PNW
Pacific Northwest
Research Station

Science
FINDINGS

INSIDE

issue nineteen / october 1999

"Science affects the way we think together."
Lewis Thomas

ALTERNATIVES TO CLEARCUTTING OF OLD GROWTH IN SOUTHEAST ALASKA

Forests in southeast Alaska support a good population of wildlife.

IN SUMMARY

This issue of Science Findings examines the results of a study designed to provide a broad array of silvicultural options for land managers. Pacific Northwest Research Station scientist Mike McClellan is leading the study and has found that timber harvesting by using alternatives to clearcutting is viable in the current marketplace and technically feasible across a wide range of cutting intensity. Other findings have shown that moderate, partial cutting encourages diverse understory vegetation, similar to vegetation found in adjacent uncut old-growth stands. The effectiveness of a wide range of alternatives to clearcutting will continue to be tested, developed, and watched by scientists, managers, and the public.

"The vigorous, the healthy, and the happy survive and multiply."

Charles Darwin, 1809-82

As Alaska and the destiny of its forests have come under increasing critical scrutiny from every quarter, local to international, forest management options other than clearcutting are being sought by land managers.

"The immediate problem we face is that much is known about the ecological effects, economics, and social impacts of clearcutting," says McClellan, a research forest ecologist with the Pacific Northwest Research Station in Juneau, "but there is little documented experience with other silvicultural systems in southeast Alaska. Alternative systems hold the promise of sustained timber production with superior protection of other forest values, but this promise needs rigorous testing."

Clearcutting is economically efficient, and in southeast Alaska's temperate rain forests, it has been the harvest method of choice for most of the 20th century. Furthermore, clearcutting is a highly effective terminator of disease in young forests. As much as 30 percent of timber volume in the region's old-growth forests is defective, the trees victims of heart-rot, with some mistletoe causing growth reduction or death.

So go the chief arguments in support of continued clearcutting, and no doubt management objectives will ensure its continued use as a silvicultural tool into the future. But the talk about alternatives has translated into action on the ground: in a joint effort, the Pacific Northwest Research Station and the Alaska Region of the USDA Forest Service have established an interdisciplinary study of ecosystem and social responses to alternative silvicultural systems.

The study of alternatives to clearcutting (ATC) in the old-growth forests of southeast Alaska was set up in 1994. It took shape as a response to the 1992 directive from the Chief of the Forest Service to reduce the amount of clearcutting and address concerns about wildlife and fish habitat as well as visual quality. McClellan is a team leader of the ATC study, whose first two sets of treatments were completed this summer.

The natural disturbance pattern in southeast Alaska is mostly small scale and rarely includes fire, unlike other parts of the Western United States. Windthrow, disease, and landslides are the chief agents of change. What the natural history of the area suggests is that it is well adapted to effects similar to those of partial cutting. It also suggests that the practice of "zoning" the forest for distinct and apparently competitive uses, such as timber, tourism, wildlife, and subsistence, may be overlooking a greater compatibility among these values than is commonly recognized.

"The use of silvicultural systems other than even-age management with clearcutting could take advantage of this adaptation to small-scale disturbance to provide a sustainable supply of timber—along with a host of other important values," says McClellan.

KEY FINDINGS

- Low or partial cutting has affected tree species composition of future stands. In most cases, low-intensity cutting will not cause stands to become dominated by western hemlock and devoid of Sitka spruce.
- Moderate, partial cutting seems to maintain diverse and abundant understory vegetation, comparable to adjacent uncut old-growth stands. Understory plant diversity and abundance, however, does decline at higher levels of partial cutting.
- Timber harvesting by using alternatives to clearcutting is viable in the current marketplace and technically feasible across a wide range of cutting intensity. Where group selection is used, gaps should be greater than 100 feet in diameter to avoid problems during tree falling and yarding.
- Harvest related damage is greater to residual trees where fewer are left. Where 75 percent of the trees were left, generally less than 15 percent were damaged; when only 25 percent of the trees remained, up to 40 percent were damaged to some extent.
- Pretreatment surveys highlighted the role of disease as an important agent of small-scale disturbance in these forests. Wind-caused uprooting and breakage of trees were less important than commonly thought.

RAPID ANSWERS FROM HISTORY

As always, when a politically charged issue gathers momentum and its supporters begin asking for scientific backup, the timeframe shifts radically. The years needed to gather and analyze data disappear in the smoke of demands for answers. Researchers sought to address this problem by designing the ATC study in two parts: a short-term retrospective study, and a longer term, operational-scale experimental study, including pretreatment studies of selected harvest areas.

Even before the experimental results started coming in, the retrospective and pretreatment studies had produced a wealth of historical data that did not previously exist, which are of interest in their own right.

"While results from the experimental study will be defensible and reliable, they will not yield any quick answers," says McClellan. "The strategy of extending the experimental study with retrospective and pretreatment studies has gotten some answers onto the table in less than 2 years. These data will provide interim guidance to land managers by quantifying how forest ecosystems responded to both natural and human-caused disturbances in the past."

The retrospective study has identified over 270 stands partially harvested from the early 1900s to the present, of which 22 have been closely studied to determine the effects of harvest intensity and pattern.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

PNW Science Findings is published monthly by:

Pacific Northwest Research Station
USDA Forest Service
P.O. Box 3890
Portland, Oregon 97208
(503) 808-2137

Sherri Richardson, Editor
srichardson/r6pnw@fs.fed.us

Check out our web site at:

http://www.fs.fed.us/pnw

USDA United States Department of Agriculture

Forest Service

Results from this short-term portion of the study are helping to answer questions about how well residual stands resist wind damage; how well conifers regenerate and grow, particularly Sitka spruce; the potential for spread of dwarf mistletoe, a disease that infects hemlock; and how well partial cutting maintains understory vegetation, especially winter forage for deer.

One of the concerns of the timber industry about alternatives to clearcutting is that low-intensity cutting will cause stands to become dominated by western hemlock and devoid of Sitka spruce.

"Our studies of historical partial cutting show quite clearly that the current proportions of Sitka spruce and western hemlock depend more on initial stand compositions than cutting intensity," notes Bob Deal, silviculturist at Juneau Forest Sciences Laboratory (FSL), and lead investigator for the retrospective part of the study. "In addition, it appears to be the small- and medium-sized residual trees that dominate current stands, not the new germinants. In other words, cutting intensity has little effect on the proportions of more- and less-desired tree species in future stands. Our evidence indicates that partial cutting will not be converting stands to pure hemlock."

Retrospective studies also have revealed that partial cutting seems to maintain diverse and abundant understory vegetation, most important for winter forage for Sitka black-tailed deer. One of the reasons for this healthy understory, Deal posits, is that partial cutting stops the excessive growth of understory conifers that typically occurs after clearcutting. Shrubs, herbs, and forbs are able to thrive in varied light conditions and under less extreme competitive conditions.

Another key concern about partial cutting has focused on logging damage during harvest and excessive windthrow and dwarf mistletoe spread after harvest. To grapple with these issues, McClellan and Paul Hennon, research pathologist at the Juneau FSL, are trying to document natural levels of wounding and decay and also to understand better the causes of tree mortality. Specifically, they no longer assume windthrow to be a consistent primary cause.

"Our preliminary results indicate that many or most canopy level trees die standing," Hennon says. "Clearly, we need to learn more about the mortality factors that lead to trees dying standing if we hope to thoroughly understand the mechanisms of small-scale disturbance." He adds that the study of tree mortality in these forests will yield an interesting perspective on what levels and types of tree death may be desirable in managed forests.

MANAGEMENT IMPLICATIONS

- Low- to moderate-intensity partial cutting of old-growth hemlock-spruce forests seem to be an effective means of maintaining many values, including wood production, wildlife and fish habitat, and visual quality. Systems that enhance the compatibility of these values reduce the need to "zone" the forest for a narrow range of uses.
- Existing forests offer lessons about the effects of disturbance on trees, stands, and landscapes—lessons that can shape our use of partial cutting and other management options. "Ecologically informed" partial cutting can produce high-quality timber and retain the forest structure essential for wildlife and fish.
- The effectiveness of a wide range of alternatives to clearcutting will be tested by experimental studies. Application and further development of these methods will require a mix of caution, creativity, and collaboration among scientists, managers, and the public.

FOOD WEBS AND HABITAT QUALITY

Death and decay on a smaller scale, of course, are also tightly integrated into the ecosystem. One pretreatment study investigated energy transport from forested headwaters to downstream aquatic habitats, seeking to clarify the dynamics of the forest-stream food web.

The stream study showed that headwater habitats can be important source areas of invertebrates, both terrestrial and aquatic, and detritus. Thus the small streams draining forested uplands serve as energy conduits that subsidize downstream food webs. According to Mark Wipfli, research aquatic ecologist at Juneau FSL, past, existing, and proposed timber harvesting that alters riparian forest canopies above these high-gradient streams will affect levels of leaf litter, other detritus, invertebrates, and sunlight reaching the stream. It may thus cause shifts in headwater stream function and productivity.

Given that clearcutting in southeast Alaska has been quite extensive in many watersheds, it has had significant and lasting impacts on the ecosystem, including on small headwater streams, according to Wipfli. The more reason, perhaps, to examine harvesting alternatives that more closely resemble natural disturbance patterns.

Other habitat effects point in a similar direction. A pretreatment study of winter wrens by Station research ecologist Toni De Santo and Mary Willson, a former research ecologist at Juneau FSL, suggests that altering the understory and forest structure will affect the reproductive ecology of this understory bird. Wren populations were higher, with increased nesting density and more mates per territory, in forests that provided such understory features as moss, downed wood, and intact streambanks.

Wrens nesting in even-aged stands had lower nest success, fewer mates, and larger territories than birds living in partially harvested stands. In addition, the study showed that several measures of reproductive fitness actually differed in habitats that were superficially similar. De Santo suggests that if this can be the case, then reproductive traits could differ even more in habitats that differ structurally from mature coniferous forest, such as clearcuts.

REVIEWING THE ALTERNATIVES

While retrospective studies were underway, the ATC team was structurally designing the long-term experimental portion of the study: nine silvicultural systems ranging from even-age management with clearcutting to uneven-age systems using single-tree or group selection. Three blocks have been located across the Tongass National Forest–at Hanus Bay, Portage Bay, and Lancaster Cove, a block being one replicate of the nine systems being studied.

The treatments are no-harvest control; clearcut; leave 5 percent of trees evenly spaced; leave 25 percent evenly spaced; leave 75 percent evenly spaced; leave 25 percent in clumps with clearcut between; harvest all trees in small groups of half to 2 acres, leaving one third of remaining trees evenly spaced; harvest 25 percent of total trees in small gaps with no other harvest; harvest 25 percent of total trees, leaving small unharvested groups and removing one-third of the remaining trees evenly spaced.

The particular ATC treatments chosen emulate stand structures that occur in native forests in southeast Alaska whose patterns result from various disturbance events, ranging from the death of a single tree from fungal attack to large-scale blowdown during violent windstorms, McClellan says.

"These nine systems do not represent the only systems that could be considered for use in southeast Alaska," he points out. "Rather, they will create a broad range of conditions that could occur after harvest or any other disturbance event."

The objectives of this part of the study are to investigate effects of these treatments on several resources, including damage to the residual trees, amount of soil disturbance, effects on soil stability, ground water, stream sedimentation, wildlife, birds, economics of harvesting, spread of insects and diseases, and the public's perception of the different harvest methods, according to McClellan.

"Of great concern is the damage to the residual trees because the trees in southeast Alaska are thin barked and easily damaged by logging activities. These residual trees are the ones we are counting on to provide specific conditions or structure in the future. If they get damaged or diseased, they may not live as long as we hoped, either as habitat, or as future crop trees."

WHILE WE WERE WAITING

The nature of the experimental portion of the study means that preliminary results will not become definitively available until several years after harvest and will continue being developed for many years into the future. Some data, however, are starting to point to future trends. For example, preliminary groundwater studies by Bob Erhardt, research hydrologist with the Juneau FSL, have suggested that rainwater moves through harvested systems at the same rapid rate as is typical of uncut areas, but that the response is likely to be "flashier," with higher and more frequent peaks on the hydrographs.

Prior research has established that "natural" landslides in uncut areas are larger, because they move larger masses of material, but about 5 to 7 years after cutting in southeast Alaska, landslides are likely to be more frequent, although smaller. This change is most likely caused by altered drainage patterns, less coarse material available to transport, and decreased soil stability as root systems decay after cutting. Answers on specific effects from different levels of partial cutting are expected from the ATC research.

But the first harvest, at Hanus Bay, has already offered crucial lessons on the levels of damage from the different treatments, operational and technical difficulties, and how accurately prescriptions could be implemented. More of these data are due in from Portage Bay summer 1999, and some early posttreatment data on wildlife are being analyzed.

"Most importantly, we have established that ATC systems are viable in the current timber marketplace, and that the treatments are feasible from technical and safety standpoints," McClellan says. "These were key concerns from the timber industry going in, particularly with respect to harvesting in some treatments where expensive helicopter logging was the only choice, such as the 25-percent single-tree selection treatments."

Ironically, because of the peculiarities of southeast Alaska's timber industry, partial cutting may offer some real advantages to the bottom line that also play well for wildlife. In a region with such a high level of defect, much of the harvest used to end up at the pulp mill. But the last two pulp mills in the region have closed in recent years, and the cost of transport from this isolated area has made harvesting of low-quality, defective timber highly unattractive, McClellan explains. An economically viable timber industry may have to focus on high-quality products to survive.

Loggers cutting a small group selection treatment of old growth at Hanus Bay in southeast Alaska.

"The good news is that defective, poor-quality trees are best left for wildlife habitat. Some foresters are concerned that the descendants of these poor-quality trees will dominate future stands and lower quality, but Bob Deal's retrospective work showed that future stand growth will be dominated by the advanced regeneration—small trees that are already growing in the understory prior to partial cutting."

LESSONS FROM THE PROCESS

Much learning has occurred along the way, outside of the actual data collection and analysis, McClellan says. First, he encountered the inherent conflict between experiment and reality. For credibility among the scientific community, treatments must be randomly assigned. But the result can mean assigning certain treatments that may be unsuited to a particular area. For example, some treatments leaving exposed clumps of trees could be placed in areas known to be vulnerable to windthrow, or a clearcut could be placed along a ferry route, with predictable results.

"We were caught in the middle between the operational and experimental aspects of the study," McClellan notes ruefully, "torn between the rules for doing science and the practical concerns that managers must face every day."

The very nature of the dialogue, however, has meant that far broader mutual understanding of the scientific and management processes now exists, he says. "These discussions take a lot of time and energy, but the study benefited from mutual learning about experiment and treatment design, what was impractical, and things like writing tree-marking guidelines. In fact, the latter was an especially revealing learning experience, focusing around the question, What's valuable and to whom?"

Several social and economic studies are planned or underway, guided by Bob Schroeder, research social scientist at the Juneau FSL. These include structured interviews looking at the expectations and social acceptance of the various treatments, and a regionwide survey that will cover ATC acceptability issues. These will be addressed to such groups as timber fallers, owners, tour boat operators, and environmentalists. The National Forest System also is doing cost and production studies.

A unit at Hanus Bay after treatment (25 percent of the trees remain).

There has been steady interaction with interested parties other than the Forest Service, including meetings with private timber owners, timber consultants, state and Native American forestry representatives, environmentalists, and the public. As the results come in and are presented publicly, there is strong regional support for the research, McClellan says.

FOR FURTHER READING

Deal, Robert L. 1999. *The effects of partial cutting on stand structure and growth, and forest plant communities of western hemlock-Sitka spruce stands in southeast Alaska.* Ph.D. dissertation; Oregon State University.

De Santo, Toni L.; Willson, Mary F. [In press]. *Predation of artificial nests and predator abundance in natural and artificial coniferous forest edges in southeast Alaska.* Journal of Field Ornithology.

De Santo, Toni L. [and others]. [In prep]. *Reproductive success of winter wrens (*Troglodytes troglodytes*) in north-temperate coniferous forests.*

Hennon, Paul; McClellan, Michael. 1999. *Heart rot and other causes of small-scale disturbance in the temperate rain forest of southeast Alaska.* In: Trummer, L., comp. Proceedings of the 46th Western international forest disease work conference; 1998; Reno, NV. Anchorage, AK: U.S. Department of Agriculture, Forest Service: 97-105.

Wipfli, Mark S.; Gregovich, D. [In press]. *Headwaters subsidize downstream food webs with prey and detritus.* Freshwater Biology.

WRITER'S PROFILE

Sally Duncan is a science communications planner and writer specializing in forest resource issues. She lives in Corvallis, Oregon.

Science
FINDINGS

U.S. Department of Agriculture
Pacific Northwest Research Station
333 S.W. First Avenue
P.O. Box 3890
Portland, Oregon 97208-3890

Official Business
Penalty for Private Use, $300

BULK RATE
POSTAGE +
FEES PAID
USDA - FS
PERMIT No. G-40

SCIENTIST PROFILE

MICHAEL H. MCCLELLAN is a research ecologist and team leader for the Silviculture of Southeast Alaska Research Team, Resource Management and Productivity Research Program, Pacific Northwest Research Station. He received his B.S. in biology from the University of Oregon, and his M.S. and Ph.D. in forest ecology from Oregon State University. He has studied soils, silviculture, and forest ecology in southeast Alaska since 1985. Before that, he worked with the National Forest System for 10 years in Oregon.

McCLELLAN can be reached at:
Forestry Sciences Laboratory
2770 Sherwood Lane, Suite 2A
Juneau, Alaska 99801-8545
Phone: (907) 586-8811 ext. 246
E-mail: mcclellan/r10@fs.fed.us

LEAD SCIENTISTS*(all with Juneau FSL)*
Michael McClellan, ATC study co-coordinator, forest ecologist
Robert Deal, forester
Toni De Santo, ecologist
Paul Hennon, plant pathologist
Robert Schroeder, social scientist
Mark Wipfli, aquatic ecologist
Richard Woodsmith, hydrologist

COLLABORATORS
Richard Zaborske, ATC study co-coordinator, regional silviculturist, USDA Forest Service Alaska Region
John Tappeiner III, Oregon State University
Kermit Cromack, Oregon State University
William Sise, Humboldt State University
James Burchfield, University of Montana