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FINDINGS

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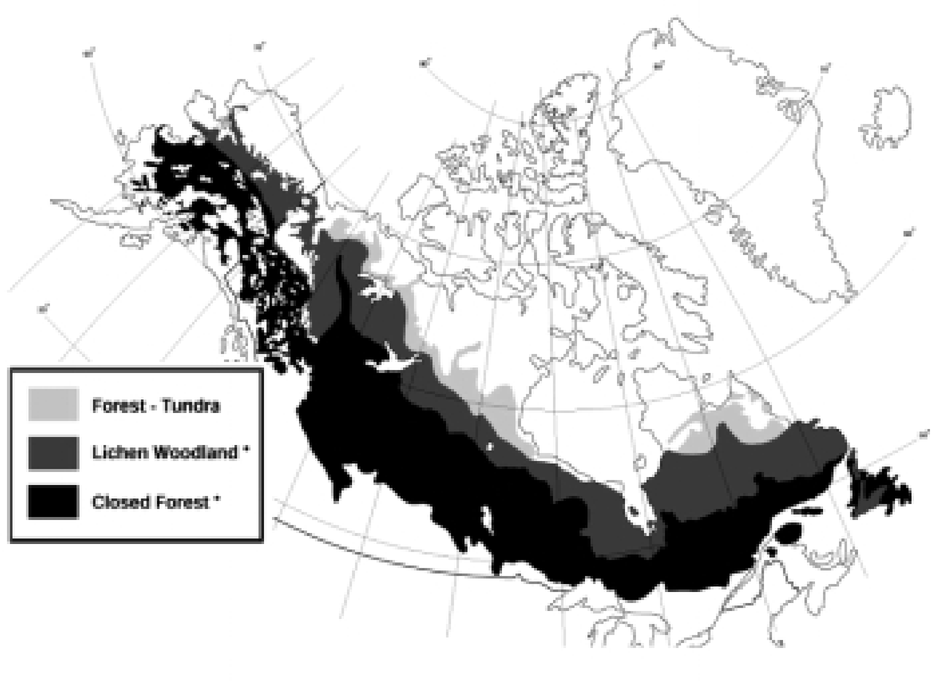
INSIDE

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

BOREAL BLENDING: TIMBER AND MOOSE IN ALASKA'S INTERIOR

Distribution of Boreal Forest of North America



Credit: Glenn Juday

The boreal forest is one of the largest biomes on Earth, but it is comparatively very unproductive and slow growing.

IN SUMMARY

Only a small body of research addresses the impacts of timber harvesting in the boreal forest of Alaska. The two projects described here began in 1970 and 1980 to develop more reliable methods of regenerating white spruce—the main commercial species in interior Alaska—from seed, and quantifying vegetation and soil responses.

A "by-product" of timber harvest is increased moose browse and cover provided by deciduous saplings (birch, poplar, and aspen) and brush species such as willow. The importance of moose in the economy of interior Alaska guarantees a major role in the values behind forest management decisions.

Recent reevaluations of both projects have significant implications for the management of white spruce but also extend to other present-day forest management issues, including aesthetics, biodiversity, wildlife management, and coarse woody debris budgets.

"The annual value of the moose hunt in meat alone exceeds $12 million, which is more than the total stumpage value for timber harvested in the boreal region of Alaska."

Trish Wurtz

The boreal forests of interior Alaska, seen from the air, resemble nothing so much as Legoland trees laid out on a vast scale. Brown tundra, fall-yellowing deciduous hillsides, and rivers milky with glacial silt stand out from the dark green of white spruce, the dominant conifer and most important commercial timber species. Neither settlements nor clearcuts interrupt the vistas in any noticeable way. Growing conditions are harsh here, and late-successional forests look stunted to eyes accustomed to the grander forests of the Pacific Northwest.

"The boreal forest is one of the largest biomes on Earth. But it is comparatively very unproductive and slow-growing," says Trish Wurtz, a research ecologist with the PNW Research Station, stationed in Fairbanks. "The most important limiting factor in these forests is soil temperature. For example, north-facing slopes and old flood-plain terraces are typically underlain by permafrost and have very low productivity. Nutrient availability is also key."

Boreal succession on both uplands and flood plains is characterized by rapid growth of hardwoods like aspen, birch, and balsam poplar, and tall shrubs like willows and alder. White spruce and other conifers may become established early in succession but are slow growing and may not dominate a site for 50 to 100 years. On some sites, scruffy-looking black spruce replaces white spruce when the forest floor builds up sufficiently to cool soil and allow permafrost to enter the profile.

KEY FINDINGS

- Over the 27 years of the upland study, no significant differences arose between shelterwood and clearcut overstory treatments, in terms of density or growth of any plant species.
- In the first 5 years after treatment, spruce grew better on scarified surfaces than unscarified. But by 27 years, this trend had reversed dramatically, and spruce on scarified surfaces were significantly smaller.
- Utilization by moose of the harvested and scarified areas increased relative to untreated areas and remained high 27 years after treatment. Cover of aggressive bluejoint reed grass had returned to preharvest levels in the same period.
- On Willow Island, harvesting and site preparation dramatically altered the soil temperature regime, with the largest effects on sites that were clearcut and burned. Temperature increases in shelterwood units, although less dramatic, were still significant.

Fire is the chief agent of natural disturbance, and with distances so great, and settlements so few, much of interior Alaska is zoned by land managers as "allow-to-burn." Thus there is a mosaic of vegetation types, including scattered stands of mature white spruce available for house logs and lumber.

"Because of our unique growing conditions, and also because of a lack of infrastructure and the distance from timber markets, the timber industry of interior Alaska is very small," says Wurtz, The total harvest from all 3.2 million acres of Tanana Valley state forests for the last 20 years has averaged less than 1,500 acres per year.

BOREAL HARVESTING CHALLENGES

Nonetheless, timber harvest in Alaska attracts some of the scrutiny familiar to residents of the lower 48. A prevailing theory is that most people in Alaska are from somewhere else, and bring with them the fear that timber harvesting will follow a pattern like that experienced in other places. Access to timber is a major issue, with distances pushing costs up. Road building attracts negative attention, and harvest decisions are often based on whether winter roads and ice bridges across rivers can be used for transport during winter, when most harvesting is done.

"We rarely go over 5 percent of the allowable cut," says Wurtz. "The new management plan for the Tanana Valley state forest calls for a significant increase in the cut, but under present market conditions, the cut will still be far below what is believed to be sustainable."

Little is known about managing these stands, however, especially how to regenerate forests naturally from seed after harvest. White spruce is particularly dependent on seed availability—good seed crops can be separated by as much as 12 years—and on seedbed condition, in a region where its seeds do not survive in the soil for long.

"Wildfire creates a mosaic of seedbed conditions depending on its severity, the substrate type, and shading by living and dead plant materials," says Wurtz. "Local climate and soil conditions interact to present a wide range of probabilities for germination and seedling establishment."

The Alaska Division of Forestry is learning about disturbance patterns and how to link their harvest decisions to them. "We also need to look at region-wide diversity," says Marty Welbourn Freeman,

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program manager for forest resources. "Many of the areas that now receive the greatest public interest have been the most intensively used in the past, so that almost all the areas around settlements are previously unmanaged second growth."

Around Fairbanks, for example, the burgeoning demand for fuel for the first 40 years of the 20th century came from stern-wheeled river boats fueled by wood, as well as mining activities, the railroad, and power plants. Spruce stands were intensively logged, and in some cases burned, often resulting in complete conversion to hardwoods. The slower growing spruce are only now beginning to recolonize these sites.

LAND MANAGEMENT IMPLICATIONS

- The upland study documents, for the first time in Alaska, a long-term negative effect of intensive scarification on the growth of white spruce. As a result, managers are rethinking their reliance on scarification, or choosing different scarification equipment.
- Scarification had a huge positive effect on development of browse volumes and also provided year-round horizontal cover for various wildlife species. This and other results will contribute to managing production of cover and browse.
- Shelterwood units were perceived more favorably by the public than clearcuts and were less visible from the air; partial overstory retention may mitigate visual impacts of harvesting.

SUCCESSION AND MOOSE IN BOREAL FORESTS

Alaska's boreal forests also play a central role in supporting a large moose population. Willow is the favored food of the big ungulates, and its health and vigor affects the welfare of a significant proportion of Alaska's people, according to Wurtz.

"Moose hunting is widely practiced in Alaska. It is an annual fall ritual culturally important to both Native and non-Native Alaskans, and has a real and immediate impact on the economy of the state. More important, the resource is literally food on the table for thousands of Alaskan families every year." About 7,000 moose are harvested annually statewide: with an average meat yield of 500 pounds per animal and an assumed replacement value of $3.50 a pound, the annual value of the hunt in meat alone exceeds $12 million, more than the total stumpage value of timber harvested in the boreal forest region of the state, she says.

When mature timber is harvested, the successional cycle begins again, and the timber is replaced on most sites with prime moose forage. With the right combination of harvest and scarification, the forage supply can increase 20- to 45-fold, and the carrying capacity for moose increases as well. Such increases are typical after wildfire as well, Wurtz explains.

"Some forest managers are shifting their silvicultural methods to focus on moose habitat enhancement, with timber production as a secondary goal. Such an approach is not without precedent; in Sweden, extensive silvicultural manipulations have led to a steady and long-term increase in moose populations. Now, more moose are harvested in Sweden every year than exist in the entire state of Alaska," Wurtz notes.

EXAMINING HARVEST TECHNIQUES

In the late 1960s, neither harvest methods nor their effects on moose were widely discussed; alternatives to clearcutting were rarely imagined.

"White spruce in Alaska had never been managed, just harvested in a 'take-the-best' manner way," says John Zasada, now with the North Central Experiment Station in Grand Rapids, Minnesota. [At the time, he was with the PNW Station's Institute of Northern Forestry from 1969 to 1985.] "There was concern by state forestry people that we needed to learn a lot more about regeneration, especially as we had no nurseries or infrastructure to support production of seedlings. Harvesting white spruce in Alaska was assumed to create conditions similar to those of natural disturbance, yet achieving natural regeneration proved difficult. Natural regeneration rarely seemed to produce well-stocked stands."

Zasada initiated a study in 1970 that compared results of clearcutting and shelterwood harvesting on an upland site within 20 miles of Fairbanks, in the Bonanza Creek Experimental Forest. He based his prescriptions on studies out of Canada in the 1950s, as no such studies existed in Alaska at the time.

"The typically poor natural regeneration of white spruce after clearcut harvesting was the original driving force behind this study," he explains. "It was predicted that leaving dominant trees regularly dispersed throughout the cutting unit would help overcome the problem of seed availability." He further proposed that mechanical scarification, with a bulldozer blade, could be used to distribute mineral soil seedbeds regularly and at the optimal time.

The site selected was considered productive, and the soil was well drained and free of permafrost. Six small study units were logged during summer 1972: three 5-acre shelterwood units, and three 3-acre patch clearcut units. Leave strips between the various cuts were 30 yards wide; shelterwood leave trees were selected from the best spruce on the sites, with almost 50 trees to the acre. Whole tree harvesting was used to minimize fuel loading and site preparation costs. The site was scarified immediately after harvesting.

WRITER'S PROFILE

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

PREDICTIONS AND SURPRISES

The study was unusual for its time in that all vegetation was inventoried before harvest, with all species tracked after treatment. (This attention to all plant species, Zasada says, was mainly due to the influence of Les Viereck and Joan Foote, ecologists at the Institute of Northern Forestry at the time.) For example, Zasada documented the duration of dominance by bluejoint reed grass, an aggressive colonizer of harvested areas.

"We were successful in getting spruce back by natural regeneration, which hadn't been achieved all across Canada at that time," says Zasada, but he notes that they were helped immeasurably by a massive seedfall in the season after harvest, along with timely and higher-than-usual rainfall. "At first we were hesitant to make confident statements about natural regeneration when we knew that serendipity had played a role," he says. "But state foresters are now seeing a lot more regeneration happening naturally on organic seedbeds, so the results may not be as unique as we thought in the early years of the study."

The greatest surprise in the study was the effect of scarification, or mechanical soil preparation, which had both negative and positive results.

"In the first 5 years after treatment, spruce grew better on scarified surfaces, as had been predicted. Scarification was the preferred treatment at the time," says Wurtz. "But by 27 years, this trend had reversed dramatically. Spruce on scarified surfaces were significantly smaller than those on unscarified surfaces."

Intense competition from other woody species is believed responsible for the reversal. This theory agrees with the finding that numbers of moose using the area after harvest with scarification increased and still remained higher 27 years after treatment.

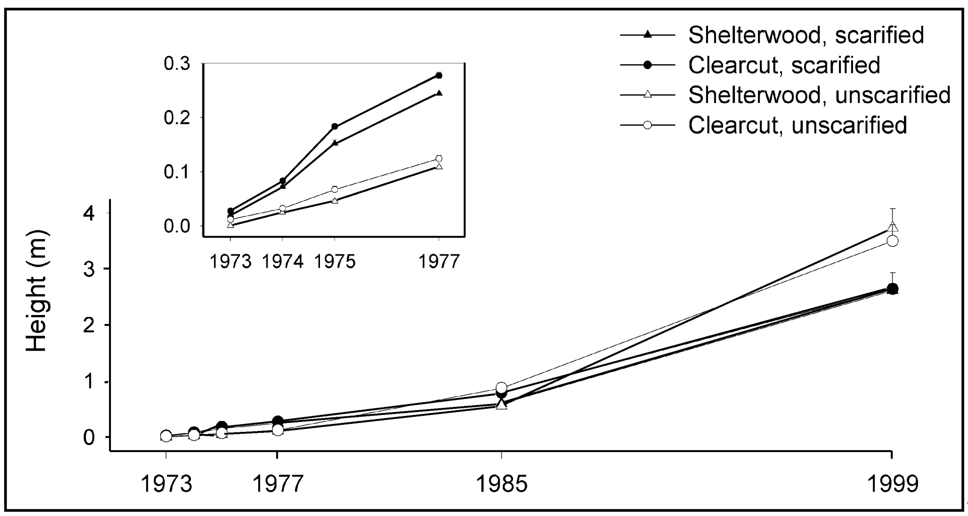
"Another surprise was that the shelterwood trees, which were removed after 15 years, could still respond to improved growing conditions even though they were more than 150 years old," says Zasada. "When we reduced their competition, their growth rate increased markedly. Shelterwoods also were perceived more favorably by the public than clearcuts and were less visible from the air.

OF MOOSE AND MEN

Before this study, Wurtz notes, managers expressed concern that partial overstory retention systems might slow the production of moose browse on harvest units. They believed shade might reduce both the production of vegetative sprouts and the regeneration from seed of browse species.

"This concern turned out to be unwarranted; we found no differences between shelterwoods and clearcuts in the density or growth of any plant species. Scarification did have a drastic effect on the understory, however, creating dense populations of birch, willow, and aspen, all prime moose browse species." Because many Alaskans still practice the subsistence lifestyle to some extent, including trapping for fur, it was notable that the scarified patches provided year-round horizontal cover for various wildlife species, including microtines such as voles, snowshoe hares (a keystone boreal prey species), and lynx.

Partly because of the link between timber harvest and moose, cooperators on the projects include both the Tanana Chiefs Conference, Inc. (an Alaska Native Corporation), and the Alaska Department of Fish and Game (ADF&G). The ADF&G has used willow and birch stem density data from this research to develop its own numerical management objectives for moose browse production after timber harvest. In fact, the department is beginning a large-scale comparison of different scarification techniques and equipment. The goal is to enhance deciduous saplings and shrubs as horizontal cover and forage for early-successional species, such as moose.



Credit: Corel Gallery

In the first years after harvest, growth of young spruce seedlings was best on scarified surfaces (inset). But by 27 years, this trend had dramatically reversed; growth was best on unscarified surfaces.

"Moose represent our largest single-species management program, since they're so critical economically and simply as protein," says Tom Paragi, a wildlife biologist with ADF&G. "We look at the regeneration results through wildlife eyes, and will continue with experiments on different types of scarification along with broadcast burning, trying to bring back the best browse and cover possible."

Although browse alone does not make good moose habitat, Wurtz points out that timber harvest and moose browse are ultimately complementary.

FLOOD-PLAIN FINDINGS

A second, similar study was begun on Willow Island in the Tanana River near Fairbanks in 1980 with an objective to "demonstrate management alternatives." Effects of harvesting on flood-plain vegetation and soils also were measured.

Five treatments were applied to a 175-acre area: two types of shelterwood cutting, clearcuts with and without broadcast slash burning, and a thinning.

Willow Island differs from the Bonanza Creek site in that its forests originated from primary succession: that is, plant communities develop on sites previously without vegetation. They grew on silt and sandbars and did not follow wildfire. Thus, after logging, sites such as Willow Island are described as secondary succession, and the study here allowed researchers to examine the different characteristics of the two kinds of succession on flood-plain sites.

"A remarkable feature of how these sites regenerated was the invasion of aspen after harvesting and site preparation," says Zasada. "Aspen is common on many of the units, especially the clearcut and burned sites; whereas it occurs rarely and only as a seedling during primary succession."

With productivity so dependent on soil temperature, the study was able to track changes in this limiting factor after harvest. "Not surprisingly, clearcutting followed by broadcast burning resulted in the most marked changes in vegetation and soil temperature," says Zasada. "Removal of the vegetation and blackening of the soil surface resulted in significant increases in soil temperature."

The result was that any permafrost present before disturbance was gone from the soil profile by the second year after logging.

Clearcutting without burning had less impact on soils and vegetation, and effects of shelterwood treatments on vegetation were minimal. Shelterwood soil temperature increases, however, were not far behind those of clearcuts; apparently the disturbance from creating shelterwoods is sufficient for some soil warming, Zasada explains. Thinning caused only small soil temperature increases.

CHANGES IN FOREST MANAGEMENT

The findings from these two studies have directly affected approaches to forest management by both state and Native corporations. "The upland study represents the only long-term examination of a case in which full stocking was achieved on both unscarified and scarified surfaces," Wurtz explains. "Our data are contributing directly to a reexamination of Alaska's Forest Practices Act (FPA) by the state of Alaska, Division of Forestry, Department of Natural Resources."

According to Regional Forest Supervisor Chris Maisch, the Division of Forestry is using the two studies to examine differences between flood-plain and upland sites, informing the debate on proposed changes in the FPA riparian management standards. The Division of Forestry is also reevaluating the stocking requirements of the FPA and regeneration methods in general. Relying on natural regeneration, for example, could increase rotation length by 10 to 15 years, he says.

Bob Ott, research forester for the Tanana Chiefs Conference, Inc., representing the many Native Corporations that are prime landholders in interior Alaska, sees multiple values coming from the two studies.

"The results from this work show that leaving trees on a site does not reduce productivity and gives us options we didn't know we had before. Furthermore, in Alaska, the time pressure for regeneration is less because the value of the timber is lower, so we can analyze upcoming seed years and choose between natural regeneration and planting," he says. "Leaving trees for aesthetic reasons is also important, and it's vital that the many social and cultural groups now coming to the table have more information to help develop community visions."

Forest Resources Program Manager Welbourn Freeman emphasizes the benefits of such long-term studies. "We need to have greater humility about the length of our studies," she says. "After all, these forests are not only long lived, they are highly dynamic, and to think that we see all the trends over a short number of years is nonsense."

Zasada concurs. "What is as important as any of the findings from these studies is the passing of the baton between young and older generations of Forest Service researchers," he says.

Alaska state motto: North to the future. Boreas was the Greek god of the north wind.

FOR FURTHER READING

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