

# NRRI *Now*

Winter 2015

## Natural Resources Research Institute

UNIVERSITY OF MINNESOTA DULUTH  
Driven to Discover™

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*NRRI has generated decades of data in the St. Louis River Estuary. Now we're sharing the science with the public.*

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~ Growing Strong Industries

~ Developing New Ideas

~ Nurturing Natural Resources

# FROM THE DIRECTOR: ROLF T. WEBERG



“  
*As the University’s applied research laboratory regarding use of natural resources and economic development, we are participating in new collaborative opportunities to deliver solutions-based research.*”

Welcome to the Winter 2015 edition of NRRI Now. Since our fall edition, the Institute has continued to pursue engagement and conversations with our colleagues on the Duluth and Twin Cities campuses, our industry and agency partners, environmental organizations, the business community and our regional entrepreneurs. As a result, Minnesota stakeholders are becoming more aware of NRRI, our mission and our work.

We have also continued to integrate the broad expertise within the Institute as we consider development of multidisciplinary research programs. As the University’s applied research laboratory regarding use of natural resources and economic development, we are participating in new collaborative opportunities to deliver solutions-based research.

Our environment generates our economy. Said another way, an economy without a healthy environment is not sustainable in the long term. An organism cannot live on its own wastes and an economy is really no different. No one wants to be in an unhealthy environment; it does not attract investment, cannot retain the best and the brightest needed to drive innovation and does not support economic diversity and growth.

Participation in today’s industries and businesses requires a commitment to the regional community for responsible operation. The public offers a “social license” to operate based

upon the trust that the intended activities will be performed safely, without significant harm to the environment, human health & safety or the regional economy. This license, once lost, can be very difficult to regain.

NRRI is in a unique position, with its broad expertise, to assist in the definition and maintenance of the “social license.” We continually leverage our environmental science expertise as a foundation for development of technical solutions to challenges associated with use of our natural resources and the environmental impact.

In this issue, we showcase solutions or balanced guidance to regional challenges such as invasive species, shipping, landfill reduction and bat habitat implications to forestry industries. We also continue to assist our industry partners in enhancing efficiency and waste reduction.

I hope that you enjoy this issue and, as always, appreciate your responses, input and support.

A handwritten signature in black ink, which appears to read "R. T. Weberg". The signature is stylized with a large, sweeping flourish at the end.

# Sharing stories & science

## St. Louis River Estuary gets the spotlight on a new website

It's easy for residents in northwestern Wisconsin and northeastern Minnesota – states separated by the St. Louis River Estuary – to find “their own little patch of wilderness” as Dave Zentner says. He's one of the featured storytellers in a new website devoted to the “Stories and the Science” of the Estuary. It's a special place that melds industry, recreation and wildlife habitat in a delicate balance. The site aims to improve understanding of the many issues associated with the history of the river and estuary.

NRRI helped with the “science” side of the website, answering such questions as:

- How do we humans impact the environment of the St. Louis River Estuary?
- How has water quality changed over the decades?
- What are we doing to restore habitat for fish, birds and other wildlife?
- The estuary ranges from forested shorelines to a modern shipping port. How does that influence wetland plants and important aquatic insect communities?

“Our goal is to connect people with science and drive home the understanding that people are part of the ecosystem,” said George Host, principal investigator on the project. “When you improve people's understanding of both the science and the history of a place, they are more engaged and better caretakers.”

The “Stories and Science of the St. Louis River Estuary” site was created by faculty and staff from NRRI, the University of Wisconsin, and the Minnesota and Wisconsin Sea Grant programs with help from many partners. Featured topics include wild rice, fishing, recreation, community and restoration projects. Site visitors



Key for map:	
	Fishing
	Shipping
	Wild Rice
	Community
	Recreation
	Restoration

can challenge themselves with “GeoQuests” – iPhone-based games and geocaches that highlight key places and issues in the estuary, or they can use the “deep map” to explore the ecology and history of this unique place.

Host developed special geocache-based games for teachers to use with their students, giving them the tools to collect real science data. Families and visitors in the area can also interact and learn.

“This is a unique website,” said Host. “We are hoping this blending of science, stories, mobile apps and deep maps on the Internet will encourage people to get out and explore this fascinating ecosystem.”

StLouisRiverEstuary.org launched in December with the help of many social media posts attracting thousands of visits. The project received funding from Sea Grant and the Minnesota Pollution Control Agency.



[www.StLouisRiverEstuary.org](http://www.StLouisRiverEstuary.org)



# NRRI EXPANDS KNOWN LOCATIONS OF INVASIVE SNAIL

**I**nvasive species are sneaky. It can be hard to know just how extensively they're spread and what kind of environmental stress they can cause. This fall, NRRI scientists greatly added to the list of known locations of faucet snails (*Bithynia tentaculata*) in the Great Lakes. The new locations show the snails have invaded many more areas along the Great Lakes coastline than anyone realized.

The spread of these small European snails is bad news for water fowl – the snails carry intestinal flukes that kill ducks and coots.

“We’ve been noting the presence of faucet snails since 2011 but didn’t realize that they hadn’t been officially reported from our study sites,” explained Valerie Brady, NRRI aquatic ecologist who is collaborating with a team of researchers in collecting plant and animal data from Great Lakes coastal wetlands.

Research teams from 10 universities and Environment Canada have been sampling coastal wetlands along the Great Lakes coast since 2011 and have found snails at up to a dozen sites per year [See map 1]. This compares to the current known locations shown on the U.S. Geological Survey website [see map 2].

“Our project will, over five years, take us to every major coastal wetland in the Great Lakes. These locations are shallow, mucky and full of plants, so we’re slogging around,

getting dirty, in places other people don’t go. That could be why we found the snails in so many new locations,” explained Bob Hell, NRRI’s lead macroinvertebrate taxonomist. “Luckily, they’re not hard to identify.”

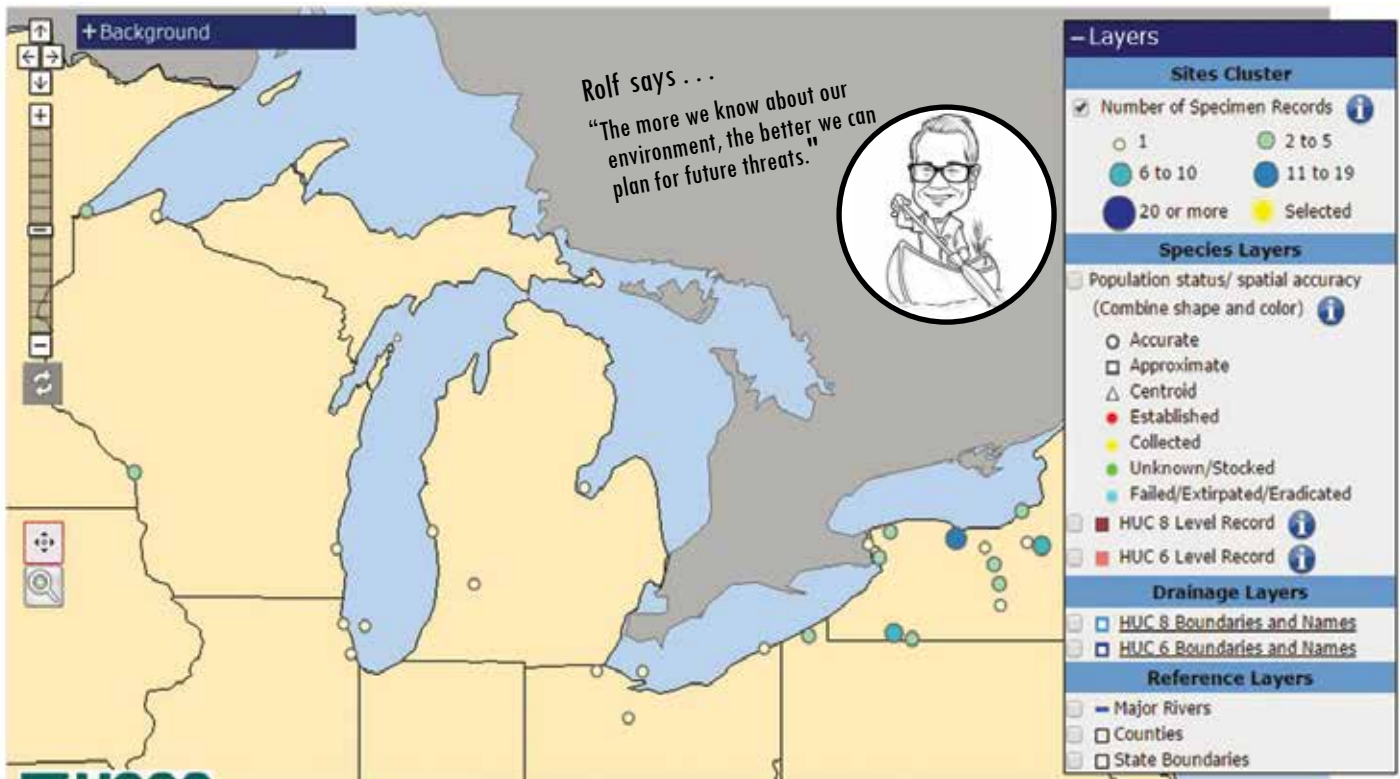
The small snail, 12 – 15 mm in height at full size, is brown to black in color with a distinctive whorl of concentric circles on the shell opening cover that looks like tree rings. The tiny size of young snails means they are easily transported and spread and they are difficult to kill.

According to the Minnesota Department of Natural Resources, the faucet snail carries three intestinal trematodes that kill ducks and coots. When waterfowl consume the infected snails, the adult trematodes attack the internal organs, causing lesions and hemorrhage. Infected birds appear lethargic and have difficulty diving and flying before eventually dying.

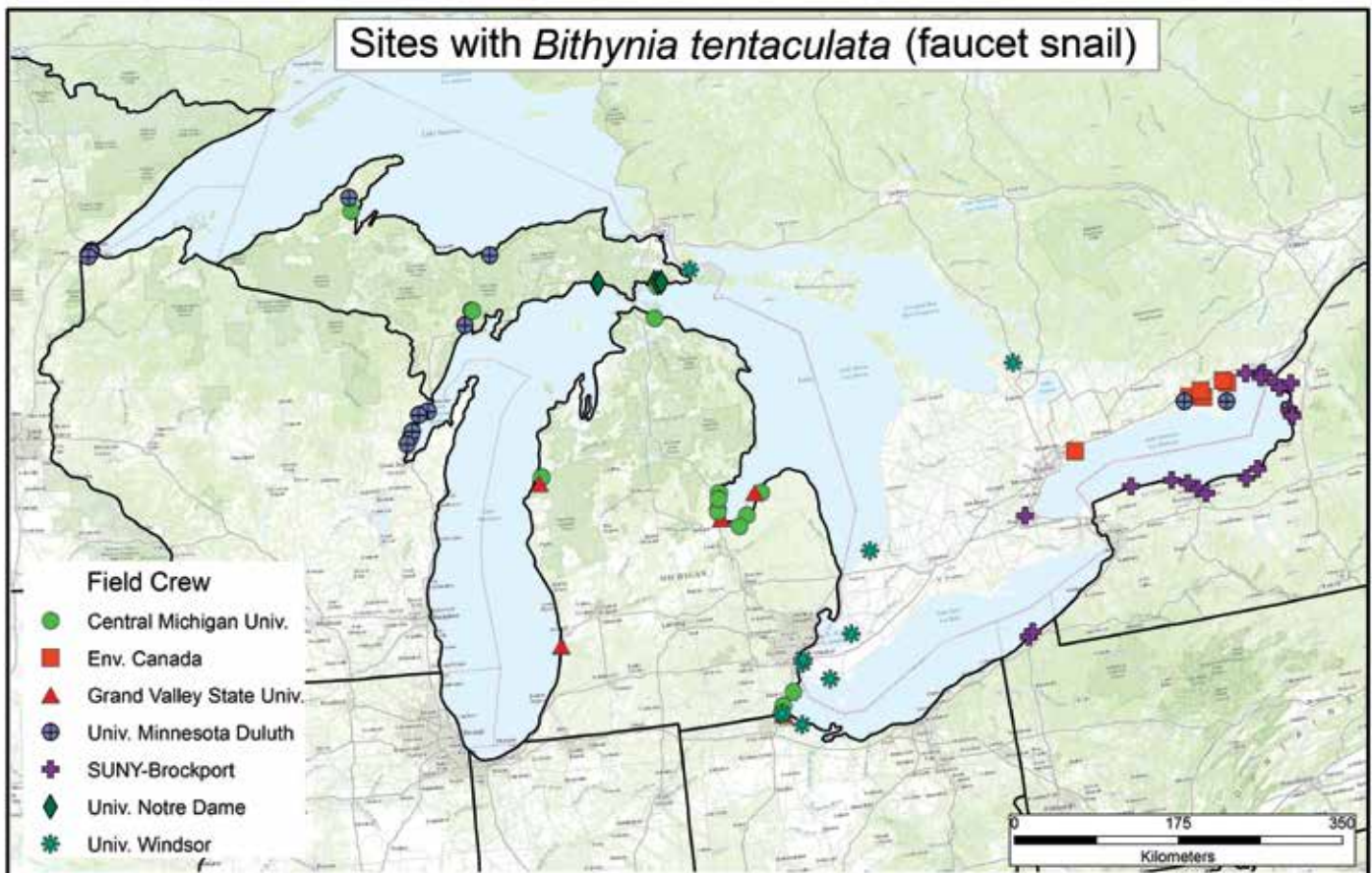
Although the primary purpose of NRRI’s project is to assess how Great Lakes coastal wetlands are faring, detecting invasives and their spread is one of the secondary goals. The scientific team expects to report soon on the spread of non-native fish and has helped to locate and combat invasive aquatic plants.

“Humans are a global species that moves plants and animals around, even when we don’t mean to. We’re basically homogenizing the world, to the detriment of native species,” Brady said while underscoring the importance of knowing how to keep from spreading invasive species. Hell added, “We all have to make sure we clean everything thoroughly before we move to another location.”

For more information on how to clean gear and boats to prevent invasive species spread, go to [www.protectyourwaters.net](http://www.protectyourwaters.net).



MAP 1: Previously-reported locations of the faucet snail in the Great Lakes. From the US Geological Survey invasive species tracking website, <http://nas.er.usgs.gov/>.



MAP 2: Locations of faucet snails discovered during wetland assessment sampling by field crews from 10 major universities and Environment Canada in collaboration with USEPA's Great Lakes National Program Office. Project funding from the Great Lakes Restoration Initiative. Site icons indicate which crew found the snails. Map credit: NRRl Geographic Information System Lab.



1. Epicurean's CNC router cuts bread boards from the recycled paper/plastic composite material.



2. The resulting odd scraps are gathered and sent to NRRI.

NRRI Scientist and Materials Specialist Victor Krause is helping Loll Designs, local outdoor furniture manufacturer and Epicurean sister company, with sunlight and weathering testing. Pieces of the different colors of recycled plastics are loaded in a frame to expose a portion to the elements on NRRI's rooftop.

"We have it set at an angle that will see the most sun throughout the day," Krause explained. "Then monthly we change that angle, and each year we cut off one inch from each sample to note the color change."

The rooftop results are compared to a similar study done in NRRI's QUV accelerated weathering tester in the mechanical test lab. The QUV reproduces the damage on materials by sunlight, rain and dew. This helps Loll get the best information to their customers about weathering and aging of their products.



NRRI researcher Victor Krause adjusts the roof top frame

Dave Benson just couldn't take it anymore. Enough was enough. He stood looking at the weekly roll-off dumpster, filled with high quality material, going off to the landfill. He had to do something.

Benson is chief financial officer of Epicurean, a Duluth-based culinary supplies manufacturing business. Their signature recycled wood fiber material products result in odd shaped scraps that he wanted to keep from filling that dumpster.

"I just hate seeing that material go to the dump. It's good stuff and we're paying to throw it away," said Benson. "Our company philosophy has always been to reduce waste and use and reuse as much as you can."

NRRI has a long relationship with Epicurean and its sister company, Loll Designs, helping with product development and testing as the companies grew and developed new product lines. Benson knew there could be possibilities for making chopsticks out of the odd scraps, but needed help developing the manufacturing process.

NRRI machinist Steve Johnson took on the challenge. The quarter-inch thick scrap material is a composite of recycled cardboard and epoxy resin. It's durable and dishwasher safe, but it's also an abrasive material that needs to be machined with diamond-coated cobalt steel cutting tools and carbide router bits.

# SCRAP MATERIALS BECOME NEW PRODUCT LINE

NRRI helps Duluth company make products that reduces their waste



3. NRRI student worker Richie Vang, and others, learn how to prototype a new manufacturing process and make a new potential product for Epicurean.

4. Once the new manufacturing process is perfected, the chopsticks made from scraps will keep some of the material out of the landfill and add a new product line.

“So we had to come up with a process of taking it from the scrap form to sticks with dual tapers,” said Johnson. And it’s not as straightforward as one might think. Johnson had to develop two precision cutting steps, plus a chamfering step to bevel the end, and a tumble process to smooth the edges. And time is money in the manufacturing business. Efficiencies are important and time trials were conducted.

“The first ones were about a minute and a half with a manual mill... then we stepped it up and now we’re between 30 and 45 seconds per chopstick,” Johnson said.

When a focus group was brought in to test the chopsticks, it was apparent that the pointy end wasn’t as important as they thought. Not having to make that fine cut also sped up the manufacturing process.

“So Steve and I figured out how to get the production process down, but how do we get them into mass production? What if Williams Sonoma or Crate and Barrel want an order of 5,000? Can we do it?” Benson asked.

He had his art department develop packaging and launched the product line at a Chicago trade show in

early 2014. They were well received and the orders started coming in. It wasn’t long before production just couldn’t keep up with sales.

NRRI hired student workers to manufacture the chopsticks with a dual mission – to give them real-world manufacturing experience and help meet Epicurean’s demands. Meanwhile the process continues to be readied for the next step – setting up Epicurean to manufacture chopsticks at their facility.

“I feel really good about this project,” said Benson. “We’re making a product out of material that would go to the landfill. And NRRI has been a tremendous help in figuring out how to make this happen.”

Rolf says . . .

“Transforming waste into product is good business -- and another sustainable solution!”



# Where bats fly free

**NRRI study will help forest managers understand bat habitat**



Photo credit: Lisa Powers



**B**ecause they're nocturnal and pretty much stay out of our way, bats might not be at the top of one's list of concerns. But bats are important. Without those flying mammals, the millions of mosquitoes and other insects they eat each summer night would be feeding on us. Bats are integral to ecosystem balance.

But now bats are threatened by an emerging disease that's killing them by the millions. White Nose Syndrome is caused by a fungus picked up in caves during hibernation. First identified in 2006 in New York, it has spread throughout the Northeastern United States and into Canada, down to Mississippi and west to Missouri. Based on its rate of spread, White Nose Syndrome will probably reach Minnesota in the next few years.

The U.S. Fish and Wildlife Service has proposed listing the Northern Long-Eared Bat for protection under the Endangered Species Act, which would affect Minnesota's forestry industry. Forests are important habitat for bats and the listing could affect when and how trees are harvested in the summer, as well as

interfere with other forest habitat management protocols.

NRRI is teaming up with the Minnesota Department of Natural Resources on a project recommended for funding by Minnesota's Legislative-Citizen Commission on Minnesota Resources (LCCMR) that will provide more insight into bat habitat in Minnesota forests.

A priority for the Department of Natural Resources is to find a balance between conserving bat habitat and maintaining sustainable forest management in Minnesota. "We need to build that balance on sound scientific information," said Rich Baker, DNR endangered species coordinator. "I can't imagine better partners than NRRI and the U.S. Forest Service in conducting the research that will give us that solid foundation."

Minnesota bats have not been confirmed with White Nose Syndrome but all indications are that it is coming. Cave explorers are encouraged to disinfect their clothing and equipment after each excursion. In many parts of the country, caves are closing to curtain

the spread of the disease. Bats can live to be more than 30 years old, but with only one young per year, recovering from a population decline is difficult.

"Females use maternity roosts to raise young until they can fly. Right now we don't know which trees they use and how long they use them," explained NRRI Biologist Ron Moen, who is principal investigator on the project. "They hibernate in caves in the winter, but in the spring, summer, and fall they live in the forest."

Moen and his team of researchers plan to start on the three-year research project this spring. They will set up finely strung nets to catch the bats, attach tracking devices, and then find the trees where bats roost.

"Then we'll return in the evening to count the bats coming out of each roost tree and find out how long a tree is used," Moen explained. "Basically, we'll be identifying characteristics of maternity roost sites to help make the best management decisions."





NRRI researcher Matt Mlinar

## NRRI minerals lab upgrades technology to get more from Minnesota Ore

Minnesota's iron ore mining industry seems as old as dirt in Minnesota, but like any business, it has to innovate and evolve. For mining, the changing availability of limited ore deposits drives innovation. NRRI is anticipating another change on the horizon – increased mining and processing of hematite ores in addition to the magnetite ores that are currently being made into taconite pellets.

NRRI has the know-how and now the technology to prepare the Iron Range for this evolution. A new Wet High Intensity Magnetic Separator will allow the lab to conduct research on the process of recovering low magnetic hematite ores.

Currently, magnetite is recovered with low intensity magnetic separators and a silica flotation process. But the low intensity magnets don't work with the low magnetic properties of the hematite, so those ores are being sent to the tailings piles as a waste rock. The new separator is made with rare earth electromagnets which produce the high intensity magnetic field with electricity which attracts even the low magnetism of the hematite.

NRRI's new separator is small, processing just 200 gram batches at a time, but it will lay the groundwork for testing on the physical and chemical properties of the ore to meet the needs of the steel industry.

"In the next 10 to 15 years, as mines start to run out of magnetite, they'll be looking at other opportunities for iron, like hematite," said Dick Kiesel, director of NRRI's minerals lab in Coleraine, Minn. "We want to be ready for that."

Both magnetite and hematite are iron oxides, but the oxidation state of iron is not the same for both minerals. Hematite is 70 percent iron, reddish



in color and is mined around the world. Magnetite has an iron content of 72 percent and is the Range's "low hanging fruit" for ore recovery. The current taconite facilities were built to easily recover the magnetic iron and until recently, the low-magnetic iron was considered waste material. In fact, the process of making taconite pellets results in the magnetite becoming oxidized to hematite in the firing process.

"The technology is getting better and magnet strength is getting higher," said Kiesel. "This is a huge opportunity for the Iron Range to recover more of its valuable ores."



# On the front line of the invasion

## NRRI collaborates to reduce invasive species in the Great Lakes

Duluth-Superior Harbor, at the most pristine end of the Great Lakes, is the freshwater port most heavily invaded with non-native species. It's easy to understand why. Duluth-Superior is often the last stop on international routes and ballast water from all over the globe gets emptied there so ships can reload.

It's a one-way ticket for unwelcome guests that can wreak havoc on the locals.

NRRI expertise in understanding the tiniest of freshwater organisms is being applied on a large, collaborative project to curtail ballast-mediated invasions. NRRI Scientist Euan Reavie, an expert in aquatic microorganisms, is one of the lead researchers for the Great Ships Initiative, a project of the Northeast-Midwest Institute, housed in a facility in Superior, Wisc.

The Initiative is working to resolve the problem of ballast hitchhiking species in the Great Lakes as quickly, effectively and economically as possible, within regulatory guidelines. In December, the researchers released a report on their study of the effectiveness of eight commercially available ballast filter systems.

"Ships will be required to have validated treatment systems," explained Reavie. "And we're the only freshwater facility that can test these candidate systems."

The land-based testing facility pulls in water from the harbor at 340 cubic meters per hour and sends it through filter systems provided by different manufacturers. Stringent information was collected on both ends – input and output. Filter company participation was important to the study and to provide transparency to their customers, the ship owners.

"It was the ship owners who expressed initial concern because they basically have to 'shop in the dark' when they're purchasing filter systems," explained the Initiative's Principal Investigator, Allegra



Cangelosi. "They don't know what they can expect from the systems."

The Initiative held a webinar to coincide with their released report on the performance of the filter systems. Each vendor also received a complete analysis of their specific filter product. The researchers found that all filters functioned effectively, but none achieved the federal ballast water discharge standard of 10 microorganisms per milliliter of water. Reavie is also leading a study to discern whether or not 10 is the right number per milliliter to prevent future invasions, though it's still a tremendous improvement over 1,000 to 2,000 before the filtering.

"Some people want to see zero organisms in the ballast," Reavie said. "But the lower the number, the more difficult it is to confirm scientifically. For instance, if we wanted to test for one cell per milliliter, we'd have to analyze 10 times as many samples."

The researchers didn't go into this project expecting one filter to completely eradicate organisms in

ballast water. They will continue research on other filter systems that include complementary techniques like ultraviolet light and chemical treatments such as chlorine and ozone to reach the mandated standard.

"The harbor has incredible organism diversity and that really challenges the systems," Reavie added. "But while complicated, we were able to simulate what a ship might experience elsewhere."

In 2015, the researchers will test systems on the ships themselves, travelling to China, the Netherlands and California. For more information visit [www.greatshipsinitiative.org](http://www.greatshipsinitiative.org)

### GREAT SHIPS INITIATIVE RESEARCH PARTNERS

- Northeast-Midwest Institute
- Natural Resources Research Institute
- University of Wisconsin-Superior
- University of Oregon
- AMI Consulting Engineers
- Ballast Water Management Filter System Developers
- Several Ship Owners

## Doing our mission from the inside out!

By Ryan Hueffmeier, NRRI Sustainability Coordinator

**S**TUDENT-DRIVEN SUSTAINABILITY RESEARCH IS HELPING TO MOVE NRRI TOWARD LOWERING ITS ENERGY FOOTPRINT AND BEING A ZERO WASTE RESEARCH INSTITUTE.

Energy reduction strategies and streamlining the recycling process is giving students hands-on, applied experiences. As a land grant university with a public research mission, it is imperative that students are given opportunities to develop skills to be agents of change locally, regionally and globally. Future leaders must be able to address the challenges that lie ahead.

One of UMD's strategic goals is to use the university's resources - infrastructure, technologies, information and people - to support the campus in a sustainable manner. The sustainability program at NRRI was developed in July 2013 and works in partnership with UMD's Office of Sustainability to implement focused approaches to reduce waste and support the results with data to share with the University system and the greater community.

Sustainability@NRRI gives students the opportunity to work on obvious improvements like energy efficiencies, infrastructure and waste stream, as well as the social aspects of sustainability. Is more efficient lighting easier on staff eyes? Will a parking lot garden promote healthy eating? Students develop NRRI projects through the viewpoint of economic, social, and environmental benefits with broader applicability in mind.

The program goes beyond the standard definition of sustainability - how current needs are met while offering future generations the same opportunities. NRRI wants students to be part of the ever-evolving conversation on sustainability issues and to consider things like resiliency, broadly defined as the ability to adapt and grow in the face of unforeseen challenges.

Sustainability@NRRI has four student researchers working on a variety of projects. They're also assessing the feasibility of a solar wall and developing a survey to understand the staff's sustainable beliefs and actions.



Graduate research assistants Eleva Potter and Matt Detjen are moving sustainability @ NRRI forward.



### Program Successes:

- Since October 2013, an in-house composting operation has diverted over 3,000 lbs. of organic material from the landfill.
- A lighting audit found that replacing the fluorescent lights in three stair towers with LED bulbs would use 43% less energy.
- In just a few months, NRRI has turned 2,740 pounds of paper into funds to support students' time in the sustainability program.
- Research, outreach, and education have streamlined the internal recycling program (aluminum, paper, plastic bags, printer toner cartridges, batteries, electronics, and hazardous waste).
- Presenting information at community and university events has helped to spread the word about NRRI's efforts and the institute as a whole.
- NRRI's thermally modified wood is being tested for durability as raised garden beds at the facility, making use of compost generated onsite.
- A Holiday Magazine Drive brought in 450 pounds of recyclable paper over a two-week period.

Visit us online: [www.nrrri.umn.edu](http://www.nrrri.umn.edu)



The Natural Resources Research Institute was established by the Minnesota Legislature in 1983 to foster economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector employment.

**Rolf Weberg, director**

**Center for Water & the Environment**

Lucinda Johnson, director

**Center for Applied Research & Technology Development**

Donald Fosnacht, director

**Center for Economic Development**

Elaine Hansen, director

*NRRRI Now*

June Kallestad, editor/writer

Trish Sodahl, graphic design

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Natural Resources Research Institute  
University of Minnesota Duluth  
5013 Miller Trunk Highway  
Duluth Minnesota 55811-1442

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## Donation expands NRRRI's air quality research capabilities

The world is a dusty place. And dust particle pollution can be a health hazard. Knowing what's in the air is vital to protecting people from dust that can pass through the throat and nose and enter the lungs. In this case, size matters.

NRRRI is now uniquely equipped to gather and measure airborne particles of varying sizes while its geologists can identify the mineralogy of the particles. This combined skill set is made possible by a generous equipment donation by Virgil Marple, a retired University of Minnesota professor of mechanical engineering. The donated equipment is two high volume, three-stage samplers that he re-designed to make them more versatile for research.

"There are only three or four of these machines in the world and Virgil has donated two of them to our program," said NRRRI Program Director George Hudak.

Various state and federal agencies use high volume filter samplers to test air for regulatory compliance. They use a locker-sized instrument that draws in air and collects particles that are 10 and 2.5 micrometers in diameter – five and 30 times smaller, respectively, than the width of a strand of human hair. It's at that size that the particles can be breathed into the lungs and impact human health.

But the samplers that Marple modified and donated to NRRRI can also collect "super fine particles" such as those found in smoke and haze that have a diameter of one micrometer – 50 times smaller than that hair strand. NRRRI has also purchased three Micro-Orifice Uniform Deposit Impactors, called the MOUDI. This instrument pulls in much smaller amounts of air than the high volume samplers, but separates particles into 10 progressively smaller orifice sizes. Having two types of samplers gives NRRRI a wide range of capability for performing comprehensive air studies.

Marple worked with Dale Lundgren of the University of Florida and Bernard Olson at the University of Minnesota to design the three-stage high volume samplers. The team was working on a project in the desert southwest where there was interest in determining if the "Fine Particle Standard" should be at 2.5 or one micrometer. "But I'm retired now and I wanted them to go somewhere to do some good," Marple said.

There are plenty of opportunities for air quality research in Minnesota, explained Hudak. "The donation of this equipment greatly enhances the range of the types of studies we can do," he said. "Virgil continues to be a tremendous mentor to us here at NRRRI and we're honored that he has donated this equipment to our program."



A re-designed high-volume, 3-stage air sampler.