UNIVERSITY OF MINNESOTA DULUTH

A GREAT UNIVERSITY ON A GREAT LAKE

NATURAL RESOURCES RESEARCH INSTITUTE

NRRI *Now*

Autumn 2010

Sunrise over Lake Superior. NRRI receives U.S. EPA funding for Great Lakes Restoration Initiative research.

~Growing Strong Industries
~Developing New Ideas
~Nurturing Natural Resources
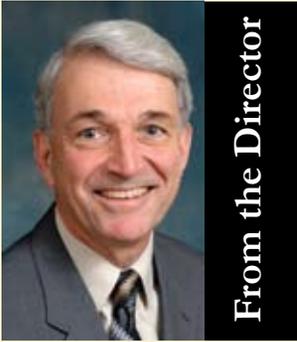
JOB CREATION – NRRI STYLE

Michael J. Lalich

Faced with a tenuous economy in the aftermath of an election period, we keep hearing: "It's all about jobs to revitalize the economy." Economic development leading to jobs is easier said than done, of course, and there are numerous approaches on how best to achieve that. From my perspective, much of this thought is aimed at near term fixes and single action initiatives, which makes reaching the objective particularly difficult when it comes to the important manufacturing sector – a sector facing growing international competition.

I'm far from an expert on the economy, but I have had an opportunity to see what does and doesn't work for NRRI and our clients. A request early this year to testify on economic development and job creation before a Minnesota legislative committee gave me cause to think about what NRRI does in the context of the current conversation about stimulus and moving the economy forward.

I see NRRI's activities and strategies as a bit above and beyond what is being promoted in the mainstream conversation, and as vitally important to help stabilize and promote business and industry. This is particularly true in an increasingly competitive international environment with emerging countries like China attempting to gain advantage by not always adhering to free market practices. To explain, let me first characterize the current "job creation" conversation by grouping the nature of proposed and ongoing initiatives:

"Combining the business acumen of individuals and companies with NRRI technical capabilities raises prospects for business growth to a new level."

1. **Investment in Infrastructure** (Roads, Schools, etc.) The argument, particularly in political circles, relates to how effective "stimulus" is in creating jobs and jump-starting the economy. It seems to me that these actions do have a short term benefit for job creation and a longer term benefit by having better infrastructure in place. Consideration has to be given to the cost of these efforts and if they can be sustained.

2. **Favorable Business Tax and Regulatory Environments** Fair tax and regulatory systems provide a foundation that poises companies to prosper and grow. Alone, however, they are not sufficient. Businesses need to keep up with innovation and production efficiency, as these vital markers of business success in a competitive world are no longer just the province of the United States.

3. **"Job Creation" Programs** (Job Z, Grants and Loans to Business, etc.) These kinds of incentives are helpful, but by and large, incomplete. Many factors, not just one or two, determine business success. These strategies are no match for more comprehensive job creation strategies and efforts emerging in the international marketplace.

4. **Recruit Business from Elsewhere** Domestic and international companies want to relocate and expand. Typically, they are offered some financial and property incentives by units of government. In addition, a convincing argument has to be made that a location is suitable, if not ideal. Local communities are forced to play to not lose ground, and they may be successful, but looking a larger geographical area this may be a zero sum game. To keep up with competition, these efforts become difficult and frequently costly.

The NRRI Model for Job Creation

NRRI employs a "grow business" applied technology model. For the past 25 years, we have been systematically and strategically investing in our applied research infrastructure. NRRI has been able to assemble outstanding laboratories and pilot development facilities, equipped with a broad array of research and development equipment that is primarily, but not exclusively, targeted to working with and on our region's natural resources. This infrastructure, in the hands of outstanding, experienced applied research and development professionals, represents a powerful capability for collaboration with entrepreneurs and small and large businesses.

One only has to page through recent NRRI Now editions to see examples of how NRRI teams with entrepreneurs and small business to develop new products or improve business proficiency. These individuals and companies, particularly those in the wood products industry, by themselves could not reasonably be expected to have the research capacity, knowledge, or financial resources to grow and prosper. However, combining the business acumen of these individuals and companies with NRRI technical capabilities raises prospects for business growth to a new level.

Emergence of NRRI's Coleraine Minerals Laboratory as the key minerals processing research and pilot development facility of Minnesota's taconite industry has allowed NRRI to assist this important industry with product quality and production efficiency issues that are critical to the industry's efforts to stay competitive. Further, NRRI's efforts on its longer term vision to help the industry by developing value added products (iron nodules) and by-products (aggregate) have gained momentum and private sector business support. Couple this with NRRI's well recognized 25-year effort to assist the development of Minnesota's non-ferrous minerals industry, and NRRI's role to help sustain and grow our region's largest industry is evident.

NRRI's "job creating" economic development model is to provide tangible applied research and development to companies, large and small, collaborating closely with these partners in the process.

Watching wetlands

$2.3 million to measure coastal conditions around the Great Lakes

Now that we know what the plants, bugs and birds in the Great Lakes coastal areas can tell us, it's time to go after that information. In particular, what can these "bioindicators" tell us about the condition of the wetlands?

Round one of the Great Lakes Environmental Indicators (GLEI) project was a collaborative effort from 2001 to 2006. Led by NRRI, this massive project created a portfolio of bioindicators to measure the condition of the U.S. coastal regions of lakes Superior, Michigan, Huron, Erie and Ontario. The indicators project studied microscopic algae, aquatic macroinvertebrates, wetland vegetation, birds, and amphibians across the 200,000-square-mile basin, in all types of nearshore ecosystems.

At the same time, the Great Lakes Coastal Wetland Consortium developed a suite of strictly wetland

bioindicators. After a funding hiatus, money is again available to continue the important work of both of these efforts and meld them together.

The Consortium received $10 million to assess the condition of all coastal wetlands in the Great Lakes, and to compare bioindicators developed by both groups, even into Canada. NRRI's $2.3 million role will be a five-year effort to sample the western end of the Great Lakes, and to help support the sampling efforts across the rest of the basin.

"We'll go everywhere we have to – Isle Royale, the Apostle Islands, Kakagon Slough – from Duluth to Milwaukee we'll be collecting and analyzing samples from the coastal wetlands. In some places it's going to be very difficult and a lot of work," said NRRI Scientist and Project Coordinator Valerie Brady.

But Brady is ready, because she will be organizing the field work and field safety training for all the sampling crews that will go out across the Great Lakes, training them on data quality requirements, and how to enter data correctly into the project database.

"Even after training, sampling coastal wetlands isn't always straight-forward," said Brady. "Wetlands get partially destroyed, water levels go way up and way down, and getting access can be difficult. When the crews need advice, we have to be available to help them figure it out."

And because of experience gained with the GLEI project, NRRI's Geographic Information System Lab is also charged with sample site selection, GIS analyses, and landscape indicator analysis for the entire project – from Minnesota's North Shore to upstate New York. NRRI will provide the field crews with the maps and sampling points they need. NRRI's GIS team will also create a giant database that can hold all of the information and provide it to the Environmental Protection Agency.

Wetlands around the Great Lakes' coasts play an essential role as habitat for unique plants, insects, birds, and other animals. Wetlands also filter pollutants, reduce coastal damage during high water years, and provide important spawning and nursery areas for fish.

Brady explained that tracking the condition of the wetlands is important to make sure degraded wetlands are improving, and to protect those that are still in good condition.

"Each lake has a variety of marshes, swamps, bogs and wet meadows," she said. "Each type is unique and hosts unique bug, fish and bird communities. If we don't keep a watch on our wetlands, we might not realize how much they're degrading until it's too late to fix them easily."

Wetlands Consortium Project Partners

Central Michigan University – Project Leader
UMD's Natural Resources Research Institute
State University of New York – Brockport
Lake Superior State University
Notre Dame University
Grand Valley State University (in Michigan)
University of Windsor

University of Wisconsin – Green Bay, River Falls, and Superior
Oregon State University
Bird Studies Canada
Michigan Department of Natural Resources and Environment
Environment Canada
USEPA Great Lakes National Program Office (cooperator, funding agency)

Indicators of our influence

$ 1.6 million for Phase II Project

NRRI scientist Dan Breneman during the 2001 pilot study

Plotting and sloshing and boating their way along the coastal areas of the Great Lakes in 2002, scientists started collecting the first comprehensive data on indicators to monitor the health of the lakes' ecosystems.

This winter, NRRI scientists are planning Phase II of the Great Lakes Environmental Indicators project. Phase I was a $6 million, five-year effort funded by the Environmental Protection Agency. This second phase received $1.6 million for a three year study.

"We're going to be much more targeted and strategic," said NRRI Center Director Lucinda Johnson. "And we'll use data from the Coastal Wetland Consortium project which is collecting samples at 1,500 locations." (See story on page 3.)

But while Great Lakes Environmental Indicators II will be more focused, it will also be expanded.

"This time, we're expanding the scope to the Canadian side of the Great Lakes," said Johnson. "That's important because pollutants and invasive species don't respect political borders. What happens on one side of a lake affects the entire system."

Starting this spring, NRRI field technicians will be sent out to 60 locations – including 20 new sites in Canada – to collect samples and document the status of the indicators. Environmental indicators are the biological, chemical or physical attributes that can be measured and monitored to provide insight on the study area's condition. Bugs and plants are examples of biological attributes. Chemicals can include endocrine disrupters or carcinogens. Physical attributes range from crashing waves on a rocky shore to quiet, swampy bays.

The indicators will be tested against each other. Which indicators are the most cost or time effective? Which give the most accurate information about specific conditions?

"The EPA is really firm that this project develops a set of recommendations – go here, do this, and this is the information you'll get," explained Johnson. "They don't just want a series of methods."

Scientists will also look for landscape changes – new housing, roads or parking lots, for instance – at 20 sites that were sampled in 2002 to see if the changes affected the values of the measured indicators.

"This research gives the EPA the information and tools it needs to safeguard the environment and protect human health," said Johnson. "We have to know how our decisions affect water quality before we can make wise decisions."

Muddy No More

$ 845K for stream restoration

Trout in Duluth's Amity Creek say thank you. The fish – and the rest of us who enjoy clean water – appreciate the new funding that will fix eroding banks, reduce stormwater runoff, and teach people how to keep the water clean.

The Great Lakes Restoration Initiative has granted nearly $845,000 to implement a variety of restoration and protection projects on Amity which joins with the Lester River before it feeds into Lake Superior. Both the Lester and Amity have been designated as "impaired" with excessive sediment and the goal is to clean them up and keep them healthy.

"These trout streams are easily harmed by excess muddiness caused by soil, grit and other gunk washing in," said NRRI aquatic scientist Rich Axler who is leading this effort. "We also have too much storm water from neighborhood street sewers that goes straight into the streams and erodes the banks."

The restoration efforts evolved from NRRI's Weber Stream Restoration Initiative which is a collaborative effort that began with seed money from former Duluthian Ron Weber. The entities involved with NRRI are the South St. Louis Soil & Water Conservation District, the City of Duluth and Minnesota Sea Grant. This new project will be managed by the Minnesota Pollution Control Agency. The expertise of 20 other partner organizations will also be tapped for this effort.

3-Prong Approach to Clean Streams

1. **Remediation and restoration of sediment sources**, such as eroding banks, repair to bridges and culverts, reforestation where needed.

2. **Tools for rural stormwater runoff and erosion reduction**, such as computer models for township planning.

3. **Outreach and education**, such as project results on www.LakeSuperiorStreams.org and through the Superior Regional Stormwater Protection Team.

Amity Creek restoration project completed in 2009.

GLRI

Great Lakes Restoration Initiative

How much can a moose munch?

$200K to measure forage availability
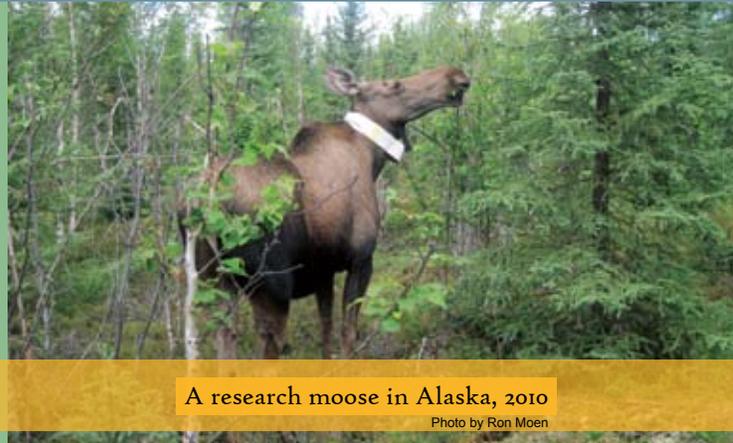
A research moose in Alaska, 2010
Photo by Ron Moen

Moose can eat up to 100 pounds of twigs and shrubs per day, so it's understandable that Minnesota biologists are asking the question: Do we have enough food for them?

Concern about declining moose populations in northeastern Minnesota has attracted funding to understand more about these iconic woodland creatures. New funding of almost $200,000 from the Great Lakes Restoration Initiative will focus on the availability of moose habitat and its proximity to food sources.

"It's more than just 'is there enough?' With summers like the one we just had, where it's pretty hot for days in a row, the moose don't move as much or eat as much, and then they may not be able to put on their winter weight," explained NRRI biologist Ron Moen. "So we have to look at how close the forage is to cooler bogs and swamps – what is truly accessible."

The funding will provide money to restore over 200 acres of moose foraging habitat along the North Shore of Lake Superior. Restoration means putting outgrown food plants back within reach of munching moose, either by shearing, hand-cutting or prescribed burns.

Working with another study on radio-collared moose, the scientists will go where moose have been, following in their tracks and gathering data on their eating habits.

"Moose will strip the leaves off a twig, and can take over 10,000 bites in a summer day and 3,000 bites in a winter day," Moen explained. "We can look at what's left behind and determine if they're getting the quality and quantity of forage necessary to maintain good health."

The three-year study will be conducted with the cooperation from the Department of Natural Resources, and the U.S. Forest Service. County foresters may also collaborate in the effort.

PLANT PROTECTION FROM THE INSIDE OUT

Tom Levar inspects plants in NRRI greenhouse.

Adapting a chemical used to deliver medicines through the skin, NRRI scientist Tom Levar has developed a way to protect plants from hungry deer and mice by delivering a natural hot pepper concentrate through the roots of young plants, making them inedible.

"This is a game-changing technology," said Eric Summa, CEO of Repellex USA, which licensed the technology from the university. "We're excited because there really is no other systemic deer repellent like this. It goes right into the plant, and doesn't wash off like spray deterrents."

Levar, a forestry and horticulture specialist, was familiar with how Dimethyl sulfoxide (DMSO) was used in veterinary and sports medicine to open pores in a membrane and move medicines through skin. He developed the plant formulation to move different types of protection chemicals through easily accessible plant pores.

In the case of Repellex, tablets with the delivery formulation are placed near the roots of a plant and, when watered, release a natural hot pepper concentrate known as capsicum that is absorbed by the plant.

"This is a great application because capsicum is very safe and very effective," said Levar. "There is no genetic modification. Eventually the plant will outgrow the capsicum treatment, but it lasts much longer than spray repellents because it doesn't wash off in the rain."

This systemic plant conditioning composition, as the technology is formally known, can also be used with insecticides or fungicides. "Anything within the realm of plant protection that includes small molecule active ingredients," said Levar. He started his research on the DMSO formulation with a bitter substance used to keep children from sucking their thumb.

"We did a lot of testing, mostly with tree growers in nurseries where they have a huge problem with mice eating away at their plants," said Elizabeth Summa, president of Repellex USA. "We think professional growers and homeowners will find value in planting two tablets with their trees and not having to worry about their investment."

The product has been submitted to the Environmental Protection Agency for registration. Once approved, it will be available to commercial growers and shipped to retailers, likely in time for the spring planting season.

The university's Office for Technology Commercialization negotiated the license agreement for the systemic plant conditioning composition with Repellex. "This is an excellent example of how research at the Natural Resources Research Institute can be applied in an environmentally sound manner and, at the same time, help promote economic development and create jobs," said Eric Hockert, technology marketing manager.

Creating environmental leaders

NRRI trains college students in the community

Finding and training people to bridge the gap between environmental advocacy groups needing help and potential student volunteers is at the heart of a newly-funded program led by NRRI scientist Pat Schoff.

GLISTEN—a sparkly little acronym that stands for the Great Lakes Innovative Stewardship Through Education Network—is a program funded by the Corporation for National and Community Service, a federal agency best known for programs such as VISTA and AmeriCorps. The corporation's Learn and Serve America program supports students in service-learning projects throughout the country.

Schoff explained that GLISTEN is truly innovative in that it connects college students with the community on many levels while also teaching them valuable skills for future environmental careers.

"We really see this growing exponentially, as the students become teachers and mentors in their communities," said Schoff. "It will provide invaluable experiences for students interested in leadership positions in the emerging green economy."

Academic and community environmental groups around the Great Lakes receive GLISTEN funds to train undergraduate students as Stewardship Liaisons who in turn receive leadership, service-learning and community engagement training, as well as practical, on-the-job training from the community organizations. Faculty also incorporate stewardship concepts into their curriculum and offer opportunities for undergraduate students to take part in service-learning projects.

"I think it's great to have student liaisons informing and educating other students," said Julene Boe, executive director at the St. Louis River Alliance. "It gives greater recognition to issues and concerns of the Great Lake, and ultimately we'll have better informed students coming into the work force."

UMD student Zach Moore led the group's stream monitoring program which assesses water quality of streams flowing into Lake Superior. UMD student Micaella Kinzli was responsible for organizing and coordinating the annual Beach Sweep at the Great Lakes Aquarium, part of an international coastal clean-up effort.

"Micaella did a great job coordinating and recruiting volunteers. She made sure they had the tools they needed and taught them how to collect data on the debris collected," said Sarah Erickson, aquarium education director. "Beach Sweep is also an awareness campaign. Micaella helped us educate the public about what gets washed up on the shore, so she learned public relations, as well as about the aquarium."

The Western Lake Superior GLISTEN project includes Lake Superior College, the University of Wisconsin-Superior and Northland College in Ashland, Wisc. In addition to UMD, the project is also sponsored by the National Center for Science and Civic Engagement at the Harrisburg University of Science and Technology.

This GLISTEN cluster, one of 10 around the Great Lakes, will receive funding for three years. The goal is to expand the local program with more faculty willing to add the stewardship element to their courses, and add community partners for more service-learning opportunities.

"I study birds because they are indicators of the health of our planet.."
~ Jerry Niemi
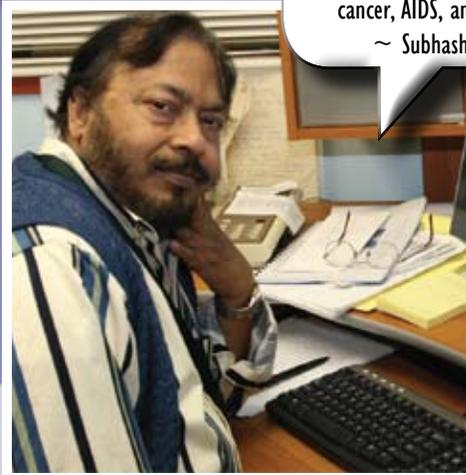
"I use mathematical chemo-bioinformatics for the assessment of potential toxicity of pollutants and new drug discovery for cancer, AIDS, and malaria."
~ Subhash Basak

"I'm studying the effect of chemicals and a warming climate on frogs to understand how human activities influence wildlife and aquatic ecosystems."
~ Jennifer Olker

NURTURING NATU

"I try to understand how human activities on the land influence aquatic ecosystem health and then develop tools for assessing and restoring the environment."
~ Lucinda Johnson

"My research and educational outreach relates to how invasive earthworms, like angle worms and night crawlers, are negatively affecting hardwood forests. I'm also working with university staff and students to establish a Sustainable Agriculture Program at UMD."
~ Cindy Hale

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"I am evaluating ship-board ballast water treatment systems to determine whether they can prevent non-native species invasions in the Great Lakes while having a negligible impact on maritime commerce."
~ Euan Reavie

"My research i
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"I generate study designs and sampling protocols that provide a snap-shot of the aquatic community for biological monitoring of local lakes and streams. Our goal is to provide cost-effective results with methods that are standardized, defensible and applicable to a variety of water bodies."
~ Dan Breneman
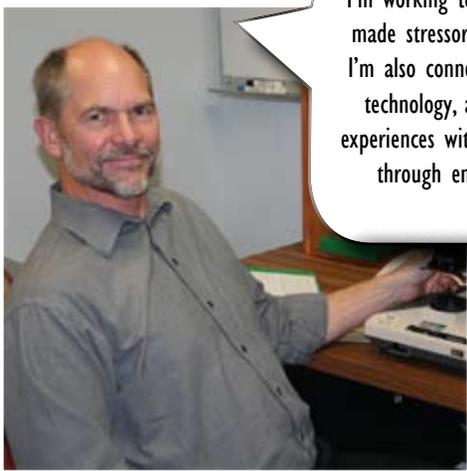
"I'm working to discover the effects of man-made stressors on developing amphibians. I'm also connecting undergraduate science, technology, and engineering classrooms experiences with community-based programs through environmental stewardship."
~ Pat Schoff

"Environmental data is varied and complex. I'm helping teachers, business owners, resource managers, elected officials — anyone and everyone — understand how weather, vegetation, geology, land use and human activities interact to affect the health of streams and lakes."
~ Rich Axler

URAL RESOURCES

take the birds-eye view of Minnesota's cape to help decision-makers address issues d to our complex mosaic of forests, lakes streams. My goal is to provide data that bute to maintaining viable ecosystems and sustainable use of natural resources."
~ George Host
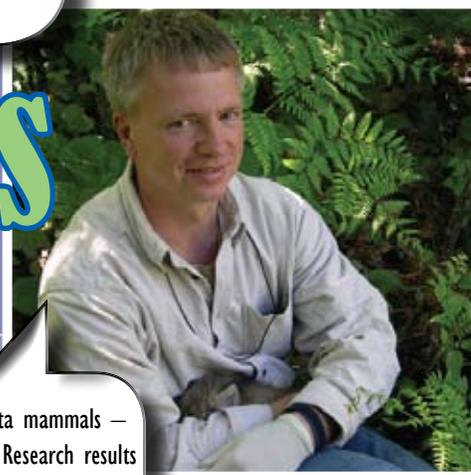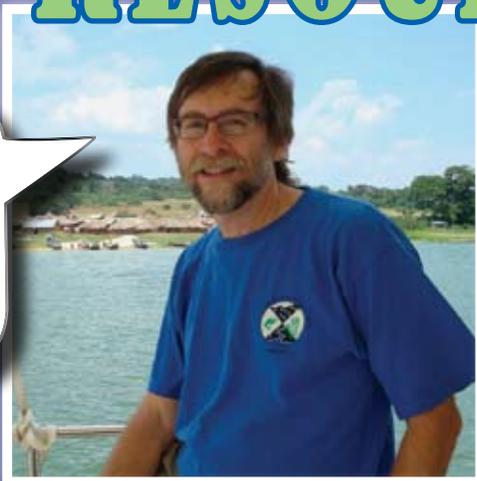
"I work on Minnesota mammals — from mice to moose. Research results have direct application to managing Minnesota's natural resources."
~ Ron Moen

"I develop advanced landscape and ecosystem data analyses to characterize ecosystem stress and ecological value, including land/water interaction, to prioritize protection, preservation, and restoration efforts."
~ Terry Brown

focused on helping educe the impacts of as excessive stormwater streams, wetlands, Lake her natural resources."
alerie Brady

"I'm studying microscopic organisms as indicators of past and present environmental conditions, enabling water quality managers to set realistic goals for aquatic remediation."
~ Amy Kireta

NRRI stream collaborative wins environmental award

Benefactor Ron Weber accepts award from EPA's Cameron Davis.

In July, a Duluth-based stream restoration collaborative received national recognition – make that bi-national recognition from the U.S. and Canada.

U.S. Environmental Protection Agency Senior Advisor Cameron Davis presented the 2010 Environmental Stewardship Award to Ron Weber whose private donation to NRRI started the Weber Stream Restoration Initiative. Each year, the Lake Superior Binational Forum recognizes people who make a "superior" effort to protect or restore the lake's natural environment.

"The Weber Initiative was highly scored by the binational judging panel because it represents a partnership of scientists and resource managers from more than 25 different groups that has culminated in at least 13 stream-related projects along Lake Superior's North Shore," said Lissa Radke, U.S. coordinator for the Forum.

Started in 2005 with endowment funds and garnering almost $2 million in externally funded grants, the Weber Stream Restoration Initiative's goal is to enhance habitats and biodiversity in Lake Superior tributary streams by protecting and restoring watersheds along Minnesota's North Shore.

"We believe that protection and restoration of these streams will be successful only if both the root causes of damage, as well as the symptoms of disturbance are addressed," said Rich Axler, lead investigator on the project. "That's why we depend on a consortium of professional resource managers, academic scientists, and the public in cross-disciplinary communication about ongoing activities in the North Shore watersheds."

The Lake Superior Binational Forum is a multi-sector stakeholder group of U.S. and Canadian volunteers that work together to provide input to governments about lake issues and educate basin residents about ways to protect and restore the lake. More about this organization is at www.superiorforum.org.

'Getting more from corn' continues

Photo Credit: Josh Kohanek

Funding to test commercial potential of enhanced ethanol process

Two years ago, we announced that NRRI Chemist Pavel Krastusky (above) and his team had developed a process for making corn ethanol manufacturing more efficient and productive.

Today, we're happy to report that the University of Minnesota's Initiative for Renewable Energy and the Environment has granted $250,000 to design an integrated biorefinery and to assess the commercial potential of the process on a pilot scale basis.

Ethanol plants produce billions of gallons of renewable fuels each year. However, they also produce millions of tons of byproduct called dried distillers grains with solubles (DDGS), a low-protein livestock feed. When applied to the average ethanol plant, the integrated technology tested in this project is expected to increase the number of products from the plant and increasing its annual profit by $21 million.

Ethanol plants will be able to produce 10 percent more ethanol than they do now, and also a high-protein distiller's grain to make protein-rich livestock feed, biodiesel fuel and an additional 10 percent ethanol.

If applied to the entire ethanol industry, the improved capacity is expected to enhance energy efficiency by 15 percent and increase the production of transportation biofuel by 20 percent. Successful completion of this project will be a crucial step toward large-scale commercialization of an integrated biorefinery.

(With information from IREE/Theresa Bipes)

Cutler-Donahue bridge in Madison County, Iowa.
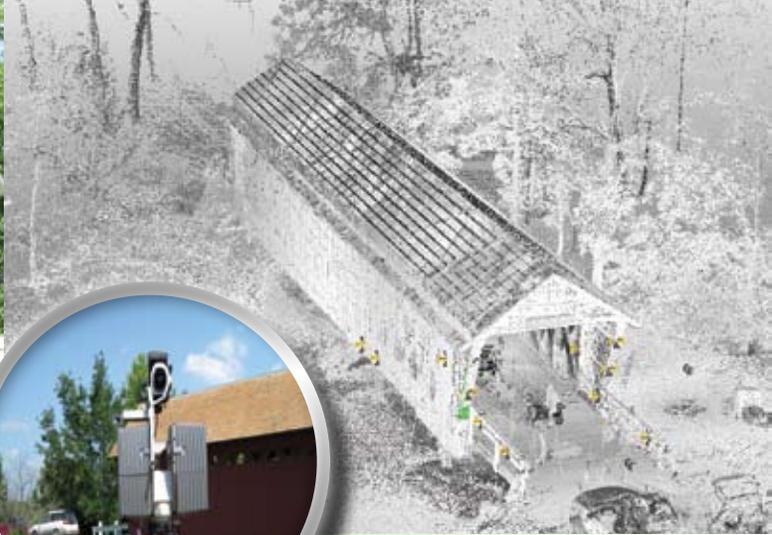
Digital point cloud image.

Bridging the old with the new

Historic bridges are preserved with laser technologies

When the Zumbro River crested at 22.8 feet in September, local residents actually felt a bit of relief. At least it didn't reach the projected 28 feet that would have been a worse disaster for the town of Zumbrota, Minn.

Flooding in Goodhue County this summer was devastating to many businesses and homeowners, but another close call came when the swollen river just skimmed the bottom of the town's historic covered bridge.

Had the water reached its projected crest, however, work by NRRI this summer would have proven invaluable. Into the future, the covered bridges of Madison County in Iowa and Minnesota's one remaining covered bridge in Zumbrota are digitally imaged – down to the knot holes – and preserved for posterity.

Madison County has lost 13 of its original 19 covered bridges, built in the late 1880s – the last destroyed by arson in 2009. With no engineered drawings of the bridges, rebuilding from preserved pictures and inaccurate plans would require a lot of guesswork. The USDA Forest Products Laboratory contacted NRRI wood products Program Director Brian Brashaw to find a way to preserve the details of the remaining bridges.

Brashaw partnered with Faro Technologies, Inc. and SightLine, LLC to create computerized renderings using a 3-D laser scanning device that collects millions of points on any object. Each bridge took SightLine 6-8 hours to gather the raw scan data. NRRI intern Sam Anderson could then process the data into a digital "point cloud" (see photo above) and AutoCAD images.

"This is a great demonstration of the potential of this equipment," said Brashaw. "The bridges are a big tourist draw to these rural areas. And there are other new opportunities. We can figure out how to apply this technology to manufacturing plants, measure volumes of forest stands, or gather accurate landscape measurements for stream remediation projects."

After completing 30-plus scans on each bridge, each one is photographed, tape-measured and the information is processed with unique software provided by kubitUSA. The digital files are then sent to the USDA Forest Products Lab. With the Zumbrota bridge records, a 1/100th scale replica built in NRRI's rapid prototyping center was also included. The digital collection will eventually be added to the Library of Congress and each community will receive detailed information for their historical archives.

"We enjoyed working on this project with NRRI," said SightLine President Penny Anstey. "The bridges are important to the economy and history of these communities. And this is what we got into this business for, to preserve history."

It's not a day at the beach
NRRI's summer student employees 'work it'

From earthworms to new construction techniques, the variety of research taking place at NRRI is fascinating – and we're happy for the help we get from college students.

This year NRRI hired 50-some undergraduate and graduate students to help with the nitty gritty tasks of research in both the Center for Applied Research and Technology Development and the Center for Water and the Environment. Here's a smattering…

Tyler Johnson – A Construction Function

This fall when Tyler Johnson returned to UMD's Mechanical Engineering Department as a senior, he had more than a summer tan. He comes back skilled in construction, construction design, product development and accounting. And he has the envy of fishing friends –

one of his jobs at NRRI was to help design a new style of portable ice fishing house.

"The inventor came to us with the idea of using Knapp panel connectors that we've used on other projects to make Ice Condos," said Johnson. "We designed three prototypes and I designed the bed system, so that was my contribution."

Johnson also worked on building a "hot box" for an NRRI scientist that will measure insulation values of wall prototypes. This is a smaller version of what's already on the market and will save the project thousands of dollars.

"I just got done taking a thermodynamics class last semester,

so it's a great project to push my knowledge," Johnson said. "Working at NRRI gives me great exposure to businesses and new ideas."

April Severson – Going Microscopic

Working seven hours a day, three days a week is plenty when those days are spent analyzing ultra microscopic particles. Using a scanning electron microscope, April Severson is charged with searching out very specific particles collected in the air on Minnesota's Iron Range.

"I'm working on the lung health study, looking at the air samples collected for any elongated particles," said Severson. The Minnesota Taconite Workers Health Study is a research initiative funded by the State of Minnesota to understand health issues of Iron Range taconite workers.

Severson thinks using the high-powered microscope, and the science behind the project, is "very cool." She seeks out any particles that have a length three times longer than the width, records the image and the location where it was found.

Severson is a senior mechanical engineering student at UMD this fall.

Byron Ninham – As the Worm Turns

Figuring out how to educate anglers on the damaging effect of non-native earthworms on Minnesota's sugar maple forests is tricky. Basically, all earthworms in the forests of northern Minnesota are non-native. And yet, most anglers stare wide-eyed in disbelief when told they're not good for the forests.

Byron Ninham is one of four undergraduate students working with eight fishing resorts on the Leech Lake Reservation/Chippewa National

Forest in northern Minnesota to determine the best way to persuade anglers to dispose of bait properly (i.e., in the trash). As a 2010 graduate of UMD in environmental studies, Ninham said his summer job is "definitely cool."

"One of our team members is working to pass legislation that would make information on proper disposal mandatory on bait containers," said Ninham. "There are still areas on the Leech Lake Indian Reservation that are earthworm free and we'd like to keep it that way."

Ninham is working on an independent project to understand the effects of earthworms on sugar maple sap production, which is important culturally and economically to the Ojibwe people. He is also using GIS data to better understand the long-term changes to earthworm invaded forests.

"I'm using the tradition of oral history to gather information from tribal elders, too, about the importance of the maple forests, and the traditions," said Ninham who is a member of the Oneida Nation of Iroquois.

Other team members are gathering information on the impact of fishing tournaments and the spread of earthworms, and talking with professional anglers about bait options and bait sales.

Becky Abel – Batty for Bats

We've all seen bats flying in the dusk of a summer evening, but not a lot of hard data has been collected on forest bats in Minnesota's arrowhead region.

In her third year in UMD's Integrated BioSciences graduate program, Becky Abel is out to change that – at least for the bats along Minnesota's North Shore.

"I kind of have a thing for bats," she said with a grin, "and bats are just poorly understood. So I

proposed research on how bats are differentially using habitat on the North Shore."

To do this, Abel is using acoustic bat detectors – a piece of equipment she attaches to a tree that has microphones that record ultrasonic signals that bats produce while flying and foraging. She leaves it up for a few days, then downloads the data.

"I can see little ticks that indicate the call structure which tells us which species of bat it is," Abel explained. "Then we can see how frequently the calls are recorded to get an index of activity in different habitats."

This is her second summer working on the project, which she hopes will lead to research on bat migration patterns that can be used when decisions are made to locate wind turbines.

Will DeRocher – A Better Biomass

Taking chemistry at UMD was a wise move before working at NRRI. As he does research on torrefying wood chips – basically baking out the moisture and removing some volatiles – Will DeRocher is applying his classroom studies to real world applications. In this case, he's making waste wood into an alternative fuel.

"We are gathering a database on how well various species of wood respond to torrefaction, collecting the heating values and how much heat we can get per pound, or unit value, of torrefied wood," DeRocher explained.

He can envision a time in the future when torrefied biomass is used in pellet stoves or even as a replacement for coal. As a civil engineering major at UMD, DeRocher likes being part of the research that moves it forward.

"A lot of things I've worked on at NRRI are finding uses for waste, recycling it into products that are sellable," he said. "Torrefied wood is a lot more energy dense and a lot more user-friendly than regular wood chips."

Josh Bednar – The Real Twitter

With a lifelong interest in wildlife, taking an ornithology class at UMD sealed his fate. Josh Bednar was destined to wake at 4 a.m. on summer mornings, head for the woods, and listen to bird calls. As part of NRRI's bird team, Bednar is charged with monitoring bird populations for the Forest Bird Survey – a 20-year-old database of increasing and decreasing bird species in three regional forests.

"I had to pass a test showing I could identify about 80 bird species by sound and visual identification," said Bednar. "This is my second year and I've improved, I'd say, 100-fold over what I could do last year. I really like it."

Bednar is hoping to become a wildlife biologist when an opportunity opens up, but in the meantime, he's happy to keep listening to bird calls and adding to the survey database as long as he can.

Andrea Crouse – Telling Water's Story

A love of Lake Superior and the natural beauty of the Duluth area motivates graduate student Andrea Crouse in her studies… and her projects at NRRI.

This summer she worked with Minnesota Sea Grant funding to find new ways to help people understand the connection between land use and water quality.

"We're informing some meteorologists in town about stream data animation available from sensors in five Duluth streams," Crouse explained. "We want to help them educate people about how land use and weather affect water quality and fish habitat. Meteorologists are well respected, 'easy access' scientists for the public, and everyone tunes in to watch the weather up here."

Through this project, Crouse has found that people in the Duluth area enjoy fishing the trout streams and

the natural beauty which makes it easier to bridge the land-water connection.

"The meteorologists we've worked with have been excellent, really listening to what we're trying to explain and then distilling it to fit their short timeframe," said Crouse. "I find sound bites challenging, but I'm learning to be more streamlined with what I say, thinking about just one message I want to get across."

Crouse is working on a thesis project for her master's degree in Integrated Biosciences at UMD.

Paul Kimpling – New Wave Heating

Staring down his last year of college at UMD, Paul Kimpling is grateful for the two summers he's spent working on a wide variety of projects at NRRI.

"It's fun, and I'm learning things that can help me in the future," he explained. "I'm getting a different perspective on how to think through solutions to problems."

Kimpling's latest project at NRRI involved taconite tailings and microwave ovens – a seemingly odd

combination. But, working with an industrial microwave company, Kimpling helped to collect data on the ability of waste taconite rock to attract heat with microwaves and different applications for the two together.

"I'm all over the place, working on many different things at NRRI," said Kimpling. He worked on a pothole patch product that NRRI is developing and an energy absorbing block. He also helped microwave contaminated sediments from the Duluth harbor to see if this would kill any potential invasive species lurking within.

"I'm more of a water resources guy, but it is great working on so many different projects and the variety of people I get to work with," he said.

Hold back the rain

Scientists hold rain garden workshops to educate public

When it comes to rainfall, this summer was a doozy in northern Minnesota – some 15 inches of rain fell in June, July and August. Combined with the area's clay soils and steep slopes, a lot of people were seeing pools gathering in their yards, or worse, in their basements.

"Water will go where it can," says Valerie Brady, NRRI aquatic scientist. "The best we can do is encourage it to go where we want it and away from where it will cause problems."

A very effective, and lovely, way to do that is with a rain garden. Properly designed, it will capture and hold water that runs off roofs, driveways and lawns, filtering pollutants and letting the stormwater slowly absorb into the earth.

"During big rain events, stormwater runoff from neighborhoods and streets can overburden nearby streams causing the banks to erode, making the water muddy and filling the streambed with dirt," said Brady. "A rain garden can hold back hundreds of gallons of water."

Brady explained that her own property generated over 2,500 gallons of stormwater runoff during a one-inch rain storm. She captures as much as she can with rain barrels and rain gardens.

"In a typical rain storm, a house roof alone will generate hundreds of gallons of runoff," said Brady. "That doesn't even count the garage, driveway, yard... You get the picture. It's a lot of water."

To educate Duluth residents on how to build rain gardens, Brady teamed up with Minnesota Sea Grant and the City of Duluth to hold workshops in June and August. The workshops were a combination of classroom, touring blooming rain gardens, and then lending a hand to build one.

Peggy Donahue lives in Duluth's Woodland neighborhood and she's had a wet basement this year. She had been thinking about putting in a rain garden, but needed the know-how.

"I thought I knew where to put it, right where the water was pooling up," said Donahue. "But now I won't put it there. I learned the right placement."

She will choose a location that's a low spot on her lawn, but that drains water naturally, at least 15 feet away from her foundation. She also learned how to choose plants that survive droughts to drenching.

Kenwood neighborhood resident Delores Grunwald also appreciated learning about stormwater and the university research being done in Duluth. She wants to build a rain garden at her church and said the workshop was "definitely worthwhile and very interesting."

University of Minnesota Extension Educator Eleanor Burkett, who taught the classroom portion of the workshop, said that the partnership approach of the workshops was key.

"That's what it really takes. A community coming together to do their part to keep excessive stormwater from degrading the streams," she said. "When people understand the science, it's not an abstract concept anymore. They asked really good questions."

More information on rain gardens can be found at LakeSuperiorStreams.org/toolkit or through Minnesota Sea Grant at www.seagrant.umn.edu.

Participants learn how to build a rain garden.

Valerie Brady (left) plants vegetation during the workshop.

You, too, can canoe

NRRI helps inventor develop paddle for one-arm use

Photos courtesy of Cindy Dillenschneider.

Millions of people find solace with a canoe, a paddle and access to Minnesota's abundant lakes, rivers and streams. Yet for those with upper body disabilities, a simple canoe paddle can be a barrier that keeps them from participating in this sport.

One woman set out to change that by inventing a paddle that is fully functional using one arm. The "One-Arm Freedom" paddle was born of Cindy Dillenschneider's determination to share her love of outdoor recreation by making paddling more inclusive.

NRRI was able to help her move her idea forward with its rapid prototyping capabilities.

"I really appreciate the work that Steve [Kossett] did through NRRI's prototype center," said Dillenschneider. "His work and encouragement were critical in moving the paddle to the next stage of development."

The tricky part to this new invention was the angle piece connecting a shaft from the shoulder saddle to the paddle. It had to be strong enough to take repeated pressure of heavy duty paddling. There was nothing like it already available.

"Steve helped create the design that would allow the specialty part to be made in production mode," she explained. "I made this piece myself with what's called a 'lost wax' casting process which took me over 20 hours per piece! NRRI's lab was a significant time saver."

NRRI has four different rapid prototyping technologies which are ideal for small volume items. Once the design of a part is perfected, other manufacturing methods are generally more economical.

"We used our Fused Deposition Modeling machine with black ABS plastic to match the carbon fiber material that goes over the top," explained Kossett, NRRI's prototype lab director. "I drew up a CAD (Computer Aided Design) model of the prototype she had made. We then quickly made about 20 models for actual functional testing and evaluation."

Dillenschneider doesn't think of herself as an entrepreneur. As a professor of Outdoor Education at Northland College in Ashland, Wisc., her primary goal is to make outdoor recreation more inclusive. She isn't quite prepared to give up teaching for the world of product design, marketing, product liability and production.

"It sounds easy enough to make a product and sell it, but there are a number of steps involved in getting a product to market," said Kossett. "Getting an effective prototype is just one essential step."

The One-Arm Freedom paddle will be manufactured and sold by Bending Branches in Osceola, Wisc., with assistance from Extreme Tool and Engineering in Wakefield, Mich.

"People with physical impairments spend so much time trying to figure out, 'how am I going to do this,'" she said. "A veteran in rehab at Walter Reed Hospital tried the paddle prototype and said how great it was to be an active participant in an outrigger canoe. To be able to just jump in and paddle..."

www.nrri.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.

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Chancellor Lynn Black (fourth from the left) is shown with NRRI directors and program managers during his first visit to the institute.

New Chancellor sees NRRI as 'integral' to UMD

NRRI welcomed new University of Minnesota Duluth Chancellor Lynn Black in September. The Chancellor toured NRRI, stopping to meet with a variety of staff who shared their passion for their research.

"I was very impressed with the excellence of NRRI... the amount of external funding and wide range of research," said Chancellor Black. "UMD's future is clearly aligned with what NRRI does. I'm very interested in building a strong connection with the community, more

opportunities for students to do internships, more individual collaborations."

Under his leadership, UMD is embarking on a strategic plan that will address the university's strengths and challenges. NRRI is also scrutinizing its mission and strategic goals for the future.

"NRRI is an integral part of the future of UMD," said Black. "In difficult budget times, we need collaborations and more sophisticated relationships with industry. That is where NRRI clearly excels."