NC NEWS
NORTH CENTRAL FOREST EXPERIMENT STATION
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Creating Opportunities in Young Aspen Stands

In The News

Any day now, tens of millions of aspen leaves will flood the northwoods with their ethereal green light. Though aspens seem ubiquitous, inventories have shown that certain age classes of aspen are less abundant than others. "Past practices have left us with high acreages of young and mature aspens, but fewer in between," explains John Zasada, project leader of the Northern Forest Silviculture unit in Rhinelander and Grand Rapids. In 10 to 20 years, this gap could create a shortfall in this important economic resource.

To compensate, forest managers are exploring the possibility of commercially thinning younger stands. This would allow them to "capture" the wave of mortality that normally occurs in 25- to 30-year-old stands, and turn it into high-quality pulp, which is ideal for making coated paper.

What Happens When You Thin Aspen?

For foresters, land managers, and researchers, the question "Can we commercially thin aspen?" begs larger questions about thinning's effects:

- How does thinning affect the overall productivity of residual trees, i.e., their net rates of photosynthesis, their ability to tolerate environmental stress, and their potential for suckering in the future?
- How does the distribution of thinned stands across the landscape affect the spread of pests like forest tent caterpillar and hypoxylon canker? Are aspen trees in thinned stands more resistant to attacks by these pests and more resilient should they be attacked?
- How does thinning affect non-game birds that feed on insect pests?
- How does thinning affect habitat for game species such as ruffed grouse?
- What happens to soil fertility as carbon is removed from the site?
- What happens to soil structure when stands are entered several times?
- What are the economic effects of thinning operations on rural communities?

To answer these questions, a team of researchers from NC and the University of Minnesota (UM) successfully applied for $85,000 in Forest Service CROPS (CReating OpportunitieS) funds. The purpose of the CROPS program is to improve forest health and stimulate rural economies by managing small-diameter stands. NC's proposal—*Thinning Aspen Stands: Creating Heterogeneous Landscapes for Forest Productivity*—fits the bill nicely. It proposes to experimentally thin aspen at various densities, using various harvest techniques, and then study the effects on ecological and economic vitality.

The CROPS project is the inaugural effort in the station's new Forest Productivity integrated research program. Scientists include: from NC, silviculturist and coordinator John Zasada, entomologist Bill Mattson, ecologist Eric Gustafson,

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John Zasada

CROPS study asks: Can commercial thinning help boost the vigor of northwoods aspen?

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physiologist Jud Isebrands, forest operations engineer Jim Mattson, geneticist Don Riemenschneider, pathologist Mike Ostry, economist Mike Vasievich, biologist Dick Buech, ecologist Brian Palik; and from UM's Aspen-Larch Cooperative in Grand Rapids, scientists Andy David and Dan Gilmore. The cooperation and support of land managers from the Minnesota Department of Natural Resources, Itasca County, Chippewa National Forest, and the Blandin Paper Company is pivotal.

"It's important to realize we're not working in a knowledge vacuum," John Zasada said. "The springboard to this project was work by NC scientists over the past 40 years (particularly by Don Perala), work by Natural Resources Research Institute scientist Bill Berguson, and preliminary thinning trials by Blandin Paper Company."

A Clonal Conundrum

Before the research can begin, the team has to evaluate candidate sites to see if they meet industry criteria for an economically feasible harvest. "Mapping these stands will, by itself, meet an important CROPS goal," Zasada said.

The clonal nature of aspen presents another challenge that none of the other CROPS projects face. To insure genetic variety, the study sites have to be large enough to encompass more than one clone (a genetically identical grouping of trees). The "clone spotters" will look for differences in spring phenology, tree architecture, timing of fall color change, and more.

Once the sites are selected, scientists will document stand conditions and vegetative composition, analyze plant chemistry as it relates to food sources for insects, evaluate soil conditions and soil carbon, and estimate wildlife use. After thinning, they'll remeasure these conditions, assess damage to aspen roots and future suckering potential, determine tree damage and potential for infection by disease, estimate potential for infection and defoliation at a landscape scale, and analyze the economics of various thinning practices.

Carbon-wealthy trees might use their new-found affluence to beef up chemical defenses, or to bounce back after defoliation.

Spending Carbon Wealth Wisely

Years ago, this kind of experiment might have looked at biomass only—tree growth as a result of thinning. New thinking has led researchers to hypothesize that "bigger trees" may not be the only expression of post-thinning vigor. Carbon-wealthy trees might use their new-found affluence to beef up chemical defenses, or to bounce back after defoliation. A mosaic of thinned stands across the landscape could act as a barrier to the spread of pest outbreaks, or as habitat to birds that prey on insects. The net effect would be the same, in that well-defended trees wouldn't succumb or lose as much growth when stressed.

Economic vigor could also be spurred by aspen thinning. A commercial thinning would yield 5-7 more cords of wood per acre than the standard prescription (harvest at 30-40 years with no intermediate cutting). On Minnesota State lands alone, this could mean 200,000 more cords of pulpwood annually. And if residual trees become larger as a result of thinning, as some evidence suggests, higher value products such as lumber and veneer could make it to market.

"What's exciting to me about this study," Zasada said, "is the chance to work with a team to address relevant questions that have real consequences." Planned products include field manuals, guides, refereed journal articles, hands-on demonstrations, workshops, and conferences. Thinking years ahead, Zasada added, "We want to establish this study in such a way that researchers and managers who come after us can continue the work." For more information, contact John Zasada at 218-326-7109 or jzasada/nc_gr@fs.fed.us.

People on the Move. . .

Congratulations!

Dan Dey, *Columbia*, was promoted.

Dwight Streblow, *Grand Rapids*, received an award for exceptional initiative, conscientiousness, and perseverance over a 3-1/2-year period in implementing, maintaining, and successfully completing the Clearwater County Study.

Moving on...

Marge Holdaway, *St. Paul*, retired.

Mike Hogan, *St. Paul*, resigned.

Bundling Up with Nature's Insulator: Chunkwood Trials

In many parts of the world, springtime goes by the name "mudtime." As frost leaves the ground, roads turn to quagmires. Even gravel roads can become unstable when the mud beneath them starts to ooze. For some folks, mudtime simply means more car washes, but for others, it means days of work lost, and payrolls not met.

"In places subjected to winter freezing, Forest Service roads can become impassable to logging trucks during spring thaw," said Jim Mattson, project leader of the Forest Engineering project in Houghton. "Truck traffic is typically restricted from county and township roads as well." In New England, soupy conditions can close roads for weeks at a time, cutting supply lines to nearby towns. The same thing can happen in the fall when snow melts atop a warm dirt road.

Chunkwood to the Rescue

Problems like these set Mattson and his colleagues thinking about a new road-building material—solid enough to support the trucks, but easier to lay and maintain than asphalt. Enter chunkwood—disks, cylinders, and fist-sized chunks of wood that make a surprisingly tough and inexpensive road-building material that sets up quickly and eventually degrades. The machine that creates chunkwood was the brainchild of NC's now-retired Rodger Arola and Edsel Matson, who hold the patent for "the chunker."

Jim Mattson is now teaming up with the US Army's Cold Regions Research and Engineering Lab (CRREL) to test yet another quality of chunkwood. "Wood is a natural insulator," said Mattson. "Theoretically, we thought chunkwood could keep the ground from freezing in winter, thereby avoiding the springtime thaw." This interests the US Army, which often has to get heavy equipment across rapidly thawing ground.

If a chunkwood road keeps the ground beneath it warm, Mattson reasons, it should also work in the reverse, keeping frozen ground frozen. This would be useful in permafrost conditions, where overland travel causes melting of the permafrost, which eventually destroys this fragile layer.

To test the first hypothesis, Mattson and his colleagues from the Army's Cold Regions Research and Engineering Lab built an experimental road at Harshaw Farm in Rhinelander. In a span of 100 meters, they removed the topsoil and built six test sections of roadbed:

1. Control
2. 2-inch-thick sheets of Styrofoam
3. 1 foot of chunkwood
4. 2 feet of chunkwood
5. 2 feet of chunkwood mixed with sand
6. 3 feet of chunkwood

All of the test sections are covered with geotextile fabric and 8 inches of road gravel. In each segment, an 8-foot probe measures temperatures at 16 different levels, transmitting data (via phone) to Houghton's computers every 15 minutes. Survey instruments keep an eye on the road surface to see if elevation changes with frost-heaving.

"So far, two out of three winters have been cold enough to get results," reported Mattson. "Both years, the 2- and 3-foot-deep chunkwood segments kept the ground from freezing. In other segments, frost was detected as deep as 5 feet into the ground."

"We've been really impressed with chunkwood's insulating properties," said cooperator Maureen Kestler, a research civil engineer with the US Army. "We just wish there were more machines available."

James Mattson

Roads built with NC's patented "chunkwood" may be an antidote to the muddy, spring-thaw blues.

Floating Atop Sugar Sands

A manufacturer has yet to step forward to build a commercial version of the chunker. In the meantime, the two prototypes built at Houghton have been winning rave reviews. Forest Service engineer Rob Fallon tried chunkwood on the sugar-sand roads of the Chequamegon-Nicolet National Forest's Washburn District, which can be treacherous no matter what time of year it is. "Logging trucks sink up to their wheel wells in the fine sand, and it gets so bad we have to pull them through with skidders," Fallon said. "Chunkwood has been amazingly effective in these conditions."

Harvesting wood for roads can help accomplish other goals on the forest, says Fallon. "We stockpiled chunkwood by thinning overstocked stands, restoring oak savannas, cutting fire breaks, etc. Material that may not have qualified for a timber sale was put to good use," he said.

Maintaining the 340,000 miles of low-volume roads on national forest system lands is a serious concern for the Forest Service. According to Mattson, "Chunkwood technology may be one way to economically maintain the needed road system in some situations." For more information, contact Jim Mattson (906) 482-6303 or jmattson/nc_ho@fs.fed.us.

Novel Synthesis Wins Quality Research Award

Entomologists Ken Raffa of the University of Wisconsin and Mike Wagner of Northern Arizona University say they chose wisely when they selected NC research entomologists Bob Haack and Bill Mattson to write a chapter for their 1993 book, *Sawfly Life History Adaptations to Woody Plants*.

"The temptation for most of us, when asked to write a review chapter, is to encapsulate what's already been written," Raffa said. "Instead, Bob and Bill looked at existing data with new questions, and wound up with a genuinely novel synthesis." That synthesis earned them this year's NC's Quality Research Award.

The team was trying to find patterns that would explain which sawfly species are prone to "outbreak," that is, to build up to damaging population levels, and why. The fact that Haack and Mattson were not sawfly specialists didn't worry the editors. "Bob and Bill are two of the best conceptual thinkers in forest entomology," Wagner said. "We knew that they wouldn't shy away from the big questions—the whys behind ecological phenomenon."

Patterns in the Data

Haack and Mattson began by determining how many of the 1,000 species of North American sawflies feed on woody plants and on which plant genera they feed. They then related the distribution of tree-feeding sawflies to traits of their woody hosts, including latitudinal range, relative abundance, life history, and number of species in the tree genus. "Our decision to focus on tree hosts was inspired by the theory of island biogeography," Bill Mattson explained. "The tree is like an island to which organisms migrate and then function as communities."

Asking "Which trees have been colonized over evolutionary time by sawflies and why?" revealed interesting relationships. The farther north a tree species' range extends, for example, the more likely it is that sawflies are among their most significant pests. Sawflies are more numerous on tree species that are short-lived, sun-loving, and have low to medium nutrient demands. Finally, plant genera with lots of plant species host more sawfly species.

Bob Haack, Bill Mattson, and redheaded pine sawfly larvae.

G. Heaton

In search of historic patterns in the Great Lakes region, Haack and Mattson collected and combed through 125 annual pest reports from Michigan, Minnesota, Wisconsin, and Ontario. These records showed that pine-feeding sawflies reached epidemic proportions more frequently than any other kind of sawfly. Exotic sawflys were more outbreak prone than natives.

When Haack and Mattson compared life-history traits of outbreak vs. nonoutbreak conifer-feeding sawflies in the Great Lakes region, a pattern emerged—a suite of adaptations that may explain pest status. Sawflies that spend their larval periods in gregarious colonies are more likely to be "pestiferous" than solitary feeders. As Haack explained, "Gregarious larvae have the advantage of being able to work together to startle predators and to consume tough pine needles."

Other traits associated with outbreak-prone species include black head capsules on larvae (greater heat absorption in the spring), greater fecundity, more developmental stages (allowing larvae to grow larger), and a greater likelihood of causing tree death.

Asking the Bigger Questions

In the tradition of the best research, the chapter led the scientists in new directions. Haack co-authored a comprehensive review of the yellowheaded spruce sawfly (Katovich, S.A.; McCullough, D.G.; Haack, R.A. 1995. *Yellowheaded spruce sawfly—its ecology and management*. GTR-NC-179). Mattson compiled the first complete listing of exotic insects that feed on woody plants in North America (Mattson *et al*. 1994. *Immigrant phytophagous insects on woody plants in the United States and Canada: an annotated list*. GTR-NC-169). He and a colleague then wrote a fascinating paper about why exotic insects from Europe do so well over here, while their American counterparts don't wreak similar havoc in Europe (Niemela, P.; Mattson, W.J. 1996. *Invasion of North America by European phytophagous insects*. BioScience 46: 741-753.) Mattson is now working on a new theory. "I'm interested in the way insects take control of the growth processes of their host plants. Some sawflies, by feeding on early shoots, actually trigger the growth of dormant reserve tree buds, which provide food for their offspring."

For more information on the chapter that started it all, see Wagner, M.R.; Raffa, K.F. eds. *Sawfly Adaptations to Woody Plants*. San Diego, CA: Academic Press: 503-545.