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**Experiment Title**

Sheep Grazing on spruce plantations at Hendrix Lake and Experimental Sheep Grazing in the Cariboo Forest Region of British Columbia

**Report Title**

Sheep Grazing on spruce plantations in British Columbia

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SHEEP GRAZING ON SPRUCE PLANTATIONS IN BRITISH COLUMBIA

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Introduction

Using sheep to graze competing vegetation from recently established conifer plantations is not a new concept. Published accounts of grazing impacts on timber regeneration date back to as early as 1898. In forests of the United States, Europe, New Zealand, Australia, Sweden and Ireland, sheep have been used as a biological means of controlling competing vegetation. Canada is now joining the list with recent sheep grazing experiments being conducted in British Columbia.

Many conifer plantations in the interior of British Columbia are severely suppressed or destroyed by competing vegetation. The major competitor is a herbaceous species called fireweed (Epilobium angustifolium). Fireweed quickly invades recent clearcuts and consumes vast amounts of moisture, nutrients and light in the summer months. During the winter the snow presses the dead fireweed down over the seedlings. This snow press deforms or crushes the seedlings. Fireweed can severely affect the survival, quality and growth of young planted spruce seedlings. One way to combat this problem is to graze sheep on spruce plantations.

In 1984 the B.C. Ministry of Forests, in cooperation with the B.C. Sheep Breeders Association, established British Columbia's first sheep grazing trial in the 100 Mile House Forest District at Hendrix Lake. The preliminary results looked promising. The sheep adequately grazed the competing vegetation in the plantations, gained acceptable weight and only caused minimal damage (5%) to the spruce seedlings. As a result the pilot trial was expanded in 1985, and some 1600 ewes and lambs were grazed for the summer on

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260 hectares (640 acres) of spruce plantations. That year, although the pilot trial was considered a silvicultural success, there were major operational problems. Over 160 sheep were killed by predators, the frequency of footrot was high and the Sheep Breeders Association ended with a severe financial deficit. As a consequence, the Chief Forester struck a Task Group which recommended to continue investigations in sheep grazing before proceeding with an operational sheep grazing program.

In June of 1986, the Hendrix Lake pilot trial was re-established and a new sheep grazing trial was established in the Horsefly Forest District at Doreen Creek. Electric fences were used around the perimeter of each grazing block to potentially minimize predator problems and improve grazing management. In addition sheep were herded by a shepherd and dogs within each grazing block. The grazing blocks ranged in size from 26 to 74 hectares and exclosures were established within each block to compare ungrazed and grazed areas. Both trials have been closely monitored for three years for levels of utilization, vegetation removal, amount and type of seedling damage and seedling growth response.

We have made progress in developing sheep grazing techniques in the last five years, however, refinements are still needed before we can operationally use sheep as a silvicultural tool. Much of the sheep management techniques have been developed cooperatively between our field foresters and the B.C. Sheep Breeders Association. By working together we are able to achieve mutual goals that benefited both forestry and agriculture.

Our results and recommendations are categorized into sheep management techniques and silvicultural treatment goals.

Sheep Management Techniques

The main functions of sheep management are to control sheep movement, supply adequate forage and minimize predator problems.

Sheep movement can be controlled by herding alone or fencing and herding combined. Both methods have been used in the Cariboo trials to adequately remove vegetation throughout the blocks, to reduce seedling damage and to minimize predator problems. Fencing without herding would create excessive
seedling damage unless very small areas were fenced and the fences were moved every 2 to 3 days. Due to the rough terrain on cutblocks relocating fences this frequently is not practical.

Electric fencing was used to temporarily partition each cut block into smaller, more manageable sections. This partitioning gave more flexibility in controlling the grazing intensity, the uniformity of graze and the grazing schedules. The size of the fenced area dictates the amount of herding required. Larger areas require more intensive herding to achieve adequate vegetation removal and to reduce seedling damage. The shepherd also must closely watch the quality and quantity of forage because the sheep will browse conifers if they are fenced into an area that has poor forage. Sheep have a preference for various types of vegetation. Clover and grasses are at the top of the list, then fireweed and other herbaceous species, followed by broadleaf woody vegetation and finally lodgepole pine, Douglas-fir and spruce seedlings. The sheep will continue to eat through the food list and if left long enough in one area they will eventually eat the crop seedlings. Another concern is the quality of forage. At our Doreen Creek trial the most preferred vegetation was severely hit by frost and became unpalatable. Since the sheep were confined within a fenced area they quickly, within hours, browsed up to to 70% of the crop trees. If the forage quality and quantity is closely monitored and sheep are moved from one fenced section to another before forage quantity or quality decreases, seedling damage will be minimized. Sheep also quickly find areas they prefer to graze and if they are not herded properly they will overgraze those areas and cause extensive seedling damage.

Electric fencing around the perimeter of a grazing area will prevent sheep from straying into the adjacent forest, which decreases predator problems and also deters predators from entering the area. We noticed a substantial reduction in predator losses from 1985, when electric fences were not used and over 160 sheep were killed, to 1986 when electric fences were used and only 16 sheep were killed by predators. Other management improvements may have also attributed to this reduction. Major drawbacks with electric fencing are the capital outlay and manpower required for fence relocation. Fencing costs can be absorbed over five years or more since the fencing is portable and reusable.
Sheep can also be herded quite effectively with shepherds and trained dogs. However, without fencing, constant herding is required in order to control grazing levels and minimize predator problems. This method is not recommended for larger flocks, over 500 sheep, due to potential predator problems. In our trials we preferred to use electric fences and a shepherd with dogs. Human presence is important in remote areas where the potential for predator interaction is high.

The location of temporary corrals is also important to sheep movement, grazing levels and seedling damage. The corral or bedding areas should be close to the current grazing area. If sheep have to travel through an area previously grazed to get to a corral, problems will occur. At our Hendrix Lake trial, up to 50% of the seedlings growing near a corral were trampled because the corral had not been relocated adjacent to each grazing area.

**Silvicultural Treatment Goals**

In order for foresters to establish a free growing crop of healthy trees, the competing vegetation must be controlled. One potential vegetation management tool is sheep grazing. The following results and recommendations are based on vegetation management techniques and crop tree responses from our two sheep grazing trials.

In order to understand vegetation management techniques for sheep grazing, one must understand the quantity and types of vegetation sheep will remove and the intensity and schedules of grazing required to meet silviculture goals.

How much vegetation should be removed to release conifer seedlings? Initially we wanted the sheep to graze 85% of the vegetation which we later realized was over ambitious. Sheep will remove large quantities of vegetation, but there is a threshold at which point sheep management and seedling damage problems erupt. In 1986 sheep grazed up to 80% of the vegetation which represented approximately 1000 kilograms per hectare (890 lbs/acre). Since cut blocks carry different amounts of vegetation, foresters should consider an acceptable level of vegetation to be left and not how much should be removed. These targets of acceptable remaining vegetation need to be refined for future sheep grazing projects.
How many years of sheep grazing will it take to control competing vegetation? Initial estimates were three to five consecutive years. After three years fireweed has regrown back vigorously in some blocks and in others fireweed has been replaced by raspberry which is a less desirable food source for the sheep. Change in vegetation patterns may cause similar or even more extreme competition than the original vegetation. The number of consecutive grazing years is still an unknown. Theoretically, grazing may have to continue until the crop trees are free growing (5 to 15 years).

How long should sheep be kept on one area? What should the grazing intensity be? Since the number of sheep and the size of cut blocks are never the same we calculated the grazing intensity in sheep days per hectare. Our recommended maximum grazing intensity is 450 sheep days/ha. In addition, sheep should not spend more than 10 days on one area. After 10 days the sheep will prefer to browse the new re-sprouts causing sheep management problems and weight loss. This grazing intensity means 450 sheep should spend one day on one hectare or 45 sheep should spend 10 days on one hectare or any combination that adds up to 450 sheep days/ha. This rate was determined for areas in which there was fully mature fireweed. Different intensities could be calculated depending on the time of vegetation development, site conditions and vegetation types.

When is the most effective time of year for sheep grazing? Early spring would be the most efficient time for grazing since the vegetation would be small and succulent. However, caution is required in early spring as the literature indicates sheep may graze seedlings shortly after budbreak. To date minimal seedling damage has occurred during this period, on our trials. As the growing season progresses fireweed becomes more woody and less palatable. The sheep will eat the leaves and leave the stems. Although this may not adversely affect the crop trees growth during the summer, the standing stems may damage the seedlings during the winter when snow presses the stems down over the seedlings. Fall grazing is also very hazardous since the forage is in poor condition from frost damage. This increases the potential for browsing damage to the crop trees. Also fall grazing is hazardous to the
sheep as predators encounters increase dramatically in the fall. The phenological development of both the crop trees and the vegetation primarily dictates the grazing schedule. Our studies suggest a schedule of grazing beginning soon after the vegetation growth will support sheep grazing, June 1 to June 15 through to the first heavy frost (August 15).

Has the seedlings survival, condition and growth been improved with sheep grazing? Seedling response is minimal since most of the trial areas have only been grazed consecutively two or three years. We have not observed any increase in survival but have started to see some growth responses. After two consecutive years of grazing there has been a reduction in seedling height growth combined with an increase in diameter growth. Because the vegetation has been reduced the seedlings don't have to compete for light and are now putting their resources not in height growth but into root growth. This is a typical response for spruce seedlings. Once the roots are well established we will see height growth increase. Some studies in the United States suggest increases in height growth may not be apparent for four to ten years after grazing. Our monitoring will have to continue for a number of years before any conclusions on seedling growth can be made.

The most outstanding observations to date are changes in seedling condition. Since sheep grazing is in an experimental stage, problems have occurred that have damaged the seedlings. Unacceptable amounts of seedling damage have been found at both grazing trials. This damage has been attributed to 1) grazing intensities greater than 450 sheep days/ha, 2) poor corral placement and 3) poor forage condition. All these problems can be corrected with better grazing management techniques. Sheep grazing cannot be justified if it continues to damage the crop trees.

Is there a future for sheep grazing on spruce plantations in British Columbia? We are optimistic that sheep grazing can become a viable silviculture tool that is beneficial not only to forestry but also to agriculture. However, before a widespread operational program begins in this province the following aspects of sheep grazing need to be addressed:
1) Sheep management techniques need to be refined to minimize damage to crop trees.

2) Predator problems require careful study so that future sheep management techniques can minimize wildlife and domestic sheep interactions.

3) We must see a positive response to the survival and growth of crop trees in order to justify sheep grazing as a viable silvicultural tool.