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Division of Wildlife Conservation

Federal Aid in Wildlife Restoration
Research Progress Report

Wildlife Habitat Enhancement in the Spruce-Hardwood Forest of the Matanuska and Susitna Valleys

by

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PROGRESS REPORT (RESEARCH)

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Study No.: 1.44 Study Title: Wildlife Habitat Enhancement in the Spruce-Hardwood Forest of the Matanuska and Susitna River Valleys

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SUMMARY

We are investigating ways of promoting hardwood (browse) establishment and other habitat values after logging. We are also testing vegetation treatments (not preceded by logging) which may enhance habitat more directly for early successional wildlife. Early indications are that disk trenching and whole tree logging prepare a more ideal seed bed for hardwoods than do skidding, root raking or flat blading. The disk trencher has considerable potential because it produces a good seed bed, yet requires very little skill to operate effectively. We are testing the herbicide glyphosate in conjunction with mechanical scarification to determine how it might most efficiently be used to control bluejoint (*Calamagrostis canadensis*) grass competition with hardwood seedlings. Glyphosate is 100% effective in killing bluejoint, but scarification provides hardwood seeds better opportunity to germinate because it exposes mineral soil. Burning after herbicide kill of bluejoint does not expose mineral soil, because grass fuels do not burn long and/or hot enough to penetrate the organic horizon.

We cleared upland black spruce stands to stimulate development of early successional hardwood stands. The sites were efficiently cleared by dozers while soil was still frozen, without displacing nutrient rich soil. Initial germination of paper birch (*Betula papryfera*) approaches 200,000 seedlings per hectare.

I tested steam as a potential defoliant for killing browse along rights-of-way. While steam effectively defoliates and may be applied where use of herbicides or fire are not acceptable, hardwoods--particularly willow (*Salix scouleriana*) and balsam poplar (*Populus tremuloides*) will require two or more treatments to deplete root reserves responsible for resprouting of shrubs.

Key Words: Habitat, forest succession, logging, boreal forest, browse, *Alces alces*.

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BACKGROUND

Most wildlife in the boreal forest benefit from the presence of hardwood vegetation. Since boreal forest succession leads toward domination by spruce, presence of hardwood species depends largely upon periodic disturbances to reestablish early successional conditions.

Historically, the two principal forces responsible for retrogression of forests and maintenance of habitat diversity have been fire and fluvial action (Rowe 1961). Both of these remove overstories and expose mineral soil, creating ideal conditions for establishing hardwood seedlings (Viereck and Schandelmeier 1980, Zasada et al 1983, Perala 1987).

A primary problem managers of moose (*Alces alces*) populations face is the maintenance of adequate habitat (Franzmann 1978). Traditional winter range is the most likely portion of moose range to be encroached upon by humans. Of much greater significance than habitat lost to development are the far-reaching effects of land management policies which cause extensive and insidious disruptions to ecosystem ability to maintain the diversity and productivity of habitats and their wildlife. Fire suppression to protect scattered, remote inholdings established by State land disposals is a case in point.

Loss of early successional habitat is aggravated by the fact that clearing and road building often stimulate development of early successional species in and near areas of greatest human presence. Such situations attract moose experiencing browse shortages where forest succession has progressed beyond browse-productive early stages. This results in unnecessarily high numbers of moose/vehicle collisions, property damage, and dangerous moose/human confrontations.

Principal hardwood species--birch, balsam poplar, and most willows--require full sunlight and exposure to mineral soil to regenerate from seed (Rowe 1961, Argus 1973, Viereck and Schandelmeier 1980, Perala 1987). Density of root and/or stump sprouts by these species is often marginal or insufficient for hardwood forest regeneration. By contrast, aspen regenerates well by root sprouting if apical dominance for the clone is eliminated by totally removing standing trees.

Complete removal of the forest canopy by logging provides the same full-light conditions and elimination of apical dominance as does overstory removal by fire. With the exception of aspen, it is critical that soils be scarified after logging so that hardwood seeds can be exposed to mineral soil. Scarification timing relative to seed availabilities of various species considerably effects which species dominate early succession.

Competition from bluejoint grass represents a major problem for hardwood reestablishment in cutover areas in southcentral Alaska. Bluejoint readily monopolizes cutover areas of the boreal forest (Mitchell and Evans 1966, Collins 1992) and greatly limits opportunities for successful hardwood germination and establishment.

Although logging may represent a useful tool for maintaining the diversity and productivity of the boreal forest where fire is excluded, little attention has been given to regeneration of hardwood species. Most commercial timber operations have not been concerned about the future of sites harvested. From observing the few sites where some form of scarification occurred, proper site preparation can make at least a 100-fold difference in density of hardwood establishment. However, incorrect methods of scarification can also devastate a site by severely disrupting its nutrient, moisture and temperature relationships.

During the 1980s, increasing concern about losses of wildlife habitat to human encroachment, vegetation succession, and potential impacts of commercial timber harvests led to the initiation of this project. Jobs reported here include (1) site preparation methods for forest regeneration, (2) herbicidal control of bluejoint grass, (3) browse stand maintenance, (4) black spruce type conversion, (5) browsing influences on reforestation, and (6) Susitna River vegetation/habitat succession. Jobs regarding seasonal habitat preferences of moose and diet composition did not begin this year. A new job was added to determine the potential of using steam to kill browse along rights-of-way.

OBJECTIVES

Study Objective

1. Test and evaluate techniques that are potentially useful for enhancing or maintaining wildlife habitat in the boreal forest of southcentral Alaska.

Job Objectives

2. Test the effectiveness of different mechanical methods for enhancing the establishment of hardwoods on logged sites.
3. Test the efficacy of glyphosate in reducing bluejoint grass competition with hardwood seedlings.
4. Determine the effectiveness of hydroaxing and burning to maintain the availability and productivity browse within hardwood stands.
5. Determine methods of converting upland stands of black spruce to productive hardwood browse communities.
6. Assess the impacts of browsing on development of hardwood forests.
7. Describe vegetation/habitat succession on the Susitna River floodplain.
8. Determine the feasibility of using steam to kill browse along rights-of-way.

METHODS

Mechanical Post-logging Site Preparation (Job 2)

Summer skidding, flat blading, root raking (clearing blade), disk trenching, and whole-tree clearing were used to scarify different mixed spruce-hardwood stands in order to enhance hardwood regeneration. A disk trencher is an implement developed in Finland and increasingly used for scarification of boreal forest soils in Canada (Coates and Haeussler 1987). Whole-tree clearing involves uprooting the entire tree by a dozer, bunching, and removing the stump and limbs. Whole-tree clearing results in a relatively high degree of scarification, with minimal displacement of nutrient rich soil into piles.

Glyphosate Control of Bluejoint Grass (Job 3)

A 1-year-old and a 5-year-old birch-spruce clearcut were treated with glyphosate at 1.6, 3.4, or 5.0 kg/ha, 5.0 kg/ha of glyphosate followed by burning, and scarification by disk trenching. Treatments were applied according to a randomized block design. Each treatment was replicated 4 times, with each replication covering 37.16 m^2.

Browse Stand Maintenance (Job 4)

We used a hydroax to cut immature paper birch, balsam poplar, aspen, and willows which had grown out of the reach of browsing moose. The plants were cut at heights varying from 15 to 76 cm. We cut some plots during October and April so that resprouting would benefit from the maximum storage of food reserves in roots. Other plots we cut during early June to test the feasibility of stimulating aspen and balsam poplar root sprouting while at the same time weakening the presence of alder in the stand.

Black Spruce Type Enhancement (Job 5)

We cleared upland black spruce stands by D-5 and D-6 dozers using flat blades. Clearing was done during late May and June while frost remained in the soil just beneath the moss layer. This enabled us to clear trees and moss without displacing A-horizon soil into the piles of cleared vegetation. If present, tree-sized birch and willow were left standing at densities of 15-20 individuals/acre to provide a seed source in addition to that supplied by neighboring intact stands of birch and willow. Meandering edges were developed for each clearing to conform with natural features of adjacent vegetation and topography. Trees were randomly piled or placed in windrows not exceeding 30 m in length.

Browsing Impacts on Forest Development (Job 6)

We constructed moose exclosures (0.2 acre) on two birch-spruce clearcuts and on one cleared black spruce site.

Vegetation/habitat Succession (Job 7)

We re-determined vegetation composition, aerial cover, density and dimensions on 32 "permanent" study sites within the lower Susitna River floodplain after 10 years.

Steam Kill of Browse (Job 8)

We treated roadside plots of paper birch, balsam poplar, willow, and alder with steam in mid July 1991. Steam was delivered at 88° C through a 1.22 m x 1.22 m x 2.44 m hooded manifold for periods of 2, 4, or 6 seconds.

RESULTS AND DISCUSSION

Mechanical Post-logging Site Preparation (Job 2)

Preliminary observations of flat-blading, root-raking and skidding treatments were reported by Collins (1992). Follow-up observations of density and growth rates of hardwoods on those treatments will be made biannually.

In 1991 additional treatments consisting of whole-tree logging and disk trenching were established. These will be sampled, as the other treatments, for hardwood density, and percent ground cover by woody and herbaceous plants in September 1992. Hardwood seed germination on these sites by late September 1991 indicated that both have high potential as site preparation techniques.

Early observations indicate that the disk trencher has considerable utility as a scarification implement, because it is easy to control the depth of its penetration and prevent substantial displacement of nutrient-rich O- and A-horizon soils. We treated 1.8 hectares per hour (1.0 hectare per hour with double passes) with this implement, versus 0.4 hectare per hour using a flat blade or root rake. Richmond and Malone (1986) reported slightly lower rates when work was done by a contractor. A single pass with this implement may be insufficient where bluejoint is highly productive. The above-ground parts of robust bluejoint plants spread completely across single passes of these scarification disks. Only those treatments receiving two or three crisscrossing passes have retained open, exposed soil where seedlings are not completely covered by overhanging grass.

Whole-tree logging is attractive, because it displaces relatively little soil into piles, and it is an efficient way of completing logging and scarification simultaneously. It completely minimizes the time lag between logging and scarification, thereby optimizing the opportunity for residual seeds to establish. This not only enables hardwood seedlings to get an earlier start on increasing competition by regenerating ground covers (e. g. bluejoint grass), but it also reduces dependency on uncertain future seedfalls. Potential application of the whole-tree clearing is somewhat limited, however, as most small logging operators do not have large enough dozers to employ the technique efficiently.

<u>Glyphosate Control of Bluejoint Grass (Job 3)</u>

All three rates of herbicide application resulted in 100% kill of bluejoint grass. At the end of the first complete growing season following kill, treatment differences in birch seed germination were determined by the following contrast tests, based on a MSE of 3.772 with 41 df:

Contrast	df	MS	F	P
Low vs High Conc. Herb.	1	0.0	0.00	1.0000
Med. vs High Conc. Herb.	1	0.0	0.00	1.0000
High Herb. vs High Herb/disk	1	1600.0	424.20	0.0001
High Herb. vs High Herb/burn	1	0.0	0.00	1.0000
High Herb/Disk vs Disk	1	480.0	127.26	0.0001

Birch seeds did not begin to germinate in herbicide/disk plots until late July 1991. Bluejoint seeds began to germinate at the same time, but they only grew 8-16 cm before the end of the growing season and generally did not compete with birch seedlings.

Cursory observations in mid September 1991 indicated that birch had germinated in herbicide and herbicide/burned plots in late August or early September. Germination on these plots was relatively late, most probably because the organic mat was undisturbed and the seeds were not in a favorable moisture environment until frequent late summer precipitation maintained adequate moisture. By contrast, exposed mineral soil maintained more constant surface moisture as a result of capillary action, if the underlying soil column had not been disturbed. Seeds germinated earlier on scarified micro-sites where the organic horizon was cut away by the disks, but not on displaced soil deposited alongside furrows. Burning of herbicide plots did not penetrate the organic mat because fuels left after logging were inadequate to support a hot enough fire.

Bluejoint seedlings which established in 1991 had grown to approximately 50 cm by the end of July 1992 and had regained dominance of the site. However, they had not produced seed.

Birch seedlings had survived increased competition from grass, but their growth was apparently slowed because of competition. Comparisons with open-grown birch seedlings at the end of the 1992 growing season and at the end of the next two growing seasons will verify treatment differences in seedling success.

Browse Stand Maintenance (Job 4)

Data collection and analysis are not complete for hydroaxed stands. However, dense sprouting of birch, willow, and aspen occurred by the end of the first growing season (1991), regardless of time of cutting. The height of cutting apparently had little or no effect on sprouting density or productivity, as most sprouts came from the base of the plant, regardless of cutting height.

Late winter snow supported the hydroax and did not inhibit its mobility, even where the snow was 107 cm deep. Cutting in late winter is advantageous because of the ready availability of hydroaxes and high nutrient reserves.

Black Spruce Type Enhancement (Job 5)

Black spruce and understory vegetation were efficiently cleared and piled without displacing A-horizon soil, as long as the soil was frozen. After the soil thawed, it was too difficult to control the depth of the clearing blade.

As of this writing, birch seed germination on sites cleared in 1991 approaches 200,000 stems per hectare. Willow seedlings cannot be accurately identified at this time, but they have apparently germinated at relatively high density. I expect more seeds to germinate, since the rainy season is just beginning. Observations of seed germination in adjacent birch-spruce stands in previous years indicated that August is the month of most germination. These dense crops of seedlings will probably experience intense intraspecfic competition in the next 2 to 3 years, resulting in a much lower density once the plants reach shrub size.

At the initiation of this project we did not know if shading from quickly regenerating horsetail (*Equisetum sylvaticum*) would prevent hardwood seed germination. It now appears that the horsetail may have acted as a nurse cover by moderating surface soil moisture and temperature fluctuations.

Upland spruce sites having a sphagnum-dominated ground cover produce excessively bulky piles and windrows, and I do not recommend clearing them for habitat enhancement unless piles were to be subsequently burned. However, if burned, such piles would smolder for long periods and prolong smoke production and the risk of fire escapement.

Chaining, followed by burning, should be tested as a more feasible alternative to clearing upland stands with sphagnum-dominated groundcover, since it would not create large piles. Chaining would also broaden the window of opportunity for clearing, since excessive depth of scarification or displacement of A-horizon soil would be less of a problem. This approach should result in sufficient exposure of mineral soil through a combination of scarification (chaining) and burning, since spruce burns considerably hotter and more readily in a downed position than when standing. Such an approach may also be more economical than any other type of spruce clearing, even with added costs of prescribed burning. Clearing and piling with a dozer in 1991 averaged $544 per hectare, whereas chaining of a spruce-aspen stand in 1983 cost $247 per hectare. Projected cost for a 243 hectare prescribed burn of an upland black spruce stand in the Susitna Valley in 1992 was $79 per hectare.

<u>Browsing Impacts on Forest Development (Job 6)</u>

Birches and willows within enclosures of a birch-spruce site cleared in 1990 and a black spruce site cleared in 1991 are not yet tall enough to be available as browse. However, the entire terminal leaders and some side branches of birches and willows within an exclosure of a 6-year-old birch-spruce clearcut have been readily accessible by moose for the past two winters. Utilization of current annual growth on birches and willows at this site approached 65% and 80%, respectively. Utilization of terminal leaders was 100% for willow and 87% for birch. These shrubs leafed out 2 days later than those inside the exclosure.

At the end of the 1992 growing season, I will determine differences in total above-ground current annual growth, as well as differences in height development. Over the next few years, I will also monitor height, diameter, density, and escapement above the browsing reach of moose as pertaining to requirements under the Forest Practices Act. Although the first growing season was only half complete as of this writing, it was obvious that unbrowsed plants were quickly exceeding the height development of browsed plants.

Vegetation/Habitat Succession (Job 7)

A manuscript summarizing a 10-year study of vegetation and habitat succession on the Susitna River floodplain is being prepared for publication.

Steam Kill of Browse (Job 8)

All three levels of steam application were sufficient to defoliate willow, birch, balsam poplar and alder. Leaves of each species developed a dull appearance as soon as condensed steam dried from their surfaces. Bluejoint grass and other understory species were also partially to fully defoliated. Bluejoint resprouted, regaining its former degree of cover by the end of June 1992.

Incomplete shrub defoliation occurred when the steam hood was held more than approximately 10 cm above the ground. Rapid exchange of outside air with steam inside the hood occurred when the hood was this distance or more from the ground. Temperature thermistors indicated that temperature dropped rapidly from 88° to 64°C under these conditions. Partial gaps between the hood and the ground, as occurred from unevenness of the ground surface, did not result in excessive exchange of steam with outside air. Thermistor readings indicated that temperature distribution under the hood did not vary by more than 1 degree C when excessive mixing did not occur.

Birch and balsam poplar did not recover from defoliation in the remainder of the 1991 growing season. In a few instances, alder developed new leaves from preexisting buds. Approximately 15% of the willows had resprouted from the lowest 20-25 cm of the plants by the end of the 1991 growing season.

As of this writing (20 July 1992), 58% of birch had basal sprouted. Ninety four and 96% of balsam poplar and willow, respectively, had also resprouted. Alders were dropped from comparisons with the other species, because a miscommunication resulted in the alder test plot being hydroaxed in September 1991.

Productivity of birch and willow regrowth was markedly depressed (as compared with current annual growth of intact shrubs), indicating that a second defoliation may result in considerable shrub mortality. Regrowth of shrub-sized balsam poplar was more robust and would probably require more defoliation, particularly if those shrubs had originated from mature trees felled in the process of right-of-way construction.

Defoliation by steam appears as effective in killing above-ground shrub parts as hydroaxing, but unlike hydroaxing, it does not enhance hardwood seedling establishment by disturbing the soil.

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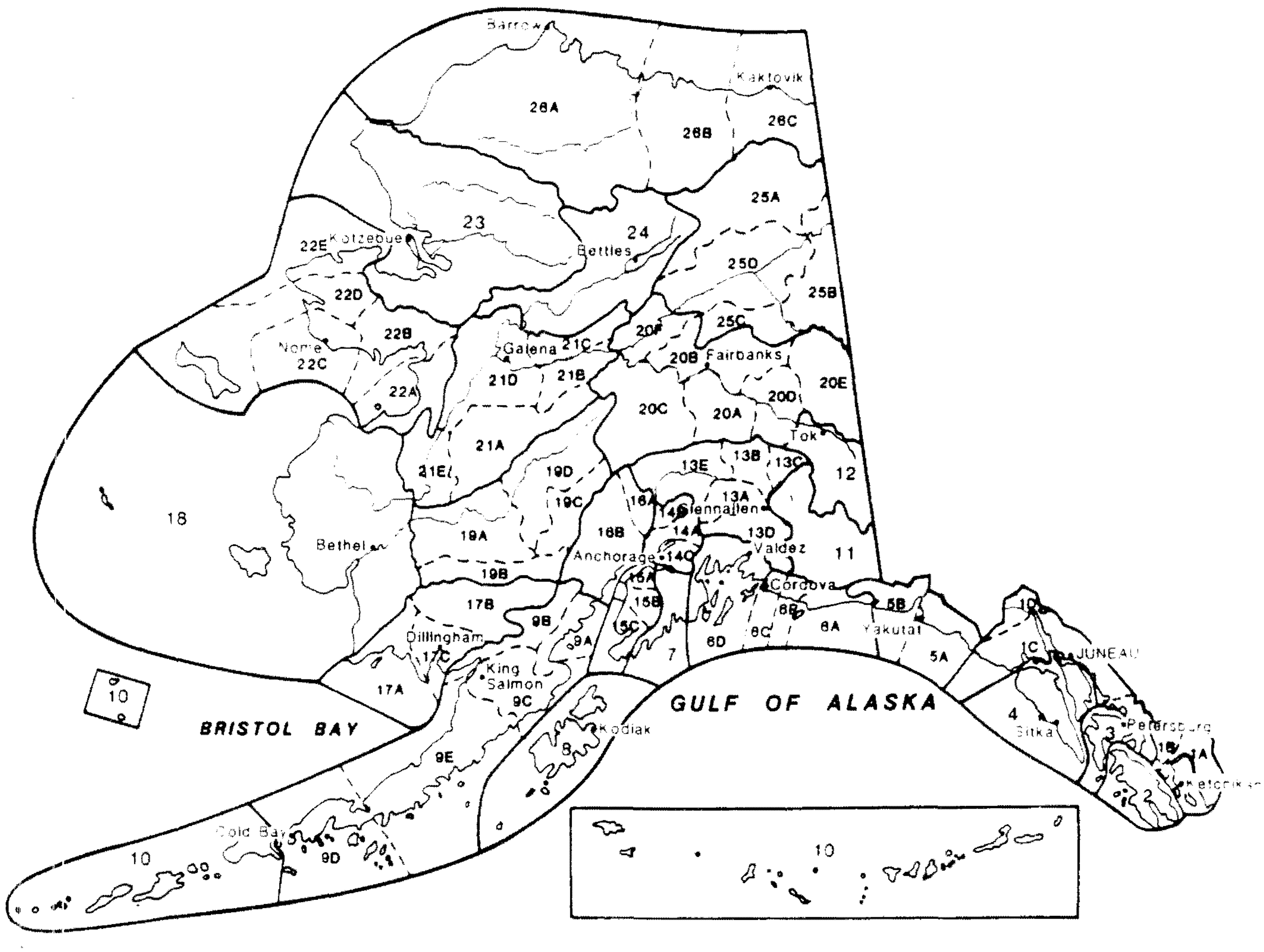

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