Great Lakes Center Newsletter

Spring 2024

RESEARCHING THE GREAT LAKES AND THEIR TRIBUTARIES SINCE 1966

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An image taken from a video clip from Lake Ontario with round gobies circled in yellow.

Use of videography to assess round goby densities in the Great Lakes

by Lillian Denecke

This past fall and winter, Great Lakes Center technician Lillian Denecke evaluated deep-water videos collected from Lakes Ontario, Huron, Michigan, and Erie to estimate round goby (*Neogobius melanostomus*) abundance. This project was funded by the U.S. EPA Great Lakes National Program Office (GLNPO) as a part of the Cooperative Science and Monitoring Initiative (CSMI) to provide further insight on the impacts of the round goby on benthic communities. The round goby is a non-native benthic fish species first introduced to the Great Lakes in 1990 via the St. Clair River and has been known to prey on benthic macroinvertebrates, including the invasive ecosystem engineers quagga and zebra mussels (*Dreissena* spp.). Use of underwater videography offers a solution to monitoring round goby density in deep lakes, since estimations of goby density via bottom trawls are difficult due to their habitat preference for rocky benthic areas, leading to underestimations.

To collect videos of lake benthos, a Benthic Imaging System (BIS) equipped with GoPros and underwater lights was lowered to the lake bottom from the U.S. EPA R/V *Lake Guardian*. Images were clipped from the videos, and gobies were identified and counted for density. Gobies were present at 35% of stations in Ontario, 11% in Erie, 9% in Huron, and 3% in Michigan. The use of videography was a success, with only minor challenges along the way. Sometimes it was difficult to clearly identify organisms because the location was shallow and murky. Other times it could be challenging to count numerous fish moving at once;

for example, a location in Lake Ontario had an average of 34 individuals in each replicate, making it difficult to count individual fish but made for an interesting video. In addition to the round goby, other benthic organisms were visible in videos such as native opossum shrimp (*Mysis diluviana*) and the invasive quagga and zebra mussels throughout all four lakes. Occasionally, other species of fish such as various shiners and deepwater sculpin (*Myoxocephalus thompsonii*) were present.

Lillian presented the results from this work virtually at the GLNPO collaborators meeting in February and hopes to continue working on this project and present more results at the International Association for Great Lakes Research meeting in Windsor, Ontario, this May. The next steps for this project are to finish processing the Ponar samples from CSMI Ontario 2023 and to compare round goby density to *Driessena* spp. density and size class structures to investigate how round gobies may be impacting *Dreissena* spp. •

The New Zealand mud snail newly detected in Lake Huron

by Susan Daniel

New Zealand mud snails.

The New Zealand Mud Snail (NZMS; *Potamopyrgus antipodarum*) is an invasive snail that was first reported in Lake Ontario in 1991, followed by Lake Superior in 2001, Lake Erie in 2005, and Lake Michigan in 2006. In 2022, we found a small population in the North Channel, representing the first record of this snail in Lake Huron. This global invader, found in 39 countries and five continents (Geist et al., 2022), has been ranked 42nd as one of the "more than 100 worst" alien species in Europe (Nentwig et al., 2018). The invasive ability of this snail is mainly due to its tolerance of pollution, brackish waters, and a variety of habitat types. Additionally, invasive populations are nearly entirely composed of asexually reproducing females, so they can produce offspring individually and a single female can give rise to a population (Wallace 1985).

To understand the status of this species in the Great Lakes, Research Scientist Susan Daniel and coauthors from the GLC combined data from the U.S. EPA Great Lakes National Program Office sampling efforts, publications, regional reports, and online databases. In the last three decades, the NZMS has spread to all of the Great Lakes, and the number of official sightings per year increased 4-fold during the last decade. The highest abundance was observed in Lake Michigan, followed by Lakes Ontario, Erie, and Huron. In Lake Michigan in 2021, NZMS lake-wide density increased 56-fold compared to 2015, comprising 93% of the total gastropod density and 79% of biomass. This spread may have been facilitated by invasive quagga mussels (*Dreissena rostriformis bugensis*) through stimulation of bottom algae and periphyton growth. While the NZMS is still spreading in Lakes Michigan and Huron, its abundance remains stable in other lakes. However, the current recorded densities in the Great Lakes are much lower than in streams and rivers.

While we are still uncertain about the effect of NZMS on native snails and other native communities, existing local and regional monitoring programs and environmental agencies should adjust survey efforts to follow the invasion, understand species preferences and community effects, and to prevent their spread into new, particularly lotic, habitats within and outside the Great Lakes region. •

The research will soon be available in "Invasion dynamics of New Zealand mud snail (*Potamopyrgus antipodarum*) in the Laurentian Great Lakes," by Daniel, S.E., L.E. Burlakova, A.Y. Karatayev, and L.E. Denecke, in press at *Hydrobiologia*.

Collaboration on quagga mussel study in Europe

by Alexander Karatayev and Lyubov Burlakova

For the last three years, we have collaborated with the Swiss Federal Institute of Aquatic Science and Technology (Eawag), working on joint proposals, presentations, publications, and scientist exchange. In the summer of 2022, Ph.D. student Linda Haltiner from Eawag visited and joined us on a benthic survey of Lake Huron on the Canadian Coast Guard coastal research and survey vessel *Limnos*. In the summer of 2023, Lyubov Burlakova and Alexander Karatayev visited Eawag and presented several talks at a seminar and a workshop "SeeWandel - Life in Lake Constance – the past, present and future."

A meeting at the Great Lakes Center between Alexander (standing, second from left) and Lyubov (seated, left), Dr. Piet Spaak (seated, center), and the six members of the Lake Constance Water Supply in February 2024.

Last year we published a joint paper, "An abundant future for quagga mussels in deep European lakes," by Benjamin Kraemer, Salomé Boudet, Lyubov Burlakova, Linda Haltiner, Bas Ibelings, Alexander Karatayev, Vadim Karatayev, Silvan Rossbacher, Raphael Stöckli, Dietmar Straile, and Piet Spaak in *Environmental Research Letters*. In this paper, we applied knowledge from our long-term quagga mussel monitoring efforts in the Great Lakes to predict future populations of mussels in deep European lakes, where they are quickly becoming a conspicuous part of the underwater landscape. We predict that quagga mussel biomass in European pre-alpine lakes, including Biel, Constance, and Geneva, may increase by a factor of 9–20 by 2045, causing serious ecological consequences and increasing operation expenses for industry using raw water by billions of dollars.

In February, our collaborator Dr. Piet Spaak visited with a group of six staff members of Lake Constance Water Supply, Mr. Christoph Jeromin (CEO), Mr. Steffen Vogler (Project Management Department), Mr. Thomas Keierleber (Project Management Department), Mr. Christian Grüner (treatment facility department), Mr. Roland Schick (Head of Laboratory Department), and Mr. Michael Petri (Laboratory Department), to discuss how our knowledge of quagga mussel biology could be used in design of a new water supply plant on Lake Costance.

Starting November 2024, Lyubov Burlakova and Alexander Karatayev will be hosted by Dr. Piet Spaak in Eawag for six months to continue our work on predicting the distribution and effect of quagga mussels on waterbodies with different morphology in both Europe and North America. These predictions will be based on our knowledge of the distribution and effects of quagga mussels in the Great Lakes and other lakes in Europe and North America. This knowledge was accumulated throughout our career, especially during the last 11 years working on U.S. EPA-funded grant, "Monitoring of benthic invertebrates in the Great Lakes." This collaborative project with experts in Eawag will result in several publications and presentations at scientific meetings, increasing the visibility of the Great Lakes Center and Buffalo State University. •

Our new Research Scientist

by Lyubov Burlakova

This spring, the Great Lakes Center appointed Dr. Nikolai Barulin to be our new research scientist. Nikolai will work on the U.S. EPA funded project "Great Lakes Long-Term Biological Monitoring Program 2022-2028."

Nikolai has been engaged in aquatic ecology research for over 18 years. He graduated from the Belarusian State Agricultural Academy in 2006, received Candidate of Sciences degree (Ph.D.) in 2009, and in 2022 he defended the Doctor of Sciences degree (D. Sc.). Since 2010, Nikolai has held the position of Chair of Ichthyology and Aquaculture Department. Before coming to the GLC, Nikolai was a Fulbright Scholar and worked as Visiting Senior Research Associate at Brown University. Nikolai's research interests are in areas of aquatic ecology, fishery, aquaculture, aquatic toxicology, use of zebrafish in biomedical research, biophysics, and deep machine learning. Throughout his research career, Nikolai published over 70 research articles, 15 chapters in books, and secured over $10 million in funding. In Belarus, Nikolai spearheaded the construction of the first recirculating aquaculture system for sturgeon and rainbow trout, and he received over 20 scientific awards. At the GLC, Nikolai will be responsible for the Cooperative Science and Monitoring Initiative extensive surveys for all the Great Lakes, and will be involved in remote sensing, image processing, data analysis, and grant management. We're happy to have you on board, Nikolai! •

Great Lakes Faculty Scholars Program

By Dr. Chris Pennuto and Kit Hastings

This spring, the GLC introduced a new program to support faculty research. The Great Lakes Faculty Scholars Program offers a one-semester course release to provide faculty the time needed to bring an external grant to fruition. The GLC will fund two faculty scholar awards per year, with one being chosen for each fall and spring semester.

Faculty interested in this program need to show evidence of prior planning or collaboration with others on any research topic relevant to the Great Lakes and/or its watershed, including urban environments adjacent or connected to the Great Lakes. Collaboration with GLC affiliates is encouraged; any faculty member with potential interests that align with the GLC mission may obtain Affiliate Status with the GLC. In addition, all applicants will need to show their home department's approval of a course release. Those who receive a course release through this program are expected to complete an external grant submission within 6 months of the end of the semester for which the course release is awarded.

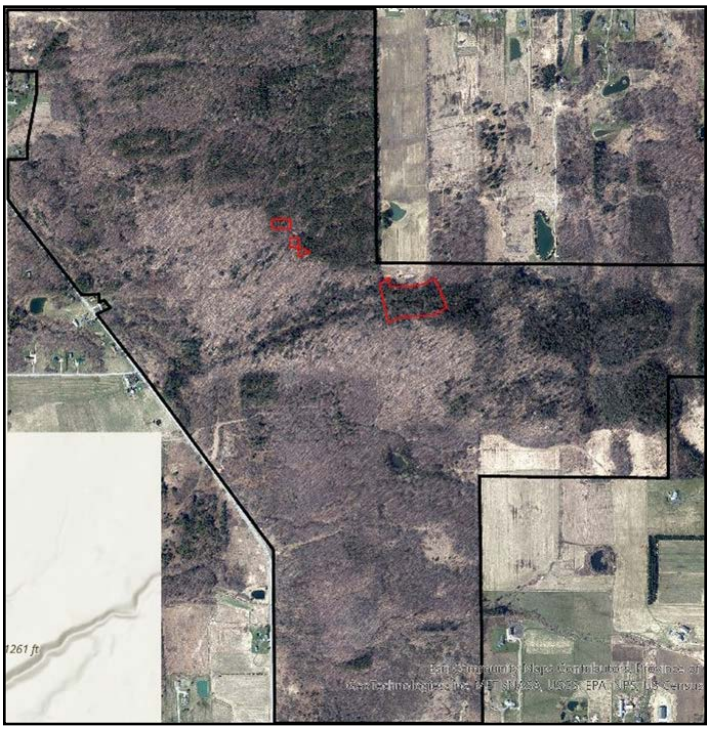
As an incentive for grant submission (and a way to reduce grant costs), faculty members in the program also may receive one Huppuch Tuition Scholarship, if needed, to entice a prospective graduate student to help carry out the proposed research. Huppuch Tuition Scholarships cover all costs associated with full-time, in-state graduate tuition for students enrolled in the Great Lakes Environmental Science thesis program.

The application deadline for the Fall 2024 semester has already passed, but applications for Spring 2025 are open until October 1, 2024. Application information and submission criteria can be found on the GLC Faculty Scholars Program website. •

Using soil type and LiDAR to map Eastern hemlock trees

by Michael Kalinka and Lindsay Piotrowski, GLES M.S. students

We conducted a GIS-based environmental conservation project for Erie County, New York, in GEG 528 Environmental Assessment and Planning Applications in GIS. This service-learning project was requested by Erie County Parks, Recreation, and Forestry. We were asked to create a digital map identifying eastern hemlock trees in Erie County Parks and Forests. This project will help Erie County combat the spread of Hemlock Woolly Adelgid (HWA, *Adelges tsugae*), an invasive forest pest posing a serious threat to Eastern hemlocks (*Tsuga canadensis*), which are a foundational species in the forests of New York State. HWA feeds at the base of the needle leaves and harms the tree's tissue by impeding the flow of nutrients and water to the end of the twigs. Long term effects would produce the mortality of trees and devastate the northern hardwood ecosystems.



A map of Boston County Forest with a few evergreen riparian forested areas highlighted with a red outline near the center part of the aerial image.

To serve the purpose of protecting the stock of Eastern hemlocks, the Erie County Parks Department charged us to conduct remote sensing-based surveys and produce a detailed digital map of the current distributions of Eastern hemlock trees. Originally, field managers and park rangers thought that the locations of Eastern hemlocks throughout Erie County properties could be determined by classifying the pixel values of vegetation on large scale aerial imageries of New York State orthoimagery. Unfortunately, we were informed by HWA remote sensing research experts at Cornell University that currently there is not a valid method available to differentiate between the similar spectral reflectance shared by evergreens and conifers, such as white pine and eastern hemlock. Hyperspectral imagery is needed for identifying the Eastern hemlock from other tree species as a frontier research project. Multi-spectral images that we obtained are not suitable for this type of species-specific research. Meanwhile, hyperspectral imageries are unavailable in the Western New York region and the data collections are expensive and time consuming. After discussing this issue with Dr. Tao Tang, the co, we hypothesized using soil type and 3D LiDAR datasets as the major criteria identifying Eastern hemlock presence in two experimental areas, Eighteen Mile Creek Park and Boston Forest Conservation Park.

Based on the previous research of Timoney et al. (1993), highly acidic soils that have moderate amounts of fine sand, insignificant amounts of clay, and that are rich in carbon and nutrients, were deemed suitable soils for conifers, including the eastern hemlocks species. After the appropriate areas of hemlock tree growth were confirmed by soil distributions, a follow-up LiDAR analysis was undertaken to determine the likelihood of similar tree distribution, biomass structure (crown), and height (age). This process was based on the analysis of three-dimensional canopy shapes. Our study is the first step to use 3D LiDAR data to identify hemlock trees.

Despite technical limitations, our research demonstrated the possibility of verifying species location and distribution based on geographic variables such as soil type and LiDAR data. The need for more readily available, hyper-spectral imagery is evident, as is the need for greater collaboration between disciplines in preventing HWA from spreading and destroying ecologically vital eastern hemlocks. •

*Special thanks to Dr. Tao Tang, professor of geosciences, for technical and academic advisement during this research.

GLES student spotlight: Lindsay Piotrowski

by Dr. Chris Pennuto

The Great Lakes Environmental Science graduate program turned 10 years old in 2023. Since our inception, we have had 43 graduate students in the program in either the thesis or internship tracks. This column is an opportunity to highlight the accomplishments of one of those students, past or present.

Lindsay Piotrowski is a current graduate student in her final semester of work in the GLES internship track. She joined the GLES program in fall 2022 after completing an undergraduate degree in Earth Sciences at Buffalo State in spring 2022. Lindsay has been very active landing a range of internships experiences over her time with Buffalo State. She interned with Niagara County Refuse Disposal District analyzing water quality data from landfill sites. Lindsay spent a summer as an invasive species survey technician with WNY PRISM conducting invasive species surveys, assisting with priority invasive species removal activities, and assisting with education and outreach tabling events at the Reinstein Woods Fall Festival and the Orleans County Fair. Her current internship is focused on assessing occurrence of hemlock woolly adelgid (*Adelges tsugae*) in Erie County parks, and creating an assessment protocol to direct management efforts.

Lindsay represents our regional community: she was born in North Tonawanda and a is member of the Seneca Nation (Bear Clan). She hopes to remain in the state, with a career aspiration of landing a position with NY DEC or one of our local federal agencies (USFWS, U.S. Army Corps of Engineers, USGS). Reflecting on some of her courses from her time with GLES, Lindsay noted that the project management requirements (PSM 601/602) provided “real-world applications. They taught me interview skills and communication in the professional setting.” We wish her luck as she prepares for the next stage in her professional journey. •

Great Lakes Center
Buffalo State University
1300 Elmwood Avenue
SAMC 319
Buffalo, NY 14222
Phone: (716) 878-4329
greatlakes@buffalostate.edu

GLC Personnel

Director

Alexander Karatayev

Research Scientists

Nikolai Barulin
Lyubov Burlakova
Mark Clapsadl
Susan Daniel
Christopher Pennuto

Adjunct Research Scientist

Richard Barbiero
Thomas Hahn
Knut Mehler
Daniel Molloy

Research Technicians

Lillian Denecke
Brian Haas
Kit Hastings (Newsletter editor)
Angela Tulumello

WNY PRISM

Brittany Hernon
Andrea Locke (Coordinator)
Rachel Taylor

Administrative Assistant

Susan Dickinson