

TWINELINE

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STRIPED INVADERS

Lake Erie's 20-Year Battle
with Zebra Mussels



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STRIPED INVADERS

Lake Erie's 20-Year Battle with Zebra Mussels

by Stacy Brannan, Ohio Sea Grant Communications



Since their invasion in the late 1980s, zebra mussels have all but eliminated native mussels by attaching to their shells, inhibiting their movement, and competing with them for food.

More than 180 different aquatic invasive species, most introduced as a byproduct of the shipping industry, can be found in the Great Lakes' six quadrillion gallons of fresh water. Some live in relatively small numbers, causing little trouble. Others come onto the scene and wreak havoc on the food web, pushing aside or completely eliminating native species to the detriment of the entire ecosystem. Sometimes this damage happens seemingly overnight. That was the case with the zebra mussel.

The first recorded discovery of zebra mussels in Lake Erie took place at Stone Laboratory on October 15, 1988, when a few were found attached to a dock that was being taken out of the lake for off-season storage. Ohio Sea Grant's response was immediate: within a month, Dr. Dave Garton, then-

Assistant Director of the program, received the first zebra mussel research grant.

"Garton made a very convincing case of the kinds of problems zebra mussels had caused in Europe, where it had lived for hundreds of years, and the kinds of potential problems it could cause in this country," recalls Dr. Jeff Reutter, Director of Ohio Sea Grant and Stone Lab. "I have to admit, I was skeptical because we'd had a scare with Asiatic clams just a few years before, and the clams didn't turn out to be a huge problem."

But within a year the zebra mussel population in Lake Erie had exploded to a density of 30,000 individuals per square meter—far more than anyone had predicted—and Sea Grant began its work in earnest. The next decade saw funding awarded to search for ways to control zebra mussels and the cost of those solutions,

determine where they came from and how to prevent additional invasions, and outline the mussels' adverse impact on Lake Erie's ecosystem.

"It turned out that our lake was zebra mussel heaven," Reutter explains. "It's the southernmost, shallowest, and warmest of the five Great Lakes, and they were far more productive here than they had been in Europe."

In fact, the difference was stark. Whereas the mussels in European waters were laying 50,000 eggs per year and reaching sexual maturity in three to five years, Garton and another Sea Grant researcher, Ohio State University's Dr. David Culver, determined they were laying 1 million eggs per year in Lake Erie and reaching maturity in 11 months.

With that kind of rapid growth, it wasn't long before water treatment and nuclear power plants came to Sea Grant, asking

for help with the large numbers of mussels blocking their water intake pipes, sometimes causing complete shutdowns of the facilities. An effective control strategy was urgently needed, and Reutter asked Dr. Gary Floyd, the Dean of Ohio State's College of Biological Sciences, for help in finding a researcher to tackle the issue.

That help came in the form of Dr. Susan Fisher, a toxicologist in and now Chair of the Department of Entomology, who at the time knew nothing at all about zebra mussels or mollusks.

"I was not the obvious person to be doing any of this, but I did have some experience in toxicity testing, so I agreed to see what we could do," Fisher explains.

She started by adopting the methodologies of the Environmental Protection Agency, which included the use of standard reference water. The plan was to get the mussels acclimated to the water and then add toxins to see what could be used to kill them, but the testing never got that far.

"We put them in the standard reference water, and they all died," recounts Fisher.

After many more attempts with the same results, it was clear that something in this typically benign water was, in fact, toxic to zebra mussels. That thing turned out to be potassium.

"It was a great discovery because potassium permanganate was already being used as a treatment in pipes to prevent corrosion," she says. "The permits to use it were already in place."

Water treatment plants and nuclear power facilities only had to move the chemical injection point back to the water intake crib and the problem was solved. Fisher announced this discovery in 1990 at the first ever International Zebra Mussel Research Conference, held in Columbus and organized by Ohio Sea Grant to bring together scientists, industry, and the media.

At the same time, Reutter was meeting regularly with two U.S. Congressmen from Ohio: Senator John Glenn, who was on the Science Committee, and Representative Ralph Regula, who served on Appropriations.

"It was important to make sure everybody understood the potential impact of this problem," remembers Reutter. "With leadership from Glenn and Regula, a strategy was developed for an appropriation of \$2 million for the first ever National Aquatic Nuisance Species Control Act in 1990." That funding,

championed by Ohio Sea Grant to specifically address zebra mussels, has remained in place since then, now expanded to cover aquatic invasive species throughout the country.

But federal funding came with some expectations: Congress wanted a price tag to put on the problem. How much money was being lost because of zebra mussels? Sea Grant could answer a small piece of that puzzle because of its respected, established relationships with the plants, facilities, and factories with water intakes on Lake Erie. In 1993, Leroy Hushak, then-Associate Director for Ohio Sea Grant, set out to

Fish and Wildlife Service, the Great Lakes Commission, and the National Oceanic and Atmospheric Administration. In all, the groups determined that zebra mussels were costing the region \$5-10 billion per year—a hefty sum for a problem that would require additional research and legislation to keep under control.

"At this point, zebra mussels were pretty much limited to Lake St. Clair and Lake Erie, but there was no way to prevent their expansion," Reutter says. "We needed our researchers to track their spread and determine where they came from so we could



The first International Zebra Mussel Research Conference in 1990, held in Columbus and organized by Ohio Sea Grant, discussed recent discoveries and ongoing projects related to the mussel's biology, impacts on the ecosystem, and economic repercussions, in addition to monitoring techniques and control alternatives.

discern the total amount power plants were spending annually on such things as damages, maintenance, cleaning, control, full or partial plant shut-downs, plant design modifications, and research.

"The one thing I could look at that the biologists couldn't was the costs," Hushak says.

His survey determined that from 1989-1994, water intake facilities had spent approximately \$120 million on issues related to zebra mussels—an average of \$430,000 per plant. Much of this money was spent to retrofit the systems by moving the potassium permanganate or chlorine injection point, as Sea Grant's research had recommended.

That cost was added to the economic impact totals being collected by the U.S.

see what other species are there and what's likely to end up in Lake Erie."

Ohio Sea Grant scientist Dr. Carol Stepien, originally at Case Western Reserve University and now Director of the Lake Erie Research Center at the University of Toledo, is the woman at the helm of tracking the zebra mussel and its more recently arrived and more aggressive cousin, the quagga mussel. She has spent the last decade using DNA to follow their spread across the country and compare mussels found in the Great Lakes with those found in their native Europe.

"I have some of the oldest zebra mussel samples available from early on in the invasion," she explains. "I use those samples to track the

genetic changes that occur in the mussels over time and where they have moved.”

After analyzing hundreds of samples from North America and Europe, Stepien believes that the alien mussels in the Great Lakes came from invasive populations in Europe and native populations in the Black Sea, and had many founding sources from many ships. This led to tremendous genetic diversity in the population, which has helped the mussels to thrive in North America.

Their numbers in Lake Erie, estimated now in the billions, have damaged the ecosystem, putting contaminants like PCBs back into the environment that previously had been effectively “locked” in the sediment on the lake floor. With a body fat content ten times higher than native mussels, zebras and quaggas are able to absorb the contaminants at high levels, then are eaten by another invasive species—the round goby.

“When we first saw that the gobies were eating the mussels, we were excited,” Reutter recalls. “But the gobies also have a high fat content, so they take on the contaminant burden, then pass it up the food web when they are eaten by smallmouth bass. Our researchers showed that the levels of PCBs coming into the system were shrinking, but the levels in the smallmouth bass population doubled, simply because of that small change.”

These discoveries by Sea Grant scientists Fisher, Roy Stein, and Elisabeth Marshall modified recommendations for how much smallmouth bass people should eat. They also underscore the importance of keeping additional species out of the Great Lakes because of the damage they can do.

“Invasive species can be very expensive and their impact can be enormous,” Reutter says. “Preventing them from getting in is really the key. We can come up with strategies to control just about anything that comes in, but once they’re here, there’s nothing we can do to get them out.”

Congress understands this continued importance, recently approving \$1 million in new funds for the Great Ships Initiative, an effort to create stricter regulation for ballast water, the single most common vector for nuisance species introduction. With help from Congress, it may be possible to turn the zebra mussel invasion 20 years ago into an important learning experience and limit future harm to the Great Lakes ecosystem. **TL**



Once thought to be “locked” within Lake Erie sediment, contaminants like PCBs and mercury biomagnify as they travel up the food chain. Ohio Sea Grant research discovered that as round gobies eat zebra mussels and are then eaten by smallmouth bass, PCB concentrations increase from 100 parts per billion in the mussels to 1800 ppb in smallmouth bass.



In 1989, Detroit Edison workers found zebra mussels clogging the power plant’s intake pipes from Lake Erie. A total of 33 dump trucks full of zebra mussels were hauled away from the site. Ohio Sea Grant researcher Susan Fisher soon found a solution in a source power plants and other such facilities were already using: potassium permanganate or chlorine. By simply moving the injection point of these chemicals, zebra mussels could be controlled in intake pipes.



Combining Politics and Partnerships

by Stacy Brannan, Ohio Sea Grant Communications

NOAA Deputy Under Secretary Mary M. Glackin (left) talks with Ohio Sea Grant Director Dr. Jeff Reutter and Sandusky/Erie County Community Foundation President Barbara Hanck. NOAA was honored with an Ohio Sea Grant Partnership Award.

Under blue skies and warm sunshine, 150 federal, state, and local elected officials gathered on July 18th for Ohio Sea Grant's 17th State Legislature and Congressional Day on the shores of Lake Erie. They were there to help celebrate Ohio Sea Grant's 30th anniversary and to experience first-hand the value and impact Lake Erie has on Ohio and the research, education, and outreach efforts that make up the cornerstones of the program.

The day started with a luncheon at the Bay Harbor Restaurant at Cedar Point Amusement Park and a celebration honoring four of Ohio Sea Grant's key partners: Old Woman Creek National Estuarine Research Reserve, the Ohio Coastal Management Program, the National Oceanic and Atmospheric Administration (NOAA), and The Ohio State University.

"I was fortunate to be involved with the start of our Sea Grant Program in Ohio and have led it for 22 of its 30 years," said Dr. Jeff Reutter, Director of Ohio Sea Grant. "Our accomplishments have been many and significant, but they have all been built around and fostered by strong partnerships involving government, academia, and the private sector."

The importance of building these strong

partnerships was highlighted repeatedly by each speaker who addressed the day's guests.

"Sea Grant is one of my favorite programs," said Mary M. Glackin, Deputy Under Secretary of NOAA. "I have seen first-hand in the last day or so how important it is to build these partnerships, to establish partnerships in funding, and to gather matching funding."

To the Island

On Gibraltar Island in Put-in-Bay, Ohio Sea Grant and Stone Lab staff were prepared to teach and demonstrate the research and activities that keep the program moving forward.

Just outside Stone Lab, Extension Educator and Coastal Training Program Coordinator Heather Elmer and Old Woman Creek summer intern Mariah Linkhart sat perched behind two Enviroscape Watershed Models—colorful, plastic boxes used to demonstrate the Lake Erie watershed microcosm.

On one box, the agricultural and urban areas were bare, with green pools of water approximating polluted run-off that often accompanies conventional land-use practices.

On the other box, sponges and other items were strategically placed to resemble

the function of best land use practices, like vegetated buffers along streams, compact development, pervious pavement, and green roofs. These practices promote rain water absorption, preventing run-off and soil erosion from ending up in Lake Erie and its tributaries.



Workshop Instructor Ben Sylak (right) and Ohio Sea Grant Assistant Director Eugene Braig (left) pick through the seine for small fish to search for aquatic invasive species.

“Over the last 25 years, a lot of progress has been made in cleaning up point sources of pollution, like waste water, stuff that comes out of the end of a pipe,” said Elmer. “But more has to be done to address non-point sources—pollutants on the watershed landscape transported to streams and Lake Erie by rainfall or snowmelt. Run-off from streets and parking lots that carries oil and salt is a good example.”

Elmer explained that the Ohio Lake Erie Commission has developed a Balanced Growth Program to address land-use impacts on Lake Erie. The program recommends a set of “best local land-use practices,” similar to those demonstrated on the Enviroscope model. It also encourages communities to look beyond their boundaries and cooperate as a watershed region to determine where they want to conserve natural resources and where they want to develop.

The Commission’s connections to Ohio Sea Grant run deep, as Tourism Program Director Melinda Huntley served on the Blue Ribbon Task Force that helped develop the Balanced Growth Program and Extension Educator Joe Lucente led a state-wide land-use conference focused on the new initiative in 2005.

Additionally, Elmer highlighted that the Lake Erie Commission has recently joined forces with Ohio Sea Grant, Old Woman Creek, and the Ohio Coastal Management Program as a partner in the Ohio Coastal Training Program (CTP). Jointly funded by NOAA and the ONDR-Division of Wildlife, the Ohio CTP provides local officials and other professionals with science-based training to inform their decisions impacting Lake Erie. Lucente and Elmer are currently working with all four programs to expand training related to land-use planning and balanced growth in the Lake Erie watershed.

Seining is Believing

On Alligator Bar, a rocky outcropping on the western tip of Gibraltar, Workshop Instructor Ben Sylak and Ohio Sea Grant Assistant Director Eugene Braig showed guests how to use a beach seine to gather and examine specimens.

“Demonstrations like this are important to teach decision-makers about the greater

than 180 aquatic invasive species found in the Great Lakes,” said Braig. “Many of those species have tremendous impacts upon the diversity of our own native Great Lakes species.”

The biggest news was their capture of several tubenose gobies, an invasive species related to the round goby. Although both species were discovered in the Lake in 1990, only the round goby has become abundant. The discovery of multiple tubenose gobies could signal a change in this dynamic.

Seining is a good way to gather this kind of data. “It’s pretty much the only way to see what species are in a shallow area,” Sylak said. “And, in turn, the mix of species is a good biological indication of water quality.”

Young smallmouth bass were also among the day’s findings. That bodes well for the smallmouth bass population as a whole.

“Gobies eat smallmouth bass eggs,” Sylak explained. “If a male bass is pulled off his nest before the fry leave the nest, the gobies will swoop in and eat all of them. Thanks to the Sea Grant-supported research that discovered this, the ODNR-Division of Wildlife now prohibits smallmouth bass harvest during their spawning season so anglers won’t target them and the defending bass can stay on their nests.”

Getting the Message

After a day of learning capped off with a reception supported by the Ohio Wine Producers and the Lake County Visitors Bureau and dinner overlooking the Lake, the legislators expressed appreciation and renewed conviction to help extend Ohio Sea Grant’s efforts in the region.

“I think it’s important to add more programming for Ohio Sea Grant because we’re learning more and more about how to take care of our most valuable natural resource, Lake Erie,” said Teresa Fedor, Ohio Senator from Toledo. “It is critically important to promote public awareness to enable future funding.”

As preparations are made to lead Ohio Sea Grant into the next 30 years, partnerships with federal, state, and local agencies like Old Woman Creek, the Ohio Coastal Management Program, NOAA, and Ohio State will provide important funding and opportunities to engage the public. Time in the sun and on the water at Legislature Day gives Ohio’s decision-makers the chance to experience the program’s critical research, education, and outreach efforts for themselves. Then, armed with this fresh perspective, they can cast more informed votes that will help Lake Erie continue to improve for future generations to enjoy. TL



Extension Educator and Coastal Training Program Coordinator Heather Elmer explains how Enviroscope Watershed Models use sponges and other items to approximate the function of best land-use practices, like vegetated buffers along streams, compact development, pervious pavement, and green roofs.

NAME Ashtabula River dredging project

COMPLETED

The Ashtabula River dredging project moved 635,000 cubic yards of contaminated sediment, including 25,000 tons of polychlorinated biphenyls (PCBs) and other pollutants, to an area landfill, which will be capped this spring.



DREDGING UP THE POLLUTED PAST

by Stacy Brannan, Ohio Sea Grant Communications

After nearly 15 years of planning, two years of physical labor, and \$75 million, the Ashtabula River dredging project is close to completion, making the river one of the cleanest, deepest harbors in Lake Erie. The project moved 635,000 cubic yards of contaminated sediment, including 25,000 tons of polychlorinated biphenyls (PCBs) and other pollutants, to an area landfill, which will be capped this spring.

"A lot of people worked very long and very hard to see the dredging completed," says Ohio Sea Grant Extension's Frank Lichtkoppler. "It was all the Ashtabula River Partnership (ARP) members working together that made this happen."

The ARP also got help from Ohio legislators, including Senator George Voinovich, who secured \$7 million from the state of Ohio. Both Voinovich and Representative Steven LaTourette supported the passage and funding of the Great Lakes Legacy Act.

"This [Ashtabula] is a national poster child for a clean-up effort leading the way for other Great Lakes Areas of Concern,"

stated Congressman LaTourette, speaking at the celebration held last summer for the completed project. "This shows what the Great Lakes Legacy Act can do."

In 1987, the lower two miles of the river had been designated as one of 43 Areas of Concern by the International Joint Commission (IJC), a group of government entities in the U.S. and Canada that determined sites in the Great Lakes region that had become polluted because of unregulated discharges and mismanagement of hazardous waste. Although a Remedial Action Plan for the river was published in 1991, no real progress was made until the community itself, along with partners including Ohio Sea Grant, chose to organize the ARP in 1994.

"We had lots of meetings, lots of tests, lots of talking, and there was talk about making it a Superfund site, which we didn't want," says Carl Anderson, a community activist, speaking of the fund established by the U.S. Environmental Protection Agency (EPA) to address abandoned hazardous waste sites.

"We were familiar with the amount of time it took to get Fields Brooks, a nearby

Superfund site, cleaned up," adds Anderson. "It would take 20 or 30 years to get it cleaned up, and then it would have the stigma of being a Superfund site. Would people be able to keep their boats in a Superfund site? We knew the water wasn't bad, just the sediment was, and we had to get that out of there."

Still, even after the ARP was established, it took another eight years and the passing of the Great Lakes Legacy Act in 2002 before funding for the project was found, and another five years before all the pieces were set in place. Dredging officially began in October 2007 and wrapped up in July 2008.

"The Ashtabula River Great Lakes Legacy Act Project was a wonderful example of the power of strong partnerships," says Susan Boehme, Coastal Sediment Specialist for Illinois-Indiana Sea Grant and Liaison to the U.S. EPA Great Lakes National Program Office (GLNPO). "The \$60 million in funding provided by GLNPO, the Ashtabula River Cooperative Group II, and the state of Ohio worked together as a team to ensure the clean-up project was successful."

From the Discussion Board

ohioseagrant.osu.edu/discuss

Bottom sediment contents based on location?

11/20/05, 09:29 by Amanda Too

Would it be safe to assume that the bottom sediment near tributaries would contain more toxins and chemicals than the sediment, say, North of North Bass Island?

Is the water cleaner the further away you get from cities and tributaries, say, 30 miles North of Ashtabula?

Furthermore, what would be the top five toxins found in Lake Erie water and sediment, and how do they affect people, fish, and avians?

Thanks for any informed responses.

Re: Bottom sediment contents based on location?

11/20/05, 14:05 by Fred Snyder,
Ohio Sea Grant Extension

Hello Amanda Too,

That's a very perceptive question. The answer, generally, is yes. Most toxic contaminants come from industrialized harbors, which means tributaries. Even polychlorinated biphenyls (PCBs) and mercury, which are carried by rainfall to a considerable degree, enter the lake as watershed drainage from the tributaries. We usually see the highest concentrations around these harbors, diminishing with distance.

As for the top five contaminants, let me give three at least. PCBs and mercury are our top two. PCBs accumulate in fatty tissues and affect immune systems, infant and juvenile development, and are thought to be linked to cancer. Mercury distributes itself through all tissues in the body; that's why trimming fatty parts of fish will reduce PCBs but not mercury. Mercury can have strong effects on the nervous system, early development, and other things.

The third, at least in industrial areas, is probably polycyclic aromatic hydrocarbons (PAHs). These are by-products of coking (the processing and use of a coal-based fuel), so industrial areas can have relatively high amounts.



"Ashtabula is a national poster child for a clean-up effort, leading the way for other Great Lakes Areas of Concern," stated Congressman Steven LaTourette. "This shows what the Great Lakes Legacy Act can do."

With the dredging accomplished, the ARP can focus on other things on the Remedial Action Plan. "We are now working on restoring the environment and hope to have the Ashtabula River taken off the IJC list of contaminated Areas of Concern in the Great Lakes in the next few years," Lichtkoppler says.

Beyond the obvious environmental benefits of the dredged river, having the deep draft available will allow for increased shipping opportunities, and a cleaner river should help provide new opportunities for local marinas and businesses.

Ohio Sea Grant is currently developing an economic baseline for the area to measure the potential economic gains that may result from the Ashtabula River project. Economic data collected from local boaters, marinas, and small businesses in the harbor area will allow a comparison to be made in a few years when the river is fully restored. TL

For more information on the project, visit www.epa.gov/glnpo/aoc/ashtabula.html.

Negative Result, Positive Outcome

Study finds no evidence of VHS in Ohio fish

by Stacy Brannan, Ohio Sea Grant Communications



Since its initial discovery in the Great Lakes in 2005, viral hemorrhagic septicemia (VHS) has been a concern for fishery managers around the region. A deadly fish disease with potential to cause massive fish kills, VHS has progressively traveled from Great Lake to Great Lake, spreading to all except Superior, infecting popular Lake Erie sportfish like walleye, yellow perch, and smallmouth bass. Until recently, however, very little was known as to whether the contagious disease had ventured into Ohio's inland lakes, rivers, and reservoirs.

Thanks to a grant from the Ohio Department of Agriculture (ODA) and the U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), a team of researchers from Ohio Sea Grant and the U.S. Fish and Wildlife Service (USFWS) began investigating how far it may have extended into Ohio, collecting fish from 22 of Ohio's most

popular lakes, rivers, and reservoirs.

In the fall of 2007 and spring of 2008, field technicians Tory Gabriel and Jen Hemmert, led by Eugene Braig of Ohio Sea Grant and Jeromy Applegate of the USFWS, captured a minimum of 170 susceptible fish per site.

At the end of the study, every fish the team collected tested negative for the disease.

"This was a wonderful opportunity to partner with Sea Grant and ODA to help monitor the health of Ohio's fisheries resources," explains Applegate. "We're happy to be able to contribute to the collection of these fish, and encouraged that the virus was not found in any of the more than 4,000 fish collected during the study."

The ODA Division of Animal Industry in Reynoldsburg found negative results in all sampled fish, including those caught in Clear Fork Reservoir, where the Ohio Department of Natural Resources, Division of Wildlife recently collected muskellunge (muskie) that

tested positive. The Ohio Sea Grant study also collected fish from Clear Fork, but that collection did not include muskellunge.

Overall, Braig is not concerned about VHS having a substantial impact on large, wild fish populations.

"You can expect a couple seasons of high mortality with the initial introduction of any potentially lethal virus, but a virus seldom causes 100% mortality, and exposed organisms that survive often develop some type of immunity," says Braig. "Note that there have been no substantial confirmed VHS-related kills on Ohio's Lake Erie waters after spring 2006, in spite of the virus' continued presence. There is a potentially greater risk to fish populations in smaller, human-made impoundments and hatcheries, especially where fish are relatively crowded or stressed."

VHS is a very contagious disease for many popular sportfish in the Great Lakes. Fish suffering from the disease can display hemorrhaging of internal organs, skin, and muscle, particularly evident in the eyes, gills, and at the bases of the fins. Other symptoms include darkened coloration, a bloated abdomen, bulging eyes, and lethargy or abnormal swimming and darting. It is also possible for fish to carry the virus but show no clinical signs of disease.

VHS cannot harm humans. Any apparently healthy fish caught in Ohio waters can be consumed with no risk to personal health.

To limit the spread of the virus in the wild, USDA-APHIS imposed a federal order in 2006 restricting international and interstate transport of susceptible fish species. Live fish of susceptible species cannot be moved across a line defined by US-6 in the west and I-90 in the east that separates Lake Erie from Ohio's inland waters. Sportfish may, however, be caught and released within a single body of water that spans state or international boundaries, such as Lake Erie. **TL**

For more about VHS, including a complete list of susceptible species, visit ohioseagrant.osu.edu/vhs.

Rounding Up the Evidence

by Stacy Brannan, Ohio Sea Grant Communications

Drs. McKay and Bullerjahn believe that glyphosate, the main ingredient in the commonly used herbicide Roundup, may be entering the Lake Erie watershed in the runoff from crops planted in the region. This may be causing the harmful algal blooms that have been recurrent in Lake Erie in the last fifteen years.

The Roundup herbicide you're using to keep the weeds out of your garden may be contributing to the growth of harmful algal blooms in Lake Erie, according to new Sea Grant research. Drs. R. Michael McKay and George Bullerjahn of Bowling Green State University are testing the effect of glyphosate, a phosphonate and the main ingredient of the commonly used herbicide, on the strains of blue-green algae found in Lake Erie.

Their interest in this possible connection began three or four years ago, when McKay came across a related journal paper. It seemed researchers had discovered that some marine algae have the ability to break down and use a class of phosphorus-containing compounds called phosphonates when phosphate levels are low in the ocean. Phosphonates had been traditionally viewed as forms of organic phosphorus that are not easily utilized by plankton.

McKay knew the troublesome blooms of blue-green algae, also called cyanobacteria, had been recurrent in Lake Erie over the past fifteen years, even though phosphorus levels have been limited in the region. He thought this new discovery could provide an important link that may help to explain the source of the problem.

Fast forward to 2008, when McKay and Bullerjahn received funding from Ohio Sea Grant to study the effects of glyphosate on the blue-green algae found in Lake Erie. In the early days of the project, Irina Ilikchyan, Bullerjahn's graduate student, has already made some important discoveries.

"Irina has shown both that many cyanobacteria present in Lake Erie have the genes allowing the uptake of

phosphonates, and these cyanobacteria can grow using glyphosate and other phosphonates as a sole source of phosphorus," Bullerjahn says.

The next step, then, for McKay and Bullerjahn will be to determine exactly what the algae do when they're put in a glyphosate-rich environment. "If you take parcels of water and you add glyphosate to them, does that change the composition of the algae?" ponders Bullerjahn. "Does that lead to the perceived rise of cyanobacteria in Lake Erie?"

Currently, the pollution models that are used to create action plans to clean up Lake Erie do not factor in phosphonates. However, McKay and Bullerjahn estimate that as much as 1,000 metric tons of glyphosate are being applied to the Lake Erie watershed, much of it from Roundup Ready, glyphosate-resistant crops planted in the region—largely corn and soybeans. If it is determined that the glyphosate is indeed increasing the amount of algae in Lake Erie, new pollution models that account for the additional phosphonates as a phosphorus source can be created.

"Research is finding that Roundup is getting into the watershed at peak farming application times, particularly in the spring," says McKay. "The glyphosate is being detected in May and early June, and we know that blue-green algae native to Lake Erie can use the compound. What we have not determined is the extent to which they are using it, and if you see a massive change in the microorganisms in the lake at that time." TL



2009 SUMMER COURSES

Earn college credit on Ohio State University's Island Campus on Lake Erie

Introductory Courses for All Majors

Open to college and advanced high school students. To qualify, high school students must have completed their sophomore year, be 15 years of age or older, and have completed one course of high school biology prior to the start of the course.

1-week courses, 3 quarter credits

- **ENR 230:** Ecology and Conservation of Birds (June 14–20)
- **EDU PAES 140.05:** Lake Erie Sport Fishing (June 14–20)
- **ENTOMOL 126:** Introductory Insect Biology (June 21–27)
- **EEOB 125:** Introductory Aquatic Biology (June 28–July 4)
- **EARTHSCI 107:** Introduction to Oceanography (July 5–11)
- **EEOB 125:** Introductory Aquatic Biology (July 26–August 1)
- **EEOB 125:** Introductory Aquatic Biology (August 9–15)

Upper-Level Courses

Our advanced courses are designed for undergraduate and graduate students in biological sciences, education, and natural resources, as well as for biology and general science teachers.

1-week courses, 3 quarter credits

- **EEOB 622:** Herpetology (June 14–20)
- **EEOB 694:** Plankton (June 14–20)
- **EEOB 513:** Field Ecology (July 26–August 1)
- **ENR 629:** Ecology and Management of Wetland Birds (August 9–15)

1-day course, 1 quarter credit

- **EEOB 692:** Ichthyoplankton Identification Workshop (June 28)

5-week courses, 5 quarter credits

Term 1: June 21–July 22

- **EEOB 400:** Evolution
- **EEOB 503.03:** Introduction to Ecology
- **EEOB 621:** Ichthyology
- **EEOB 651:** Field Zoology
- **EEOB 652:** Limnology
- **ENR 799:** Current Topics in Environment and Engineering, 1 credit (Three Thursday evening seminars)

Term 2: July 23–August 22

- **EEOB 440:** Introductory Ethology
- **EEOB 611:** Aquatic Wetland Flora
- **EEOB 653:** Fish Ecology
- **ENTOMOL 612:** Aquatic Entomology
- **ENR 367.02:** Religion, Ethics, and the Environment
- **ENR 799:** Current Topics in Environment and Engineering, 1 credit (Three Thursday evening seminars)

Non-Credit Workshops

Open to the public and college students as non-credit courses. Participants must be at least 18 years of age.

- **Lake Erie Sport Fishing Workshop** (June 5–7)
- **Plankton Identification Workshop** (June 6–7)
- **Travel Photography Workshop** (August 8–10)
- **Algae Identification Workshop** (August 15–16)
- **Algae Identification Workshop** (August 17–18)
- **Fish Sampling Techniques Workshop** (October 3–4)

Science Courses for Educators

Open to classroom teachers and education majors with a junior rank or above by summer 2009.

1-week courses, 3 quarter credits

- **ENR 690:** Global Change Education (June 14–20)
- **EARTHSCI 584:** Oceanography for Teachers (June 21–27)
- **EEOB 511:** Local Flora for Teachers (June 28–July 4)
- **EEOB 785:** Stream Ecology for Teachers (July 5–11)
- **ENR 611:** Great Lakes Education Workshop (July 12–18)
- **EARTHSCI 583.03:** Geologic Setting of Lake Erie (July 18–24)
- **EEOB 513:** Field Ecology (July 26–August 1)
- **ENTOMOL 520:** Insect Biology for Teachers (August 2–8)

REU Program

Stone Lab's Research Experience for Undergraduates Scholarship Program teaches undergraduate students in five or nine weeks how to conduct scientific, in-the-field research with some of the top researchers in their fields. Participants have the opportunity to use scientific equipment, explore the islands, collect data—even scuba dive. Students can choose from one of several focus areas, including:

- **Entomology, the study of insects**
- **Limnology, the study of inland waters**
- **Herpetology, the study of reptiles and amphibians**
- **Ornithology, the study of birds**
- **Fisheries management**
- **Biological collections curation**

Scholarships and Jobs

All students taking for-credit courses are eligible for scholarship funds, which typically range from \$100 to \$2,500. Students enrolled in five-week courses can apply for Stone Lab's part-time positions, as well as seasonal jobs at local Put-in-Bay businesses. For more information, visit stonelab.osu.edu/aid.

Course credits are based on the Ohio State University quarter credit system and are transferable to most colleges and universities.

For applications, go to stonelab.osu.edu or call 614.292.8949

Student Spotlight

Giving Thanks for Gracia

by Stacy Brannan, Ohio Sea Grant Communications

Some children shift from wanting to be a fireman to hoping to become a dentist, from teacher to artist, musician to veterinarian, trying on many different hats to narrow down the vocation they'd like to pursue. Others know what they want to do from an early age and stick to it. The latter describes Gracia Ng perfectly.



"I don't think I've ever considered doing anything but science," she says. "At this point, the question is what kind of science. There are so many possibilities."

Gracia, a junior honors student at Sycamore High School in the Cincinnati area, was pondering those possibilities last year when she received a postcard outlining Stone Lab's one-week introductory courses available to advanced high school students.

She immediately wanted to learn more and ultimately chose to apply.

Because of her longtime love for marine biology, Gracia decided to take Introductory Aquatic Biology, a class taught by Ohio Sea Grant Extension Specialist Fred Snyder. She knew a thing or two about water quality from a project she had done in middle school, but there was more to the class than she expected.

"I didn't know that we were going to get the opportunity to spend so much time outdoors, doing so many hands-on things," she explains. "We got to see different habitats: cold water, warm water. Then we compared what lives in each place and saw how the water quality affects the biodiversity. I had no idea there were so many different kinds of plankton."

Her enthusiasm for the subject matter was evident, leading to growth for her professor as well.

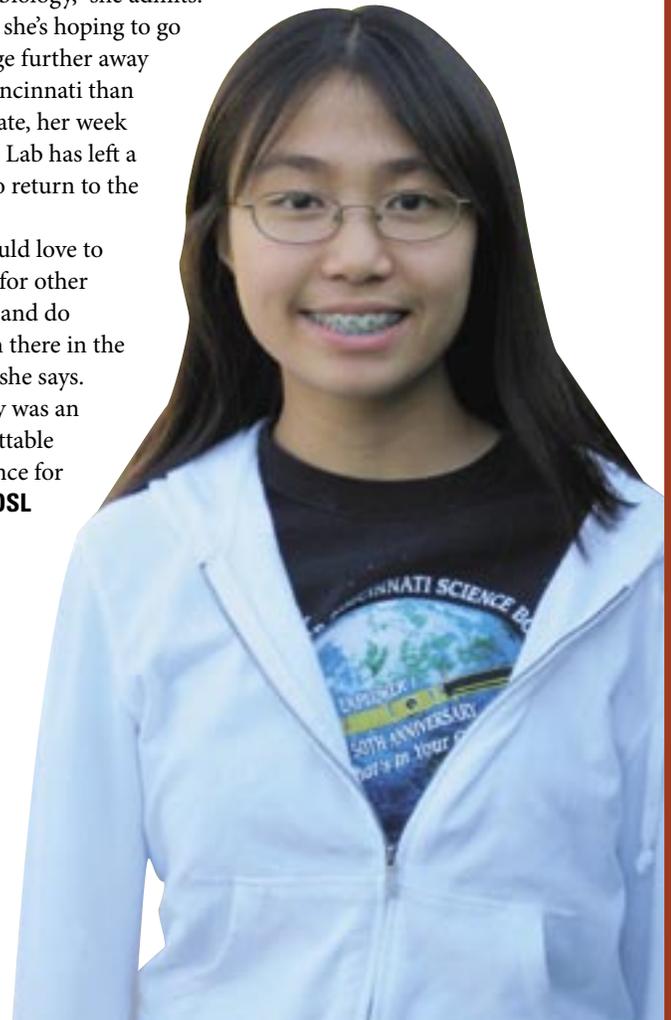
"Gracia is the kind of student you truly enjoy having in your class," says Snyder. "Yes, she is hard working and very bright, but she absolutely loved the work we were doing, and it showed. She asked questions that led me to improvements in my presentations, and for that she has my appreciation."

Now that she's back at school in Southwestern Ohio, Gracia has found that spending a week wading through water at Stone Lab had one unintended benefit: she's become the aquatic biology expert on her school Science Bowl team, and she's using her knowledge in Science Olympiad events.

The class also firmed up the type of science she wants to pursue. "I definitely want to go into some kind of biology now, and I have a very strong leaning toward aquatic biology," she admits.

Though she's hoping to go to college further away from Cincinnati than Ohio State, her week at Stone Lab has left a desire to return to the island.

"I would love to sign up for other courses and do research there in the future," she says. "It really was an unforgettable experience for me." **FOSL**



FRIENDS OF STONE LABORATORY

Dear friends,

So much has happened since I became the newest FOSL President. The fall was busy with the IHOP activities as well as a continuous effort to make the FOSL board as productive and efficient as we can be. I would like to thank all of you who donated to Stone Lab in response to our end-of-the-year letter. Your continued financial support has never been more important than it is now. The financial picture for the lab is becoming more and more challenging in these times of university and state budget realignments.

We are excited about a couple of new projects. The first is the creation of a new FOSL page on the redesigned Stone Lab website: stonelab.osu.edu/fosl. There you can get updates, make a donation, and sign up to receive e-mail notifications.

The second project is the creation of a gift registry at Lowe's home improvement stores, featuring a wish list of items that would be helpful to the operations at Stone Laboratory. You can review the list and even order items at www.lowes.com, then deliver the items yourself or have them shipped directly to the lab. Simply enter the words "Stone" and "Lab" into the name fields on the gift registry page. Any donation from the list will be greatly appreciated and used, particularly at the upcoming Spring Work Weekend April 17-19.

I would also like to thank all of you who came to the recent Winter Program and Silent Auction. I hope that everyone had an enjoyable and educational evening. We sincerely wish to thank all of the donors who contributed items for the auction, as well as all of you who bid on those items. Special thanks to Nancy Cruickshank for her excellent coordination of the event.

In conclusion, 2009 will once again offer us many opportunities to volunteer and support Stone Laboratory. Please consider what you might like to do to help this award-winning and effective program. I look forward to meeting you this year.

Sincerely,

Lisa Bircher
FOSL President

epal_lb@access-k12.org

Volunteers Needed

During the summer of 2008, Lydia Bailey and Charlene Prochazka coordinated a new program for volunteerism at Stone Laboratory. Over the course of the summer, FOSL volunteers put in over 400 hours cleaning the dorms, cottages, and dining hall; clearing brush from the island; and doing small repairs on various buildings. Although the jobs are repetitive, they are necessary to help reduce the costs of operating the lab.

The program went well, but we really need to invite others to participate this coming summer. There are many different chores and projects to fit your interests and talent levels. Volunteers are provided with meals and a place to stay, including linens, and working hours are flexible. To volunteer, contact Lydia at bailey.297@osu.edu. **FOSL**

2008 Buckeye Island Hop

Seventeen volunteers attended the 2008 IHOP, with most arriving early Friday evening, October 3, for a pizza party sponsored by Stone Lab. Several folks scraped the paint off Stone Cottage in hazardous materials gear—white suits, masks, booties, etc.—because lead paint was originally used on the building. Procedures were very detailed, and the scrapings were collected and disposed of according to EPA guidelines.

Other volunteer activities included power washing the lower levels of the classroom building, as well as dusting, sweeping, and removing copious spider webs from the interior; lubricating locks and door

hinges of several buildings; cleaning the rooms in the research building on South Bass; winterizing the landscaping at the Lake Erie Historical Society at Put-in-Bay; and scraping the paint off the interior walls of the South Bass Lighthouse tower.

Although we had a smaller group this year, we still accomplished a lot. The social events were great, including a wine reception, perch dinner, and breakfast, and the educational events were informative. As always, the support from the Stone Lab office both on the islands and in Columbus was fantastic! **FOSL**



The Friends of Stone Laboratory (FOSL) began in 1981 as a support group to “bring Stone Laboratory into the 21st century with the best possible facilities, equipment, and professors, and make this an unequaled learning experience available to all outstanding students.” Members of the Friends provide a way for former students to support the facility by raising awareness and funds for scholarships, research, and equipment.

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 Arleen Pineda, Program Coordinator (pineda.2@osu.edu)
 Kelly Dress, Office Associate (dress.3@osu.edu)

FOSL

Spring Work Weekend is coming!

April 17-19

Contact Kelly Dress at 419.285.1800 or dress.3@osu.edu to register.

Get supplies on the Stone Lab gift registry at www.lowes.com.

11th Annual Winter Program and Silent Auction

About 100 people turned out for the FOSL and Ohio Sea Grant 11th Annual Winter Program and Silent Auction, held February 18, 2009, in Columbus. In all, more than \$1,600 was raised to benefit Stone Lab programs and scholarships. FOSL would like to thank all of the Silent Auction donors:

Bob Adamov

Anthony-Thomas Candy

Don Arcuri

Black Swamp Conservancy,
 Lake Erie Islands Chapter

Boardwalk Restaurant

Lauren Bradley

Buckeye Corner

Cameron Mitchell Restaurants

Center of Science and Industry
 (COSI)

City Barbeque Restaurant

Columbus Blue Jackets
 Foundation

Columbus Guitar Society

Columbus Museum of Art

Columbus Symphony Orchestra

Columbus Zoo

Suzanne Cruickshank

Dick's Sporting Goods

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Franklin Park Conservatory

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Guy Harvey Publishing

Heineman's Winery

Katherine Huchko

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Limited Brands

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 Living Magazine

John Mahilo, DDS

Mary Kelly's Restaurant

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Perry's Cave Family Fun Center

Pure Fishing

The Refectory Restaurant & Bistro

Kristin Stanford

Ronald Stuckey

Edward and Carrie Svigel

Toledo Museum of Art

Toledo Symphony

Tony's Place

Trader Joe's

United Dairy Farmers/
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