Understory Succession following Initial Ecosystem Restoration Treatments in Ingrown Dry Forests

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Abstract

Ingrowth of dry forests in the southern interior of British Columbia often results in the retrogression of understory plant communities, the loss of habitat for sensitive wildlife species, and an increased risk of catastrophic wildfires. In the East Kootenay region, restoration of ingrown stands usually begins with a harvest pass to remove merchantable timber and reduce overstory stocking to between 70 and 400 stems per ha. Slashing is used to eliminate excess intermediate layer trees that cannot be safely removed in a prescribed fire. Two ingrown dry forest stands in the East Kootenay region were selected to study changes in understory plant community following thinning and prescribed burning. The general response of understory vegetation was a decline in production and cover followed by recovery to pre-treatment levels. Two key objectives of dry-forest restoration have not yet been achieved 3 years after treatment. Pinegrass abundance has not declined in favour of important forage bunchgrasses. Shrubs with high wildlife browse value have declined rather than increased.

Key words: partial cutting, prescribed fire, ponderosa pine, interior Douglas-fir, pinegrass, bunchgrass.

Introduction

Dry forests of ponderosa pine (*Pinus ponderosa*) and interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) occur along the valleys at low- to mid-elevations within the southern interior of British Columbia (BC). Grassland and open forests occur throughout these zones and are thought to have developed as a result of frequent fire and a combination of edaphic and topographic conditions. The understory in the open, drier areas is dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*) and fescue species (*Festuca* spp.). Common shrubs are antelope-brush (*Purshia tridentata*) and saskatoon (*Amelanchier alnifolia*). Shaded, cooler areas are dominated by pinegrass (*Calamagrostis rubescens*) (Hope et al. 1991a; 1991b).

These forests provide a wide range of habitat niches for wildlife due to their diverse structure. Dry forests also provide forage and browse for wildlife and livestock. The dry forests of the southern interior of BC have been described as fire-maintained ecosystems because they evolved with recurring disturbance by fire. Active fire suppression, however, has increased the return interval or eliminated fire altogether. Fire suppression, overgrazing, and selective logging in these forests are believed to have caused forest encroachment on grasslands and ingrowth within open forests. Encroachment is tree establishment in previously treeless openings. Ingrowth is excessive tree recruitment, primarily by shade-tolerant species, such as interior Douglas-fir, within low-density, open forests (Rocky Mountain Trench Ecosystem Restoration Steering Committee 2000). It has been estimated that 1500 to 3000 ha of open forest and grassland are lost annually to ingrowth and encroachment in the East Kootenay region of BC.

Ingrowth often results in the retrogression of understory plant communities, the loss of habitat for sensitive wildlife species, and an increased risk of catastrophic wildfires. Changes in forest structure within ingrown forests reduces forage availability for wildlife and livestock. For example, a lack of light and increased competition from pinegrass may limit the abundance of important forage species such as bluebunch wheatgrass and rough fescue (*Festuca campestris*) (Fig. 1).

Figure 1. Ingrown ponderosa pine stand near Cranbrook, BC.

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Habitat value for grassland and open-forest dependent wildlife species such as Badger, Western Rattlesnake, Gopher Snake, and the Great Basin Spadefoot Toad is also diminished with ingrowth.

Figure 2. Treated ponderosa pine stand near Cranbrook, BC.

Restoration of ingrown stands usually begins with a harvest pass to remove merchantable timber and reduce overstory stocking to between 70 and 400 stems per ha (Fig. 2). Slashing is used to eliminate excess intermediate layer trees that cannot be safely removed in a prescribed fire. In the East Kootenay region of BC, restoration prescriptions are based on land use guidelines set by the Kootenay-Boundary Land Use Plan (Province of BC 1997).

Land use plan targets have been established and ecosystem restoration of ingrown stands is occurring despite a general lack of knowledge regarding the ability to achieve all restoration objectives. Target plant communities have been well defined but an understanding of understory plant succession following different restoration treatments is required to achieve success.

The objective of this project is to document the changes in understory plant community following thinning and prescribed burning of two ingrown dry-forest stands.

Methods

Two sites (Douglas-fir dominant or ponderosa pine dominant) in the East Kootenay region were selected for restoration and study. Pre-treatment sampling for understory herbaceous plants and shrub cover, microbiotic crust, understory light, duff, fine fuel, and forage production were completed in 1999 at the two sites. The restoration treatment consisted of partial-cutting the stands to thin the forest canopy and remove intermediate layer trees. Slashing consisted of cutting pre-commercial, intermediate layers to reduce the risk of crown fire during prescribed understory burns.

The Douglas-fir site was treated in June 1999 and the ponderosa pine site was treated during June-July 2000. Plots were re-sampled in 2000, 2001, and 2003. The ponderosa pine site was subjected to a prescribed burn in April 2004, however, vegetation response has not yet been determined for the burn treatment. Detailed methods are available in Powell et al. (1999) and Page (2002).

Results (interim results for the ponderosa pine site only)

Overstory removal

The restoration treatment removed an average of 48 m^3/ha of tree volume from the ponderosa pine site, leaving 27 m^3/ha on the site. Merchantable stem density decreased by 513 stems/ha, leaving 192 stems/ha on the site. Understory light increased by 30% following the treatment.

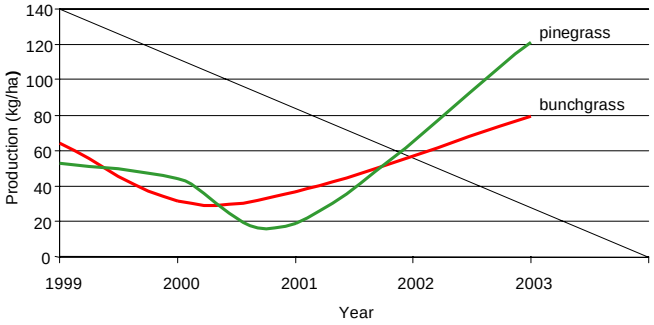

Figure 3. Aboveground production of common grasses at the ponderosa pine site from 1999 (pre-treatment year) to 2003 (3 years following treatment). Bunchgrasses were rough fescue, bluebunch wheatgrass, spreading needlegrass (*Achnatherum richardsonii*) and junegrass (*Koeleria macrantha*).

Understory vegetation production

The aboveground production of common grass species initially decreased at the ponderosa pine site (Fig. 3), then started to recover after 2 years. After 3 years pinegrass has more than doubled while the important forage grasses (e.g., bunchgrasses such as bluebunch wheatgrass and rough fescue) have increased by 24%. Forb production (not shown) is still 23% below pre-treatment (1999) level although the trend is toward recovery.

Understory species cover

The cover of kinnikinnick (*Arctostaphylos uva-ursi*) and grass species cover initially decreased and then recovered after 3 years (Fig. 4). The cover of shrubs declined following the restoration treatment and has not yet recovered to pre-treatment levels.

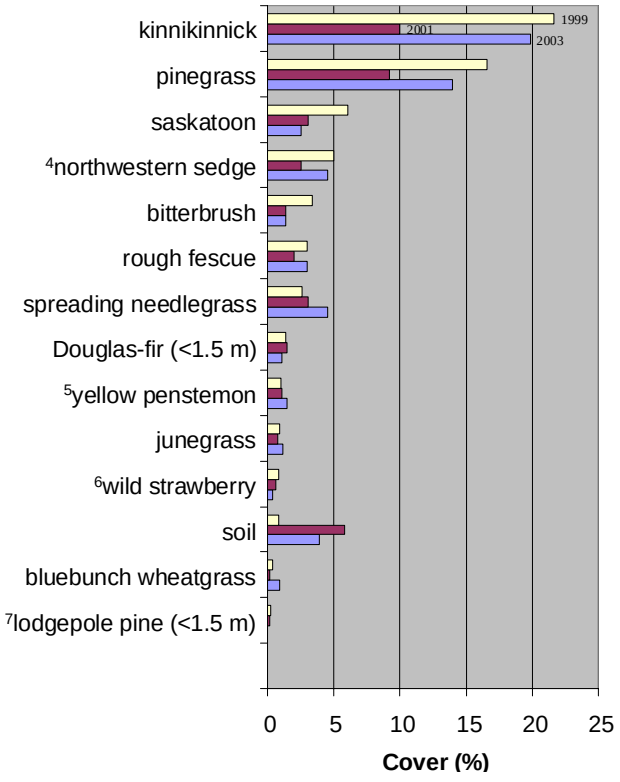

Figure 4. Canopy cover of understory species at the ponderosa pine site (1999, 2001, 2003).
[4]*Carex concinnoides*; [5]*Penstemon confertus*; [6]*Fragaria virginiana*; [7]*Pinus contorta.*

Discussion

One of the key objectives of dry-forest restoration is to increase the abundance of important forage species such as bluebunch wheatgrass and rough fescue, while reducing the abundance of their primary competitor, pinegrass. It is clear that this objective has not yet been achieved. Three years after treatment, pinegrass has recovered at the same (Fig. 4) or greater (Fig. 3) rate than most bunchgrasses.

Pinegrass occurs on shaded, cooler areas within the dry forests while bunchgrasses occur on the open, drier areas. Therefore, it is expected that pinegrass will eventually succumb to bunchgrasses in the post-restoration light/moisture regime. An important factor is that pinegrass can expand vegetatively by rhizomes while bunchgrasses must rely on sexual reproduction which tends to be sporadic in this semi-arid environment.

A second key objective of dry-forest restoration is to increase the abundance of important browse species for wildlife (e.g., saskatoon, bitterbrush). Interim results of this study suggest that these shrubs may not benefit from the initial restoration treatments of just thinning and slashing (Fig. 4).

The early trends displayed by bunchgrass, pinegrass and forb production may be due to the disturbance caused by the partial-cutting treatment. The ponderosa pine site was harvested in June-July when plants were active. The ground-based harvesting equipment, no doubt, caused damage and mortality of plants at the site. In fact, exposed soil increased from 0.8% to 6% following harvesting. Techniques that minimize understory disturbance should be explored as ways to achieve accelerated recovery of vegetation following restoration treatments. For example, harvesting on frozen or snow-covered soils when plants are dormant will minimize plant damage and soil disturbance.

Additional remeasurements will be carried out in the future to investigate the effects of restorative prescribed fire treatment on understory species composition and abundance.

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