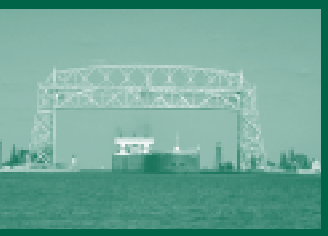
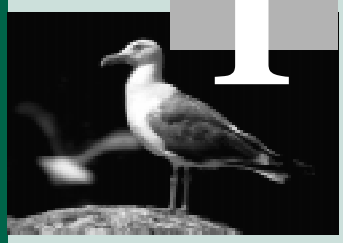
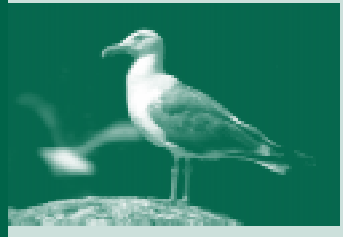
NRRI Now

NATURAL RESOURCES RESEARCH INSTITUTE SPRING/SUMMER 2001







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Cover *Story*

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NRRI's Jerry Niemi announces award at the news conference.

NRRI has been awarded a $6 million grant from the U.S. Environmental Protection Agency (EPA) to develop and test environmental indicators for the coastal regions of the U.S. Great Lakes.

This is the largest single research grant ever awarded to UMD and the largest ecological grant ever awarded by the EPA's Science to Achieve Results (STAR) research program.

The project, which is headed by NRRI center director and professor Dr. Gerald Niemi, will identify, evaluate and recommend a portfolio of environmental indicators to measure the condition of the Great Lakes coastal regions. These assessment tools will help maintain the lakes' integrity and long-term sustainability.

Like medical doctors who start with vital signs and then move on to specific diagnostic tests, 27 experts will closely examine the health of the Great Lakes.

Just as the human body has many different systems that must work cohesively, so does the environment. The Great Lakes basin, which spans two countries including eight states and one province, contains approximately 18 percent of the world's surface fresh water. What happens in one section has ripple effects across the entire basin and affects more than 36 million residents.

Environmental indicators are biological, chemical or physical attributes of the Great Lakes that can be measured and monitored to provide insight on the study area's condition. For example, scientists currently monitor the spread of exotic species such as zebra mussels. Studying zebra mussel populations, relocation patterns and reproduction, helps researchers evaluate the amount and intensity of human impact on certain aquatic ecosystems. Indicators provide an early warning system of potential problems and a proactive approach to integrating ecosystem management with increasing human needs.

In addition to researchers at NRRI and UMD, the project will include experts from the University of Minnesota Twin Cities campus, Minnesota Sea Grant, University of Wisconsin-Green Bay, University of Wisconsin-Madison, Cornell University (New York), University of Windsor-Canada, John Carroll University (Ohio) and University of Michigan. Scientists from the U.S. EPA Mid-Continent Ecology Division in Duluth and research station in Grosse Ile, Michigan, are also major cooperators on the project.

Study sites for this massive project will span the 200,000-square-mile basin. Research will be divided into five major components: water quality and diatoms (group of microscopic algae); fish and macroinvertebrates (aquatic insects, crustaceans and worms); wetland vegetation; birds and amphibians; and chemical contaminants (see pages 10-11 for details).

EPA has identified over 80 indicators that will be considered during the study. Based on nearly 500 years of cumulative expertise, Niemi and his team will

Awarded $6 Million Grant

compile and rigorously test what they consider to be the best and most comprehensive of existing and new indicators.

"At the end of the four-year period, we will provide recommendations to the environmental community on what indicators are their best bets for future monitoring efforts," said Niemi. "The EPA has provided a wonderful opportunity to critically examine which indicators can be used to determine the health of the U.S. Great Lakes coastal and near shore regions."

The Minnesota Sea Grant Program will distribute the information to the public and management agencies across the Great Lakes.

photo credit EPA

NRRI director Mike Lalich and U.S. Congressman James Oberstar discuss research at NRRI.

"NRRI scientists have achieved state, national and international acclaim for their previous work," noted U.S. Congressman Jim Oberstar. "By securing this grant, they have proven that NRRI is competitive with the best universities and research institutes in the country. Not only will the results of their work on this initiative play an important role in sustaining the long-term health of the Great Lakes, but they will also be a model for critical watersheds throughout the world."

The population explosion along the coasts of the United States has put enormous pressure on coastal ecosystems. In order to develop the sound science required to monitor these important areas, STAR developed the Estuarine and Great Lakes (EaGLe) program. This grant is the first being awarded to four focus areas that include the Great Lakes, Atlantic, Pacific and Gulf coasts.

NRRI director Mike Lalich agrees that the importance of this project reaches beyond northeastern Minnesota. "Results of the research will provide a context that will assist resource managers and leaders to make sound environmental and economic decisions relating to the Great Lakes ecosystem in the future."

photo credit EPA

(L to R) Stephen Bradbury (EPA), U.S. Congressman James Oberstar, Carl Richards (Mn Sea Grant), and Jerry Niemi (NRRI)

Environment *North*

The Great Lakes Team

photo credit NPS

The Great Lakes Environmental Indicators grant is a joint effort with NRRI's Jerry Niemi heading the project. He is relying on experts from eight educational institutions and EPA's Mid-Continent Ecology division in Duluth to assist him as well as key personnel from our Institute.

"Our goal has always been to assemble the best team possible," said Niemi. "We've done that."

A management team for the project will aid in many aspects of the project including experimental design and statistics (Ron Regal of University of Minnesota Duluth, web design (George Host of NRRI), landscape issues (David Mladenoff of University of Wisconsin Madison) and outreach (Carl Richards of Minnesota Sea Grant). At U.S. EPA-MED an additional management team headed by director Steven Bradbury will meet face-to-face or through conference calls every 4-6 weeks to insure continued progress and communication on the project. Collectively this group will be responsible for establishing milestones, assessing progress and results.

NRRI Staff

Jerry Niemi: Principal Investigator

Niemi is the principal investigator overseeing this omnibus project. His responsibilities include administration and management of the overall program. He also coordinates the project with EPA collaborators.

John Kingston: Diatoms/water quality

Kingston is the diatom (microscopic algae) project manager. By studying the organisms, researchers are able to forecast the effects of trends like eutrophication and climate change.

Rich Axler: Diatoms/water quality

Axler will assure accurate and representative measurements of the biological, physical and chemical parameters necessary for assessing water quality for the project. Historical and ongoing monitoring data, plus the intensive data collected by the project team, are intended for multiple purposes both within and beyond the study.

Carol Johnston: Wetland vegetation

Johnston will supervise the collection and analysis of the wetland vegetation as well as the GIS portion of the project. She will coordinate with subcontractors and cooperators on all aspects of the research.

Tom Hollenhorst: Geographic Information Systems

Hollenhorst will assist with study site selection, aerial photo interpretation, GIS analyses, data entry and analysis, and landscape-scale indicator development.

Lucinda Johnson : Fish/Macroinvertebrates

Johnson is an aquatic ecologist who has expertise in landscapes and aquatic ecosystem structure and function. In addition to the landscape component of the project, Johnson will be responsible for overall program coordination.

Jeff Schuldt: Fish/Macroinvertebrates

Schuldt will be coordinating fish and macroinvertebrate sampling with researchers from EPA-MED.

Dan Breneman: Field Technician Supervisor

Breneman an experienced aquatic ecologist, will oversee the field component and sample processing efforts at NRRI.

JoAnn Hanowski : Birds and amphibians

Hanowski will be one of three co-principal investigators on birds and amphibians. She will supervise field workers in the western portion of the Great Lakes basin. She will refine field methods, train field workers and evaluate data in the context of other studies in the overall proposal. Hanowski will also oversee data management and liaisons with other scientists.

George Host: Statistician and Web design

Host will work on the statistical design, database information and provide supervision of the web design.

Coordinate institutions include:

Minnesota Sea Grant

Carl Richards will lead the outreach/dissemination efforts for the project and participate as an aquatic expert on the fish/macroinvertebrate portion of the study.

University of Minnesota Duluth

Ron Regal, statistician, will be involved with the overall design, coordination of data gathering and analysis of data.

University of Wisconsin—Green Bay

Robert Howe will direct the study of birds and amphibians that will take place in the middle portion of the Great Lakes. Additionally, Howe will be involved in the reports from many participants across the Great Lakes.

University of Wisconsin—Madison

Cooperating in the project are David Mladenoff and Joy Zedler. Mladenoff is part of the management team and will apply geographic information system (GIS) tools and techniques to help determine larger-scale threats to the watershed, its biota, and ecological functions due to land use changes. Zedler will work with Carol Johnston on ways to measure the health of coastal wetland vegetation.

Cornell University—Ithaca, New York

Two researchers will cooperate on the project. Charles Smith will participate in the birds/amphibian project. Barbara Bedford will participate in the wetland vegetation study.

University of Michigan—Ann Arbor, Michigan

Cooperating in the project is Professor Eugene Stoermer, who will focus on diatoms, a group of algae found in most aquatic systems. Diatoms are preserved in lake sediments allowing researchers to study the changes in communities for hundreds of years.

University of Windsor—Windsor, Ontario

Cooperating in the project is Professor Jan Ciborowski, who will coordinate the collecting and analysis of invertebrates in Lakes Ontario, Erie, Michigan and southern Huron.

John Carroll University—Cleveland, Ohio

Cooperating in the project is Gerald Sgro and Jeffrey Johansen. Both will participate in the diatom portion of the study.

University of Minnesota—St. Paul, Minnesota

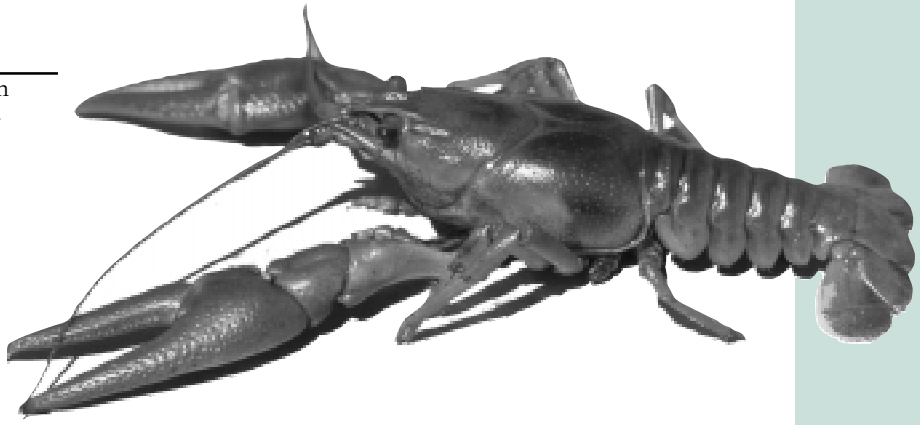
Deborah Swackhamer and Matthew Simcik are heading the contaminant portion of the project. They will have responsibility for research related with endocrine disruptor chemicals (EDCs) and polychlorinated aromatic hydrocarbons (PAHs).

U.S. EPA Mid-Continent Ecology Division in Duluth and Grosse Ile, Michigan

Teams of researchers from these labs, under the direction of Stephen Bradbury (EPA-MED laboratory Director) and Janet Keough (Associate Director for Science), will work closely with the researchers in evaluation of potential indicators. EPA Team leaders include: Naomi Detenbeck, John Kelly, Russell Kreis, David Mount, Gary Ankley, and Phillip Cook. Other EPA cooperating scientists include John Brazner, Anett Trebitz, Jo Thompson, Steve Diamond, Michael Sierszen, Mary Moffett, and John Morrice.

Environmental indicators under consideration include 80 indicators proposed by the State of the Lakes Ecosystem Conference, a forum on the Great Lakes sponsored by the US EPA and Environment Canada under the binational Great Lakes Water.

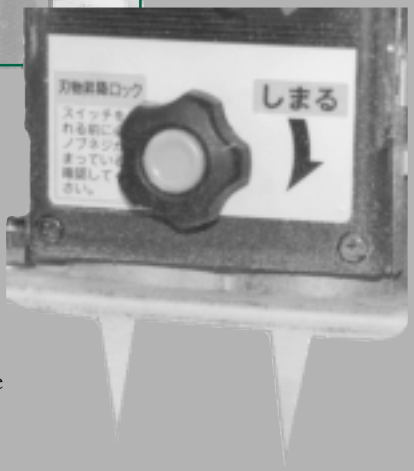
Quality Agreement. GLEI researchers, including the EPA scientists, will examine these indicators and others, and will recommend for future monitoring those which best indicate Great Lakes coastal zone condition.



Minnesota *Industry*

Forest Products Building Connections

Kato Sangyo, LHB and NRRI team members assemble and test parts



Imagine being able to frame up and enclose an entire house on a prepared site within two days with an unskilled labor crew of six. That may be possible using a Japanese house framing method that is making its way across the ocean to northeastern Minnesota. NRRI forest products researchers and LHB Engineers and Architects (of Duluth) are collaborating to bring the Kato Sangyo Metal Fit™ building system to the region.

The Kato Sangyo system computerizes the entire building process—from the computer-aid design plan to ordering materials and cutting each piece of lumber. Using patented metal connectors with laminated lumber for the frame and structural insulated panels for the walls, the entire structure adheres to a tight tolerance regime, within .5 millimeters.

LHB architect James Brew has been working with Kato Sangyo for several years. They recently partnered with NRRI to modify the Japanese system for American building standards and codes.

The Kato Sangyo company currently operates seven plants in Japan and builds over 7,000 houses each year. NRRI wood scientist Pat Donahue and LHB's Brew believe that the U.S. will need something like this in the near future. "Over half of all houses built in the U.S. today are systems-built," noted Brew. "Plus, ask any contractor about workforce and he'll tell you that getting and retaining skilled laborers is one of the biggest challenges." Brew, who has studied Japanese architecture, specializes in building "environmentally responsible" structures. Kato Sangyo fits that requirement because laminated lumber is made from small trees and waste lumber glued together to form larger, stronger pieces. According to Brew, this framing system reduces total lumber consumption by 25–30 percent, compared to traditional 2x6 framed structures. Although Kato Sangyo's Metal Fit™ system is not yet available in the U.S., the work underway by NRRI and LHB has brought the idea across the globe to be modified for the American building industry.

LHB and Kato Sangyo anticipate securing a partner to build a semi-automatic manufacturing plant in northeastern Minnesota within the next twelve months. NRRI's Donahue noted that although a semi-automated plant would employ less than 20 people, the potential spin off is farther reaching, possibly expanding the entire home building industry in Minnesota.

Wastewater Treatment Goes Organic

Mother Nature's peat really cleans up

WASTE NOT, WANT NOT! PEAT IS THE ORGANIC REMAINS OF PLANTS THAT ACCUMULATE IN WETLANDS AND MINNESOTA HAS SOME 7.5 MILLION ACRES OF THE STUFF. IT'S GREAT FOR THE GARDEN AND MOST OF WHAT IS HARVESTED IS SOLD FOR HORTICULTURAL PURPOSES. THE LEFTOVERS ARE USED IN WASTEWATER SYSTEMS.

Minnesotans love their lakes. We love them so much that we increasingly divvy up valuable lakefront property into smaller and smaller parcels for homes, cabins and resorts.

With those homes and resorts comes a need for effective wastewater treatment and septic systems, and it's definitely *not* a one-size-fits-all proposition. Different soil types, wastewater characteristics, geographic conditions and population densities each require different treatments. The wrong system in the wrong place pollutes our lakes, streams and groundwater and can potentially endanger public health. As many as 50 percent of Minnesota's septic systems don't meet state standards and many municipal systems need upgrading as well.

It's a people problem with an organic solution – peat.

Since 1995, NRRI researchers Barb McCarthy, Rich Axler, Steve Monson Geerts, and Jerry Henneck have been studying nine different wastewater treatment systems at a test site near Duluth.

"We've learned quite a few things over the past few years," said McCarthy. "We've learned that peat filters do a bang-up job at removing certain pollutants from wastewater… especially removing pathogen, or disease-causing, organisms. Peat really works best."

NRRI researcher Barb McCarthy installs pieces of the distribution network on an in-ground peat filter at the test site near Duluth.

The study site allows researchers to push the limits of what peat filters can do, as well as test its other capabilities. Now, for example, they're studying how well peat filters out viruses – a topic that is gaining national attention.

"Peat works because it is fairly acidic and the peat itself has a unique microflora of bacteria, fungi, protozoans and other organisms in it," McCarthy explained. "If you're a pathogen trying to survive in an acidic environment with a lot of other little critters that want to eat you, you're gone!"

The testing site also allows researchers to study which type of peat works best in different types of filters. They've tested locally grown moss peat (Sphagnum), a granulated reed-sedge peat, and peat imported from Ireland in modules and in-ground systems.

"We run our systems pretty hard and test them rigorously," said McCarthy. "A homeowner, for instance, wouldn't use 250 gallons of water every day. But we'll test that much to find out how much the filters can take before they break down."

Once the system is in place, the organic process does all the work. The wastewater is distributed evenly and in regular intervals near the top of the filter. As the wastewater moves through the peat, the microorganisms decompose it naturally and efficiently. Like any on-site system, peat filters need to be maintained regularly by a qualified contractor.

Thanks to the efforts of NRRI researchers and local contractors, there are now around 35 peat filter systems in use in northeast Minnesota being used for single- family homes.

"We really care about this," said McCarthy. "Through this regional partnership, we brought forth the idea that there are other approaches available and we can work together to get effective wastewater treatment systems in place. We just want to get the information out there."

In *Business*

Inventors + Entrepreneurs = Inventrepreneurs

"Without the development of the idea, there is NO product, business or jobs," said New Product Guys' Keith Henk at the first-ever Inventing 101 workshop.

The group of creative, independent people attentively listened to the steps it would take to bring their ideas to the marketplace. The workshop is the brainchild of NRRI's business development specialist, Jim Skurla and machine shop foreman, Gene Betts.

"For awhile now, I've felt that we needed specific information just for inventors," said Skurla. "This workshop was created to help people learn how to take their plans further. If people decide to continue with their products, they will be able to take an eight-week intensive InventPlus course, too."

The workshop was taught by instructors Bill Baker and Henk of New Products Guys of Bloomington, Minn. Both instructors have years of experience and have transferred ideas successfully to the marketplace.

As the day progressed, the group created their road map for success. As each stop was explained, they learned more about how to, or whether they even should, market their inventions. Each innovation needed its individual roadmap for product and market analyses, documentation and protection of ideas, financial analysis and feasibility of production.

"Your invention is your solution to a problem," said Henk. "You must determine its feasibility and viability. You need to manage the sequence of events."

At the end of the day, each participant was well on his or her way. The plan was ready—now it's time to act. For more information on invention workshops, call Jim Skurla of the NRRI Business Group at the UMD Center for Economic Development at (218) 726-7298.

Invention Fun Facts

WHAT'S AN INVENTION?

It's a new product created by humans

Since 1790 the United States Patent Office has granted more than 6 million patents.

Famous inventions:

Plywood: **Egyptians, around 3500 B.C.**

Swimming pools: **2500 B.C. in Egypt.**

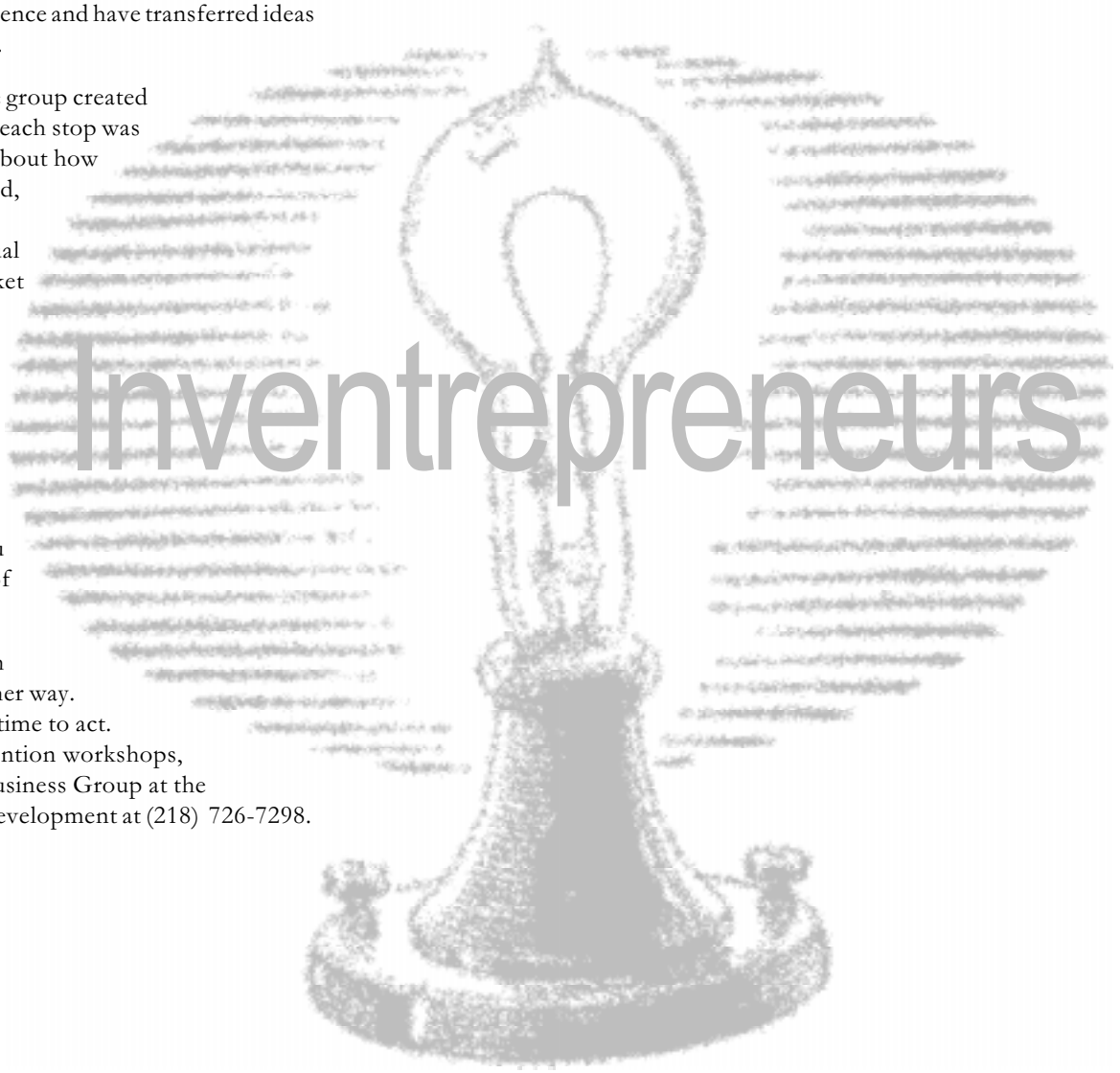
Clock: **The first public clock was made and erected in Milan, Italy in 1335.**

Automobile **as an invention was first imagined in the mid-15th century.**

Battery, **1790**

Christmas Lights, **About 1650**

Television: **1927, by Philo Farnsworth.**



NRRI Peat Processing Lab: Age-old Peat Meets Modern Technology

Peat granules act as innoculant carriers.

Sometimes technology is as simple as taking something old and turning it into something new again. That's a skill at which peat researchers at NRRI excel. Adding bench- and pilot-scale equipment to over 45 years of combined experience, they find ways to make digging in the dirt a potentially profitable enterprise.

The NRRI peat group was instrumental in matching the Pine Island Bog near Big Falls with Berger Peat Moss of Quebec, Canada. Acting as a liaison between Koochiching County and the company, they compiled existing information about the bog during the negotiation process, arranged a guided field visit to the bog, assisted with an elevation survey to determine drainage potential and continue to help the project through the permitting and licensing process.

According to Mike Hanson, Koochiching County Commissioner, the Pine Island Bog would not be on its way to development without the NRRI peat group. "They are the engine that drove the car," he said. "From relationships with the developer to technical expertise, they took a vital, active role. We also maintain a strong level of trust and that's important. I seriously doubt that we would be this far without the folks at NRRI."

While NRRI soil scientists work with local companies to continually improve harvesting operations, they also actively address alternative uses for peat. Over the past two years, researchers have been working with Minnesota Sphagnum, Inc. (MSI) of Floodwood to develop a peat granule that acts as an inoculant carrier for legume-based agriculture such as edible beans, soybeans, peas, peanuts, alfalfa and clover.

Tim Davern, general manager for Minnesota Sphagnum, describes the company's relationship with NRRI as crucial to their success. "They have been very hands-on and instrumental during the entire process," he noted. "NRRI has assisted us in every way from cost analysis, to technical product assistance to R&D and lab testing. This means survival for us."

NRRI and Minnesota Sphagnum also have a patent pending on a peat pellet that will break open to release special treatments to large landscapes like golf courses and athletic fields.

Other products launched from NRRI's peat processing laboratory include wastewater filters, oil sorbents, various soil amendments and a manure amendment.

NRRI's Seppo Valppu monitors granule processing

Partnerships *in Action*

Great Lakes Environmental Indicators Projects

The components of the Great Lakes Environmental Indicators study are designed to determine which environmental indicators can most efficiently, economically and effectively measure and monitor the condition, integrity and long-term sustainability of Great Lakes coastal ecosystems. The goal of these studies is to identify and evaluate indicators of the health of the Great Lakes. Teams of researchers bring the strength of nine institutions to comprehensively cover all areas. In addition to the teams correlating to the major elements of the study, a management team will aid Jerry Niemi in establishing milestones, deliverables and assessing progress. The management team includes: Ron Regal (Statistics—University of Minnesota Duluth), George Host (statistics, web design—NRRI), David Mladenoff (landscape issues—University of Wisconsin) and Carl Richards (outreach—Minnesota Sea Grant). The management team will work in close cooperation with EPA-MED's senior management and U. S. EPA's Great Lakes National Program Office in Chicago to insure continued progress and communication on the project.

The Great Lakes basin, spanning two countries, eight states and one province, contains approximately 18 percent of the world surface fresh water. In order to develop the sound science required to monitor priority areas, EPA developed the Estuarine and Great Lakes initiative within the STAR program. This grant is the first awarded to four focus areas that include the Great Lakes, Atlantic Coast, Pacific Coast and Gulf Coast. Study sites for this particular project will span the U.S. portion of the 200,000-square-mile Great Lakes basin.

DIATOMS AND WATER QUALITY

Nutrient loading and soil erosion are two of the major environmental threats to Great Lakes wetlands and coastal waters. Algae (such as diatoms) are a very diverse group in all aquatic systems. Because of their high species diversity (generally estimated to be approximately 100,000 different types) and short life cycles, algae respond rapidly to changes that can be missed with other sampling methods. Diatom community responses are closely linked to water quality, especially chemical disturbances from

photo credit USDA Forest

nutrients, salinity, sediments and acidification. John Kingston (NRRI) will direct the diatom research, with Rich Axler (NRRI) providing water quality expertise. Eugene Stoermer (University of Michigan) and Jeffrey Johansen and Gerald Sgro (John Carroll University) will also collaborate on this portion of the project.

FISH AND MACRO-INVERTEBRATES

photo credit MN Sea Grant

The coastal ecosystems of the Great Lakes are as diverse as any coastal systems in the world. The feeding habits of benthic invertebrates and fish bring them into close contact with the sediments, which are the primary accumulation sites of chemicals. No single indicator can capture the diverse information necessary to evaluate ecosystem condition, but these two communities are valuable as they have been used extensively as indicators in rivers and streams. Researchers will combine the best methods of identifying indicators for evaluation and test them across the Great Lakes region. Lucinda Johnson (NRRI) and Carl Richards (Minnesota Sea Grant) will lead this study with Jan Ciborowski (University of Windsor) and NRRI's Jeff Schuldt.

WETLAND VEGETATION

Wetlands are a unique coastal resource and are also among the most severely impacted areas of the Great Lakes basin. They provide habitat for a wide variety of fauna, support plant communities and buffer land-lake exchanges of nutrients. Wetland vegetation is an excellent indicator of physical and chemical condition. The advantage over many animal indicators is that vegetation remains in place, which simplifies sampling. Researchers are seeking to identify coastal wetland plant communities that could be used to evaluate both current conditions and future changes. Carol Johnston (NRRI) will lead the study of vegetative indicators of coastal wetland condition. Joe Zedler

photo credit MI Travel

photo credit NPS

(University of Wisconsin) and Barbara Bedford (Cornell University) will also be working on the project.

BIRDS AND AMPHIBIANS

The Great Lakes basin supports one of North America's richest concentrations of breeding birds, making monitoring programs particularly important in this region. Breeding success is directly related to aquatic habitat, land cover types and landscape characteristics.

Amphibians are far less diverse in the basin, but individuals of many species are common and sensitive to environmental change. This makes them ideally suited for use as indicators of land use and landscape change.

Both birds and amphibians react to ecological stressors in complementary ways with amphibians sensitive to local changes and birds sensitive to larger scale factors such as landscape degradation. Researchers will develop measurable indicators for birds and amphibians that can be applied across the basin that reflect the ecological condition of the Great Lakes. JoAnn Hanowski (NRRI), Robert Howe (University of Wisconsin) and

photo credit J. Gunderson

Charles Smith (Cornell University) will be working on bird and amphibian indicators of Great Lakes shoreline condition.

CHEMICAL CONTAMINANTS.

Environmental indicators are increasingly used to assess the status and trends in ecological condition. They may also be used to diagnose sources of ecological stress. This project will focus on two indicators: Polycyclic aromatic hydrocarbons (PAH) and endocrine disrupters such as xenoestrogens.

Both are widespread in the environment, come from known sources and are of current concern. Researchers will identify and validate effective contaminant indicators of adverse impacts on estuarine ecosystem health. Contaminant problems potentially have stress on benthic invertebrates, fish communities, nesting birds, amphibians and fish-eating mammals. Deborah Swackhamer with Matt Simcik (University of Minnesota) will head the study of contaminants.

INFORMATION DISSEMINATION

Carl Richards of the Minnesota Sea Grant program will work with other Sea Grant managers across the Great Lakes to disseminate information to the public and management agencies.

Glossary

Amphibians: cold-blooded, smooth skinned vertebrates such as frogs that characteristically hatch as an aquatic larvae and metamorphose into an adult form with air-breathing lungs

Avian: pertaining to birds

Benthic: lake bottom organisms

Diatoms: microscopic unicellular algae

Endocrine Disrupter: an external agent that interferes with the role of natural hormones in the body

Environmental indicators: a measure or several measures used to assess the health of an ecosystem

Estuarine: pertaining to the mouth of the river

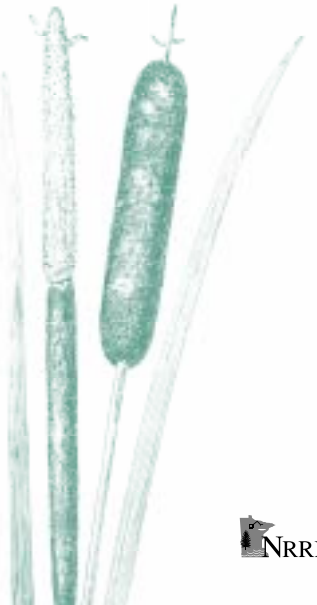
Fauna: animals in a given area

Macroinvertebrate: lacking a backbone or spinal column such as crustaceans, worms, aquatic insects

Nutrient: something that nourishes; phosphorus is a key nutrient in influencing plant growth in lakes

Polycyclic aromatic hydrocarbons (PAHs): compounds produced during the burning of organic material such as wood and fossil fuels and are a component of uncombusted petroleum

Xenoestrogens: a variety non-native estrogens found in fish tissue, sediment and water



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