Coordinated with the Department of Agriculture and Markets to direct WNY response to spotted lanternfly.
- Coordinated with Cornell Cooperative Extension and NY Invasive Species Research Institute to release of swallow-wort biocontrol agent at multiple sites.
- Participated in Great Lakes Action Agenda Working Group Meetings and sub-committee on Cattaraugus Creek.
- Held position on Great Lakes Phragmites Collaborative Advisory Committee and Funding Sub-Committee.
- Participated in National Early Detection Rapid Response Information System Network Meeting and Working Group Meetings.
- Member of the GLES PSM Advisory Board.
- Held multiple, open WNY PRISM Partnership and Working Group Meetings to allow for public involvement in regional invasive species issues.

- Reviewed and updated priority species lists for Western New York: Approaching Region Species, Early Detection Species, Data Gap Species.
- Attended the NYS Invasive Species In-Service, Cornell, NY. November 2022.
- Attended CPR/AED Training, Buffalo, NY. January 2023.
- Attended Incident Command System Training, Albany, NY. January/ February 2023.
- Attended 2023 Invasive Species Forum, Virtual. February 2023.
- Attended RISCC Management Symposium, Virtual. February 2023.

Christopher Pennuto (center) receiving award from President Katherine Conway-Turner and Dean Brian Cronk at the Faculty and Staff Recognition Ceremony on October 13, 2022.

Christopher Pennuto:

- Coordinator, GLES masters programs.
- Chair, Biology Department.
- Co-chair, Task Force on Teaching Load Equity in SAS.
- 2022 recipient of the President's Award for Excellence in Research, Scholarship, and Creativity.
- Member, BSU Sustainability Committee.
- Reviewed manuscripts for *Journal of Great Lakes Research*, *Biological Invasions*, *Aquatic Ecology*, and *Ecology of Freshwater Fish*.

Alicia Pérez-Fuentetaja:

- My research has resulted in a local wildlife habitat improvement as the "Emerald Shiner Demonstration Project" at Broderick Park, which includes a noble design for fish passage from the Niagara River into Lake Erie. This project involves repair to a portion of the existing seawall and installation of baffles for fish passage.
- Member International Association of Great Lakes Research.
- Member Association for the Sciences of Limnology and Oceanography.

Rachel Taylor:

- Served as regional representative for DEC led Invasive Species Education and Outreach Committee and Metrics Sub-Committee.
- Coordinated Boot Brush Station Program to support partners in invasive species spread prevention efforts.
- Participated in Hemlock Woolly Adelgid Survey Volunteer Training for community scientists so they could survey and report the species. February 2023.
- Coordinated with community scientists for Hemlock Woolly Adelgid Surveys, including survey locations and data collection.
- Participated in Buffalo State University Earth Day and Arbor Day Environmental Fair, Buffalo, New York. April 2023.
- Coordinated with Department of Agriculture and Markets, partners, and community scientists to facilitate and implement spotted lanternfly survey and trapping efforts.
- Attended the NYS Invasive Species In-Service, Ithaca, New York. November 2022.
- Completed CPR/AED Training, Buffalo, New York. January 2023.
- Attended NYS Department of Environmental Conservation (DEC) Incident Command System Mock Scenario for Early Detection Rapid Response Invasive Species Management, Albany, New York. January 2023.

Brianne Tulumello:

- Was actively involved in several research projects: monitoring of benthic invertebrates in Great Lakes; photographed many Chironomidae genera and other taxa for online benthic taxa list; archival, salvage and documentation of historic samples.
- Completed RF learning and development online training, Culture of Civility: Sexual Harassment (NY) (RF) FY2023. October 6, 2022.

V. Field Station Activities

Educational Support

With the lifting of COVID-19 related restrictions, we have once again been able to offer field trips, getting students back out on the water for multiple trips including trips for Fisheries and Photography classes. We have also again been able to provide experiences for high school students from Riverside High School. In addition, videos produced during the pandemic years introducing students to fish sampling techniques that are commonly used in fisheries management, demonstrated by Field Station staff in our local waterways, have been used in Buffalo State University classes.

Dr. Anselmi's ANT 389 Bioarchaeology Methods class utilized the Field Station grounds to excavate teaching casts of human remains in a staged scenario.

The Fisheries class learned how to use trap nets and electrofishing, and this year they caught a sea lamprey (*Petromyzon marinus)*, which is an invasive species that parasitizes other fish species.

Shoreline and boat ramp stabilization

As our climate warms and changes, the severity of fall and winter storms is increasing as well. When high winds persist across Lake Erie from the west or southwest, we can see incredible rises in water levels. The recent Christmas storm of 2022 resulted in the highest levels of water rise we have yet seen here at the GLC Field Station; the storm drove large amounts of floating debris onto the property and washed tons of rock and gravel into our boat ramp. We believe that damage from waves might have been worse if not for the thick layer of ice created by freezing spray. One particular area that is often damaged is the top of our

The new concrete pad at the top of the boat ramp.

boat ramp: the waves crest the paved part of the ramp and wash large stone and gravel back into the ramp. This year, with the help of campus Facilities Design and Construction and a general contractor, we were able to install a large concrete extension above the ramp that will mostly eliminate this problem. Of course, everything depends on how high the water gets during future storms. If the next large storm raises the water level just four or five inches above the last one, we will have the much larger problem of flooding in the Field Station buildings.

Osprey Nesting Platform and Habitat Enhancement Project

In 2022–2023, we continued to work on the Osprey Nesting Platform and Habitat Enhancement Project funded through the Niagara River Greenway Commission (no cost extension 2023) ($94,104, PI's Clapsadl, Haas, and Hastings). The work during this time has focused on placing additional perennials and woody plants in the plantings that were created as part of this project. All plants used are native plants that were selected for their potential to provide food, cover, and nesting sites for migrating and local birds.

Other projects

We provided field and laboratory support for multiple faculty and student research projects, including but not limited to providing support for the deployment of the GLOS (Great Lakes Observing System) buoy in Lake Erie off Dunkirk.

We have continued to maintain a rigorous regular maintenance program for our research boats. This program, coupled with the ability to store the boats in the boat shed out of sun, rain, and snow, has enabled us to keep the boats in good working order.

VI. Western New York PRISM Activities

Western New York Partnership for Regional Invasive Species Management (WNY PRISM) is a sponsored program of the Research Foundation for SUNY Buffalo State and is hosted by the Great Lakes Center. Funding for WNY PRISM is provided by the Environmental Protection Fund through a contract with the NYS Department of Environmental Conservation. Funding for WNY PRISM, through the current contract, supports continued operations through December 31, 2023.

The Western New York Partnership for Regional Invasive Species Management (WNY PRISM) works to address invasive species priorities using a coordinated partnership network for which the program provides leadership, technical assistance, and opportunities for collaboration. The goal of this program is to improve, restore, and protect local aquatic and terrestrial resources by improving the effectiveness of invasive species management efforts, engaging the public in management actions, and increasing awareness of invasive species issues throughout the eight-county, Western New York region.

To achieve established goals, WNY PRISM coordinates several high-profile priority programs. WNY PRISM runs a robust Early Detection and Response Program, several Community Science Programs, a Crew Assistance Program that sees WNY PRISM work with dozens of partners across the region each year, and a Watercraft Inspection Stewardship Program with up to 20 Boat Stewards. This is in addition to expansive education and outreach, data collection, and information management efforts.

For more information on WNY PRISM activities and results, you can find our Annual Report.

Program Highlights and Accomplishments

Western New York Partnership for Regional Invasive Species Management (WNY PRISM) continues to address invasive species priorities through our many programs and essential partnerships with regional stakeholders. Since being established in 2014, WNY PRISM has: recorded over 14,500 invasive species presence/absence data points; held and/or participated in 400 educational events; conducted 61,000 boat inspections; completed 89 Crew Assistance Program Projects; surveyed, monitored, and managed over 30 early detection sites, with 4 sites

reaching "presumed eradicated" after 7 years of no plants found; hired 144 seasonal employees; and worked with 211 partner organizations and agencies.

WNY PRISM addresses invasive species issues as identified in the WNY PRISM Strategic Plan (2019–2024) , which was developed through a year-long collaborative process involving regional partners in 2019, and updated in 2022. The original plan put forth an ambitious program designed to provide the framework by which the invasive species management needs of western New York may be met. The 2022 updates served to strengthen and expand upon the established framework by addressing shifted priorities, expanded programs, and new opportunities.

In 2022, WNY PRISM developed a new logo in accordance with new guidance for the NYS PRISM Network. The new logo and brand standards serve to provide greater consistency across the state with a clean, unified style and message that is being incorporated within each regional PRISM office. The development process involved providing the design team with an understanding of what makes Western New York unique, focusing on the varied habitats, agricultural communities, and geologic features. The resulting logo shows the importance of water and how it moves across the western New York landscape.

INVASIVE SPECIES MANAGEMENT
WESTERN NEW YORK

Several community science initiatives were implemented in 2022, including the Hemlock Woolly Adelgid Hunters, Trail Survey Program, and Spotted Lanternfly Monitoring Program. Seventeen HWA Hunters spent 57.5 hours surveying 20 sites and submitting 35 reports to iMap, both detected and not-detected. The collected data supported the release of Hemlock woolly adelgid biocontrol agents. As part of the Trail Survey Program, 12 volunteers completed 6 identified trail sections, submitting 59 presence records. Fourteen unique species were recorded with the most frequently reported species being common buckthorn (15), dame's rocket (9), multiflora rose (7), and mugwort (6). Nine spotted lanternfly monitoring traps were set up by partners and volunteers across Erie, Orleans, and Allegany Counties. The traps were monitored biweekly throughout the field season and into November.

Melanie Donofrio, Invasive Species Management Assistant, checking a spotted lanternfly trap.

WNY PRISM held our first regional Invasive Species Management Symposium on October 18, 2022, at the Buffalo State Alumni and Visitor Center. The purpose of this event was to provide the opportunity for discussions on adaptive management and to learn about how the process has been implemented. Guest presenters discussed challenges associated with restoration of diverse habitats, understanding how plant ecology and interactions can change management strategies, and discussed opportunities for funding and collaboration.

In November, WNY PRISM staff and the Steering Committee conducted a comprehensive review of our approaching region (Tier 1) and early detection (Tier 2) priority species lists. Two priority species, spotted lanternfly (*Lycorma delicatula*) and goatsrue (*Galega officinalis*), were moved from Tier 1 to Tier 2 after being confirmed in western New York for the first time in 2022. Red swamp crayfish (*Procambarus clarkia*) was also added to the early detection list and several new species were added to the approaching region list including hardy kiwi (*Actinidia arguta*), parrot feather (*Myriophyllum aquaticum*), primrose-willow (*Ludwigia peploides*), and kudzu (*Pueraria montana*). A new set of data gap species were also identified for 2023, including hemlock woolly adelgid (*Adelges tsugae*), tree of heaven (*Ailanthus altissima*), callery pear (*Pyrus calleryana*), burning bush (*Euonymus alatus*), and lesser celandine (*Ficaria verna*).

Additional highlights include:

- WNY PRISM has worked with 211 partners, including 15 new partners in 2022.
- Hired three new staff members: Douglas Knoph (Field Operations Manager), Rachel Taylor (Community Science and Engagement Program Manager), and Amanda Cooper (Aquatic Invasive Species Program Manager).
- Hired 24 seasonal staff members: Invasive Species Management Assistants (3), Education and Outreach Assistant (1), Boat Stewards/Environmental Educators (17), GIS Technician (1), and Survey & Monitoring Technicians (2).
- Held first WNY PRISM Invasive Species Management Symposium with 57 attendees.
- Updated WNY PRISM logo and branding in accordance with other PRISM regions.
- Conducted a comprehensive review and updated WNY PRISM priority species lists.
- The Crew Assistance Program received 13 proposals from 10 partners, including at least one proposal from each of our 8 counties.
- The Crew Assistance Program resulted in 12 completed projects including 16.46 miles and 1,897.76 acres surveyed, 10.43 acres treated, and 4,000 lbs. of water chestnut removed.
- Terrestrial early detection surveys were carried out at 76 sites encompassing 10,000 acres and 183.67 miles.
- Aquatic early detection surveys were carried out at 6 sites, encompassing 106.76 acres.
- Early detection priority species removal efforts resulted in 32 sites managed with a combination of herbicide and manual removal, comprised of 2,043.86 acres treated and 150 bags removed.

Attendees of the first WNY PRISM Invasive Species Management Symposium on October 18, 2022.


Crew removing water chestnut (*Trapa natans*) from Cattaraugus County Flood Control Site 16A in July 2022.

- One water hyacinth site designated as presumed eradicated after 5 years of monitoring without occurrence.
- 3,507 records were uploaded to iMapInvasives for the region, including 85 unique species.
- The top five recorded invasive species for WNY PRISM in 2022 are Eurasian watermilfoil, curly-leaf pondweed, Japanese stiltgrass, European frog-bit, and beech leaf disease (nematode).
- Beech leaf disease (nematode) was the top not-detected species.
- Tabled at 15 events, delivered 16 presentations, and held 9 Walk and Talks and 8 workshops resulting in 3,983 direct contacts.
- Obtained over 400 signatures on WNY PRISM Pledge to Protect commitment banners.

- WNY PRISM Listserv gained 42 subscribers, raising the total number of subscribers to 376.
- WNY PRISM staff responded to 83 public inquires, submitted through the website, email, and by phone. Questions about knotweed and hemlock woolly adelgid were the most common.
- Facebook posts reached 60,788 individuals and WNY PRISM added 152 new page likes.
- Instagram posts and stories reached 17,482 individuals and increased followers by 18%.
- Developed 7 Boot Brush Stations for partners, currently awaiting installation. 40 Boot Brush Stations have been fully installed across the WNY PRISM region.
- The Watercraft Inspection Stewardship Program achieved an 84.4% acceptance rate with 385 interceptions. The most encountered species were Eurasian watermilfoil (190) and curly leaf pondweed (102).
- Boat Stewards conducted 12,063 boat inspections working at 15 launches across 5 counties.
- Stewards conducted 359 Walk-Up Surveys and 216 Angler Surveys. 42.6% of anglers agreed to an inspection of their equipment, and no invasive species were observed.

Additional Projects

Mosquito Junction Swamp Restoration at Tifft Nature Preserve

Extensive invasive species removal and habitat restoration has taken place at the Buffalo Museum of Science Tifft Nature Preserve, mostly focused on the remnant marsh areas. This project focused on the important transitional areas between the marsh and additional wetlands and upland areas that continue to be threatened by invasives species. Through a collaboration with Tifft Nature Preserve and the Lyceum at Silo City, WNY PRISM worked to enhance and restore the 14 acres that make up the Mosquito Junction area of Tifft Nature Preserve. Efforts included invasive species removal and native plant restoration.

Western New York Japanese Stiltgrass (*Microstegium vimineum*) Early Detection and Rapid Response Project

WNY PRISM implemented invasive species removal focused on Japanese stiltgrass (*Microstegium vimineum*), an early detection priority species. WNY PRISM led survey and removal efforts across sites along Cazenovia Creek, Buffalo River, Hunters Creek, and Eighteenmile Creek. Removal involved the use of volunteers for hand removal and the WNY PRISM Crew for herbicide treatments. Boot brush stations were placed at trailheads to reduce the spread and reintroduction of invasive species along trails.

Crew applying foliar treatment for Japanese stiltgrass (*Microstegium vimineum*) at Hunters Creek in July 2022.

Invasive species management to protect rare habitats at Alexander and Houghton Preserves

The Nature Sanctuary Society of WNY partners with WNY PRISM to eradicate invasive shrubs from 16 acres of the NSSWNY's Houghton Preserve. Removal efforts will focus on glossy buckthorn, multi-flora rose and bush honeysuckle and aimed to protect the integrity of the preserve's sphagnum bog habitat that is home to rare species such as spotted turtle and podgrass. The project will also include detection, eradication, and control of goutweed and garlic mustard on the 118-acre Alexander Preserve, where these invasives threaten old growth forest understory habitat hosting rare and listed species such as Virginia Bluebell.

Collaboration

WNY PRISM works to provide the region with support and resources necessary to implement invasive species management projects while also working with statewide and greater regional partners. Working with partners outside of the region allows WNY PRISM to provide support for shared priorities and ensure priorities of the WNY PRISM region are incorporated into broader programs. WNY PRISM staff participate in, and/or facilitate, several local, statewide, and regional working groups, task forces, and collaboratives to better support the region we serve. Within each of these collaboratives, members work together to develop and implement a wide range of projects aimed at improving management efficacy. To date, WNY PRISM has worked with 211 partners, including 15 new partners in 2022.

WNY PRISM Steering Committee Members

- Sharon Bachman, Cornell Cooperative Extension of Erie County
- Mark Bogdan, New York State Department of Transportation
- Kathleen Buckler, U.S. Army Corps of Engineers – Buffalo District
- Robert Coady, Buffalo Niagara Waterkeeper
- Jennifer Dunn, New York State Department of Environmental Conservation
- Aaron Heminway, New York State Office of Parks, Recreation and Historic Preservation
- Colleen Keefer, U.S. Fish and Wildlife Service – Lower Great Lakes Fish and Wildlife Conservation Office
- Megan Kocher, New York Sea Grant
- Mike Shaw, U.S. Department of Agriculture – Natural Resources Conservation Service
- Bob Smith, New York State Certified Nursery and Landscape Association
- Jonathan Townsend, Chautauqua County; Royal Fern Nursery

Presentations, Workshops, and Trainings

1. Locke, A. Walk and Talk: Faun Lake. Bliss, NY. July 9, 2022.
2. Locke, A., and D. Knoph. Walk and Talk: Boston Town Park. Boston, NY. August 13, 2022.
3. Hernon, B. Terrestrial Invasive Species Management Workshop. WNY PRISM, Depew, NY. September 1, 2022.
4. Locke, A. Management for Road Crews and Highway Departments. Wyoming County Soil and Water Conservation District Management Workshop. Warsaw, NY. September 8, 2022.
5. Knoph, D. Walk and Talk: Oak Orchard Wildlife Management Area. WNY PRISM, Oakfield, NY. September 10, 2022.
6. Hernon, B. Early Detection Program Updates. WNY PRISM Symposium, Buffalo, NY. October 1, 2022.
7. Locke, A. Learning from Failure: Putting Adaptive Management to Work. WNY PRISM Invasive Species Management Symposium. Buffalo, NY. October 18, 2022.
8. Knoph, D. Crew Assistance Program Updates. WNY PRISM Invasive Species Management Symposium & Fall Partner Meeting. WNY PRISM, Buffalo, NY. October 2022.
9. Locke, A. Invasive Species in the Landscape. Jamestown Garden Club Meeting. Jamestown, NY. November 2, 2022.
10. Hernon, B. Hemlock Woolly Adelgid Identification and Surveys. Winter Ecology

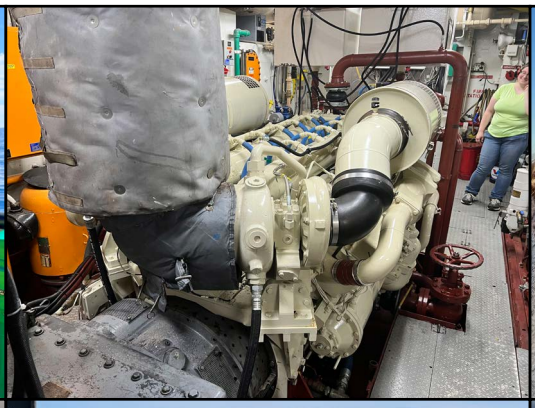
Brittany Hernon showing examples during the Master Naturalist Ecology Day Hemlock Woolly Adelgid training at Beaver Meadow on January 21, 2023.

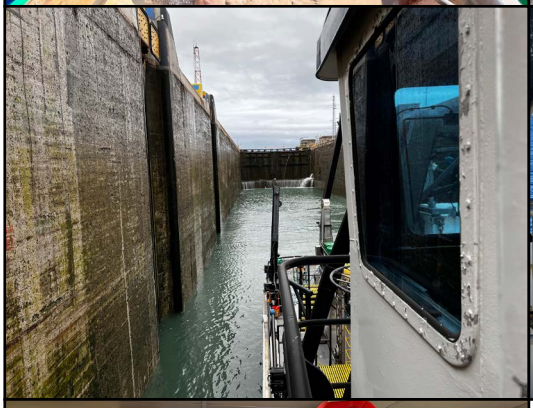
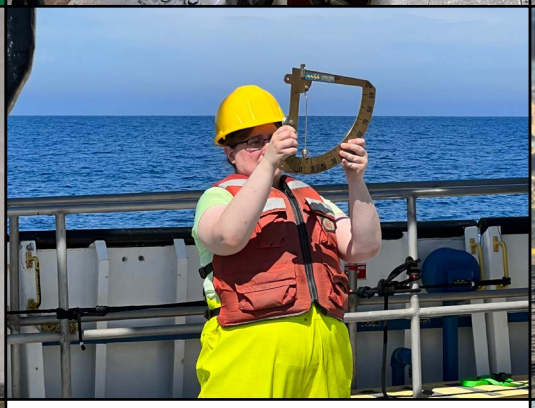
Wonderland, North Java, NY. January 21, 2023.

11. Hernon, B. Hemlock Woolly Adelgid Identification and Survey Training. WNY PRISM, Orchard Park, NY. February 11, 2023.
12. Hernon, B. What's Bugging You? Forest Pests and Diseases That May Be Harming Your Trees. Rural Landowner Workshop, Yorkshire, NY. March 4, 2023.
13. Knoph, D. Walking the Pathways of Invasion. Rural Landowners Workshop. CCE of Allegany County, Yorkshire, NY. March 4, 2023.
14. Locke, A. Data Gap Priority Species: Lesser Celandine. University at Buffalo Invasion Ecology Seminar. Virtual. March 20, 2023.
15. Locke, A. Data Gap Priority Species: Callery Pear. University at Buffalo Invasion Ecology Seminar. Virtual. March 24, 2023.
16. Hernon, B. Making the Most of iMapInvasives. WNY PRISM Spring Partner Meeting, Blasdell, NY. April 27, 2023.
17. Locke, A. Woody Invasive Species Management. ReLeaf Workshop. Buffalo, NY. May 8, 2023.
18. Locke, A., and R. Taylor. Walk and Talk: Pfeiffer Nature Center Eshelman Property. Portville, NY. June 4, 2023.
19. Hernon, B. Invasive Plant Species ID & iMapInvasives Training. WNY PRISM, Buffalo, NY. June 5, 2023.
20. Hernon, B. Invasive Forest Pests and Diseases. WNY PRISM Terrestrial Workshop, Fredonia, NY. June 7, 2023.
21. Locke, A. WNY PRISM Aquatic Invasive Species Management Workshop. Fredonia, NY. June 7, 2023.
22. Locke, A. Understanding Pathways of Invasion. New York Invasive Species Awareness Week Webinar Series. Virtual. June 8, 2023.
23. Taylor, R. Tonawanda Rails to Trails Survey Program 2023 Refresher Training – Part 1 Webinar. Virtual. June 14, 2023.
24. Taylor, R., and A. Locke. Tonawanda Rails to Trails Survey Program 2023 Refresher Training – Part II Field Refresher, Tonawanda, New York. June 20, 2023.

The attendees of the Hemlock Managers Meeting at Letchworth State Park on a mild winter day on January 18, 2023. Credit: Matt Brincka

Boat Steward Bethany Mangioni at Wide Waters Marina on June 19, 2023.

Long-Term Monitoring Summer Cruise

August - September 2022