

NRRI Now



NATURAL RESOURCES RESEARCH INSTITUTE

Winter 1999



Aspen Thinning Improves Timber Yield

NRRI researchers Dan Buchman and Bill Berguson track aspen growth rates. Mechanically thinned stands grow up to 17 percent faster than unthinned stands.

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Forestry

Mechanical thinning fattens yield

NRRRI researchers Bill Berguson and Dan Buchman have proven that mechanical aspen thinning can increase timber yields. Prior to the project that began ten years ago, relatively little research had been completed on mechanical strip thinning—a process in which a bulldozer blade clears an eight-foot-wide strip in aspen stands to promote faster growth of the remaining trees.

Funded by the Blandin Foundation, this project took National Forest Ser-

vice information about hand-thinning and modernized it to be more efficient and cost-effective. To date, 10,000 acres of aspen have been thinned when the trees were 10 years old. Berguson and Buchman are currently monitoring tree growth and health. The trees will be harvested between the ages of 35-40 for the pulp and paper industries.

Berguson projects the mechanical strip thinning to increase aspen yield by 10 cords per acre. That translates into an addi-

tional 100,000 cords of harvestable wood from the original 10,000 acres. With a conservative stumpage price of \$20 per cord, the process yields an additional \$2 million.

According to NRRI's Berguson, aspen thinning will not only improve revenue for timber sales, but it could have residual effects in terms of additional timber-related jobs, tax revenue and more trees harvested in Minnesota instead of imported.

An additional grant from the Legislative Commission on Minnesota Resources enabled NRRI and UMD Biology researchers to look at

what effects this process would have on birds and small mammals. While mechanical strip thinning mimics natural events such as windstorms, it does so at a faster rate and in straight rows. The scientists also noted that birds which thrive in young stands differ in both type and total numbers than birds that prefer mature aspen stands. This study showed that mechanical strip thinning has no negative effects on small mammals and relatively short-lived effects on most forest songbirds.

Overall, mechanical strip thinning looks to have positive effects. The strip-thinned aspen grew 17 percent faster than the unthinned and forest animals seem to be flexible enough to adapt to the rapidly changing vegetation.



In the mechanical strip thinning process, an eight-foot-wide strip of aspen is bulldozed to encourage the remaining trees to grow faster.

Lifelong Efforts Honored

Prestigious awards presented

NRRRI Director Mike Lalich was recently presented with a Distinguished Service Award from the University of Wisconsin-Madison's College of Engineering.

Lalich has directed NRRI almost since the Institute's inception in 1983. Under his guidance, NRRI has gained a state- and nationwide reputation as an effective technology transfer, environmental research and small business development center.

Lalich's career began in 1966 at the Union Carbide research laboratories in Niagara Falls, New York.

He worked for the Foote Mineral Company in Exton, Pennsylvania, where he was director of research and development from 1976 to 1984. Lalich's research contributions have focused on metals casting, particularly on developing ferroalloys to improve the properties of cast iron and steel.

A native of Upper Michigan, Lalich earned his BS and MS degrees from Michigan Tech and his Ph.D. from UW-Madison. He currently serves on the Governor's Commission on Mining and Minerals as well as the Forest Resources Council

Dr. Pavel Krasutsky received his award from Professor Alexander Yurchenko before a statue of Dmitrii Mendeleev, developer of the chemical periodic table, at the Kiev Polytechnic Institute in the Ukraine.



Research Advisory Committee and the Norwest Bank Community Action Board.

The Distinguished Service Award from UW-Madison's College of Engineering annually recognizes outstanding careers of 20 or more years in engineering or related fields.

Pavel Krasutsky

NRRI's Pavel Krasutsky was awarded with the National Award of Science in the Ukraine, the highest scientific honor given in his native country. This award is comparable to being elected to the National Academy of Sciences in the U.S.

While at the Kiev Polytechnic Institute in the former Soviet Union, Krasutsky developed a new direction in fundamental organic chemistry from which more than 500 new organic

molecules were synthesized. The appearance of new antiviral drugs and other medicines were a direct result of these efforts.

Krasutsky came to the U.S. to collaborate with Robert Carlson of the UMD Chemistry Department and to head a new NRRI-UMD College of Science and Engineering initiative which will focus on extracting chemical derivatives from natural resource-based raw materials, industrial by-products and waste streams. One derivative has shown extraordinary promise during initial testing as a pharmaceutical and has resulted in a University patent. This compound and others from the waste stream are also showing significant promise for environmentally friendly applications such as pesticides and adhesives.



NRRI director Mike Lalich received a Distinguished Service Award from John Bollinger, Dean, of the UW-Madison's College of Engineering.



Northern Ecosystems

Amphibian research underway

What do frogs and humans have in common? Most vertebrate species share the same developmental pathways and use similar processes for detoxifying and eliminating pollution from their body. Since most frogs reproduce in water and migrate to land as adults, they are particularly valuable as indicators of a wide range of environmental conditions. Amphibians, for this reason, are the focus of two NRRI research grants.

"These grants are both investigating causes of malformations in frogs recently found in Minnesota and across the northern United States and

Canada," said researcher Lucinda Johnson. "The widespread and complex nature of this problem suggests that research needs to proceed simultaneously in the laboratory and the field—our niche is the field component. We are trying to quantify how widespread and prevalent the phenomenon is, while also attempting to determine the cause."

One grant looks at amphibians, frogs in particular, as indicators of ecosystem health across the upper Midwest. This research project is part of a \$1.3 million grant from the Environmental Protection Agency and includes cooperators from the National Wildlife Health Center Laboratory and the University of Illinois.

"Our objective is to quantify the influence of wetland and landscape-scale factors (such as roads, agricultural and urban areas) on amphibians to determine whether amphibians are good indi-

cators of ecosystem health," said Johnson. The presence and type of malformations are viewed as one of many ecosystem indicators. Preliminary results from the first year of field work found that only two out of 60 sites across Illinois, Wisconsin and Minnesota had malformed amphibians--both sites were located just north of the Twin Cities.

The other project, in cooperation with the Environmental Protection Agency Midcontinent Ecology Laboratory in Duluth, focuses on UV-B radiation and its possible effects on amphibians. UV-B radiation has increased in recent decades due to decreased ozone in the atmosphere and is associated with increased incidences of skin cancer. Tadpoles develop at the same time that UV-B radiation is at its strongest and protective vegetation is minimal. UV-B radiation is absorbed by water, especially highly colored water frequently found in wetlands, making it difficult to calculate the amount of

damaging radiation to which developing tadpoles are exposed.

"Our next step is to calibrate a model to predict UV-B radiation attenuation through the water column in wetlands, in support of the lab studies being conducted at the EPA Lab exposing tadpoles to UV light," said Johnson.



NRRI field researchers participating in amphibian research include Cathy Johnson, Greg Peterson and Elaine Ruzycski. The principal investigators of the UV radiation study are Lucinda Johnson and Rich Axler. The principal investigators of the wetland indicator project are Lucinda Johnson, Carl Richards and Patrick Schoff.



Lucinda Johnson specializes in northern aquatic ecosystems and heads the current amphibian projects.



Environmental Technology

Researching a global dilemma

Sensor technology essential to identifying red tide algae across the globe will be developed by NRRI scientists and Apprise Technologies, Inc. The National Science Foundation recently awarded Apprise \$98,000 to begin initial research on a sensor that could eventually prevent human consumption of shellfish that have been contaminated by deadly red tide algae.

Of the many thousands of known algae species, only a few dozen have repeatedly proven to be toxic. Red tide algae is a name given to this group of poisonous saltwater microscopic plants that are known to reproduce, or bloom, ferociously. During photosynthesis a reddish pigment appears to give the algae its name. If shellfish such as lobsters, oysters, shrimp or crabs consume toxic algae, the toxin can be passed on to others farther up the food chain, including humans. However, this is not a common event and can be controlled by closing infested areas to harvesting.

The sensor under development will indicate the

presence of certain algae groups from a remote location in the ocean. Based on its ability to differentiate algae according to individual "fingerprints," the sensor will know when a potentially dangerous situation develops. Governmental agencies and the shellfish industry can then be more accurate in their monitoring and restriction efforts.

The research will be conducted jointly by Apprise, NRRI and UMD scientists. Robert Carlson of UMD Chemistry will oversee the project along with NRRI's Rich Axler and Elaine Ruzycki and Apprise's Eugene Tokhtuev and Viktor Slobodyan.

Apprise Technologies, Inc. was incorporated in May 1997 by private investors, the University of Minnesota and the SOTA TEC Fund using NRRI as the initial incubator location.

"NRRI's early partnership with the private sector and research support to develop the technology upon which Apprise as a company is based, represents a clear example of how the University can promote formation of new industry

Eugene Tokhtuev works on vital sensor technology at NRRI.



based on technology," said director Mike Lulich.

Despite its location far from any ocean, Apprise President Chris Owen is confident the research will be successful. "The idea and the technology are so strong that the National Science Foundation felt confident that we could develop the sensor here in northern Minnesota."

The sensor will use a technology originally developed by NASA to look at the atmosphere of other planets. Using this technology, the light spectrum associated with each planet is then compared to a library of known compounds to identify each chemical and the amount present around that planet. Each alga spe-

cies responds to an individual "fingerprint" of light as detected by a sensor. By comparing each fingerprint to a library of known alga fingerprints, the sensor can indicate when red tide alga is present.

Over 1,632 small business projects were proposed to the National Science Foundation. This sensor development is one of only 200 projects approved for funding.

Minerals

Groundbreaking at Coleraine

Construction of the new \$1.8 million building at the Coleraine Minerals Research Laboratory started this fall.

The 17,000 square foot facility will house offices, plus chemical and batch laboratories. The new building will replace approximately ten of the aging buildings on the site. Other buildings will be brought up to code, sandblasted and repainted.

The Coleraine lab title was transferred from USX Corporation in October, 1996, with the understanding that buildings would be upgraded to provide an efficient work environment for minerals research. NRRI has been leasing the facility since 1986.

"This new facility will allow us to do things much more efficiently," said NRRI director Mike Lalich. "Our research at Coleraine has helped the industry revitalize itself and we continue to seek new processes to keep the industry vital."

Funding for the new facility came through the U.S. Economic Development Agency, the State of Minnesota and the University of Minnesota. The project was assisted through Congressman James Oberstar and Representative Loren Solberg's efforts to keep Minnesota's taconite industry globally competitive.

"For many years, I've fought to make sure that basic and applied research in iron ore mining continues on the Iron Range, and I am very pleased that today we can celebrate the groundbreaking of the new Coleraine Minerals Research Lab," said Oberstar. "Due to the economic problems faced by the steel industry in recent years and the escalating cost of research, large steel producers have been forced to cut back on company-financed research and laboratory activities. Through the research that is developed at CMRL, improvements can be made

to the current ore product and new products can be produced. The result is that new jobs will be created, other jobs will be maintained and mining will remain a vital part of Minnesota's economy."

Engineering and architectural services for the site were provided by Barr Engineering of Hibbing. The construction contract was awarded to Northern Industrial Erectors, Inc. of Grand Rapids.

Minntac general manager Jim Swearingen, NRRI director Mike Lalich, Regent Tom Reagan, Rep. Loren Solberg and UMD Chancellor Kathryn A. Martin (L-R) break ground for the new facility at CMRL.



Forest Products

New technologies aid manufacturers

The earlier in the manufacturing process defects in wood are identified, the easier it is for manufacturers to determine how to process the lumber correctly, thus minimizing manufacturing costs through improved yield and production.

On a national level, NRRI's Forest Products researchers are working with Sonic Industries (recently acquired by Perceptron, Inc.) and the U.S. Department of Agriculture (USDA) Forest Products Laboratory to advance ultrasound-based defect technology for hardwood lumber. The goal is for manufacturing plants to incorporate this technology into operations resulting in better use of the wood resource, reduced costs and less rejected material.

"We want to help bring ultrasound technology from the fundamental research stage to implementation," said NRRI's Brian Brashaw. "This technology will help wood products manufacturers make better decisions about their lumber resource, resulting in improved yield while minimizing reject material further downstream in the manufacturing process."

Perceptron ultrasound technology has progressed

from a hand-held unit at the USDA Forest Products Lab to being demonstrated at the 1998 International Woodworking Fair in just two years.

"Ultrasound can be used efficiently to detect internal flaws such as cracks, splits, ring shake and honeycomb in wood with a high safety factor," said Mark Schafer, vice-president of Ultrasound for Perceptron, Inc. "We are pursuing near-term commercialization options for both green and dry hardwood lumber."

The partnering of NRRI with the USDA Forest Products Lab has been a key in moving the ultrasound from the lab into a license agreement with Perceptron. "Since the lab's mission is the development of basic science, we partner with strong applied development groups such as NRRI," said Robert Ross, project leader of the Forest Products Laboratory. "NRRI is ideally positioned to work with us on taking solutions from the lab to implementation."

Prior to Perceptron's licensing of the technology from the USDA, researchers at NRRI and the Forest Products Laboratory com-



Ultrasound scanning of red oak lumber demonstrated on a Perceptron engineering prototype will help manufacturers better identify internal defects that could cause significant reject if not found before the machining and staining processes.

pleted several studies that proved the feasibility of ultrasound to find bacterial infected sections of green lumber, which can cause significant defects during drying if not accurately identified. Additionally, dry lumber was successfully inspected for the presence of internal honeycomb and closed surface checks. These feasibility studies were completed on material from Woodcraft Industries, Rajala Lumber Company and Webster Industries.

As part of NRRI's efforts to implement automated defect technologies, researchers recently held several one-day workshops, "Defect Scanning Technology for Lumber" for 100 participants from 38 companies.

Each of the four technologies presented at the workshop provide benefits for wood products

manufacturing. Ultrasound excels at finding internal splits, checks and voids while laser systems and high-speed cameras find surface defects including knots, holes and wane. X-ray systems also identify defects like knots, decay, holes and voids. Current commercial equipment often combines several technologies to achieve the best overall performance.

"There has been a substantial jump in automated defect technology equipment in the past two years," reported Brashaw. "These technologies can operate faster, more accurately and more consistently than human graders for chop saw and rip saw applications. It has been proven that this automation increases material yield and value in both hardwood and softwood lumber operations."

In *Business*

CED Appointment

Marder steps in as new director

Dr. Stephen Marder took the reins as Director of UMD's Center for Economic Development last September. Marder, who most recently served as Director of the Pacific Islands Small Business Development Center Network in Mangilao, Guam, brings creativity, new ideas and years of managing a similar program to CED.

In addition, Marder's strong academic, scientific and professional background make him well-suited for the position. While in Guam he secured over \$4.5 million in grants and local funding including \$100,000 to establish a Woman's Business Ownership Program. He also taught graduate and undergraduate finance classes at the University of Guam

and founded both *Pacific Rim Journal of Small Business* and *The Pacific Rim Journal of Economics*.

According to Marder, the Center's staff and partners, including NRRI, are in the midst of a strategic planning review. Although he does expect some subtle changes from the process, Marder said, "We will continue to offer high-quality technical services to clients throughout the Arrowhead Region." He also noted that CED's current staff is comprehensive, dedicated and extremely hard-working.

One change scheduled for early 1999 is a quarterly newsletter, the *Arrowhead Business Advisor* (see sidebar), designed to disseminate useful, timely information to the business community in general.

Marder completed undergraduate work in chemistry and biology at Tufts University and earned his Ph.D. in finance from the University of Georgia.



Stephen Marder brings experience and innovation to his new position as CED director.

Newsletter Debut

The *Arrowhead Business Advisor*, the new quarterly newsletter featuring topics and notices pertinent to the entire Northland business community, will debut February 2, in the *Duluth Budgeteer Press*, *Hibbing Daily Tribune* and *Mesabi Daily News*. This first issue will discuss the ins and outs of business plans. Be sure to pick up a copy so you don't miss this important educational opportunity. 70,000 issues will be printed each quarter.

Kauffman Internship Program

Since last June, CED has been administrating and implementing the Kauffman Internship Program which pairs an advanced UMD business student with local business leaders to learn daily business operations. The student earns credit and a wage while the participating business receives an opportunity to mold the business leaders of tomorrow. To learn more about sponsoring an intern or any CED programs, call Lee Jensen Bujold at 218-726-8758 or 1-888-387-4594.

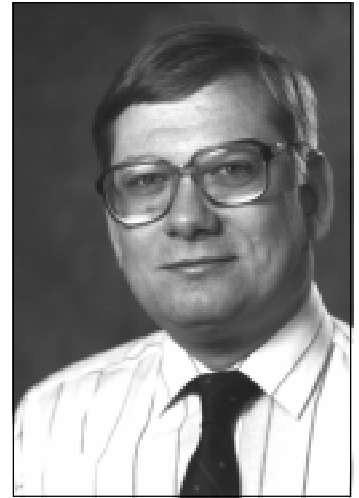
Emerging Business

Hobbyist turned entrepreneur

Another budding entrepreneur is emerging from the Twin Ports scene. Company owner, Ronald McDonald formed McDonald Truck Motor Company, Inc. in 1983 but it wasn't until recently that he found his market niche. He hand creates vintage toy trucks customized with company logos for executives and corporate sales associates. Both Hasbro and QVC are interested in marketing his product. In addition, Midwest Technology catalog, a national seller of school products, has featured McDonald's truck kits for students to assemble in shop classes.

McDonald tapped into the vast network available to entrepreneurs and small business owners throughout northeastern Minnesota. He received business assistance from NRRI and an additional \$25,000 Small Business Administration loan via the National Bank of Commerce. He also credits Barb Myers from the Northeast Entrepreneur Fund and Heidi Thimm - Bijold from the City of Duluth Business Development office for their valuable professional guidance.

Jim Skurla of the NRRI Business Group continues to assist the McDonald Truck Motor Company.



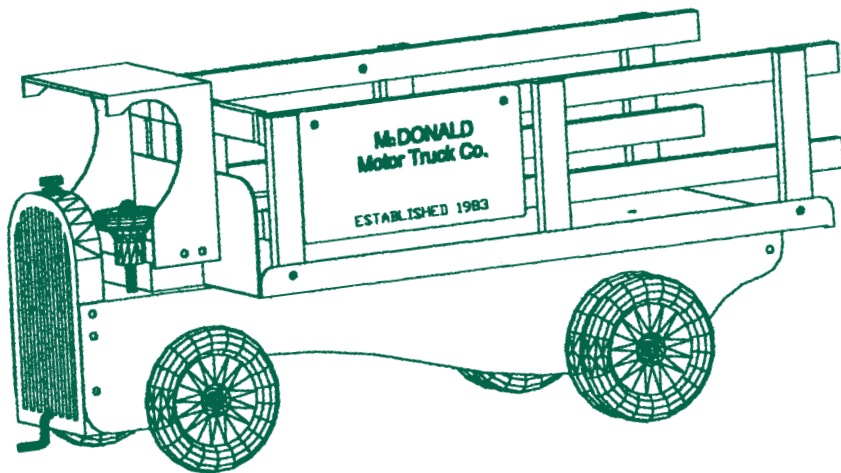
"If one person can't help me, they don't say 'no,' they just tell me who else to talk to," said McDonald.

That's how he was connected to NRRI for idea evaluation and to work with Jim Skurla of the NRRI Business Group. Skurla helped McDonald define his market and complete complex grant and loan applications. He also continues to help McDonald to update his business plan.

"It's an ongoing situation," noted Skurla. "He calls me when he hits a snag with his business or needs objective advice."

To date he has sold 45 trucks and the education catalog rolled out this past November. Currently McDonald is searching for lower-cost parts for his trucks, attending national education trade shows and marketing his product to local companies.

NRRI evaluates approximately seven idea evaluation applications each year to ensure entrepreneurial success in the Arrowhead region.



NRRI *Partners*

Forest Ecosystems

**NRRI experts
contribute to sustainable
harvest research**

When Minnesota's Generic Environmental Impact Statement (GEIS) was completed in 1994, many in-depth questions regarding forest management decisions and the long-term results of harvesting methods were left unanswered. In response, the Minnesota Forest Resources Council was created to implement the Minnesota Sustainable Forest Resources Act and to also serve as an advisory board on sustainable policies and practices. The Council currently oversees several research projects involving NRRI scientists and other experts across the

state. The results will be used to develop voluntary, sustainable-use guidelines.

Cooperation

Three projects are underway to examine harvesting methods and effects on wildlife, stream health and soil productivity. Due to their reputations as leaders in their fields, NRRI researchers are involved with all three projects; in addition, director Mike Lulich serves on the Council's Research Advisory Board.

The first two projects look at three forested areas both before and after the harvest: the Pokegama watershed near Grand Rapids, the Cloquet River water-

shed east of Virginia and the Knife River watershed just north of Duluth.

These studies also examine several harvest methods. One leaves a 100-foot strip of forest along the stream and a second, more typical method leaves three variations of the current best management practices (BMPs) of forest between the cut area and the stream. Looking at the effects of these methods combined with timber transportation practices will provide comprehensive information for agencies, industry and private landowners statewide.

Wildlife

Birds are excellent indicators of a forest's health and studying their population trends, distributions and behavior can provide an overall picture of how a major disturbance such as logging affects the forest's entire ecosystem.

NRRI's JoAnn Hanowski and Jerry Niemi along with the University's Francine Cuthbert use proven census and analyti-

cal methods to answer several questions. They want to know which types and how many birds use these forests and what happens when trees are harvested. The team is also studying how harvesting methods affect the ecosystem and if alternative harvesting methods have positive or negative effects.

Thus far in the study, this group has recorded more birds and a wider variety than originally suspected with more types of birds near streams. However, the avian effects of logging in these stream areas will not be known until the project is complete.

Streams

By their dynamic nature, woodland streams play a vital role in the ecosystem's health. Disturbances in one area can rapidly affect life in the stream, near the stream and many miles downstream. In this project, scientists examine the ecological and economic effects that harvesting methods have on streams.



NRRI's George Host uses a wedge prism to inventory the forest, including the number of trees per acre and the amount of wood in a forest stand.

Mary Kay Fox, of the University of Minnesota examines woody debris along the Knife River.

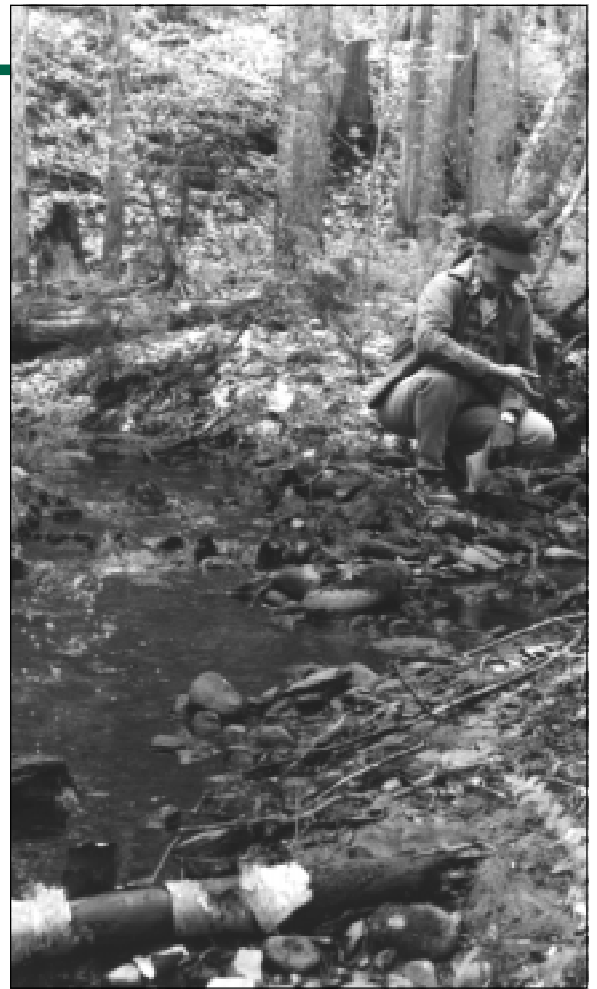


photo credit: Sara Eliason, U of M, Twin Cities

NRRI's Lucinda Johnson and Carl Richards lead one portion of the aquatic study. In it they are quantifying the stream's woody debris and other organic matter such as leaves. These factors hold an intricate place in the food web, influence insect and fish habitats and regulate the stream's channel structure and flow.

Other team members from the University and the USDA Forest Service simultaneously study the impacts of forest harvesting on fish and macroinvertebrates (food), vegetation along the stream's banks and other site-specific effects. In addition, economists are analyzing the monetary effects of the different harvesting methods.

By tying individual results together with eco-

nomics needs and impacts, the project will provide substantiated information for decision-makers that has never before been available for Midwestern-type forests.

Johnson lauded the Council for funding this broad-scale study. "It is unique in that it has built-in replication and controls and it looks at many aspects of harvesting."

Soil Productivity

In a third study, NRRI's George Host joined a research team to explore the effects of clear cutting and partial harvest practices on soil compaction, forest regeneration and biodiversity. The project looks specifically at quaking aspen and northern hardwood sites in the Chippewa National Forest

and Aitkin County that have been harvested within the last five years.

Quaking aspen, an important fiber source, covers five million acres in Minnesota while northern hardwoods such as maple cover nearly 1.5 million acres. Currently aspen is generally clear-cut while approximately 10 percent of Minnesota's wood is harvested selectively.

For the last two summers field researchers have sampled main skid trails, secondary skid trails and undisturbed areas at 36 sites. Although the project is not yet complete, Host noted that moderate to heavy

compaction seems to encourage undesirable, weedy species such as bramble to grow, rather than a diverse makeup of trees, shrubs and grasses. This is especially true on main skid trails, the areas with the most compaction.

Project results will provide a better picture of how forest harvesting methods affect the forest's ability to regenerate itself naturally. In addition, the study will reveal details on how and to what degree soil compaction affects the productivity and diversity of the future forest.

Information from all three projects will be incorporated in the Minnesota Forest Resources Council's proposed guidelines for private and public landowners which are due to be released in early 1999.

PROJECT COLLABORATORS:

Minnesota Department of Natural Resources
NRRI
U of M Fisheries and Wildlife
U of M Forest Resources
U of M Soil, Water and Climate
USDA Forest Service

Project *Highlights*

NRRI at Capitol

Prominent NRRI research will again be on display in the north corridor of the State Capital from March 8-12. This is the Institute's third year of bringing the latest and greatest projects to state legislators and the public.

Peat Development

Berger Peat Moss of Saint-Modeste, Quebec,

has signed an agreement with the Koochiching County Board to develop Pine Island Bog near Big Falls. NRRI peat experts have worked with state and county officials for two years to seal the agreement.

CED to relocate

When the Duluth Technology Village is complete, the CED staff will relocate to the new building on the 100 block of East Superior

Street. This centralized location in the heart of the city's business district will bring the University's business programs and services closer to their users--the business community itself.

Superfund Evaluation

Environmental researchers from NRRI, Minnesota Sea Grant Program and the Leech Lake Tribal Council are cooperatively assessing and monitoring

possible groundwater contamination at a site on Leech Lake tribal lands.

NRRI in Ely

Joseph Barrett, a business development specialist with NRRI's Business Group, has opened an office in Ely to extend NRRI and CED's programs to northern Minnesota.



Check us out: 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.

Michael Lalich, director

Center for Water & the Environment

Gerald Niemi, director

Center for Applied Research & Technology Development

Thys Johnson, director

Center for Economic Development

Stephen Marder, director

NRRI Now

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