Demonstrating Appropriate Silviculture for Sustainable Forestry in Central Siberia: A Russian - American Partnership

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Abstract.—A joint Northeastern Forest Experiment Station - Eastern Region team is working with Russian counterparts on a Forests for the Future Initiative in the Krasnoyarsk region of central Siberia. Russian team members include scientists from the Sukachev Institute of the Russian Academy of Sciences, managers from a number of units of the Federal Forest Service of Russia, and the directors of a logging and sawmilling enterprise. The goal is to establish a pilot project demonstrating principals of forest conservation and sustainable development. Applying silvicultural treatments appropriate for the forests of the region is a key element of the program.

INTRODUCTION

In 1993, a team of scientists and managers from the USDA Forest Service's Northeastern Forest Experiment Station and the Eastern Region was established to work with Russian counterparts on a Forests for the Future Initiative (FFI) in the Krasnoyarsk Krai (Region) of central Siberia. The goal of the FFI program is to establish pilot projects to demonstrate the principles of forest conservation and sustainable development. The first phase of the project in Krasnoyarsk was to provide geographic information system (GIS) capability at the field level in Siberia. Begun in 1995, the second phase was to establish demonstrations of sustainable forestry practices in areas scheduled for harvesting. This paper will present background, progress, and plans for Phase Two.

Currently, members of the American team include scientists from the Northeastern Forest Experiment Station, and managers from Region 9, Region 1, and the Washington Office of the Forest Service. Russian team members include scientists of the Sukachev Institute of the Russian Academy of Sciences, managers from a number of units of the Federal Forest Service of Russia, and the directors of a state-owned logging and sawmilling enterprise.

In preparation for Phase Two, the American team visited Siberia in 1995 to become familiar with the ecology of the region and the state of research in the area. We returned to Siberia in 1996 to witness harvest operations in the area. Also in 1995 and 1996, several delegations of Russian researchers, managers, and industrialists visited northern New England and the Lake States to view our long-term research and operations on national forest and industrial forest lands, and visited California and Montana to learn about prescribed burning.

AN OVERVIEW OF KRASNOYARSK KRAI

Krasnoyarsk Krai is in the Asian part of the Russian Federation and occupies 233 million ha or 13.6 percent of the country's territory. The krai lies between 51° and 81° N, and 78° and 113° E, and includes the geographic center of Russia. Its southern boundary is the Sayan Mountains and its northern, the Arctic Ocean. Elevation ranges from 100 to 3,000 m above sea level. In the past, many political exiles, including Lenin, were sent to the region; today its population is about 3 million people, most living in cities. The first democratic elections in the krai were held in 1993.

The Yenisei River, one of the world's largest with a total length of more than 4,000 km, flows through Krasnoyarsk Krai. It starts in the Sayan Mountains and flows north to the Kara Sea, dividing east and west Siberia. The two largest hydro-electric stations in Eurasia are on the Yenisei. With its many tributaries, the Yenisei forms an important transportation network for goods and passengers. One of its tributaries, the Angara, is the outlet of Lake Baikal. Although the rivers are extremely important for transportation within the region, they are of limited value for exporting goods because the outlet is to the Arctic Ocean. The Trans-Siberian Railway crosses the Krai; however, distances to commercial centers are vast. In a direct line it is 3,200 km west to Moscow and 3,000 km east to Vladivostok.

The Krasnoyarsk Krai takes its name from its capital city. Located on the Yenisei, the city of Krasnoyarsk, which loosely means "beautiful red riverbank," was founded in 1628 by a nobleman from Moscow and some 300 Cossacks. It is an industrial, cultural, and educational center with a population of nearly 1 million people.

The area within Krasnoyarsk Krai chosen for demonstrating sustainable forestry is in the Predivinsk lespromkhoz (a timber enterprise) within Bolshoya Murta leskhoz (equivalent to a national forest in the United States). Bolshoya Murta is also the name of a village and the surrounding administrative district, similar to a county. Predivinsk is a village of about 5,000 people on the east bank of the Yenisei River, east-northeast of Bolshoya Murta. The people who live in the village are entirely dependent on the timber enterprise for their livelihoods. They work either in the sawmill, as loggers, or in support of those activities.

THE FORESTS OF BOLSHOYA MURTA

The Bolshoya Murta leskhoz (approximately 57° N, 93° E) is about 450,000 ha in size and 93 percent forested. The climate is continental with a mean annual temperature of 1.0° C, and maximum and minimum temperatures of 36.9°

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and -48.0° C, respectively (E. Vaganov, personal communication). Precipitation averages 406 mm per year, the growing season averages 146 days, and soils typically freeze to a depth of 172 cm. The area was not covered by the last continental glacier.

The leskhoz is divided by the Yenisei River. The western part of Bolshoya Murta is southern taiga and subtaiga forest-steppe transition. These sites are quite flat. Soils are Podzolic (Alfisol and Spodosol) and Chernozem (Mollisol). The eastern part is mountain taiga forest. The mountains are not large and only moderate slopes are encountered. Soils there are also Podzolic. The area is south of the permafrost zone.

The southern taiga and mountain taiga forests are comprised of "dark coniferous", "light coniferous", and hardwood stands. Except for scattered trees occasionally harvested for local use, these stands have never been logged. However, because of natural disturbance, average stand age is only about 91 years (E. Vaganov, personal communication). Nevertheless, coring of individual trees when we were there indicated some more than 200 years old. Furthermore, many of the stands we visited had the appearance of being uneven-aged. Trees of the forest-steppe transition are mostly birch, *Betula*, and pine, *Pinus*.

Although they are at higher latitude, dark coniferous stands found in Bolshoya Murta are strikingly similar to spruce-fir, *Picea-Abies*, forests of eastern North America. Siberian spruce, *P. obovata*, is similar to red spruce, *P. rubens* Sarg., so common in Maine and Atlantic Canada, and to white spruce, *P. glauca* (Moench) Voss, which is common across the northern United States and Canada. Siberian fir, *A. sibirica*, is similar to balsam fir, *A. balsamea* (L.) Mill. Although it is a stone pine (i.e., 5-needle fascicles, short-winged or wingless seeds), Siberian pine, *P. sibirica*, (called cedar by the local people) seems to have an ecological niche much like eastern white pine, *P. strobus* L., in mixed conifer forests of eastern North America. These are all relatively tolerant species and the stands tend to have multiple cohorts. Natural disturbances include insect epidemics, wind, and fire. After stand-replacing disturbance, dark coniferous stands are followed by the region's only large hardwoods, birch, *B. pendula*, and aspen, *Populus tremula*.

Light coniferous stands of Scotch pine, *Pinus sylvestris* L., are usually even-aged and appear similar to natural stands of red pine, *P. resinosa* Ait., in the Lake States. With increasing latitude, Siberian larch, *Larix sibirica*, progressively replaces pine in light coniferous stands. However, in the area where we are working, pine is much more common than larch.

Essentially all land in Russia is owned by the state. Forests are classified into three groups according to function. Group I forests are protected. Degree of protection varies by sub-group but, in general, only light partial salvage and sanitary cuts are allowed. Protection is provided to ensure a presence of Siberian pine in the forest, for riparian zones, shelter belts along roads, and at forest-town interfaces. In Bolshoya Murta, 11.7 percent of the forest area is Group I (E. Vaganov, personal communication). Wood from Group II forests can be harvested for local use, but these forests also have defined protective functions. Only 3.2 percent of the forest area of Bolshoya Murta is Group II. Forests in Group III are subject to industrial wood harvesting and the wood can be exported outside the region. These forests are supposed to be protected from fire and regenerated after harvesting. In Bolshoya Murta, 85.1 percent of the forest area is Group III, and thus available for industrial management.

Various elements of the Federal Forest Service of Russia are responsible for inventory, protection, and management of the forests. Under Soviet rule, state-controlled industrial enterprises harvested and processed timber. Since then, many of the enterprises have been privatized. The enterprise located in Predivinsk, however, remains state-owed, under the direction of an appointed official. Like the few other state-owned enterprises in non-strategic industries, the Predivinsk Lespromkhoz operates as an independent unit.

Because of the current state of the economy in Russia, operating funds for federal agencies are extremely scarce. To maintain a viable organization, the Federal Forest Service resorts to innovative methods to raise revenue. While harvesting and processing are generally performed by industry, the Federal Forest Service is responsible for thinning and salvage operations, the income from which they can keep. The organization also keeps some of the money collected in fines levied for violating forest statutes.

CURRENT SITUATION

Silvicultural treatments in the Soviet Union were mandated based on forest type, stand structure, slope, and whether the site had sufficient advanced regeneration of valuable species. The same or similar rules still apply. However, since the breakup of the Soviet Union, these rules are not strictly enforced for a number of reasons, both economic and political in nature.

Russian partners in this project include ecologists, silviculturists, and fire behavior scientists from the Sukachev Institute, and managers from the Federal Forest Service at levels equivalent to Region, Forest, and District in the USDA Forest Service. We also work with members of the aerial fire suppression branch, which is separate from forest management. The director of the Predivinsk lespromkhoz and key members of his staff are also active participants. These Russians are all well trained and highly professional. They understand the ecology of their forests and how they should be managed. However, our Russian partners face severe economic and cultural barriers to implementing appropriate silviculture. Markets within the krai are limited and access to export markets is poor owing to the vast distances involved. The agencies represented by the partners in this project do not encourage dialogue between their personnel, probably a legacy of strict centralized control. That culture may also explain why silvicultural treatments are mandated and not prescribed on a site-specific basis.

Dark Coniferous Forest

In the Predivinsk lespromkhoz, tracts of dark coniferous forest are clearcut with little concern for regeneration. Harvesting is in 50-ha units using tracked feller-skidders. See Folkema and Holowacz (1985) for detailed descriptions of Russian logging equipment and practices. This equipment has several limitations: the operator can only harvest trees to the left; the boom reach is only 5 m; and trees cannot be lifted once cut—so tops are dragged across the site before the butt of the tree is placed in a bunk at the back of the machine. Furthermore, skidding progresses in 5-m wide strips across the harvest unit with each skid trail being the previously felled strip. Thus, the whole unit is covered by skidding and all advanced regeneration is destroyed. If artificial regeneration was an option, such harvesting might be acceptable. However, there is neither nursery capacity nor infrastructure to ensure that all harvest units get planted, and there is no funding available to release established conifer seedlings from hardwood competition.

Before mechanized harvesters were available, trees were felled by hand crews using chainsaws and moved to landings by cable skidders. That operation protected advanced regeneration. Paradoxically, even though the economy is poor, loggers in the area are no longer willing to fell trees by hand. The reason given for this anomaly was an unacceptably bad safety record for hand-felling operations. Yet, this is a concern that could be overcome with proper training. Perhaps the view that technology is a panacea for the current production slump and the possibility (however remote) to garner state funds for technological modernization are additional factors. Regardless, the director of the lespromkhoz feels compelled to continue mechanical harvesting and its resulting destruction of the regeneration.

In 1996, an experimental prescribed fire was used to reduce slash in a recent clearcut and to prepare the site for planting. That successful experiment was innovative. In Russia, fire is routinely considered destructive, and prescribed fire is a radical idea and virtually untested management tool. Only time will tell when, or if, prescribed burning will become an accepted practice.

Light Coniferous Forest

In Bolshoya Murta, most Scotch pine stands are in riparian zones or on slopes and, therefore, clearcutting is not permitted. However, we did visit one unit where pines had been harvested and strips of seed trees were left to regenerate the site. Pine stands are characterized by large volumes of high-quality, high-value sawtimber. In the only active operation we saw in such stands, individual trees were selectively cut (i.e., high graded) using a feller-buncher. Because it was considered a thinning operation, the logs were milled and sold by the local unit of the Federal Forest Service (equivalent to a Ranger District on a national forest in the United States). Although the best stems were removed, the cut was light and the residual stand retained a high density of quality trees. Furthermore, the feller-buncher operator did an excellent job of protecting the residual stand from damage while cutting and maneuvering harvested trees.

We saw a number of pine stands with evidence of low intensity, understory wild fires. In each case, good stocking of seedling and sapling pines existed in the burned areas, suggesting that fire might be an effective way to establish advanced regeneration before harvesting the overstory. As in the dark coniferous forest, however, prescribed fire has not been considered a method for achieving silvicultural goals. Nevertheless, prescribed fire could have significant implications for regeneration and maintenance of pine stands.

ACCOMPLISHMENTS AND PLANS

Since its beginning in 1993, this project can claim a number of accomplishments. Communications among all the partners are improving, and there is a strong sense that what we are trying to accomplish is extremely important. Undoubtedly, the greatest accomplishment has been bringing together the various agencies responsible for inventorying, protecting, managing, and utilizing the forests to work toward a common goal. Phase One, developing local capacity to build, maintain, and use GIS technology is operational and nearly complete. Managers of the forests around Bolshoya Murta have been authorized to experiment with treatments other than those normally prescribed by rule; the prescribed burn in 1996 is the first attempt at such innovation. Exchange visits between Russian and American partners have improved our understanding of each other and of our respective forests. These exchanges have shaped our annual work plans, infusing this project with a high degree of flexibility.

We have a number of objectives for the future. Within the next year, GIS technology should become available to the lespromkhoz, thus completing Phase One. Under Phase Two, we have two immediate objectives. One is to plan and conduct a site preparation underburn in a light coniferous stand to demonstrate the potential of fire to enhance natural regeneration of pine. The other is to conduct a trial harvest designed to protect some advanced regeneration in a dark coniferous stand using existing mechanical harvesting equipment.

The proposed harvest will cut 5-m wide skid trails in the conventional way, alternated with 5-m strips where trees will be cut and removed while providing some protection for advanced regeneration. Regeneration will be lost on the skid trails and not fully protected on the adjacent strips, but any regeneration saved is an improvement over present practice. This logging method is technically feasible using existing equipment, but is somewhat more difficult operationally. The director of the lespromkhoz is skeptical about the economics of the method but willing to try it as a demonstration. Over the longer term, we hope to encourage harvesting equipment manufacturers to demonstrate their machines in the region. Under similar terrain and forest conditions in the industrial spruce-fir forest of Maine and elsewhere, state-of-the-art feller-bunchers operating on designated skid trails do a good job of protecting advanced regeneration.

To its credit, this project has succeeded in generating a series of quick accomplishments. We hope that continued successful demonstrations of silvicultural techniques will lead

to a willingness to consider a longer term approach and integrated planning. We would like to identify some areas well before they are scheduled for harvest and prepare a thorough prescription. The evaluation would consider the state of advanced regeneration and recommend appropriate prescribed fire and cutting methods to control the composition and density of the future stand. In conclusion, the Russian-American partnership has tangible accomplishments and the vision needed to develop appropriate silvicultural prescriptions to help sustain the forests of Siberia for the future.

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