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Vegetation Development after Clearcutting and Site Preparation in the SBS Zone

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Vegetation Development after Clearcutting and Site Preparation in the SBS Zone

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ABSTRACT

The changes in floristic composition and structure that occur after clearcutting and site preparation in four ecosystems in the Sub-Boreal Spruce Zone are outlined. Responses of species to burning and mechanical site preparation are examined and the strategies for recolonization and survival used by different species are investigated. Implications of these findings to ecological classification and management to meet silvicultural and wildlife objectives are addressed.

ACKNOWLEDGEMENTS

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1 INTRODUCTION

Predictive models of revegetation after clearcutting and site preparation are essential to the development of management prescriptions that will meet integrated resource use objectives. These models will provide information on expected changes in the composition and structure of vegetation over time.

Potential resource management conflicts exist because failure to achieve the silvicultural objective of establishing free-growing plantations is thought to be due, in part, to the presence of shrubby and herbaceous vegetation (Stewart 1984); therefore, reduction in the level of vegetation is a goal of some silvicultural treatments. However, the goals of other management activities may include vegetation enhancement, since these shrubs and herbs may also provide valuable forage and habitat for wildlife.[1] The importance of these species in contributing to long-term site fertility is another important management consideration.

Models of vegetation development following different site preparation treatments will facilitate the evaluation of silvicultural prescriptions and the scheduling of stand tending and rehabilitation activities.

In cool and moist climatic regions, such as the Sub-Boreal Spruce (SBS) Zone, vegetation may reduce crop tree survival and growth through: snow press damage (B. Richards, pers. comm., 1986); reduction of soil temperature because of shading (D. Spittlehouse, pers. comm., 1986), or reduction in light levels or quality (D. Draper, pers. comm., 1986). However, little quantitative assessment has been made to determine the importance and nature of interactions between crop trees and other vegetation, or the response of vegetation to different site preparation treatments. Considerable logging and rehabilitation activities are centred in the SBS zone and particularly in the Willow River variant of the Wet Cool Central subzone (SBSj1). Assessments of plantation performance have indicated that many wetter than mesic sites are classified as "Not Satisfactorily Restocked" (NSR).

The SBS zone is also of noted value for wildlife, particularly moose and bears, which use shrubby and herbaceous vegetation that develops after logging or wildfires. Floristic composition and vegetation structure are important determinants of the wildlife habitat values.

Development of land use prescriptions that will preserve essential resource values requires a common framework for communication. The existing Biogeoclimatic Ecosystem Classification (BEC) system (Pojar *et al.* 1987) provides such a basis for planning. Information on the changes in the presence and abundance of indicator species and other site characteristics that occur after sites are harvested will facilitate the extension of this classification to seral stands.

1.1 Objectives

The aim of this study is to determine the nature of vegetation re-establishment in recently harvested and site-prepared sites in the SBSj1 so as to provide:

1. a basis for predicting rates of revegetation and floristic composition in sites after different site-preparation treatments;
2. insight into the relationships between pre-harvest and post-harvest vegetation and other site attributes, which will facilitate the classification of seral ecosystems within the existing BEC system.

Information on patterns of vegetation development will enable managers to:

1. improve predictions of brush potential after different treatments
2. improve the scheduling of silvicultural surveys and treatments
3. determine priorities for site rehabilitation
4. predict wildlife habitat values

[1] Walmsley, M.E., W.G. Biggs, and C.J. Clement. 1986. The impact of silvicultural herbicides on wildlife and wildlife habitats: problem analysis. B.C. Min. For., Res. Branch, Victoria, B.C. Unpublished report.

1.2 Literature Review

General patterns of post-fire vegetation development have been described for a range ecosystems in cool and moist climatic regimes similar to the SBS zone. Summaries of vegetation succession in boreal regions (Viereck and Schandelmeier 1980; Wein and MacLean 1983; Parminter[2]), in interior cedar-hemlock forests (Antos and Habeck 1981; Stickney 1986), in montane and subalpine forests (Arno *et al.* 1985), and in coastal areas (Kellman 1969) have been published.

Some monitoring of vegetation development after silvicultural treatments has been done in northern Alberta (Corns and LaRoi 1976) and the western Cascades (Dyrness 1973; Long 1973; Lyon 1976; Wittinger *et al.* 1977; Irwin and Peek 1979). In British Columbia, preliminary accounts of vegetation development in the Interior Cedar Hemlock Zone and in the Engelmann Spruce Subalpine Fir Zone have been compiled.[3,4] Eis (1981) provides information on some of the ecosystems of the SBS zone. However, very little site specific information on the response of vegetation to prescribed burning or mechanical site preparation exists for most ecosystems in British Columbia.

1.3 Study Area

The SBSj1 subzone variant extends east from Prince George to the Rocky Mountains, north towards McLeod Lake, and south along the Bowron and Willow river valleys. It is wetter than the Fraser Basin Moist Cool Central (SBSe2) subzone variant to the west and drier than the Very Wet Rocky Mountain (SBSf) subzone towards the mountains in the east (Figure 1). Many of the SBSj1 ecosystems are comparable to those in the adjacent SBSe2 and SBSf, and those of the Moist Cold Northern Sub-Boreal Spruce subzone (SBSn). Average annual precipitation in the SBSj1 is about 800 mm with a range of 542 to 1102 mm. There is 350 mm (230-408) of seasonal precipitation during May to September. Mean annual temperature is 2.5°C (1.9-3.4°C), with a seasonal mean temperature of 11.3°C (9.8-12.4°C). There are approximately 973 (742-1137) growing degree days above 5°C (McLeod and Meidinger (compilers) 1985).

Rolling morainal landscapes predominate with glacial fluvial, fluvial, and lacustrine sediments along rivers. Soils are typically Luvisols, Brunisols, and Podzols, with Organics in depressions. Humus layers in the mature forests are 5-10 cm thick and are classified as Hemimors and Hemihumimors. Hydromors are found in the wettest sites (DeLong *et al.* 1986).

Research was concentrated on submesic to hygric sites that support the SBSj1/06 Queen's cup,[5] SBSj1/01 Oak fern, SBSj1/07 Devil's club, and SBSj1/08 Horsetail ecosystems (Appendix 1-Table 1; Figure 2). Hybrid white spruce (*Picea glauca* x *engelmannii*)[6] and subalpine fir (*Abies lasiocarpa*) form the climax forests in these four ecosystems. Shrubs including *Lonicera involucrata, Ribes lacustre,* and *Vaccinium membranaceum*; herbs such as *Cornus canadensis, Gymnocarpium dryopteris, Rubus pedatus, Streptopus roseus, Orthilia secunda,* and *Tiarella trifoliata*; and the mosses *Pleurozium schreberi* and *Ptilium crista-castrensis* are consistently found in these mature ecosystems (Appendix 1-Table 2).

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[2] Parminter, J.V. 1983. Fire-ecological relationships for the biogeoclimatic zones and subzones of the Fort Nelson Timber Supply Area. B.C. Min. For. Unpublished draft report.

[3] Ketcheson, M.V., A. Warner, and S. Thompson. 1985. An evaluation of published climax associations as a framework for a predictive vegetation hazard rating system for the ICHa1, ICHa2 and ESSFc biogeoclimatic units in the Nelson Region. B.C. Min. For., Nelson, B.C. Unpublished draft report.

[4] Dawson, R. 1985. An initial study of vegetation development following logging in the Cariboo Forest Region. B.C. Min. For., Williams Lake, B.C. Unpublished draft report.

[5] Classifications of the SBSj1 ecosystems were developed by DeLong *et al.* (1986) and R. Coupé and A. Yee (editors). 1982. Identification and interpretation of ecosystems in the Cariboo Forest Region. B.C. Min. For., Williams Lake, B.C. Unpublished draft report. A simplified version of these was used as a basis for this work (see Appendix 1-Table 2).

[6] Appendix 2 lists species codes and scientific and common names.

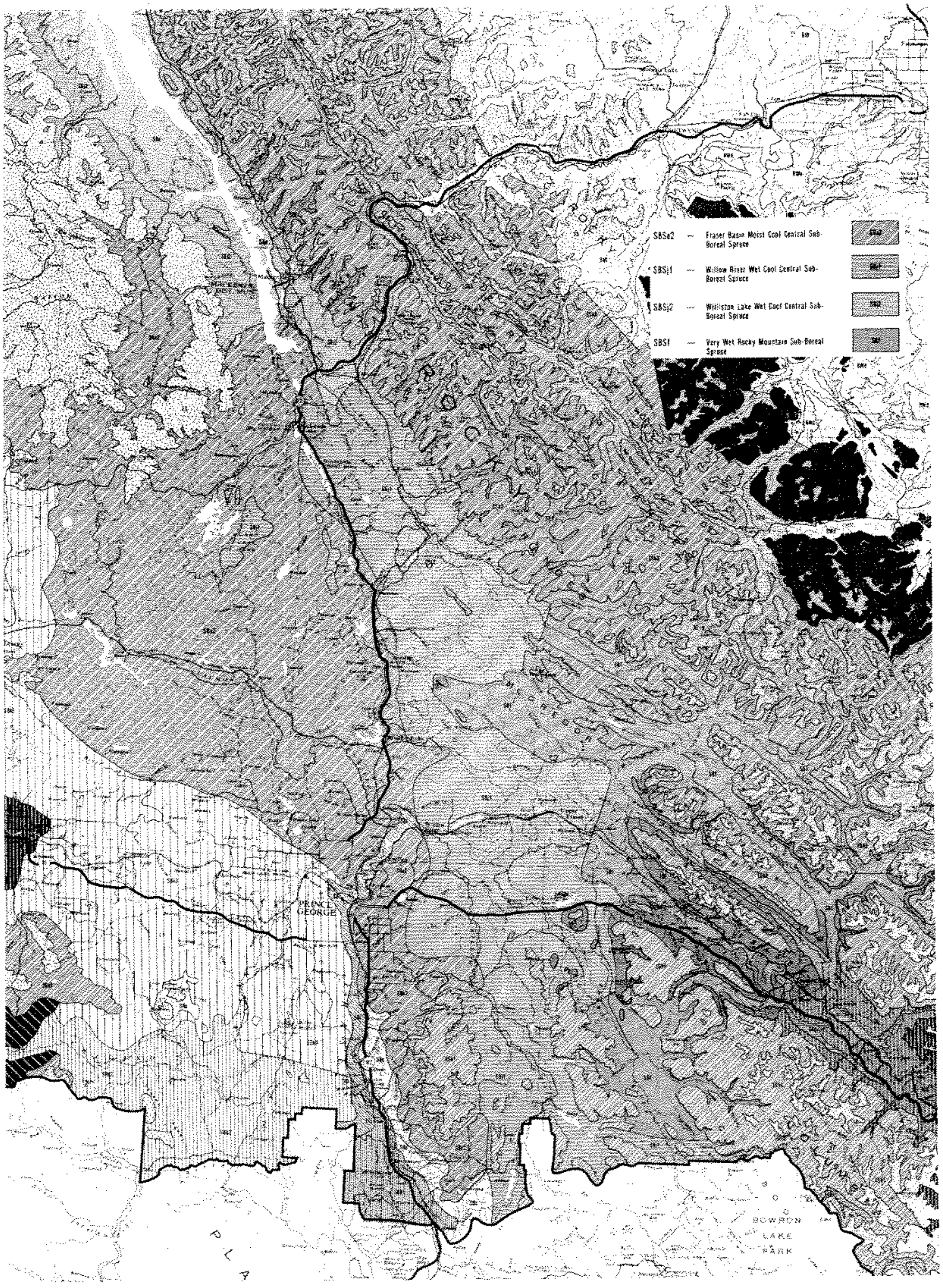

FIGURE 1. Map of the distribution of the SBSj1 subzone variant.

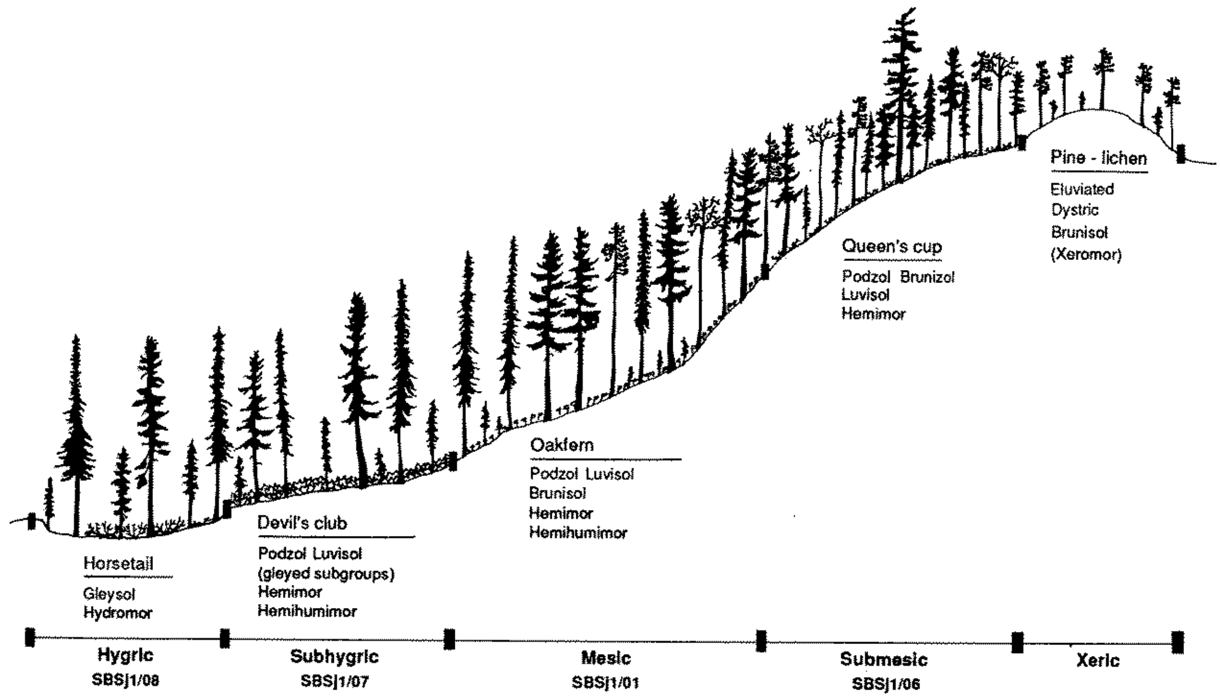

FIGURE 2. Schematic representation of the distribution of ecosystems in the SBSj1 subzone variant.

The Queen's cup association occupies submesic sites and is typically found on middle and upper slope positions on glacio-fluvial terraces and morainal and colluvial blankets (Figures 2 and 3). *Pinus contorta* is a characteristic tree species and *Populus tremuloides*, *Betula papyrifera*, and Douglas-fir (*Pseudotsuga menziesii*) are occasionally present (Appendix 1-Table 2). The shrub layer is moderately well developed and includes *Spiraea betulifolia*, the most characteristic shrub, and *Vaccinium membranaceum* and *Rubus parviflorus*. Herbs include *Cornus canadensis*, *Clintonia uniflora*, and *Aralia nudicaulis.* The moss layer is conspicuous. Soils in these sites are well drained, medium to coarse textured Podzols, Luvisols, and Brunisols that have a 4-7 cm thick Hemimor humus layer (DeLong *et al.* 1986).

The Oak fern association occurs in mid-slope positions on moderately well-drained, medium textured parent materials (Figures 2 and 4). The moderately well-developed shrub layer includes *Vaccinium membranaceum*, *Lonicera involucrata*, *Rubus parviflorus*, and *Ribes lacustre* (Appendix 1-Table 2). *Gymnocarpium dryopteris*, a species whose abundance in these sites differentiates the Oak fern from the Queen's cup association, *Rubus pedatus*, *Lycopodium annotinum*, *Veratrum viride*, *Cornus canadensis*, and *Streptopus roseus* are common herbs. Soils are moderately well-drained Podzols, Brunisols, and Luvisols and have a 3-8 cm thick Hemimor or Hemihumimor humus layer. These sites are considered to have good productivity (DeLong *et al.* 1986).

Subhygric sites, which are typically in middle to lower slope positions and on north-facing slopes, support the Devil's club ecosystem (Figures 2 and 5). Parent materials include morainal, fluvial, and lacustrine deposits. *Oplopanax horridus*, which distinguishes this association, and *Lonicera involucrata*, *Ribes lacustre*, and *Rubus parviflorus* are important components of the shrub layer (Appendix 1-Table 2). Ferns, including *Dryopteris assimilis*, *Athyrium filix-femina*, and *Gymnocarpium dryopteris*, are also typical. *Mnium* spp. are characteristic mosses. Soils are moderately well- to imperfectly drained gleyed Podzols and Luvisols that have a 5-15 cm thick Hemimor or Hemihumimor humus layer (DeLong *et al.* 1986).

FIGURE 3. Mature SBSj1/06 Queen's cup ecosystem.

FIGURE 4. Mature SBSj1/01 Oak fern ecosystem.

FIGURE 5. Mature SBSj1/07 - Devil's club ecosystem.

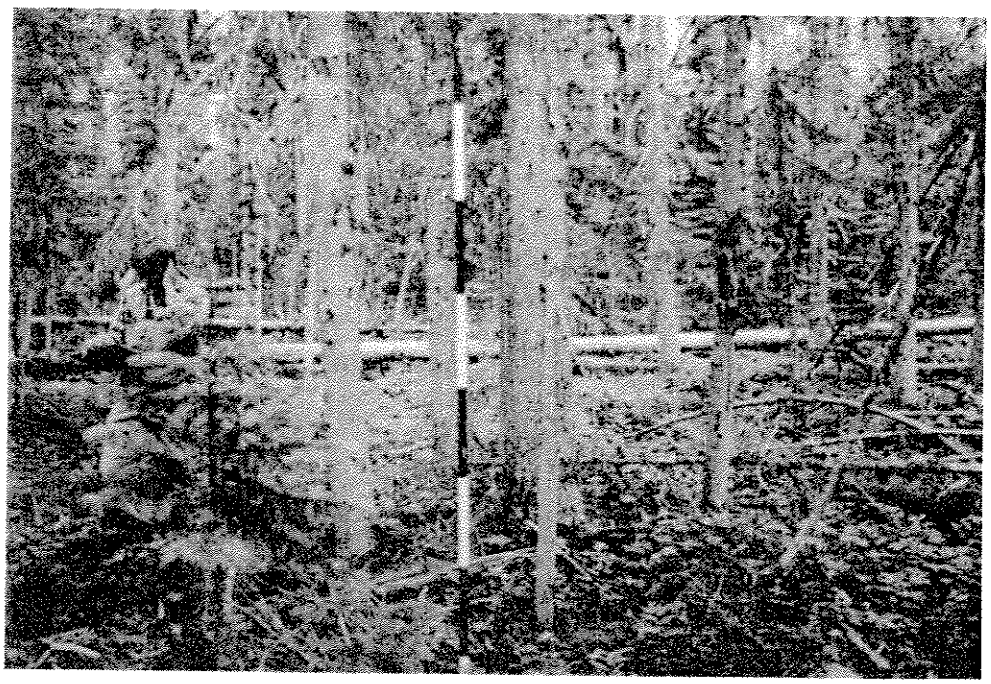

FIGURE 6. Mature SBSj1/08 - Horsetail ecosystem.

Flat and depressional hygric sites on fluvial, lacustrine, and morainal materials support the Horsetail ecosystem (Figures 2 and 6). *Alnus incana* ssp. *tenuifolia*, *Equisetum sylvaticum*, *E. arvense*, *Dryopteris assimilis*, and *Hylocomium splendens* are characteristic of this association. Other differentiating but less abundant species include *Calamagrostis canadensis*, *Circea alpina*, and *Geum macrophylum* (Appendix 1-Table 2). Organic-rich Gleysols with thick (5-40 cm) Hydromor humus layers develop on these sites, where the water table is generally within 50 cm of the surface for most of the year (DeLong *et al.* 1986).

1.4 Treatment History and Prescriptions

All the sites sampled in the SBSj1 were clearcut in the past 24 years. Submesic and mesic sites were usually summer-logged and wetter sites were harvested in winter. Prescribed burning was generally used for site preparation. Exact burning impact could not be determined because fire effects at the time of burning were not assessed. Nevertheless, observations made in this review indicate that, in general, submesic sites were more severely burned because they often have a drier surface duff layer when burned.

Blade scarification and other mechanical treatments were used, either alone or on sites where burns had been unsuccessful. Hybrid spruce was planted on most of the mesic and wetter sites, with natural or planted lodgepole pine regeneration used on the submesic sites.

2 METHODS

2.1 Field Sampling

Detailed sampling was done in 1984 and 1985 by the authors, and reconnaissance sampling of older stands was carried out in 1986 by C. DeLong.

Potential areas for detailed sampling were selected using recent subzone and forest cover maps and air photos were available. Final selection of seventy-seven sites was done in the field. Detailed sampling was concentrated on sites disturbed within the past 10 years, but a few sites where it had been up to 24 years since site preparation were sampled as well. Wherever possible, paired sampling with mature stands was done to ensure that ecological classification of the clearcuts was accurate.

Vegetation was sampled in 10 x 10 m plots. Percent cover of all species within each of six height strata (0-0.25, 0.26-0.50, 0.51-1.0, 1.01-2.00, 2.01-3.00, and 3.01-5.00 m) was recorded. Deciduous trees were included in the shrub layers. A shallow (30 cm) soil pit was dug and the standard description made for the upper soil and humus layers, according to methods in Walmsley *et al.* (1980).

Reconnaissance sampling, restricted to the determination of species presence, was done in sites which had been burned more than 10 and less than 24 years before 1986. These plots can be differentiated from the detailed plots by the plot numbers that begin with a letter (e.g., G13h34).

Harvesting, site preparation treatments, and planting information were obtained from history records in the Prince George East and Prince George West Forest Districts, and verified as much as possible by field inspection.

2.2 Analysis

2.2.1 Classification

The VEGSORT program (*see* Meidinger *et al.* 1987) was used to compare species composition in seral and climax ecosystems, and to group the seral vegetation data according to the ecosystem unit identified in the field. TWINSPAN (Hill 1979), a polythetic divisive classification program, was also used to evaluate floristic similarity among plots. Field designated classifications were modified on the basis of these results.

2.2.2 Vegetation structure and composition

A preliminary list of key seral species was developed by comparing the species found in the sample plots to those described by Haeussler and Coates (1986) as important competitors. Frequencies of these species were then calculated for all plots, and species having very low frequencies were eliminated. Other species that had high cover and constancy were added. Table 1 lists key seral species.

An estimate of the volume of space occupied by each species was calculated by summing the product of area covered (m^2) and average height (m) in each stratum in each plot. Area covered in the 100-m^2 plot was determined by subjective cover estimates. Average height was defined as the mid-point of each stratum. An individual plant was considered to belong to only one stratum. Graphs of cover, volume, and height over time were plotted for total shrubs, deciduous trees, and herbs and for individual species within each stratum, and these graphs were compared for differences in vegetation development among ecosystems and site preparation treatments. Hand-fitted lines were added to the graphs. Small sample size limited comparisons with mechanically prepared sites and hygric ecosystems.

TABLE 1. A list of key deciduous tree, shrub and herb species in seral SBSj1 ecosystems

Scientific name	Common name	Scientific name	Common name
Alnus incana ssp. *tenuifolia*	mountain alder	*Rubus parviflorus*	thimbleberry
Calamagrostis canadensis	bluejoint	*Rubus idaeus*	red raspberry
Epilobium angustifolium	fireweed	*Salix* spp.	willows
Lonicera involucrata	black twinberry	*Sambucus racemosa*	red elderberry
Populus tremuloides	trembling aspen	*Vaccinium membranaceum*	black huckleberry
Ribes lacustre	black gooseberry		
Ribes laxiflorum	trailing black currant	*Viburnum edule*	highbush-cranberry

3 RESULTS AND DISCUSSION

3.1 General Pattern of Revegetation After Site Preparation

The floristic composition of stands after disturbance is determined by: 1) the severity of the disturbance and condition and abundance of understory vegetation before disturbance, as this will influence the extent to which the pre-existing vegetation survives and re-establishes; 2) the suitability of conditions for germination and survival of seed-banking species; and 3) the availability and establishment success of off-site seeds.

Although it was not always possible to identify the mechanism of revegetation in sites that were disturbed more than a few years before sampling, it appeared that many of the species in mesic and wetter sites resprouted from pre-existing plants. Several species establish through the germination of buried seeds. Only a few species appear to seed in from off-site sources. Figure 7 illustrated the vegetation development evident 1 year after burning in some sites.

Herbs, especially fireweed, increased in cover over the first 6-8 years after burning and then began to decline in cover. Shrubs and deciduous trees continue to increase in cover. Figure 8 shows a mesic site 4 years after burning. Where plantations are successful, crop trees are expected to overtop and shade, and thus reduce the cover of herbs and shrubs. The development of vegetation 9 and 16 years after burning is illustrated in Figures 9 and 10. Differences between ecosystems are illustrated in Figure 11.

Seed-banking annuals such as *Geranium bicknellii* and *Corydalis sempervirens* are present the year after burning, but were gone by the 2nd year. *Epilobium angustifolium* was usually common by 2 years after burning or mechanical site preparation. Species diversity increased over time as additional species became abundant. *Ribes laxiflorum*, *Rubus idaeus*, species of *Salix* and *Carex*, and members of the Asteraceae family (including *Antennaria neglecta*, *Anaphalis margaritacea*, and species of *Hieracium*, *Agoseris*, and *Taraxacum*) were among those species that were common after sites were disturbed, but not present in the mature forest ecosystems. These species were most abundant on the drier sites, where generally more severe burning and/or greater disturbance from summer logging exposed more mineral soil and destroyed more of the original vegetation. *Rubus parviflorus* and *Equisetum arvense*, common in subhygric and hygric forested sites, respectively, invaded all sites after harvesting (Figure 12).

Over time, most of the herb and low shrub invader species were overtopped by taller invading or resprouting deciduous trees, including *Populus tremuloides*, *Betula papyrifera*, species of *Alnus* and *Salix*, and conifers, including hybrid spruce and lodgepole pine. The more shade-tolerant ground level shrubs and herbs, which had been present in the forest stand, generally persisted (Figure 12).

3.2 Rate of Revegetation After Site Preparation

On burned sites, the general rate of vegetation development was greatest on the Devil's club sites, followed by the Oak fern and Queen's cup ecosystems (Figure 13). The high shrub and herb volumes associated with the Devil's club sites are likely due to a combination of low burning intensity, which may stimulate shrub regrowth, and higher moisture and nutrient conditions present in these sites. Although species with the potential to develop into dense shrub thickets (e.g., *Lonicera involucrata*, *Vaccinium membranaceum*, and *Rubus parviflorus*) occurred in all of the ecosystems sampled, shrub regrowth differed according to variations in environmental conditions and burning impact. In general the rate of revegetation of ground level species was slower on the drier sites, but these sites also had a larger component of deciduous trees before harvesting and therefore could rapidly develop into deciduous tree dominanted stages if extensive resprouting occurred. Shrub and herb development was less in Horsetail than in Devil's club sites, possibly because the cold wet soils of the Horsetail ecosystem inhibit vegetation growth.

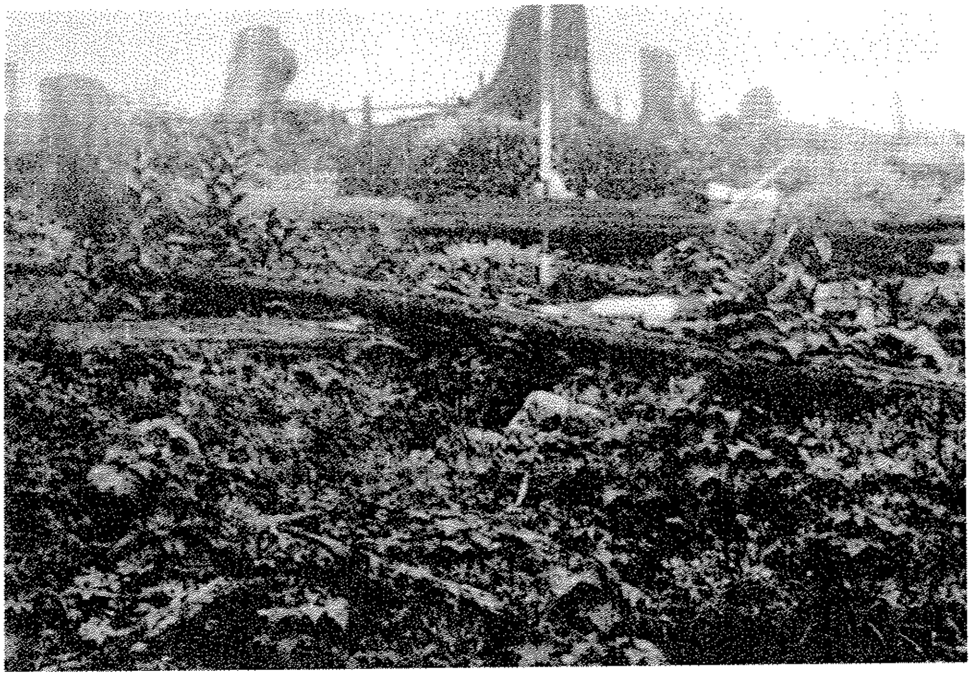

FIGURE 7. A mesic site 1 year after burning.

FIGURE 8. A mesic site 4 years after burning.

FIGURE 9. A mesic site 9 years after burning.

FIGURE 10. A mesic site 16 years after burning.

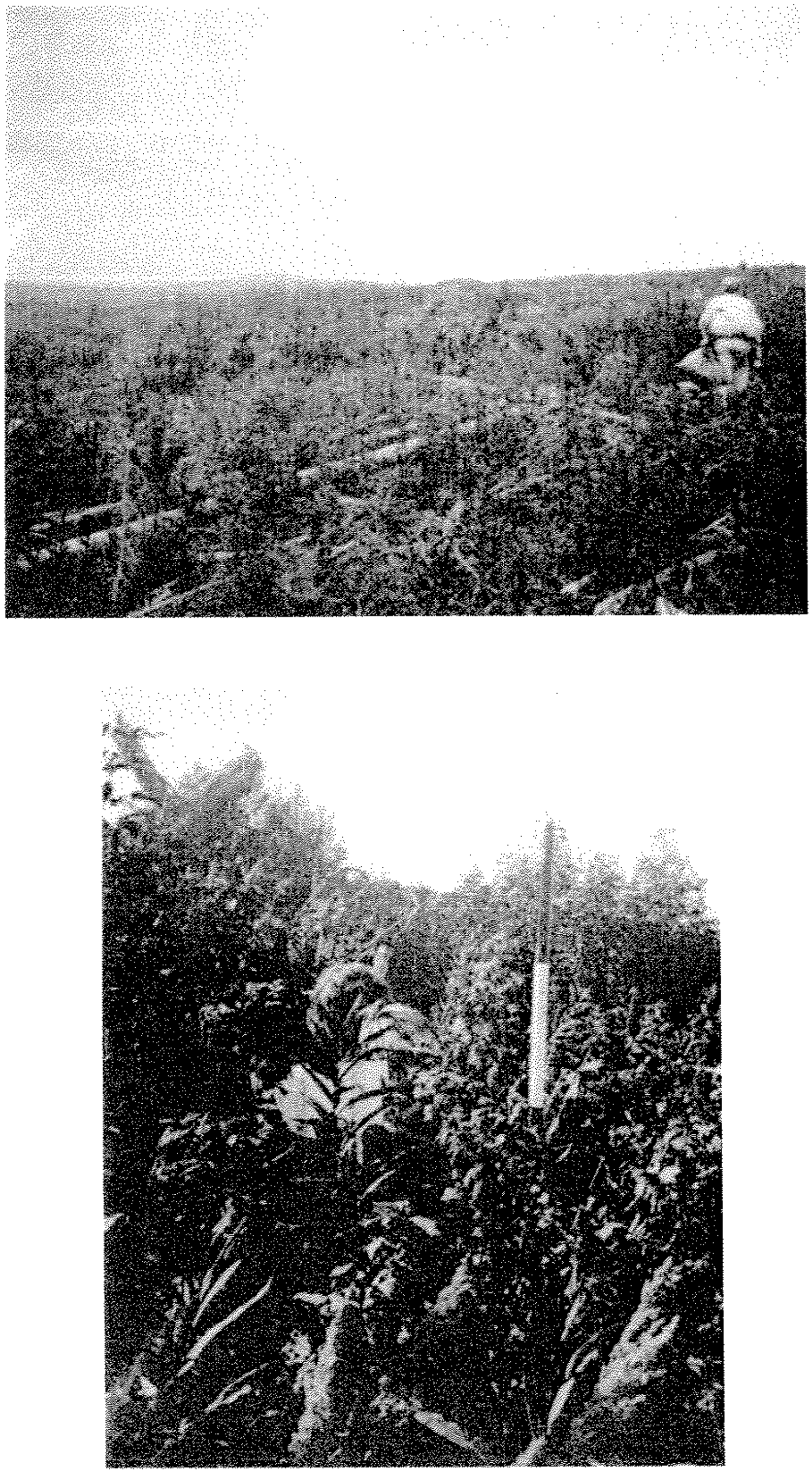

FIGURE 11. A Queen's cup site 4 years after burning and a Devil's club site 7 years after burning.

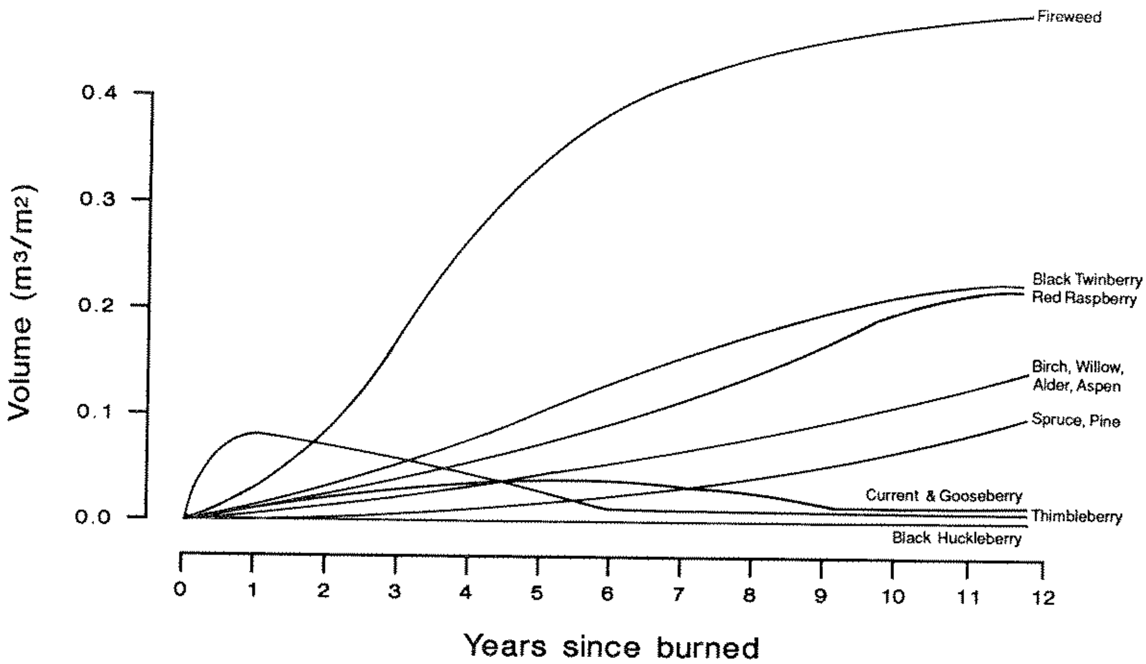

FIGURE 12. Schematic representation of the development of key species in seral (<10 years since burned) SBSj1 ecosystems. (See Appendix 5 for species values.)

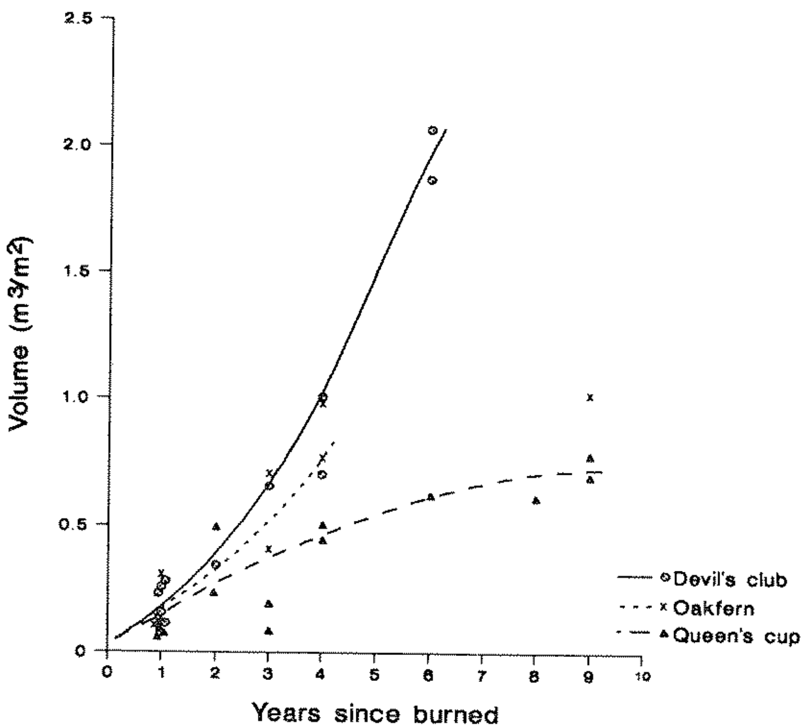

FIGURE 13. Volume of herbs, shrubs, and deciduous trees in seral (<10 years since burned) ecosystems in the SBSj1 subzone variant.

3.3 General Soil and Humus Layer Properties

Although most soil properties generally remain comparable to pre-logging conditions, soils in submesic sites appear drier and subhygric soils wetter after site preparation. The increase in surface temperature following logging and site preparation results in accelerated decomposition of the litter layer through fungal and faunal activity in these circum-mesic sites. These rapidly changing humus layers are classified as Mormoders.

3.4 Ecosystem-Specific Changes After Site Preparation

3.4.1 Queen's cup ecosystem

Many of the species present in mature Queen's cup forests remained after disturbance, although often with reduced abundance. However, some plants took longer to re-establish and other new species invaded, especially after severe disturbances. Important species in the seral (<10 years since disturbed) Queen's cup ecosystems include *Epilobium angustifolium*, *Rubus idaeus*, *Populus tremuloides*, and *Cornus canadensis* (Appendix 3-Table 3). *Spiraea betulifolia*, a species characteristic of the climax ecosystem, was generally present in the seral state. In general, seral Queen's cup ecosystems were best differentiated from mesic seral sites by the greater abundance of *S. betulifolia* and *P. tremuloides* and lesser amounts of *Vaccinium membranaceum*, *Lonicera involucrata*, and *Sambucus racemosa* in submesic sites (Appendix 3-Table 1; Appendix 5-Table 1; Appendix 7-Table 1)

Herbs reached their maximum height of about 0.75 m by the 3rd year after disturbance; herb cover continued to increase over the first 9 years after disturbance (Figure 14). The tallest herb layer (0.5-1.0 m) was dominated by *Epilobium angustifolium* with a small component of *Calamagrostis canadensis*.

Although most shrubs remained less than 1 m in height (Figure 14), deciduous trees, including aspen and cottonwood, were sometimes over 4 m tall by 4 years after disturbance. Total shrub and deciduous tree cover increased steadily. *Lonicera involucrata*, *Ribes lacustre*, *Rubus idaeus*, and occasionally *Viburnum edule* reached a height of 1 m, while *Ribes laxiflorum* and *Rubus parviflorus* generally remained less than 0.5 m tall. Willows reached 2 m or more by 9 years after disturbance.

Increased exposure because of canopy and humus layer removal appeared to dry the soil in these sites. Humus layers, typically classified as Orthic Mormoders, were decomposing faster than on mature sites, as evidenced by the presence of an Ah layer not found in mature forest Orthic Hemimors (Appendix 6-Table 1; Appendix 8-Table 1).

3.4.2 Oak fern ecosystem

Dominant species in the seral Oak fern ecosystem included *Epilobium angustifolium*, *Rubus parviflorus*, *Rubus idaeus*, and *Lonicera involucrata* (Appendix 3-Table 4). Natural regeneration of subalpine fir was common. There were no species that clearly differentiated seral Oak fern stands from other seral ecosystems, however, *Sambucus racemosa* and *Vaccinium membranaceum* are most characteristic of mesic sites (Appendix 3-Table 1). Some climax constants including *Lonicera involucrata*, *Ribes lacustre*, *Rubus pedatus*, *Streptopus roseus*, *Valeriana sitchensis*, *Gymnocarpium dryopteris*, and *Cornus canadensis* were also important in early seral ecosystems, while other climax constants such as *Lycopodium annotinum* and several moss species were much less common in seral stages (Appendix 3-Table 4; Appendix 5-Table 2; Appendix 7-Table 2).

Herbs peaked at a height of about 1 m (Figure 14). Total herb cover reached 50-100% by 4 years after disturbance. *Epilobium angustifolium* was the only herbaceous species that reached a height of over 1 m; other species were generally less than 0.5 m tall. Total shrub and deciduous tree cover was generally less than 60% (Figure 14). *Lonicera involucrata*, *Rubus idaeus*, *Rubus*

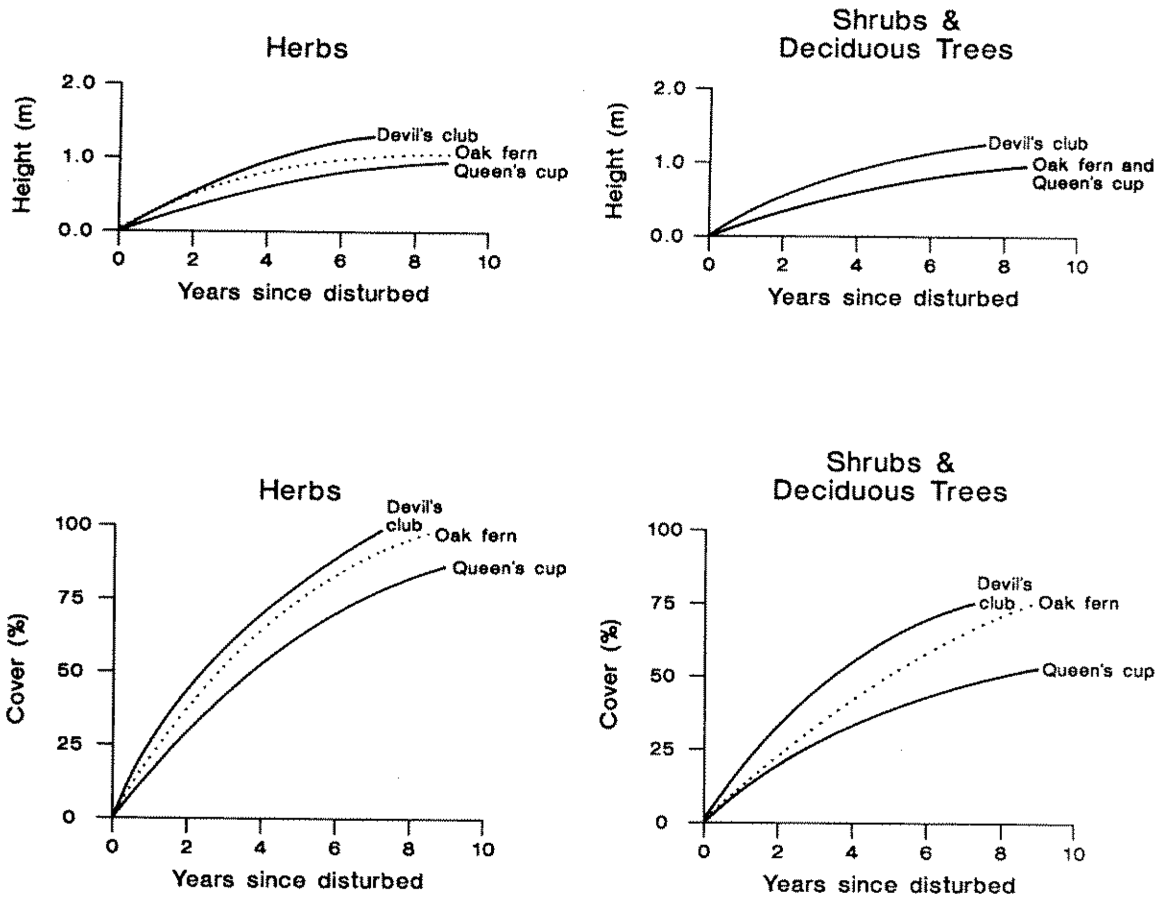

FIGURE 14. Cover and height of herbs, shrubs and deciduous trees in three ecosystems in the SBSj.

parviflorus, *Ribes* spp., *Sambucus racemosa*, and *Viburnum edule* reached a height of about 1 m by 3 years after disturbance. *Vaccinium membranaceum* generally remained less than 0.5 m tall. *Populus tremuloides* and *Salix* spp. continued to increase in height over time.

Humus layers in the seral Oak fern sites, classified as Orthic Mormoders, were characterized by rapid decomposition of organic material. Those in mature forests were generally Orthic Hemimors (Appendix 6-Table 2; Appendix 8-Table 2).

3.4.3 Devil's club ecosystem

Dominant species included *Epilobium angustifolium*, *Rubus parviflorus*, *Rubus idaeus*, *Ribes lacustre*, and *Lonicera involucrata* (Appendix 3-Table 5). *Actaea rubra*, *Cornus sericea*, *Veratrum viride*, and *Oplopanax horridus* differentiated seral Devil's club ecosystems from mesic seral SBSj1 ecosystems (Appendix 3-Table 1). *Gymnocarpium dryopteris*, *Tiarella trifoliata*, *Epilobium angustifolium*, *Rubus idaeus*, *Ribes lacustre*, and *Rubus parviflorus* were seral constants. All, except *Epilobium angustifolium* and *Rubus idaeus*, are also climax constants. Other climax constants, including *Oplopanax horridus*, *Rubus pedatus*, *Streptopus roseus*, *S. amplexifolius*, and *Dryopteris assimilis* were uncommon in the seral sites and therefore are not reliable ecosystem indicators (Appendix 3-Table 5; Appendix 5-Table 3; Appendix 7-Table 3).

Herb cover increased rapidly in the first 4 years after disturbance and maximum height was about 1.5 m by the 7th year after disturbance (Figure 14). *Epilobium angustifolium* is the only herb that exceeded 1 m in height; other prominent herbs, including *Calamagrostis canadensis* and *Athyrium filix-femina*, remained shorter.

Shrubs reached about 1.5 m in height (Figure 14) and 65% cover by the 7th year after disturbance. *Cornus sericea* and *Lonicera involucrata* are the tallest shrubs. *Sambucus racemosa* and *Viburnum edule* sometimes reached a height of 1-2 m after 6 years. *Ribes* spp., *Rubus parviflorus*, and *R. idaeus* were usually less than 1 m in height, and *Vaccinium membranaceum* was generally less than 0.5 m. Taller *Populus tremuloides* and *Salix* spp. were found in most sites. *Alnus* species and *Populus balsamifera* ssp. *trichocarpa* were found in some recently disturbed sites and *Betula papyrifera* occurred in some older cutblocks.

Humus layers in burned Devil's club sites were classified as Orthic Mormoders, reflecting the rapid decomposition typical of these sites. Those in forested sites are usually classified as Orthic Hemimors and Hemihumimors (Appendix 6-Table 3; Appendix 8-Table 3).

3.4.4 Horsetail ecosystem

Dominant species in the seral Horsetail ecosystem included *Lonicera involucrata*, *Rubus idaeus*, *Rubus parviflorus*, *Alnus incana*, *Ribes lacustre*, *Epilobium angustifolium*, *Equisetum* spp., and *Calamagrostis canadensis* (Appendix 3-Table 6). Climax constants, including *Lonicera involucrata*, *Ribes lacustre*, *Gymnocarpium dryopteris*, *Equisetum sylvaticum*, and *Cornus canadensis*, were generally present in seral Horsetail sites; other climax constants, including *Rubus pedatus* and *Streptopus amplexifolius* were uncommon (Appendix 3-Table 6; Appendix 5-Table 4; Appendix 7-Table 4).

Herbs reached up to 75% cover 1 year after disturbance and up to 80-100% cover after 3 years. Most herbs were a maximum height of about 0.75 m. *Epilobium angustifolium* reached 1-2 m height in the first few years after disturbance, while the prominent herbs, including *Athyrium filix-femina* and *Calamagrostis canadensis*, generally remained less than about 0.5 m in height. Shrub cover peaked at about 50% after 7 years. *Lonicera involucrata* dominated the upper strata along with *Rubus ideaus* and occasionally *Viburnum edule*. *Ribes lacustre* had a significant cover in the 0.5-1 m stratum by 7 years after disturbance. *Rubus parviflorus* and *Ribes laxiflorum* generally remained less than 0.5 m in height. *Alnus incana* ssp. *tenuifolia* and *Salix* spp. developed into tall shrubs.

Humus layers in forested Horsetail sites included poorly drained Mors, Moders, and Mulls, while those in recently burned sites were typically very poorly drained Saprimulls with thick organic layers (Appendix 6-Table 4; Appendix 8-Table 4).

3.5 Species Responses to Site Preparation Treatments: revegetation dynamics and implications

Epilobium angustifolium (fireweed)

Epilobium angustifolium, a minor component of the mature forest stands in the SBSj1, resprouted from rhizomes and established from seeds throughout cutblocks soon after burning and mechanical site preparation (Appendix 3-Tables 3-6; Appendix 5; Appendix 7). Site preparation appears to reduce competition from other species and provide a suitable seedbed (Watson *et al.* 1980). Fireweed will resprout from rhizomes the year after burning in cedar-hemlock sites (Stickney 1986). Seeds, which are reported to be viable for less than 2 years (Myerscough 1980), often arrive on-site soon after site preparation.

Peak abundance of fireweed is reached by the third growing season in coastal sites[7] and by the 5th year in cedar-hemlock sites, with declines in abundance evident by the 10th year (Stickney 1986). In the

[7] Brand, D. 1984. Assessment of the growth of Douglas-fir plantations. IV. Characteristics and dynamics of competing vegetation. Univ. B.C., Vancouver, B.C. Unpublished report.

SBSj1, however, where site occupancy by other species was probably slower, fireweed grew to a height of about 1 m on submesic sites and about 1.5 m on mesic and wetter sites within a few years. It achieved over 50% cover, and then appeared to decline in abundance (Appendix 5; Appendix 7). In Alaska, fireweed continues to increase in cover for up to 30 years on boreal spruce sites, declining as the forest canopy closes (Foote 1983).

Maximum fireweed development occurs in the most severely burned boreal and cedar-hemlock sites (Ahlgren 1960; Mueggler 1965; Morris 1970). A similar trend is evident in the SBSe2, where *E. angustifolium* is most abundant on the ecosystems that correspond with the SBSj1 Queen's cup and Oak fern associations, is less abundant in the SBSe2 Devil's club ecosystem, and is virtually absent from the SBSe2 Horsetail ecosystem. This pattern suggests that fireweed is a poor competitor in these wetter sites where other pre-existing vegetation often resprouts soon after burning (Eis 1981). In the SBSj1, however, *E. angustifolium* was most abundant on mesic and subhygric sites, in spite of greater abundance of other vegetation (Appendix 9-Figure 1). This suggests that in some situations the greater availability of moisture and nutrients may be more important than potentially negative effects of other vegetation.

Fireweed may contribute to seedling snow press damage (J. Pollack, pers. comm., Jan. 1985, cited in Haeussler and Coates 1986; B. Richards, pers. comm., 1985; Brand[8]) and to reducing soil temperature by shading (D. Spittlehouse, pers. comm., 1986) in mesic and wetter sites in the SBSj1. On submesic sites, the species did not appear to have sufficient volume or density to cause appreciable snow press damage to lodgepole pine, which is usually planted on these sites and generally grows fast enough to avoid light competition or mechanical damage from fireweed. The importance of moisture competition between lodgepole pine and *E. angustifolium* on drier sites and the potentially beneficial effects of shading and other positive contributions of the species, which absorbs nutrients released after burning and thus maintains them on site (Watson *et al.* 1980), have not been determined.

Lonicera involucrata (black twinberry)

Lonicea involucrata, a shade-tolerant species, was one of the most common shrubs in mature and seral SBSj1 ecosystems (Appendix 1-Table 2; Appendix 5; Appendix 7). In cedar-hemlock sites other species of *Lonicera* survive burning and resprout from the root crown the following year (Stickney 1986). The species often disappears after severe burning in boreal sites, but resprouts vigorously after light burns (Ahlgren 1960). In seral SBSj1 ecosystems, black twinberry had greater abundance on mesic and wetter sites and was consistently present after burning in the Oak fern ecosystem (Appendix 9-Figure 2). Resprouting and growth of the species after prescribed burning was fairly slow in the Queen's cup ecosystem, where it was more likely to be killed by burning (Appendix 3-Table 2; Appendix 5; Appendix 9-Figure 2). There was no evidence of re-establishment from buried seeds during the first ten years after disturbance in sites in the SBSj.

Eis (1981) reported that *L. involucrata* increased on sites in the SBSe2 that are comparable to the SBSj1 Oak fern, Devil's club, and Horsetail ecosystems, achieving the greatest cover and height on the wettest, mechanically prepared sites. Eis (1981) also found that 6 years after logging, *L. involucrata* was common on burned and mechanically prepared SBSe2 sites that are comparable to the SBSj1 Oak fern ecosystem, and cover increased to 25% in the burned SBSe2 Devil's club ecosystem and to 40% on mechanically prepared SBSe2 Horsetail sites.

Black twinberry reached a height of 1.2 m within 2 years on burned SBSe2 Horsetail sites and after 7 years on SBSe2 Devil's club sites. In the SBSj1 black twinberry reached a maximum of about 1.5 m in height. The greatest cover of black twinberry was in the Horsetail association in the SBSj1 and SBSe2.

Rubus parviflorus (thimbleberry)

Rubus parviflorus, a common understory species in mature SBSj1 forests, (Appendix 1-Table 2) was consistently present in both burned and mechanically prepared sites with an average cover of about 5-10% (Appendix 3-Table 1; Appendix 5; Appendix 7; Appendix 9-Figure 3). Thimbleberry remained less than about 1 m in height and was generally shorter on drier sites.

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[8] Brand, D. 1984.

Algren (1960) found *Rubus* species to be resistant to — and often enhanced by — burning in the boreal. *Rubus parviflorus*, a prolific seed producer and a long-term seed-banker, establishes immediately after burning from seed and by resprouting from rhizomes in the SBSj. Similar results are reported for the cedar-hemlock (Stickney 1986), coastal (Kelpas 1978), and intermountain areas (Wright 1972). Thimbleberry was sometimes abundant immediately after burning but appeared to decrease in volume over time in the drier mesic and submesic SBSj1 ecosystems (Appendix 9-Figure 3). This suggests that the species may be well adapted to the high nutrient availability and low competition from other species found immediately after burning, but is less successful once other species have re-established. Thimbleberry is found at low light levels, but is most abundant at 60-100% of full light levels in Oregon sites (Emmingham 1972). Eis (pers. comm., 1987) also found a decrease over time in the cover of *R. parviflorus* in the SBSe2 equivalents of the SBSj1 Oak fern and Queen's cup ecosystems as other vegetation increased in height. Once established, thimbleberry increases through rhizomatous extension in larch/fir sites in Montana (Stickney 1981) and British Columbia (Marchant and Sherlock 1984).

Wittinger *et al.* (1977) reported that thimbleberry was more abundant after burning in cedar-hemlock sites, but that it declined in abundance over 25 years. On coastal sites, establishment occurred immediately after burning, maximum height growth was reached in the first few years, and the species remained abundant for 5 years.[9]

Thimbleberry was most abundant on the subhygric SBSe2 (Eis 1981) and SBSj1 Devil's club ecosystems where it was likely most abundant before harvesting. It appeared to expand to occupy sites left vacant by the die-back of devil's club, which does not tolerate canopy removal. In the SBSj1 Horsetail sites, lack of an initial source for *R. parviflorus* appeared to limit development of the species.

Rubus idaeus (red raspberry)

Rubus idaeus is generally absent from mature SBSj1 forests, although present in openings in the mature SBSj1 Devil's club ecosystem (Appendix 1-Table 2). The species, which re-establishes through resprouting and germination of stored seeds in the SBSj was consistently present after sites were disturbed and had an average cover of 7-20% for the first 10 years after disturbance (Appendix 5; Appendix 7). Burning promotes the development of the species by stimulating germination of buried seeds (Sharp 1970; Stickney 1986) and resprouting of underground rhizomes, which are quite resistant to burning (Ahlgren 1960; Wright 1972).

Foote (1983) found that *R. idaeus* invaded black and white spruce sites the 1st year after burning in Alaska, but declined once trees were established. Ahlgren (1960) reported that red raspberry took at least 5 years to become dominant on jack pine sites in northern Minnesota, and then declined in abundance. *R. idaeus* generally remained less than 1 m in height in all SBSj1 sites and increased in volume over the first 10 years after site preparation (Appendix 9-Figure 4). By 14 years after burning, red raspberry was generally no longer present in mesic and submesic sites in the SBSj, presumably because it was shaded out by other species (Appendix 5-Tables 1 & 2). *Rubus idaeus* does not tolerate shade and devotes more energy to seed production as it becomes shaded (Whitney 1982).

The most rapid growth rates in burned sites appeared to be in the SBSj1 Devil's club ecosystem, where burning impacts were probably less severe and nutrient and water availability greater, followed by the Oak fern and Queen's cup ecosystems (Appendix 9-Figure 4). Raspberry has a high demand for soil nutrients and is most abundant where they are plentiful (Wright 1972). No difference in the abundance of the species on burned compared with mechanically prepared sites was apparent.

Salix spp. (willows)

Willows are generally shade-intolerant (Lyons 1952; Rawson 1974) and are not typically found in most mature SBSj1 forests (Appendix 1-Table 2). They seeded into clearcuts after disturbance and were

[9] Brand, D. 1984.

a common component of seral stands, particularly wetter sites, by 6 years after site preparation (Appendix 9-Figure 5). *Salix* spp. were important in mesic and submesic SBSj1 sites up to at least 16 years after burning (Appendix 5-Tables 1 and 2). Willows resprout readily from the root crown after fire (Wright 1972; Stickney 1986). Resprouting is maximized by quick, hot fires and inhibited by longer burns (Wright 1972; G. MacKinnon, pers. comm., Jan. 1985, cited in Haeussler and Coates 1986). Although seeds are widely dispersed (Stickney 1986), seed viability is short lived (Zasada *et al.* 1983) and development from seedlings is slow in larch/fir sites in Montana (Stickney 1981). Comparisons of burned and unburned sites in Alaska (Viereck and Dyrness 1979) and Idaho (Mueggler 1965) show that willows are favoured by burning. There was no difference in the abundance of the species after burning, compared to mechanical site preparation in the SBSj (Appendix 3-Tables 3 to 6).

Alnus incana ssp. *tenuifolia* (mountain alder)

Alnus incana ssp. *tenuifolia* was common in the mature hygric Horsetail ecosystems in the SBSj1, but was rarely found in drier forested sites (Appendix 1-Table 2). Although quite shade-tolerant (Krajina *et al.* 1982), mountain alder is usually found where there is good exposure to sunlight (Lyons 1952). It is generally absent from mature Devil's club sites, but will establish in these subhygric sites after burning. Mountain alder was restricted to seral Horsetail and Devil's club ecosystems in the SBSj1. Increases in abundance after canopy removal have been reported, especially on wetter sites, and alder resprouts after burning or if damaged (Healy and Gill 1974; Stickney 1986). Seedling viability is low (USDA 1974) and germination of the species may require the saturated soils that are generally only available in wet sites (Healy and Gill 1974). This could explain why it was not found in mesic and submesic SBSj1 sites (Appendix 3- Table 1). No difference in the abundance of the species on burned compared to mechanically prepared areas was observed (Appendix 3-Tables 3 to 6). Although total cover was generally low in sites in the SBSj1, mountain alder will grow to a height of several metres within a few years after being disturbed.

Populus *tremuloides* (trembling aspen)

Populus tremuloides was a common component of the mature submesic SBSj1 Queen's cup ecosystem, which has a history of frequent fires. Although generally not abundant in the mesic and wetter forest stands at the time of harvesting, aspen was found in the range of submesic to subhygric sites after site preparation. Suckering from the root system is common. No evidence of establishment from seeds was observed in the sites sampled in the SBSj. Strothman and Zasada (1957) found that the seed was viable for only 2 or 3 weeks, and Barnes (1966) suggested that reproduction by seed is limited because this short period of viability rarely occurs when there is enough moisture to ensure seedling survival. Seedling survival is also low in the boreal (Rowe 1983). There was no apparent difference in the abundance of the species after either mechanical site preparation or burning in the SBSj1 (Appendix 3-Tables 3 to 6).

Aspen suckers will grow very quickly and can be over 2 m in height within a few years in the SBSj1. Total cover was generally around 10-20% in the mesic and submesic sites by 16 years after sites were disturbed (Appendix 5).

Ribes laxiflorum (trailing black currant)

Ribes laxiflorum, although relatively uncommon in mature SBSj1 forests, germinated from buried seeds and was fairly abundant by the 3rd year after sites were disturbed (Appendix 9-Figure 6). Other species of *Ribes* are also reported to be seed-bankers in cedar-hemlock (Stickney 1986) and boreal (Rowe 1983) sites. No appreciable difference in the cover of the species was found in different seral ecosystems or in burned vs mechanically prepared sites (Appendix 3-Tables 3 to 6). *Ribes laxiflorum* did not usually exceed 0.5 m in height, even on the richest SBSj1 sites. Other species apparently outcompeted *R. laxiflorum* within a short time, as it was not common in older burned sites (Appendix 5-Tables 1 and 2). Other *Ribes* species are also shade-intolerant (Viereck and Little 1972) and nutrientdemanding (Haeussler and Coates 1986), and *R. laxiflorum* is probably not as successful once the initial flush of nutrients is depleted and taller vegetation shades it. The lack of rhizomatous sprouting and the reliance on seed germination (M.Newton, pers.comm., cited in Haeussler and Coates 1986) noted in other *Ribes* species could also explain the decline of this species over time, as the surface seedbank is exhausted and shading by other vegetation makes conditions for new seedling establishment less favourable.

Ribes lacustre (black gooseberry)

Ribes lacustre, a fairly shade-tolerant species, was often present with low cover in mature SBSj forest stands (Appendix 1-Table 2). It was usually present with less than 10% cover in both mechanically prepared and burned sites (Appendix 5; Appendix 7). Site preparation does not appear to have a detrimental effect on established plants and average cover in mature stands was comparable to that of clearcuts in the SBSj1. There may be an initial increase in abundance of the species in the first few years and then a decline by 9 or 10 years when taller vegetation had begins to shade it out (Appendix 9-Figure 7). Like other species of *Ribes*, *R. lacustre* is a long-term seed-banker that establishes immediately after burning in the SBSj and cedar-hemlock sites in Idaho (Stickney 1986). Rhizomatous extension is limited (Stickney 1986). In the SBSj1, plants remained less than 1 m tall.

Vaccinium membranaceum (black huckleberry)

Vaccinium membranaceum is a fairly shade-tolerant species common in the mesic and submesic mature SBSj1 forests, where it typically had about 10% cover. No obvious increase in the abundance of the species was evident for up to 10 years after burning in the SBSj1 (Appendix 9-Figure 8). Eis (pers. comm., 1987) observed similar results in the SBSe2. The species was set back by burning and seedling establishment was limited in these sites in the first 10 years. The greater abundance of *V. membranaceum* on mechanically treated compared to burned SBSj1 clearcuts also indicates that burning can kill the species (Appendix 5; Appendix 7; Appendix 9-Figure 10). In the SBSj, re-establishment after burning occurs only through resprouting from the rhizome; no seedling establishment has been observed. Similar results were reported in Idaho (Stickney 1986). Although *V. membranaceum* increases in vigour and cover after canopy removal, no increase in stem density or seedings has been reported in northern Idaho (Mueggler 1965) or in the Pacific Northwest (Minore *et al.* 1979). Miller (1977) also reported very little seedling establishment in burned sites in Montana and recovery from burning is described as slow in Oregon and Washington (Minore *et al.* 1979). In coastal sites, light fires stimulate sprouting from dormant vegetative buds on underground rhizomes, but intense fires kill rhizomes (Minore *et al.* 1979). In boreal sites, other species of *Vaccinium* have comparable abundance on light, heavy and unburned sites, indicating that response to burning is variable (Ahlgren 1960). Because *V. membranaceum* is an important component of mature forest stands, it is expected to maintain a presence on sites over time as the canopy closes.

In the SBSj1, plants were generally less than 0.5 m tall in <10 year old sites. The species is not perceived to be an important competitor in the SBSj1 or in the SBSe2 (Eis 1981), or in areas in Oregon and Washington (Minore 1979, cited in Haeussler and Coates 1986).

Calamagrostis canadensis (bluejoint)

Although common only in the hygric forested sites, *C. canadensis* was frequently present with low cover (<10%) in SBSj1 sites after disturbance. No difference in abundance was observed on mechanically prepared vs burned sites (Appendix 3-Tables 3 to 6). Rhizomes survive and increase in abundance after burning and the species also rapidly seeds-in to disturbed sites in Alberta (Watson *et al.* 1980). Bluejoint establishes immediately after and is enhanced by burning in the boreal in Minnesota (Ahlgren 1960) and Alaska (Foote 1983). Other species of *Calamagrostis* also survive burning and establish by seed in cedar-hemlock sites (Stickney 1986). *Calamagrostis canadensis* did not appear to be a serious competitor on any of the sites in the SBSj1, although it develops into continuous mats 3 or 4 years after logging in the boreal near Dawson Creek and in eastern Canada (Frisque *et al.* 1978).

Sambucus racemosa (red elderberry)

Although not common in mature submesic and mesic SBSj1 sites (Appendix 1-Table 2), *S. racemosa* establishes from buried seeds and through resprouting from rootstocks immediately after burning and is common by 3-4 years after burning (Appendix 5; Appendix 7; Appendix 9-Figure 9). *Sambucus racemosa* was found to be a seed-banking species on the coast (A. McGee, pers. comm., 1987), and is apparently enhanced by burning in cedar-hemlock (Mueggler 1965) and coastal sites (Lafferty 1972; Wright 1972). The species also resprouts from rootstocks in Oregon (M. Newton, pers. comm., Dec. 1984, cited in Haeussler and Coates 1986) and in cedar-hemlock sites (Stickney 1986). In some coastal sites, no increase in cover is apparent after burning.[10] *Sambucus racemosa* increased in abundance over the 6 years studied in the SBSe2 (S. Eis, pers. comm., 1987).

Viburnum edule (highbush-cranberry)

Viburnum edule was present with limited cover in submesic to hygric forests and in burned sites in the SBSj (Appendix 1-Table 2; Appendix 5; Appendix 9-Figure 10). Low impact fires stimulate germination of highbush-cranberry seeds and resprouting of stems in the boreal forest (Rowe 1983). Parminter also found that shallow burns did not kill rhizomes and noted sprouting at the base of stems after fires in northern British Columbia.[11] No appreciable increase in the abundance of *V. edule* was evident in the SBSj1 (Appendix 9-Table 13), although the species appeared to become more frequent over time (Appendix 5; Appendix 7).

[10] Brand 1984.

[11] Parminter, J. 1983.

4 SUMMARY AND CONCLUSIONS

4.1 Classification Within the Existing Biogeoclimatic Ecosystem Classification System

Attributes used to classify sites, including moisture and nutrient regime, and floristic composition can change markedly when sites are disturbed. Changes in moisture regime are particularly evident on severely disturbed submesic sites, which may appear drier, and on wet sites, where the water table may rise after forest canopy removal. Floristic composition changes considerably on severely disturbed sites and indicator species important in identifying ecosystems may be lacking. In areas where disturbance has been minimal, e.g., on lightly burned sites, or where undisturbed vegetation remains after patchy burns or mechanical site preparation, floristic composition is similar to pre-treatment conditions and existing ecosystem guides can easily be used to provide accurate site classification. More information is needed on revegetation patterns in severely disturbed sites.

4.2 Rate of Revegetation

The rate of vegetation development was greatest on the Devil's club sites, followed by the Oak fern and Queen's cup sites. The high vegetation volumes associated with the subhygric Devil's club sites are likely due to a combination of low burning intensity, which may stimulate shrub regrowth, and to greater availability of moisture and nutrients.

4.3 Revegetation Strategies of Key Species

4.3.1 Establishment

Species establish in sites through the germination of seeds already on-site or newly arrived after disturbance, and/or through the resprouting of underground rhizomes that have survived burning or other disturbances. *Sambucus racemosa, Ribes lacustre, R. laxiflorum* and *Rubus idaeus* establish through seedbank germination. *Populus tremuloides* re-establishes through the resprouting of underground stems or roots. Some species, including *Epilobium angustifolium, Calamagrostis canadensis,* and *Rubus parviflorus,* may establish by seed but also extend their range by vegetative reproduction. Mode of re-establishment of some species, including *Viburnum edule, Lonicera involucrata,* and *Vaccinium membranaceum* has not been well established. *Betula papyrifera* and *Salix* spp. appear to seed-in over time.

4.3.2 Persistance and longevity

Plants that increased in abundance over the first 10 or more years included *Populus tremuloides,* which will form the forest canopy on drier sites; *Alnus incana* ssp. *tenuifolia,* which persists in the understory in wetter sites; and *Salix* spp., which are greatly diminished once the forest canopy has developed. *Calamagrostis canadensis* increased after disturbance, particularly in the hygric sites. *Lonicera involucrata* and *Vaccinium membranaceum* were slow to regrow after disturbance, but persist and are important in the understory of mature forests.

Some of the species common immediately after disturbance, although initially abundant, are not very shade-tolerant and are outcompeted by taller species over time. *Epilobium angustifolium* persisted for up to 20 years; *Rubus idaeus* was replaced on submesic and mesic sites by about 14 years after the initial disturbance; and *Rubus parviflorus,* although common in mature coniferous forests, appeared to decline as the deciduous forest canopy developed. *Ribes laxiflorum* was abundant initially, but was short lived.

4.4 Site Preparation Effects

Burning diminished the abundance of a number of the original plant species on submesic and mesic sites, however fireweed rapidly occupied these sites. In moister sites, burning reduced the abundance of shrubs and herbs initially, but significant regrowth of these species and invasion by fireweed occurred in a short time. There were not enough similarly treated, mechanically prepared areas to allow an adequate assessment of the effects of this treatment.

5 LIMITATIONS OF THE STUDY

The use of a chronosequence approach to developing ecosystem-specific predictive models of vegetation development after different site preparation treatments is limited by the following factors:

1. lack of information on pre-treatment vegetation and site conditions. This caused difficulties in classifying sites disturbed by harvesting and site preparation, according to the BEC system, when no comparable adjacent mature forests existed.
2. difficulty in determining site history — such as time of year harvested — because of limitations of the site history record system.
3. lack of information on, and considerable year-to-year and site-to-site variation in, treatment impacts. Specifically, variations in climatic conditions at the time of burning partly determine burning intensity, which influences whether vegetation is killed or only temporarily set back by burning.
4. variation in local alphagenic factors (including phenological status of the vegetation at the time of treatment and presence of off-site seed sources), which, although they influence vegetation development patterns, cannot be determined through sampling years later.

The impacts of different levels of vegetation on crop tree performance were not specifically assessed. It was not feasible to make this type of an evaluation without a detailed knowledge of site history, including information on seedling condition at time of planting, site preparation impacts, and climatic conditions. Such information could only be obtained through detailed monitoring.

6 RECOMMENDATIONS

6.1 Classification

Further investigations into the nature of vegetation development after clearcutting and site preparation should be done to facilitate the development of field guides to the classification of seral ecosystems. Particular emphasis should be placed on determining how floristic composition and site moisture and nutrient regimes change following the most commonly used site preparation treatments. Priority should be given to ecosystems where silvicultural rehabilitation or habitat enhancement activities are under way to ensure that ecological classification can be readily used as a framework for the development of management prescriptions.

6.2 Species Response to Treatment

Research should focus on determining the response to site preparation treatments of dominant species (e.g., *Populus tremuloides*, *Epilobium angustifolium*, and *Rubus parviflorus*), which may be important competitors with crop trees, and of other components of the mixed shrub complex, including *Salix* spp. and *Betula papyifera*, which are of particular importance to wildlife. Determination of growth rates and mode of re-establishment (vegetative reproduction, seedbank germination, or invasion of new seeds) should be a priority.

6.3 Relationship Between Competing Vegetation and Crop Tree Performance

Studies should be initiated to determine the impacts on crop trees of the type and volume of vegetation established after burning in Devil's club sites. Hypotheses that spruce growth is limited by competition for light, water, or nutrients or by maintenance of low soil temperatures, should be tested. Research should also focus on determining the possible beneficial effects of non-crop vegetation, such as protection from loss of winter snow cover and dessication damage, shading in drier sites, and improvement of site nutrient regime. Determination of the level of non-crop vegetation that is optimal for long-term productivity is essential.

Although impacts of non-crop vegetation on crop trees were not specifically assessed in this study, observations suggest that the ground level vegetation on submesic and mesic sites is not generally dense enough or tall enough to have a significant negative impact on spruce tree performance as a result of shading or reduced soil temperatures. However, snow press damage may occur on the mesic sites, especially where fireweed is abundant soon after burning. In the Devil's club and Horsetail sites, where vegetation regrowth was greatest, reduction in spruce tree performance may be expected.

6.4 Research Approaches

Predictive models of revegetation should be developed through the establishment of experimental sites that are classified ecologically prior to treatment and monitored to determine specific impacts of site preparation treatment and subsequent vegetation development patterns.

7 LITERATURE CITED

Ahlgren, C.E. 1960. Some effects of fire on reproduction and growth of vegetation in northeastern Minnesota. Ecology 41:431-445.

Antos, J.A. and J.R. Habeck. 1981. Successional development in *Abies grandis* (Dougl.) Forbes forests in Swan Valley, western Montana. Northwest Sci. 55: 26-39.

Arno,S.F., D.G. Simmerman, and R.E. Keane. 1985. Forest succession on four habitat types in western Montana. U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. INT-177.

Barnes, B.V. 1966. The clonal growth habit of American aspens. Ecology 47:439- 447.

B.C. Ministry of Forests. 1981. Taxonomic classification of humus forms in ecosystems of British Columbia. First approx. B.C. Min. For., Land Manage. Rep. No. 8.

Canada Soil Survey Committee, Subcommittee on Soil Classification. 1978. The Canadian System of Soil Classification. Can. Dep. Agric. Publ. 1646. Supply and Services Canada, Ottawa, Ont. 160 p.

Corns, I.G.W. and G.H. LaRoi. 1976. A comparison of mature with recently clear-cut and scarified lodgepole pine forests in the Lower Foothills of Alberta. Can. J. For. Res. 6: 20-32.

DeLong, C., S. Jenvey, and A. McLeod. 1986. A field guide for the identification and interpretation of ecosystems in the SBSj1 in the Prince George Forest Region. Second approx. B.C. Min. For., Prince George, B.C.

Dyrness, C.T. 1973. Early stages of plant succession following logging and burning in the western Cascades of Oregon. Ecology 54: 57-69.

Eis, S. 1981. Effects of vegetative competition on regeneration of white spruce. Can. J. For. Res. 11:1-8.

Emmingham, W.H. 1972. Conifer growth and plant distribution under different light levels in the Siskiyou mountains of southwestern Oregon. M.Sc. thesis. Oreg. State Univ., Corvallis, Oreg.

Foote, M.J. 1983. Classification, description, and dynamics of plant communities after fire in the taiga of interior Alaska. U.S. Dep. Agric. For. Serv., Res. Pap. PNW-307.

Frisque, G., G.F. Weetman, and C. Clemmer. 1978. Reproduction and trial projected yields 10 years after cutting 36 pulpwood stands in eastern Canada. For. Eng. Res. Inst. Can., Tech. Pap. No. TR-36.

Haeussler, S. and D. Coates. 1986. Autecological characteristics of selected species that compete with conifers in British Columbia: a literature review. B.C. Min. For., Land Manage. Rep. No. 33.

Healy, W.M. and J.D. Gill. 1974. Alders. *In* Shrubs and vines for northeastern wildlife. J.D. Gill and W.M. Healy (editors). U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. NE-9, pp. 6-9.

Hill, M.O. 1979. TWINSPAN - A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of individuals and attributes. Ecology and Systematics. Cornell Univ., Ithaca, N.Y. 90 p.

Irwin,L.L. and J.M.Peek. 1979. Shrub production and biomass trends following treatments within the Cedar-Hemlock Zone of northern Idaho. For. Sci. 25:415-426.

Kellman, M.C. 1969. Plant species interrelationships in a secondary succession in coastal British Columbia. Syesis 2: 202-212.

Kelpas, B.R. 1978. Comparative effects of chemical, fire and machine site preparation in an Oregon coastal brushfield. M.Sc. thesis. Oreg. State Univ., Corvallis, Oreg.

Krajina, V.J., K. Klinka, and J. Worrall. 1982. Distribution and ecological characteristics of trees and shrubs of British Columbia. Univ. B.C., Fac. Forestry, Vancouver, B.C.

Lafferty, R.R. 1972. Regeneration and plant succession as related to fire intensity on clear-cut logged areas in the coastal cedar-hemlock type: an interim report. Can. For. Serv., Pac. For. Res. Cent., Internal Rep. BC-33.

Long, J.N. 1973. Initial stages of secondary plant succession in a series of *Pseudotsuga menziesii/Gaultheria shallon* stands in western Washington. M.Sc. thesis. Univ. Wash., Seattle, Wash.

Lyon, L.J. 1976. Vegetal development on the Sleeping Child Burn in western Montana, 1961-1973. U.S. Dep. Agric. For. Serv., Res. Pap. INT-184.

Lyons, C.P. 1952. Trees, flowers and shrubs to know in British Columbia. J.M. Dent and Sons Ltd., Vancouver, B.C.

Lutz, H.J. 1955. Ecological effects of forest fires in the interior of Alaska U.S. Dep. Agric., Tech. Bull. No. 1133.

McLeod, A. and D. Meidinger (compilers). 1985. Biogeoclimatic units of the Prince George Forest Region. Map - 1:600 000, B.C. Min. For., Victoria, B.C.

Marchant, C. and J. Sherlock. 1984. A guide to selection and propagation of some native woody species for land rehabilitation in British Columbia. B.C. Min. For., Res. Rep. R84007-HQ.

Meidinger, D.V., E.H. Hamilton and T. Fleming. 1987. Ecosystem Classification Program data processing system user's guide. B.C. Min. For. Land. Research Report RR87006-HQ, Victoria, B.C.

Miller, M. 1977. Response of blue huckleberry to prescribed fires in a western Montana larch-fir forest. U.S. Dep. Agric. For. Serv., Res. Pap. INT-188.

Minore, D., A.W. Smart, and M.E. Dubrasich. 1979. Huckleberry ecology and management research in the Pacific Northwest. U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. PNW-93.

Morris, W.G. 1970. Effects of slash burning in overmature stands of the Douglas-fir region. For. Sci. 16:258-270.

Moss, E.H. 1936. The ecology of *Epilobium angustifolium* with particular reference to rings of periderm in the wood. Amer. J. Bot. 23: 114-120.

Mueggler, W.F. 1965. Ecology of seral shrub communities in the cedar-hemlock zone of northern Idaho. Ecol. Monogr. 35:165-185.

Myerscough, P.J.1980. Biological flora of the British Isles: *Epilobium angustifolium* L. J. Ecol. 68:1047-1074.

Pojar, J., K. Klinka and D.V. Meidinger. 1987. Biogeoclimatic ecosystem classification in British Columbia. For. Ecol. Manage. In press.

Rawson, J.W. 1974. Willow. *In* Shrubs and vines for northeastern wildlife. J.D.Gill and W.M. Healy (compilers). U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. NE-9, pp. 147-149.

Rowe, J.S. 1983. Concepts of fire effects on plant individuals and species *In* The role of fire in northern circumpolar ecosystems. John Wiley & Sons Ltd., New York, N.Y., pp. 135-154.

Sharp, W.M. 1970. Ecology of shrubs and vines. *In* Shrubs and vines for northeastern wildlife. J.D.Gill and W.M. Healy (compilers). U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. NE-9, pp. 2-5.

Stewart, R.E. 1978. Origin and development of vegetation after spraying and burning in a coastal Oregon clearcut. U.S. Dep. Agric. For. Serv., Res. Note PNW-317.

———. 1984. Effects of competing vegetation on forest trees: a bibliography with abstracts. U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. WO-43.

Stickney, P.F. 1981. Vegetative recovery and development. *In* Clearcutting and fire in the Larch/Douglas-fir forests of western Montana. U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. INT-99, pp. 33-40.

———. 1986. Data base for early postfire succession on the Sundance Burn, northern Idaho. U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. INT-189.

Strothman, R.O. and Z.A. Zasada. 1957. Silvical characteristics of quaking aspen (*Populus tremuloides*). U.S. Dep. Agric. For. Serv., Res. Pap. 49.

U.S. Department of Agriculture (USDA). 1974. Seeds of woody plants of the United States. U.S. Dep. Agric. For. Serv., Agric. Handb. 450.

Viereck, L.A. and C.T. Dyrness. 1979. Ecological effects of the Wickersham dome fire near Fairbanks, Alaska. U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. PNW-90.

Viereck, L.A. and E.L. Little. 1972. Alaska trees and shrubs. U.S. Dep. Agric., Handb. No. 410.

Viereck, L. and L.A. Schandelmeier. 1980. Effects of fire in Alaska and adjacent Canada - a literature review. U.S. Dep. Interior, Bureau of Land Manage. BLM - Alaska Tech. Rep. No. 6.

Walmsley, M., G. Utzig, T. Vold., D. Moon, and J. van Barneveld. 1980. Describing ecosystems in the field. B.C. Min. Environ. and Min. For., RAB Tech. Pap. No. 2 and B.C. Min. For. Land Manage. Rep. No. 7.

Watson, L.E., R.W. Parker, and D.F. Polster. 1980. Manual of species suitable for reclamation in Alberta. Alta. Land Conserv. Reclamation Council Rep. No. RRTAC 80-5 2 Vols.

Wein, R.W. and D.A. MacLean. 1983. The role of wildfire in northern circumpolar ecosystems. J. Wiley and Sons, Toronto, Ont.

Whitney, G.G. 1982. The productivity and carbohydrate economy of a developing stand of *Rubus idaeus*. Can. J. Bot. 60: 2697-2703.

Wittenger, W.T., W.L. Pengelly, L.L. Irwin, and J.M. Peek. 1977. A 20-year record of shrub succession in logged areas in the cedar hemlock of northern Idaho. Northwest Sci. 52: 161-171.

Wright, H.A. 1972. Shrub response to fire. *In* Wildland shrubs - their biology and utilization. C.M. McKell, J.P. Blaisdell, and J.R. Goodin (editors). U.S. Dep. Agric. For. Serv., Gen. Tech. Rep. INT-1, pp. 204-217.

Zasada, J.C., R.A. Norum, R.M. Veldhuizen, and C.E. Teutsch. 1983. Artificial regeneration of trees and tall shrubs in experimentally burned upland black spruce/feather moss stands in Alaska. Can. J. For. Res. 13:903-913.

APPENDIX 1. Ecosystem classification used in the SBSj1 subzone variant

TABLES

TABLE 1. Ecosystem classification in the SBSj1 subzone variant

Current classification [a]		Classification used in this report
Symbol	**Ecosystem name**	**Ecosystem**
SBSj1/02	Pine lichen	NS[b]
SBSj1/03	Pine - velvet-leaved blueberry	NS
SBSj1/04	Black huckleberry - moss	NS
SBSj1/05	Douglas-fir - maple	NS
SBSj1/06	Black huckleberry - Queen's cup	Queen's cup
SBSj1/01	Black twinberry - oak fern - black huckleberry	Oak fern
SBSj1/07	Devil's club - oak fern	Devil's club
SBSj1/08	Black twinberry - thimbleberry	NS
SBSj1/09	Spruce - horsetail - oak fern	Horsetail
SBSj1/10	Spruce - horsetail - speckled alder	Horsetail
SBSj1/11	Bogs	NS

[a] This classification was developed in 1985 and represents a revision of the SBSj1 classification in the Prince George Forest Region (DeLong *et al.* 1986) and in the Cariboo Forest Region (Coupé and Yee (editors), 1982).
[b] NS: Not sampled.

TABLE 2. Common and differentiating species in mature ecosystems in the SBSj1 subzone variant

Classification of SBSJ1 Units					
This Report	06	01	07	08	08
Current Climax	06	01	07	09	10
No. of PLots	26	47	18	6	7
Species Code	Constancy and Mean Percent Cover				
ABIE LAS	V 12.3	V 15.7	V 15.8	V 10.5	V 9.7
PICE ENE	V 12.4	V 21.7	V 15.2	V 16.0	V 27.9
RIBE LAC	IV 0.4	V 1.8	V 1.4	V 1.7	V 2.7
VACC MEM	V 11.5	V 7.2	IV 3.1	IV 1.4	III 0.4
LONI INV	IV 0.9	V 4.9	IV 1.5	V 4.3	V 9.6
VIBU EDU	III 0.7	IV 1.1	III 0.6	IV 1.6	III 1.3
CORN CAN	V 20.0	V 12.6	V 10.1	V 9.2	V 12.1
GYMN DRY	IV 2.8	V 25.4	V 24.8	V 8.7	V 9.9
STRE ROS	IV 3.1	V 4.8	V 4.0	IV 3.3	III 0.3
ORTH SEC	IV 0.6	IV 0.4	IV 0.2	IV 0.1	IV 0.1
TIAR TRI	III 0.7	IV 3.6	V 5.7	V 3.7	V 1.3
RUBU PED	IV 4.6	V 7.3	V 5.5	V 6.3	IV 2.1
PLEU SCH	V 32.3	V 17.0	IV 5.2	V 6.0	V 12.4
PTIL CRI	V 38.3	V 29.4	V 7.6	V 5.4	V 15.4
PINU CON	V 11.5	III 3.4		I 1.7	I 0.7
POPU TRE	II 0.3	I 0.2			
BETU PAP	II 1.0	I 0.4	II 0.5		
PSEU MEN	II 3.2	I 0.2			
SPIR BET	IV 1.8	II 0.5	II 0.2	II 0.0	I 0.0
RUBU PAR	III 3.6	IV 4.3	V 4.5	III 1.2	
ARAL NUD	IV 2.9	III 2.7	II 1.2	I 0.1	IV 3.7
CLIN UNI	V 2.5	IV 1.0	III 1.3	II 0.0	I 0.1
LYCO ANN	IV 5.5	V 4.2	IV 1.8	III 0.3	III 0.6
VERA VIR	II 0.2	IV 1.2	III 0.9	III 0.1	
OPLO HOR	I 0.1	II 0.9	V 30.4	V 20.8	III 1.0
DRYO ASS	II 0.1	III 3.0	V 8.2	V 3.4	IV 2.1
ATHY FIL	I 0.0	II 0.4	IV 6.8	IV 6.7	V 1.6
MNIU MED	I 0.0	II 1.2	II 3.2	I 2.2	III 3.6
MNIU NUD	I 0.5	II 2.1	II 5.3		
ALNU INC 2				II 5.9	IV 3.5
EQUI SYL	I 0.0	II 0.1	III 2.0	V 2.4	V 8.9
EQUI ARV		I 0.1	II 0.1	V 13.5	V 19.0
CALA CAN	I 0.1	I 0.0		III 0.1	III 1.3
CIRC ALP		I 0.0	II 0.2	III 0.3	III 0.3
HYLO SPL	III 5.3	IV 11.8	III 12.0	III 26.2	V 15.1

Key to Presence Classes

Presence Class	Per cent Presence
I	0-20
II	21-40
III	41-60
IV	61-80
V	81-100

[a] This classification was developed using data collected by the Prince George Forest Region and Cariboo Forest Region ecologists and pedologists. Not all ecosystems are shown.

[b] This table presents a partial species list only.

[a] See Appendix 2 for full species names.

APPENDIX 2. Code, scientific, and common names of species used in this report.

Scientific name	Species Code	Common name
Abies lasiocarpa	ABIE LAS	subalpine fir
Actaea rubra	ACTA RUB	baneberry
Agoseris spp.	AGOS ERI	mountain-dandelions
Agrostis spp.	AGRO STI	bent grass
Alnus incana ssp. *tenuifolia*	ALNU INC2	mountain alder
Amelanchier alnifolia	AMEL ALN	Saskatoon
Anaphalis margaritacea	ANAP MAR	pearly everlasting
Antennaria neglecta	ANTE NEG	field pussytoes
Aralia nudicaulis	ARAL NUD	wild sarsaparilla
Aster modestus	ASTE MOD	great northern aster
Athyrium filix-femina	ATHY FIL	lady fern
Betula papyrifera	BETU PAP	paper birch
Brachythecium spp.	BRAC HYT	
Calamagrostis canadensis	CALA CAN	bluejoint
Calamagrostis scribneri	CALA SCR	Scribner's small reed grass
Calliergon cordfolium	CALL COR	
Carex spp.	CARE X	sedges
Chimaphila umbellata	CHIM UMB	pipsissewa
Circaea alpina	CIRC ALP	enchanter's nightshade
Clintonia uniflora	CLIN UNI	queen's cup
Cornus canadensis	CORN CAN	bunchberry
Cornus sericea	CORN SER	red-osier dogwood
Corydalis sempervirens	CORY SEM	pink corydalis
Delphinium glaucum	DELP GLA	pale larkspur
Dicranum polysetum	DICR POL	
Disporum hookeri	DISP HOO	Hooker's fairybells
Dryopteris assimilis	DRYO ASS	spiny wood fern
Epilobium angustifolium	EPIL ANG	fireweed
Equisetum spp.	EQUI SET	horsetails
Equisetum arvense	EQUI ARV	common horsetail
Equisetum pratense	EQUI PRA	meadow horsetail
Equisetum sylvaticum	EQUI SYL	wood horsetail
Galium boreale	GALI BOR	northern bedstraw
Galium triflorum	GALI TRF	fragrant bedstraw
Geranium bicknellii	GERA BIC	Bicknell's geranium
Geum macrophyllum	GEUM MAC	large-leaved avens
Goodyera oblongifolia	GOOD OBL	western rattlesnake plantain
Gymnocarpium dryopteris	GYMN DRY	oak fern
Heracleum sphondylium	HERA SPH	cow-parsnip
Hieracium spp.	HIER ACI	hawkweed
Hieracium albiflorum	HIER ALB	white-flowered hawkweed
Hylocomium splendens	HYLO SPL	step moss
Lathyrus ochroleucus	LATH OCH	creamy peavine
Linnaea borealis	LINN BOR	twinflower
Lonicera involucrata	LONI INV	black twinberry
Lycopodium annotinum	LYCO ANN	stiff club-moss
Marchantia polymorpha	MARC POL	
Mitella nuda	MITE NUD	stoloniferous mitrewort
Mnium spp.	MNIU M	leafy mosses
Mnium medium	MNIU MED	
Mnium nudum	MNIU NUD	
Moneses uniflora	MONE UNI	single delight
Oplopanax horridus	OPLO HOR	devil's club
Orthilia secunda	ORTH SEC	one-sided wintergreen
Osmorhiza chilensis	OSMO CHI	mountain sweet-cicely
Peltigera aphthosa	PELT APH	
Petasites palmatus	PETA PAL	sweet colt's-foot

APPENDIX 2. Code, scientific, and common names of species used in this report. — *Continued*

Scientific name	Species Code	Common name
Picea glauca x *engelmannii*	PICE ENE	hybrid white spruce
Pinus contorta	PINU CON	lodgepole pine
Pleurozium schreberi	PLEU SCH	red-stemmed feather moss
Polytrichum spp.	POLY TRI	haircap mosses
Populus balsamifera ssp. *trichocarpa*	POPU BAL2	black cottonwood
Populus tremuloides	POPU TRE	trembling aspen
Pseudotsuga menziesii	PSEU MEN	Douglas-fir
Ptilium crista-castrensis	PTIL CRI	knight's plume
Rhytidiadelphus triquetrus	RHYT TRI	
Ribes lacustre	RIBE LAC	black gooseberry
Ribes laxiflorum	RIBE LAX	trailing black currant
Rosa acicularis	ROSA ACI	prickly rose
Rubus idaeus	RUBU IDA	red raspberry
Rubus parviflorus	RUBU PAR	thimbleberry
Rubus pedatus	RUBU PED	five-leaved bramble
Rubus pubescens	RUBU PUB	trailing raspberry
Salix spp.	SALI X	willows
Sambucus racemosa	SAMB RAC	red elderberry
Shepherdia canadensis	SHEP CAN	soopolallie
Smilacina racemosa	SMIL RAC	false Solomon's-seal
Smilacina stellata	SMIL STE	star-flowered Solomon's-seal
Sorbus scopulina	SORB SCO	western mountain-ash
Spiraea betulifolia	SPIR BET	birch-leaved spirea
Spiraea douglasii	SPIR DOU	pink spirea
Streptopus amlexifolius	STRE AMP	clasping-leaved twistedstalk
Streptopus roseus	STRE ROS	rosy twistedstalk
Taraxacum spp.	TARA XAC	dandelions
Tiarella trifoliata	TIAR TRI	three-leaved foamflower
Tiarella unifoliata	TIAR UNI	unifoliate-leaved foamflower
Vaccinium membranaceum	VACC MEM	black huckleberry
Vaccinium myrtilloides	VACC MYR	velvet-leaved blueberry
Vaccinium ovalifolium	VACC OVA	oval-leaved blueberry
Valeriana sitchensis	VALE SIT	Sitka valerian
Veratrum viride	VERA VIR	green false-hellebore
Viburnum edule	VIBU EDU	highbush-cranberry
Viola spp.	VIOL A	violets
Viola glabella	VIOL GLA	stream violet

APPENDIX 3. Species composition of seral ecosystems

TABLES

TABLE 1. Cover and constancy of common and differentiating species in seral (<15 years since mechanically site prepared or burned) SBSj1 ecosystems

Ecosystem	SBSJ1/06	SBSJ1/01	SBSJ1/07	SBSJ1/08
Name	Queen's cup	Oak fern	Devil's club	Horse-tail
No. of Plots	15	18	12	12
Species Code	Constancy and Cover			
Trees				
PICE ENE	IV 2.6	IV 2.6	V 1.4	V 2.0
POPU TRE	IV 7.1	III 1.2	II 1.0	II 0.5
ABIE LAS	III 1.1	IV 2.0	II 0.4	II 0.4
PINU CON	III 1.2	II 1.3	I 0.0	
Shrubs				
RUBU IDA	IV 6.5	V 9.9	V 8.5	V 4.5
RIBE LAC	III 1.1	IV 1.6	V 4.1	V 1.9
RUBU PAR	IV 3.8	V 5.6	V 16.6	III 4.5
SALI X	IV 1.0	III 2.5	III 1.3	IV 1.8
RIBE LAX	III 1.3	IV 2.0	IV 2.0	III 0.8
LONI INV	III 2.4	V 4.5	V 5.1	V 7.3
VACC MEM	III 1.3	V 1.3	III 1.0	III 0.3
SPIR BET	IV 6.4	III 0.9	II 0.9	II 0.4
SAMB RAC	II 0.7	IV 1.5	III 0.8	III 0.6
VIBU EDU	II 0.4	II 0.4	IV 0.9	II 0.3
OPLO HOR	I 0.0	I 0.1	IV 1.7	I 0.0
CORN SER	I 0.3	I 0.1	III 4.5	II 0.5
ROSA ACI	II 2.4	II 0.2	II 1.4	IV 2.3
ALNU INC 2	I 0.0	I 0.0	II 2.8	III 2.2

Key to Presence Classes

Presence Class	Per cent Presence
I	0-20
II	21-40
III	41-60
IV	61-80
V	81-100

Ecosystem	SBSJ1/06	SBSJ1/01	SBSJ1/07	SBSJ1/08
Name	Queen's cup	Oak fern	Devil's club	Horse-tail
No. of Plots	15	18	12	12
Species Code	Constancy and Cover			
Herbs				
EPIL ANG	V 29.2	V 40.0	V 28.1	V 28.1
CORN CAN	V 6.4	V 4.3	IV 4.0	V 1.3
CALA CAN	III 1.1	IV 1.4	III 2.4	V 4.6
TARA OFF	IV 0.3	III 0.5	II 0.2	III 0.1
CARE X	III 4.1	III 0.6	I 0.1	III 1.7
RUBU PED	III 1.4	IV 2.4	II 1.5	II 0.6
LINN BOR	III 3.5	IV 1.0	II 0.9	I 0.2
STRE ROS	III 0.5	IV 0.9	II 0.3	I 0.2
CLIN UNI	III 1.0	III 0.2	II 0.4	I 0.0
VERA VIR	I 0.0	III 0.4	III 0.5	I 0.4
GYMN DRY	II 0.4	V 2.9	V 8.8	IV 2.0
TIAR TRI	II 0.9	V 2.3	V 4.0	III 0.5
GALI TRF	II 0.2	III 0.2	V 1.4	V 1.1
EQUI SYL	II 0.1	I 1.1	III 1.7	IV 4.9
EQUI ARV	I 0.1	II 1.6	III 3.1	III 4.2
ATHY FIL		II 0.2	III 0.5	III 1.6
ANAP MAR	III 0.6	II 0.7	II 1.0	II 0.2
HIER ALB	III 1.1	II 0.5	I 0.0	I 0.1
ACTA RUB	I 0.1	I 0.1	IV 0.8	II 0.3
DISP HOO	I 0.7	I 0.1	III 0.3	I 0.0
PETA PAL	II 0.5	II 1.1	II 0.3	III 2.8
RUBU PUB	I 0.2	II 0.1	II 0.2	III 1.5
VIOL A	I 0.0	II 0.1	II 0.2	III 0.6
EQUI PRA	I 0.1		I 1.3	III 2.9
Mosses				
POLY JUN	IV 25.8	III 15.8	III 9.0	III 6.7
PLEU SCH	II 2.8	III 3.0	III 4.2	III 5.6
PTIL CRI	II 0.1	II 2.1	III 3.4	III 5.3
MNIU M			III 2.6	III 3.0

TABLE 2. Cover and constancy of common and differentiating species in seral (<10 years since burned) SBSj1 ecosystems

Ecosystem	SBSJ1/06	SBSJ1/01	SBSJ1/07	SBSJ1/08
Name	Queen's cup	Oak fern	Devil's club	Horse-tail
No. of Plots	11	8	8	6
Species Code	Constancy and Cover			
Trees				
PICE ENE	IV 2.2	IV 3.1	IV 0.6	V 0.4
POPU TRE	V 2.0	II 0.6	II 1.3	I 0.2
PINU CON	III 0.7	II 2.1		
Shrubs				
RUBU IDA	V 7.5	V 9.6	V 5.7	V 3.3
RUBU PAR	IV 4.5	V 9.4	V 19.4	III 0.7
RIBE LAC	IV 1.3	V 0.9	V 3.5	IV 0.5
ROSA ACI	III 2.2	II 0.1	II 0.9	V 1.4
SALI X	IV 0.8	II 2.3	II 1.3	III 0.7
VIBU EDU	III 0.5	II 0.3	IV 1.3	II 0.2
SPIR BET	III 4.6	III 1.6	II 1.1	I 0.2
RIBE LAX	III 1.7	III 4.0	IV 2.8	II 0.4
SAMB RAC	II 0.9	IV 2.2	III 1.0	I 0.8
VACC MEM	II 0.8	V 1.0	III 1.3	II 0.2
LONI INV	II 2.6	IV 2.5	IV 4.4	V 3.7
SORB SCO	I 0.2	III 0.5	II 0.1	III 0.4
OPLO HOR	I 0.1	I 0.1	IV 1.5	I 0.0
CORN SER	I 0.1	II 0.2	IV 3.4	II 0.6
ALNU INC 2	I 0.0		II 4.0	III 2.0
Herbs				
EPIL ANG	V 30.3	V 36.3	V 18.4	V 24.6
CORN CAN	V 6.4	V 3.3	IV 3.9	V 0.6
CARE X	III 5.5	IV 1.0	II 0.1	V 1.3
CLIN UNI	III 0.4	IV 0.3	II 0.6	I 0.0
STRE ROS	III 0.6	IV 0.6	I 0.0	
TIAR TRI	II 1.0	V 3.1	V 3.6	II 0.2
VERA VIR	I 0.1	IV 0.3	IV 0.6	I 0.3
GYMN DRY	I 0.5	IV 2.2	V 4.1	III 0.4
GALI TRF	II 0.2	III 0.2	IV 1.0	V 0.4
EQUI SYL	II 0.1	II 2.5	IV 2.4	III 5.8
LINN BOR	II 2.6	IV 0.7	I 0.6	
RUBU PED	II 0.3	IV 2.5	II 0.6	I 0.1
VALE SIT	I 0.3	IV 0.4	I 0.1	II 0.3
ACTA RUB	I 0.1	II 0.1	IV 1.0	I 0.2
EQUI ARV	I 0.2	I 0.1	IV 3.6	II 6.3
DISP HOO	I 0.8	II 0.3	III 0.4	II 0.0
ARAL NUD	I 1.0	II 1.0	III 0.2	
CALA CAN	III 1.2	III 0.9	III 3.6	V 3.6
PETA PAL	II 0.6	II 0.3	I 0.1	IV 3.3
RUBU PUB	I 0.2	I 0.1	II 0.2	IV 1.1
GALI BOR	I 0.7		I 0.0	III 0.9
EQUI PRA	I 0.2		I 0.1	III 5.7
Mosses				
POLY JUN	IV 24.5	II 2.5	II 1.3	III 1.8
MNIU M			III 1.3	II 0.2

Key to Presence Classes

Presence Class	Per cent Presence
I	0-20
II	21-40
III	41-60
IV	61-80
V	81-100

TABLE 3. Cover and constancy of common species in mature and seral (<10 years since mechanically site prepared and burned) SBSj1/06 (Queen's cup) ecosystems

SBSJ1/06 Queen's cup Ecosystem

Stage		Mature	Seral	
Treatment			Mechan.	Burned
No. of Plots		26	3	11
Type	**Species code**	**Constancy and Cover**		
	Trees			
B				
cc	PICE ENE	V 12.4	IV 1.7	IV 2.2
cc	ABIE LAS	V 12.3	V 3.0	II 0.7
cc	PINU CON	V 11.5	IV 1.7	III 0.7
C				
sc	POPU TRE	II 1.0	IV 24.2	V 2.0
	POPU BAL		II 1.0	III 0.2
	Shrubs			
A				
	RUBU PAR	III 3.6	V 1.8	IV 4.5
	LONI INV	IV 0.9	IV 2.2	III 2.6
	RIBE LAC	IV 0.4	IV 0.7	III 1.3
	AMEL ALN	II 0.3	IV 3.5	II 0.4
	CORN SER	II 0.2	IV 1.0	I 0.1
	ROSA ACI	III 1.1	II 4.0	III 2.2
B				
	VACC MEM	V 11.5	V 2.7	II 0.8
	SORB SCO	IV 0.5	IV 0.7	I 0.2
	VIBU EDU	III 0.7		III 0.5
C				
	SPIR BET	IV 1.8	V 8.5	III 4.6
	SAMB RAC	I 0.0	IV 0.4	II 0.9
sc	RUBU IDA		V 5.0	V 7.5
	SALI X		II 0.7	IV 0.8
	RIBE LAX		II 0.2	III 1.7
	Herbs			
A				
	LINN BOR	IV 2.4	IV 2.7	II 3.6
cc	CLIN UNI	V 2.5	IV 3.3	III 0.4
	TIAR TRI	III 0.7	II 0.7	II 1.0
	SMIL RAC	III 0.6	II 0.2	II 0.1
B				
cc,sc	CORN CAN	V 20.0	IV 6.8	V 6.4
	RUBU PED	IV 4.6	IV 5.3	II 0.3
	GYMN DRY	IV 2.8	V 0.4	I 0.5
	ARAL NUD	IV 2.9	IV 3.7	I 1.0
	ORTH SEC	IV 0.6	II 0.7	II 0.1
	LYCO ANN	IV 5.5	II 0.0	I 0.1
	STRE ROS	IV 3.1		III 0.6
C				
sc	EPIL ANG	III 0.1	V 28.5	V 30.3
	CALA CAN	I 0.1	IV 0.5	III 1.2
	CARE X		II 0.2	III 5.5
	HIER ALB		IV 0.7	III 0.4
	TARA OFF		IV 0.1	IV 0.4
	ANAP MAR		IV 0.1	II 0.6
	Mosses			
B				
cc	PTIL CRI	V 38.3	V 0.4	I 0.1
cc	PLEU SCH	V 32.3	V 8.4	II 1.5
	HYLO SPL	III 5.3	II 0.0	I 0.0
	RHYT TRI	III 8.2		
C				
	POLY JUN	I 0.0	IV 12.3	IV 24.5

Key to Table

Presence Class	Per cent Presence
I	0-20
II	21-40
III	41-60
IV	61-80
V	81-100

A Species that have similar constancy and cover in climax and seral stages.
B Species that appear to decline in constancy and/or cover after logging and site preparation.
C Species that appear to increase in constancy and/or cover or to invade after logging and site preparation.
cc climax constant - present in more than 80% of the plots in a climax ecosystem.
sc seral constant - present in more than 80% of the plots in a seral ecosystem.

TABLE 4. Cover and constancy of common species in mature and seral (<10 years since mechanically site prepared or burned) SBSj1/01 (Oak fern) ecosystems

SBSJ1/01 Oak fern Ecosystem

Stage		Mature	Seral	
Treatment			Mechan.	Burned
No. of Plots		47	9	8
Type	**Species Code**	**Constancy and Cover**		
	Trees			
B				
cc	PICE ENE	V 21.7	V 2.1	IV 3.1
cc	ABIE LAS	V 15.7	IV 0.5	II 3.8
	PINU CON	III 3.4	III 0.6	II 2.1
C				
	POPU TRE	I 0.2	III 1.9	II 0.6
	Shrubs			
A				
sc	RUBU PAR	IV 4.3	V 2.8	V 9.4
cc,sc	LONI INV	V 4.9	V 6.8	IV 2.5
cc	RIBE LAC	V 1.8	IV 2.4	V 0.9
cc,sc	VACC MEM	V 7.2	V 1.6	V 1.0
	SORB SCO	III 0.2	II 0.3	III 0.5
B				
	VIBU EDU	IV 1.1	II 0.6	II 0.3
	VACC OVA	III 2.6	II 0.3	II 0.0
	AMEL ALN	III 0.3		
C				
sc	RUBU IDA	I 0.1	V 11.2	V 9.6
	RIBE LAX		IV 0.5	III 4.0
	SAMB RAC	I 0.0	IV 1.1	IV 2.2
	SALI X		IV 1.9	II 2.3
	SPIR BET	II 0.5	II 0.4	III 1.6

SBSJ1/01 Oak fern Ecosystem

Stage		Mature	Seral	
Treatment			Mechan.	Burned
No. of Plots		47	9	8
Type	**Species Code**	**Constancy and Cover**		
	Herbs			
A				
sc	TIAR TRI	IV 3.6	V 2.0	V 3.1
	LINN BOR	III 1.3	IV 1.2	IV 0.7
	GALI TRF	III 0.1	III 0.1	III 0.2
B				
cc,sc	GYMN DRY	V 25.4	V 3.6	IV 2.2
cc,sc	CORN CAN	V 12.6	V 5.4	V 3.3
cc	RUBU PED	V 7.3	V 2.5	IV 2.5
cc	STRE ROS	V 4.8	IV 1.3	IV 0.6
	CLIN UNI	IV 1.0	II 0.2	IV 0.3
	VERA VIR	IV 1.2	II 0.2	IV 0.6
	SMIL RAC	III 0.5	I 0.1	II 0.1
	STRE AMP	III 0.4	II 0.1	II 0.1
	LYCO ANN	V 4.2	II 0.5	II 0.1
	DRYO ASS	III 3.0	II 0.3	I 0.1
	ARAL NUD	III 2.7	II 0.1	II 1.0
	TIAR UNI	III 0.9		I 0.1
	ORTH SEC	IV 0.4		
C				
sc	EPIL ANG	II 0.1	V 43.3	V 36.3
	CALA CAN	I 0.0	IV 2.0	III 0.9
	VALE SIT		II 0.2	IV 0.4
	HIER ALB		III 0.8	II 0.3
	TARA OFF		III 0.2	II 0.1
	Mosses			
A				
cc	PTIL CRI	V 29.4	II 3.3	I 1.0
cc	PLEU SCH	V 17.0	IV 4.5	II 1.8
	HYLO SPL	IV 11.8	I 0.0	
	RHYT TRI	IV 6.2	I 1.3	
B				
	POLY JUN	I 0.0	IV 28.2	II 2.5

Key to Table

Presence Class	Per cent Presence
I	0-20
II	21-40
III	41-60
IV	61-80
V	81-100

A Species that have similar constancy and cover in climax and seral stages.
B Species that appear to decline in constancy and/or cover after logging and site preparation.
C Species that appear to increase in constancy and/or cover or to invade after logging and site preparation.
cc climax constant - present in more than 80% of the plots in a climax ecosystem.
sc seral constant - present in more than 80% of the plots in a seral ecosystem.

TABLE 5. Cover and constancy of common species in mature and seral (<10 years since mechanically site prepared or burned) SBSj1/07 (Devil's club) ecosystems

SBSJ1/07 Devil's club Ecosystem

Stage		Mature	Seral	
Treatment			Mechan.	Burned
No. of Plots		18	4	8
Type	**Species Code**	**Constancy and Cover**		
	Trees			
B				
cc,sc	PICE ENE	V 15.2	V 3.0	IV 0.6
cc	ABIE LAS	V 15.8	III 1.0	II 0.2
	Shrubs			
A				
	SAMB RAC	III 0.8	III 0.4	III 1.0
	VIBU EDU	III 0.6	III 0.3	IV 1.3
B				
cc	OPLO HOR	V 30.4	IV 2.0	IV 1.5
	VACC MEM	IV 3.1	II 0.5	III 1.3
	VACC OVA	III 3.7	II 0.1	II 1.3
C				
cc,sc	RUBU PAR	V 4.5	V 11.0	V 19.4
cc,sc	RIBE LAC	V 1.4	V 5.3	V 3.5
sc	LONI INV	IV 1.5	V 6.5	IV 4.4
sc	RUBU IDA	IV 0.3	V 14.0	V 5.7
	RIBE LAX	I 0.1	IV 0.5	IV 2.8
	CORN SER	II 0.1	III 6.5	IV 3.4
	SALI X		IV 1.4	II 1.3

SBSJ1/07 Devil's club Ecosystem

Stage		Mature	Seral	
Treatment			Mechan.	Burned
No. of Plots		18	4	8
Type	**Species Code**	**Constancy and Cover**		
	Herbs			
A				
cc,sc	TIAR TRI	V 5.7	V 4.8	V 3.6
sc	GALI TRF	IV 0.4	V 2.3	IV 1.0
	CLIN UNI	III 0.2	II 0.0	II 0.6
	VIOL A	III 0.3	II 0.3	II 0.1
	EQUI SYL	III 2.0	II 0.3	IV 2.4
	ACTA RUB	III 0.2	II 0.5	IV 1.0
	VERA VIR	III 0.9	II 0.3	IV 0.6
	DISP HOO	II 0.8	II 0.3	III 0.4
	ARAL NUD	II 1.2		III 0.2
B				
cc	CORN CAN	V 10.1	IV 4.0	IV 3.9
cc,sc	GYMN DRY	V 24.8	V 18.0	V 4.1
cc	RUBU PED	V 5.5	III 3.3	II 0.6
cc	DRYO ASS	V 8.2	II 1.0	II 0.1
cc	STRE ROS	V 4.0	III 0.9	I 0.0
	ATHY FIL	IV 6.8	III 1.0	II 0.2
cc	STRE AMP	V 0.5	III 0.4	II 0.1
	SMIL RAC	IV 2.5	III 0.4	II 0.1
	LYCO ANN	IV 1.8		II 0.1
	TIAR UNI	III 1.3		II 0.1
	ORTH SEC	IV 0.2		
C				
sc	EPIL ANG	I 0.0	V 47.5	V 18.4
	EQUI ARV	II 0.1	III 2.0	IV 3.6
	CALA CAN		II 0.0	III 3.6
	Mosses			
B				
cc	PTIL CRI	V 7.6	IV 6.3	II 1.9
	PLEU SCH	IV 5.2	IV 6.3	II 3.2
	HYLO SPL	III 12.0		
	RHYT TRI	IV 10.1	II 0.8	
C				
	POLY JUN	I 0.1	IV 24.5	II 1.3
	MNIU M	II 1.8	III 5.3	III 1.3

Key to Table

Presence Class	Per cent Presence
I	0-20
II	21-40
III	41-60
IV	61-80
V	81-100

A Species that have similar constancy and cover in climax and seral stages.
B Species that appear to decline in constancy and/or cover after logging and site preparation.
C Species that appear to increase in constancy and/or cover or to invade after logging and site preparation.
cc climax constant - present in more than 80% of the plots in a climax ecosystem.
sc seral constant - present in more than 80% of the plots in a seral ecosystem.

TABLE 6. Cover and constancy of common species in mature and seral (<10 years since mechanically site prepared and burned) SBSj1/08 (Horsetail) ecosystems

SBSJ1/08 Horsetail Ecosystem

Stage		Mature	Seral	
Treatment			Mechan.	Burned
No. of Plots		13	4	6
Type	Species Code	Constancy and Cover		
	Trees			
B				
cc,sc	PICE ENE	V 22.4	V 2.3	V 0.4
cc	ABIE LAS	V 10.1	IV 1.3	
	Shrubs			
A				
cc,sc	LONI INV	V 7.2	IV 11.3	V 3.7
cc,sc	RIBE LAC	V 2.2	V 3.5	IV 0.5
	ALNU INC 2	III 4.6	IV 0.5	III 2.0
B				
	VACC MEM	IV 0.9	IV 0.8	II 0.2
	VIBU EDU	IV 1.4	III 0.5	II 0.2
	OPLO HOR	IV 10.1		I 0.0
C				
sc	RUBU IDA	III 0.3	IV 7.5	V 3.3
	ROSA ACI	II 1.7	II 3.0	V 1.4
	RUBU PAR	II 0.6	IV 12.0	III 0.7
	SALI X	I 0.2	IV 1.6	III 0.7
	SAMB RAC	II 0.2	V 0.6	I 0.8
	RIBE LAX		V 1.6	II 0.4

SBSJ1/08 Horsetail Ecosystem

Stage		Mature	Seral	
Treatment			Mechan.	Burned
No. of Plots		13	4	6
Type	Species Code	Constancy and Cover		
	Herbs			
B				
cc	EQUI SYL	V 5.9	V 4.5	III 5.8
cc	GYMN DRY	V 9.3	IV 4.5	III 0.4
cc,sc	CORN CAN	V 10.8	V 1.8	V 0.6
cc	EQUI ARV	V 16.5	IV 2.3	II 6.3
	ATHY FIL	IV 4.0	IV 2.8	II 0.4
cc	TIAR TRI	V 2.4	V 1.4	II 0.2
	RUBU PUB	IV 2.0	II 1.8	IV 1.1
	VIOL A	III 0.7	II 0.3	III 0.1
cc	RUBU PED	V 4.0	II 0.5	I 0.1
	MITE NUD	III 1.3	II 0.3	II 0.1
	LINN BOR	III 0.5	II 0.3	
	STRE ROS	III 1.7	II 0.5	
	LYCO ANN	III 0.5	II 0.0	
	ARAL NUD	III 2.0	II 0.0	
	SMIL RAC	III 0.0	II 0.5	
cc	STRE AMP	V 0.6		I 0.0
	DRYO ASS	IV 2.7		II 0.0
	TIAR UNI	III 1.6		I 0.1
	ORTH SEC	IV 0.1		
C				
	CALA CAN	III 0.7	IV 4.3	V 3.6
	GALI TRF	III 0.2	V 1.5	V 0.4
	EPIL ANG	II 0.1	V 43.3	V 24.6
	PETA PAL	II 0.2	II 0.5	IV 3.3
	CARE X		II 0.5	I 0.3
	EQUI PRA		II 0.1	III 5.7
	ASTE MOD		II 0.3	III 2.6
	TARA OFF		III 0.0	III 0.1
	HERA SPH	I 0.1		III 0.9
	GALI BOR	II 0.1		III 0.9
	DELP GLA			III 0.2
	Mosses			
B				
cc	PTIL CRI	V 10.8	V 4.5	I 0.0
cc	PLEU SCH	V 9.4	IV 6.8	I 0.1
	HYLO SPL	IV 20.2		
C				
	MNIU M		III 3.8	II 0.2
	POLY JUN		IV 10.0	III 1.8
	MARC POL			III 2.8

Key to Table

Presence Class	Per cent Presence
I	0-20
II	21-40
III	41-60
IV	61-80
V	81-100

A Species that have similar constancy and cover in climax and seral stages.
B Species that appear to decline in constancy and/or cover after logging and site preparation.
C Species that appear to increase in constancy and/or cover or to invade after logging and site preparation.
cc climax constant - present in more than 80% of the plots in a climax ecosystem.
sc seral constant - present in more than 80% of the plots in a seral ecosystem.

APPENDIX 4. Distribution of detailed plots by ecosystem, year, and treatment type

Years since dist.	Ecosystem association															
	06				01				07				08			
	T	B	M	U	T	B	M	U	T	B	M	U	T	B	M	U
1	-	-	-	-	3	3	-	-	4	2	2	-	2	2	-	-
2	2	2	-	-	-	-	-	-	1	1	-	-	1	-	1	-
3	2	2	-	-	3	2	1	-	1	1	-	-	2	2	-	-
4	4	2	2	-	5	2	3	-	3	2	1	-	2	2	-	-
5	-	-	-	-	3	-	2	1	1	-	-	1	2	-	1	1
6	1	1	-	-	2	-	2	-	2	2	-	-	1	-	1	-
7	2	1	1	-	-	-	-	-	1	-	1	-	2	-	1	1
8	1	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-
9	2	2	-	-	1	1	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-
12	1	-	-	1	-	-	-	-	1	-	-	1	2	-	1	1
13	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
14	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-
Total	16	12	3	1	20	9	9	2	14	8	4	2	15	6	6	3

T = total, B = burned, M = mechanically treated, U = untreated

APPENDIX 5. Vegetation composition of burned seral SBSj1 ecosystems

TABLES

TABLE 1. Vegetation composition of the seral (<25 years since burned) SBSj1/06 (Queen's cup) ecosystem

Years Since Burned			2		3		4		6	7	8	9		11	13	14	15		16				19	24
Plot Number	Average Value		820 5885	820 5889	820 8881	820 8882	822 9117	822 9166	822 9120	820 5872	822 9198	822 9127	822 9196	G16 G12	G16 H34	822 9173	G16 H44	G16 190	G16 158	G16 17	G16 20SW	G16 14	H13 F14	G16 25W
No. of Species Per Plot	25.8		22	28	15	13	36	31	25	29	36	29	35	25	22	40	26	15	23	19	28	22	20	28
Species Code	%P	MC	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C
B1 Layer																								
POPU TRE	18.2	1.1					2		5		.5					16								
ALNU VIR 2	4.5	0.1							2															
PINU CON	4.5	0.1														2								
ALNU INC 2	4.5	0.0									.5													
POPU BAL	4.5	0.0									.5													
B2 Layer																								
POPU TRE	77.3	2.9	.5 5	1	.5	.1	1	1	10			5		5	+		+	+	20	10		+	5	+
PICE ENE	72.7	1.8			.5	.5	1	.1		2	1	17	2	+		10		+		+	+	+	1	+
RUBU PAR	68.2	4.2	2 5	30			3		5	3	6	.1		+	+	3	10		+		+	+	25	
SPIR BET	68.2	4.0	12 6	2			2	20	10		5			+		20	+	+	+	+	+	+	10	
BETU PAP	59.1	2.6	.5 3				.1			30				+	+	1	+		5	+	+	+	15	+
PINU CON	59.1	2.2	.1 2	1				4			.5		2	+	+	5	+	+				+	30	+
LONI INV	54.5	2.0		2	.5			1					25	+		1	10	+		+	+		+	+
SALI X	54.5	1.1		1	.5		.5	1		2	.5	2	1			4			10		+			+
RUBU IDA	50.0	3.9	1 5	10	10	5	1		3	10	3	40			+		+							
ROSA ACI	50.0	1.3	8 4	3					1		10		2	+	+		+		+	+				+
VIBU EDU	50.0	0.7	.1 1	2					1	.5			2	+	+		+		5	+				+
VACC MEM	45.5	1.4						8	1			.1			+	2	+		+	+	+	15		
RIBE LAC	45.5	0.8		1	.1		1		.5	.5		10	1		+		+		+					
AMEL ALN	40.9	1.1					1			.5	3				+	4		5	5	5			+	
RIBE LAX	31.8	0.9			15	.5	.5		.5			2		+		.1								
VACC MYR	27.3	1.0	.5 5													8		+	+		+			10
SORB SCO	27.3	0.4						2	.5						+	4			+		+			
POPU BAL	22.7	0.1		1			.1	1				.1												+
SAMB RAC	18.2	0.5			1		.5			.5		8												
ABIE LAS	18.2	0.4						2		4		2				.1								
SORB SIT	13.6	0.2	.1 2								3		.5											
ACER GLA	13.6	0.1													+				+		+			
SHEP CAN	9.1	0.2									3													+
PSEU MEN	9.1	0.1							2												+			
ALNU VIR	9.1	0.1															+					+		
LEDU GRO	9.1	0.0	.1 1					1																
OPLO HOR	9.1	0.0					.5		.1															
C Layer																								
EPIL ANG	100.0	22.1	7 4	1	15	10	20	40	15	65	60	50	50	35	25	20	30	10	10	10	+	+	10	+
CORN CAN	95.5	4.4	6 6	7	5	1	.5	9	10	.5	20	8	3	+	+	5	+	+	1		+	+	15	+
TARA OFF	72.7	1.1	.1 2	1		.1			1	.5	.1	.1	1	10	+		+		5	+	+		+	+
LINN BOR	63.6	4.2						6		20	2		2	+	+	15	+	7	+	15	+	20		+
CLIN UNI	63.6	2.0					2	.1	1	.5	1			+	+	1	+	+	5		+	10	20	
STRE ROS	63.6	0.6	.1 2	.5	.1		.1	5				1		+		1	+				+	+	+	+
PETA PAL	50.0	1.2		4							2	1	.1	+		.1		15		+	+	+		+
ARAL NUD	45.5	0.8		10			1							+	+		+		+	+	+	+		+
CALA CAN	45.5	0.8	.1 3		2		.5				1	.1	10			1	+		+	+				
GYMN DRY	36.4	0.7		.5								5		+			5		+		+	+	2	
SMIL RAC	36.4	0.3		.5			.5		.5								+		+		+	+		+
RUBU PED	31.8	0.3				.5		.1		.5			2	+		2							+	
CARE X	27.3	2.8	35 6	15		10				.5		.1				.1								
MAIA CAN	27.3	1.3												10	10		+			5	+			+
HIER ALB	27.3	0.6					.5	.1			.5	2	1			10								
ANAP MAR	27.3	0.6						1			2	3	.5			2							5	
ASTE CIL	27.3	0.4	.1 3													.1		+	+	5				+
RUBU PUB	27.3	0.3								.5			2	+	+						+			+
EQUI SYL	27.3	0.1	.1 3		.5		.1							+		.1	+							
ORYZ ASP	22.7	0.9													+		+	+		8				10
DISP HOO	22.7	0.5					2		7						+		+				+			
TIAR TRI	18.2	0.5		5			.5					5	1											
CINN LAT	18.2	0.2									.5	3				.1							+	
GALI TRF	18.2	0.1		1			.5					1				.1								
ORTH SEC	18.2	0.1					.1			.5			.5									+		
STRE AMP	18.2	0.1					.5	.1			.5											+		
GALI BOR	13.6	0.4									3		5											+
TRIS CER	13.6	0.1						1			1		.5											
EQUI ARV	13.6	0.1		1				1								.1								
ARNI COR	13.6	0.1					.5			.5														+
TIAR UNI	13.6	0.1					.5			.5											+			
POAC EAE	9.1	0.8		2			15																	
PYRO ASA	9.1	0.4											3							5				
ASTE CON	9.1	0.2							3		1													
POA PAL	9.1	0.1									.5					2								
LYCO OBS	9.1	0.1																				+		+
ACTA RUB	9.1	0.1		1						.5														
THAL OCC	9.1	0.1					1						.5											
HIER AUR	9.1	0.0	.1 1							1														
SENE CIO	9.1	0.0								.5	.5													
LYCO COM	9.1	0.0														.1								+
VIOL A	9.1	0.0							.1														+	
VERA VIR	9.1	0.0									.1		.5											
ANTE NEG	9.1	0.0				.1			.1															
HIER ACI	9.1	0.0				.1	.1																	
D Layer																								
POLY JUN	40.9	15.9		30	5 5	5 6		40	15 6		65	60	60			60								
TORT ULA	13.6	1.8					5 6		5 6			30												
PLEU SCH	13.6	0.8						4		10		3												
BRYU M	9.1	2.0		10							35													
AULA PAL	9.1	0.9										.1	20											
BRAC HYL	9.1	0.2								2			2											
PELT APH	9.1	0.0											1			.1								

In reconnaissance plots a + indicates the species was present. Although the cover is not recorded it may be significant. Cover of dominant species is indicated.

TABLE 2. Vegetation composition of the seral (<17 years since burned) SBSj1/01 (Oak fern) ecosystem

Burned SBSj1/01 Oak fern Ecosystem - Includes Prince George Seral Data

Years Since Burned			1			3		4		9	12		13		14		15				
Plot Number	Average Value		822 9118	822 9138	822 9140	822 9144	822 9145	820 8873	822 9153	822 9131	H13 F 2A	H13 F 2	J1A 6	820 5871	G16 H38	H13 F10	G16 15A	G16 15D	G16 13B	H13 F12	G16 H11B
No. of Species Per Plot	26.2		23	30	30	29	29	41	33	28	19	18	12	36	36	28	20	17	21	22	25
Species Code	%P	MC	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C	%C
B1 Layer																					
PICE ENE	5.3	0.4												7							
B2 Layer																					
RUBU PAR	84.2	4.4	25	15	15	5	10	.5	5		+	+		1	+	+	+	+		+	+
LONI INV	78.9	4.3	.1		1	1	5		10	3	+	10	10		5	+	5		10		10
POPU TRE	68.4	5.4	3					1		1	10	10	+	5	+	+		30	20	10	10
RIBE LAC	68.4	0.6	.1	.5		2	.5	1	2	1				.5	+	+	+			+	
VIBU EDU	63.2	1.9	.5		.5				1		10	+			+	+	10	+	5	+	
PICE ENE	57.9	2.6		.5		1	.5	14		9	+				+	+		+	+	20	
RUBU IDA	47.4	4.1	.1	1	1	5	5	10	5	50				.5							
SPIR DOU	47.4	2.0						5		.1		+	+		10	10			5		+
ROSA ACI	47.4	0.7		.5	.5								7		+		+	+	+		+
AMEL ALN	47.4	0.5									+				3	+	+	+	+	+	+
RIBE LAX	42.1	1.9				20	10	1		1			+	.5		+					+
PINU CON	42.1	1.1			.1			12		5	+				+	+		+			+
SAMB RAC	42.1	1.0				10	4	.5	2	1				.5	+						+
SPIR BET	42.1	0.9	5	2	1	5								.5		+		+			+
VACC MEM	42.1	0.5		1	.5	1	1	.5	4	.1						+					
BETU PAP	36.8	2.1									7	+		20	+	+		+		10	
SALI X	36.8	1.9						8		10			+	10	5	+				+	
ABIE LAS	26.3	1.7				.1		25	5					.5	+						
SORB SCO	26.3	0.3		.5	.5	2			1								+				
ALNU VIR 2	15.8	0.3				.5		5	1												
ALNU VIR	15.8	0.1									+	+				+					
VACC OVA	15.8	0.1					.1			.1										+	
PSEU MEN	10.5	0.1									+					+					
CORN SER	10.5	0.1		1	.5																
ACER GLA	10.5	0.1	.5														+				
TSUG HET	10.5	0.1												.5	+						
C Layer																					
EPIL ANG	100.0	25.5	20	.5	5	20	40	75	65	65	20	20	+	40	10	+	+	+	+	50	50
CORN CAN	89.5	2.3	1	1	1	3	5	8	5	2	+	+		2	10	+	+	+	+		+
TARA OFF	68.4	3.5				.5		.5		.1		10	+	5	+	5	+	+	+	40	+
GYMN DRY	68.4	2.0	.5		.1	1	1	3	12					2	5	+	10	+		+	+
CLIN UNI	63.2	1.6	.1	1	.5	.5	.5		.1		10	+				10	+			5	+
CALA CAN	52.6	2.6			3			2	1	1	10	10	+		+	20	+				
PETA PAL	52.6	1.1	1		.5			.5				+	+	3	5	+			7		+
ARAL NUD	52.6	0.8	5	1	2						+				+	+	+	+			+
STRE ROS	52.6	0.5		.5	.5			.5	2	1	+	+				+		+		+	
EQUI SYL	47.4	1.4					15	5			+	+	+		+	+			+		+
TIAR TRI	42.1	1.3	.5	.5	.5	5	3	5	10						+						
LINN BOR	42.1	0.4		.1		.5		4	.1	1				.5	+						+
VERA VIR	36.8	0.3		1	1	1	.5	1				+								+	
SMIL RAC	36.8	0.2		.5	.5				.1					.5	+		+			+	
RUBU PED	31.6	1.1				.5	.5	15	3	1				.5							
RUBU PUB	31.6	0.7			1										5	+		+	5		+
CARE X	31.6	0.4		2	3	2	.5	.5						.5							
VIOL A	31.6	0.1	.1	.5	.1	.5	.5	.5	.1											1	
ATHY FIL	26.3	0.7					.5				+	+		.5						10	
ASTE CIL	26.3	0.2						.5							+		+		+		+
VALE SIT	26.3	0.2		.5	.5	1	1		.1												
GALI TRF	26.3	0.1		.1		.5	1		.1					.5							
PYRO ASA	21.1	0.2									+			.5				+	+		
DISP HOO	21.1	0.2	.5	1	.5															+	
POAC EAE	21.1	0.1	.5	.1			1	1													
AGOS ERI	15.8	4.3											80		+						+
GERA BIC	15.8	1.4	3	9	15																
CORY SEM	15.8	0.4	5	3	.1																
HIER ALB	15.8	0.2						.5		2					+						
MAIA CAN	15.8	0.1													+		+		+		
STRE AMP	15.8	0.1				.1			1					.5							
LYCO ANN	15.8	0.1						.5	.1					.5							
AGRO STI	10.5	0.9						8		9											
ANTE MIC	10.5	0.9										10				7					
HIER PIL	10.5	0.6						.5						10							
ANAP MAR	10.5	0.2						3		1											
ASTE CON	10.5	0.1		1	.5																
EPIL WAT	10.5	0.1				1	.5														
EQUI ARV	10.5	0.1		1										.5							
SMIL STE	10.5	0.1				1	.5														
ARNI COR	10.5	0.1	.5														+				
ACTA RUB	10.5	0.1					1		.1												
OSMO CHI	10.5	0.1		1					.1												
TIAR UNI	10.5	0.1	.5											.5							
D Layer																					
POLY JUN	15.8	1.6							10	10				10							
PLEU SCH	10.5	0.7						4 5	10												
TORT ULA	5.3	3.9								75											
DICR ANU	5.3	2.1						40 7													
PTIL CRI	5.3	0.4						8													
SPHA GNU	5.3	0.3						5 5													

In reconnaissance plots a + indicates the species was present. Although the cover is not recorded it may be significant. Cover of dominant species is indicated.

TABLE 3. Vegetation composition of the seral (<7 years since burned) SBSj1/07 (Devil's club) ecosystem

Burned SBSJ1/07 Devil's Club Ecosystem										
Years Since Burned			1		2	3	4		6	
Plot Number	Average Value		822 9119	822 9137	820 5892	822 9194	822 9116	822 9191	822 9115	822 9121
No. of Species Per Plot	0.0		28	36	21	35	36	28	31	25
Species Code	%P	MC	%C	%C	%C	%C	%C	%C	%C	%C
B1 Layer										
ALNU INC 2	25.0	3.4							25	2
SALI X	25.0	0.9				1			6	
POPU TRE	12.5	0.6					5			
POPU BAL	12.5	0.3							2	
ABIE LAS	12.5	0.1				1				
B2 Layer										
RIBE LAC	100.0	3.5	.5	.5	.5	5	10	10	.5	1
RUBU PAR	87.5	19.4	40	10		25	30	10	10	30
RUBU IDA	87.5	5.7		.5	3	10	1	10	1	20
LONI INV	75.0	4.4	1	1	1	10	4	18		
OPLO HOR	75.0	1.5	3	.5		.5	5		2	1
VIBU EDU	75.0	1.3	.5	.5		2	1	4		2
PICE ENE	75.0	0.6		.5		1	1	.5	1	.5
CORN SER	62.5	3.4	.5	1		5	15			6
RIBE LAX	62.5	2.8			1	3		3	5	10
VACC MEM	50.0	1.3		.5	5	2		3		
SAMB RAC	50.0	1.0			.5			.5	5	2
SPIR BET	37.5	1.1	5	3		1				
ROSA ACI	37.5	0.9	1	1						5
ALNU INC 2	25.0	1.3	.5						10	
VACC OVA	25.0	1.3				8		2		
POPU TRE	25.0	1.0		5			3			
SALI X	25.0	0.8							6	.5
AMEL ALN	25.0	0.5				3		1		
SORB SIT	25.0	0.5				3		1		
ABIE LAS	25.0	0.1				.5	.5			
SORB SCO	25.0	0.1	.5	.5						
SPIR DOU	12.5	1.9			15					
C Layer										
EPIL ANG	100.0	18.4	2	.5	15	15	20	15	15	65
GYMN DRY	100.0	4.1	.1	.5	1	15	5	8	3	.5
TIAR TRI	100.0	3.6	.1	1	.5	10	2	15	.5	.1
CORN CAN	75.0	3.9	2	1	3	10		15	.5	
GALI TRF	75.0	1.0	.5			3	3	1	.5	.1
VERA VIR	75.0	0.6	.5	.5	.1	1	.5	2		
EQUI ARV	62.5	3.6	2	.1			1		25	1
EQUI SYL	62.5	2.4	3		5			1	5	5
ACTA RUB	62.5	1.0	5	.5		1	1	.5		
CALA CAN	50.0	3.6			25	.5		3	.5	
DISP HOO	50.0	0.4	.5	.5			2			.1
ARAL NUD	50.0	0.2		.5		.5	.5			.1
CLIN UNI	37.5	0.6		.5		3	1			
POAC EAE	37.5	0.4					2		.5	1
ATHY FIL	37.5	0.2			.5			.5	.5	
VIOL A	37.5	0.1	.1	.1			1			
TIAR UNI	37.5	0.1	.1				1			.1
CORY SEM	37.5	0.1	.1	.5	.5					
ARUN DIO	25.0	3.0					4		20	
GERA BIC	25.0	0.7	5	.5						
RUBU PED	25.0	0.6		.1				5		
RUBU PUB	25.0	0.2	1	.5						
OSMO CHI	25.0	0.1	.5	.5						
LYCO ANN	25.0	0.1		.5		.3				
ANTE NEG	25.0	0.1			.1				.5	
DRYO ASS	25.0	0.1						.5		.1
MITE NUD	25.0	0.1		.1			.5			
SMIL RAC	25.0	0.1		.1			.5			
STRE AMP	25.0	0.1					.1		.5	
LINN BOR	12.5	0.6						5		
ARNI COR	12.5	0.5	4							
ASTE CON	12.5	0.5	4							
TARA OFF	12.5	0.3								2
AGRO STI	12.5	0.1				1				
AQUI FOR	12.5	0.1					1			
EQUI PRA	12.5	0.1								1
PETA PAL	12.5	0.1		1						
VALE SIT	12.5	0.1				1				
D Layer										
MNIU M	50.0	1.3			.5	5	.1		5	
PLEU SCH	37.5	3.2				10	.5	15		
PTIL CRI	37.5	1.9				5	.5	10		
POLY JUN	37.5	1.3			1	8			1	
MARC POL	37.5	0.3			.5		.5		1	
TORT ULA	12.5	1.9					15			
BRYU M	12.5	1.3						10		
BRAC HYL	12.5	0.6				5				
BRAC HYT	12.5	0.1					1			

TABLE 4. Vegetation composition of the seral (<5 years since burned) SBSj1/08 (Horsetail) ecosystem

Years Since Burned	Burned SBSJ1/08 Horsetail Ecosystem		1		3		4	
Plot Number	Average Value		822 9122	822 9139	820 5894	820 5893	822 9123	822 9136
No. of Species Per Plot	0.0		22	31	19	20	28	42
Species Code	%P	MC	%C	%C	%C	%C	%C	%C
B1 Layer								
ALNU INC 2	16.7	0.2						1
B2 Layer								
LONI INV	100.0	3.7	1	5	7	5	2	2
RUBU IDA	100.0	3.3	2	1	.5	15	.5	.5
ROSA ACI	100.0	1.4	.5	2	4	.5	.5	1
PICE ENE	100.0	0.4	.5	.5	.5	.5	.5	.1
RIBE LAC	66.7	0.5		.5		1	1	.5
ALNU INC 2	50.0	1.9		.5		1		10
RUBU PAR	50.0	0.7			.5	3		.5
SALI X	50.0	0.7		1			2	1
CORN SER	33.3	0.6	.5					3
RIBE TRI	33.3	0.5					1	2
RIBE LAX	33.3	0.4			.5	2		
VACC MEM	33.3	0.2		.5	.5			
VIBU EDU	33.3	0.2			.5	.5		
SAMB RAC	16.7	0.8				5		
POPU TRE	16.7	0.2	1					
SPIR BET	16.7	0.2		1				
C Layer								
EPIL ANG	100.0	24.6	50	.5	50	2	30	15
CALA CAN	100.0	3.6	.5	10	5	.1	3	3
CORN CAN	83.3	0.6		.5	1	1	.5	.5
GALI TRF	83.3	0.4		.5	.1	1	.5	.5
PETA PAL	66.7	3.3	1	15			2	2
RUBU PUB	66.7	1.1	.5	5		.1		1
POAC EAE	66.7	0.3	.5	.1		.1		1
VIOL A	66.7	0.1		.5	.1		.1	.1
EQUI SYL	50.0	5.8				5	.1	30
EQUI PRA	50.0	5.7	30	2			2	
ASTE MOD	50.0	2.6	.5				10	5
GALI BOR	50.0	0.9	.1	.5			5	
HERA SPH	50.0	0.9	.5	3			2	
GYMN DRY	50.0	0.4		.5	1			1
DELP GLA	50.0	0.2	.1				1	.1
TARA OFF	50.0	0.1	.1		.1	.5		
EQUI ARV	33.3	6.3		8				30
EPIL WAT	33.3	1.7				10		.1
ELYM US	33.3	0.7	2				2	
ATHY FIL	33.3	0.4		.5				2
TIAR TRI	33.3	0.2		.5				.5
MITE NUD	33.3	0.1		.1				.5
DISP HOO	33.3	0.0	.1	.1				
DRYO ASS	33.3	0.0		.1				.1
ASTE RAC	16.7	0.8					5	
ANGE GEN	16.7	0.5						3
CIRC ALP	16.7	0.5						3
URTI DIO	16.7	0.5	3					
CARE X	16.7	0.3					2	
VERA VIR	16.7	0.3		2				
ACTA RUB	16.7	0.2						1
THAL OCC	16.7	0.2					1	
D Layer								
MARC POL	50.0	2.8		1 3			.5	15
POLY JUN	50.0	1.8			.5		5	5
TORT ULA	33.3	7.5					30	15
MNIU M	33.3	0.2		.1 3				1
BRAC HYT	33.3	0.1			.1			.5

APPENDIX 6. Environmental attributes of burned seral SBSj1 ecosystems

TABLES

TABLE 1. Environmental attributes of the seral (<25 years since burned) SBSj1/06 (Queen's cup) ecosystem

	Burned SBSJ1/06 Queen's cup Ecosystem - Includes Prince George Seral Data																						
Years Since Burned		2		3		4		6	7	8	9		11	13	14	15		16				19	24
Plot Number	Mean	820 5885	820 5889	820 8881	820 8882	822 9117	822 9166	822 9120	820 5872	822 9198	822 9127	822 9196	G16 G12	G16 H34	822 9173	G16 H44	G16 19D	G16 15B	G16 17	G16 20SW	G16 14	H13 F14	G16 2SW
*** LOCATION ***																							
GEOGRAPHIC		EWIL	BOWR	WILG	WILG	TSAC	GRIZ	HART	BEAV	CHUC	WILL	HODD			ISPA								
LOCATION CODE		LOBR	FSRD	EORD	EORD	HFRD	LKRD	HWAY	FSRD	HFRD	OFRD	AFRD			LKRD								
NTS MAP SHEET		93G 16 G	93H 13 C	93G 9 G	93G 9 G	93J 15 E	93G 9 G	93J 15 E	93G 16 H	93J 9 D	93G 9 G	93J 11 G			93G 9 G								
LONGITUDE (DEGREES)		122	121	122	122	122	122	122	122	122	122	122			122								
(MINUTES)		1007	4646	1313	1322	5528	0918	5558	0020	2730	1215	4858			0924								
LATITUDE (DEGREES)		53	53	53	53	54	53	54	53	54	53	54			53								
(MINUTES)		5247	4934	3828	3833	5640	4254	5511	5620	3044	3859	5250			4107								
*** ENVIRONMENT ***																							
ELEVATION (M)	882.9	740	860	990	1000	870	990	760	670	890	1015	900			910								
SLOPE GRADIENT (%)	10.9	06	2	23	0	25	5	17	10	30	5	8	0	12	4	20	3	20	3	3	20	20	3
ASPECT (DEGREES)		300	350	70	999	225	230	275	330	145	140	280	999	206	220	190	176	325	202	70	273	136	140
MESO SLOPE POSITION		MD		MD	LV	LW	MD	UP	UP	LW	MD	MD	LV	MD	MD	M-U	UP	U-M	UP	LV	U-M	M-U	LV
EXPOSURE		FR		WI	WI	FR	WI	IN			WI				WI								
SURFACE SHAPE		CC	CC	ST	ST	ST	ST	ST			ST	ST			ST								
MOISTURE REGIME		SM	SM	SM	SM	SM	M	SM	SM	SM	SM	SM	MS	SM	SM	M	SM	M	SM	MSM	SMM	SMM	SMM
NUTRIENT REGIME		M	M	SM	SM	PM	SM	SM	M	M	M	SM	M	SM	M	M	SM	M	SM	M	SM	M	M
TERRAIN		M B	FGB	FGT	FGT	M B	FGB	M B	M B	M B		M B			FG								L
COARSE FRAG. (%)	36.6	30	0	40	65	15	22	20	26	57	24	63	40	50	18	10	30	60	50	25	80	80	0
SOIL		BR	O	O	O	BR	O	O	BR	E	O	E			O								
SUBGROUP (CSSC 1978)		.GL	.HFP	.DYB	.DYB	.GL	.HFP	.GL	.GL	.DB	.HFP	.DB			.DYB								
FAMILY PARTICLE SIZE		LS	S	CL	SS	FL	LS	CL	LS	LS	CL	SS	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
ROOTING DEPTH (CM)	23.3	20	15	30	15	20	12	15	20	49	15	38			30								
SOIL DRAINAGE		W	W	W	W	MW	MW	MW	MW	W	R	W			W								
HUMUS FORM (MOF 81)		O.RD	O.TD	O.HR	O.RD	O.RD	O.RD	O.RD	O.TD	O.RD	O.RD	O.RD	O.R	O.R	O.RD	O.RD	O.R	O.R	O.R	O.R	O.R	O.R	O.R
HUMUS THICKNESS (CM)		3	2	4	5	6	11	5	7	4	4	4	3-5	3	5	5-8	3-5	5-7	2-5	3	0-3	4	3-5
*** SURFACE SUBSTRATE **																							
GROUND COVER (%) DECAYING WOOD	13.3	15		5	5	3	30	5	30	5	30	3			15								
BEDROCK	0.0	0		0	0	0	0	0	0	0	0	0			0								
COB. & STONES	0.1	0		0	0	0	0	0	0	1	0	0			0								
MINERAL SOIL	2.5	20		0	0	0	5	0	0	2	0	0			0								
ORG. MAT.	78.3	65		65	95	97	65	95	70	92	60	97			85								
*** SITE HISTORY ***																							
YEAR LOGGED (19__)		81	81	82	82	80	78	79	76	76	75	72			59					70			
YEAR BURNED (19__)		82	82	82	82	81	80	79	77	76	75	75	75	73	70	71	71	70	70	70	70	67	62
YEAR PLANTED (19__)		83	83	84	84	83		82	78	83	77	78	76	73	71				70				64
YEAR BRUSHED OR NSR (Z)							82						85						83				

TABLE 2. Environmental attributes of the seral (<17 years since burned) SBSj1/01 (Oak fern) ecosystem

Years Since Burned	Burned SBSJ1/01 Oak fern Ecosystem - Includes Prince George Seral Data	1			3		4		9	12		13		14		16				
Plot Number	Mean	822 9118	822 9138	822 9140	822 9144	822 9145	820 8873	822 9153	822 9131	H13 F 2A	H13 F 2	J1A 6	820 5871	G16 H38	H13 F10	G16 15A	G16 15D	G16 13B	H13 F12	G16 H11B
*** LOCATION ***																				
GEOGRAPHIC		AGNS	CHUC	CHUC	HOLA	HOLA	ISPA	KETC	NARR				BEAV							
LOCATION CODE		PTRD	HFRD	HFRD	NACK	NACK	LKRD	HFRD	LKRD				FSRD							
NTS MAP SHEET		93J	93J	93J	93G	93G	93G	93H	93H				93H							
		15 E	9 D	9 D	9 B	9 B	9 G	5 C	12 D				13 E							
LONGITUDE (DEGREES)		122	122	122	122	122	122	121	121				121							
(MINUTES)		5307	2546	2515	1126	1128	0733	5218	5810				5939							
LATITUDE (DEGREES)		54	54	54	53	53	53	53	53				53							
(MINUTES)		5307	3103	3101	3442	3446	3919	1926	3402				5542							
*** ENVIRONMENT ***																				
ELEVATION (M)	944.7	840	900	820	1070	1080	900	1155	975				762							
SLOPE GRADIENT (%)	9.5	0	22	43	9	10	5	25	2	20	7	0	5	0	0	10	7	0	12	3
ASPECT (DEGREES)		999	200	110	190	230	330	285	180	226	280	999	282	999	999	3	360	999	76	50
MESO SLOPE POSITION		LV	MD	UP	MD	UP	UP	MD	LV	M-LW	MD	LV	MD	LV	LV	LW	MD	LV	M-LW	LV
EXPOSURE		WI	FR	FR	FR	FR		WI	WI											
SURFACE SHAPE		ST	CC	ST	ST	ST	ST	ST	ST											
MOISTURE REGIME		SM	M	SM	M	M	M	M	SM		M		M	M-SH	M	M	M-SM	M	M	M
NUTRIENT REGIME		M	M	M	M	M		M	M	M	SM		M	M		SM	M	M-PM	M-PM	
TERRAIN		M B	M B	M B	M B	M B	M B	M B	M B		L	L	M B	L	L			L		L
COARSE FRAG. (%)	15.4	25	10	5	18	10	30	60	15	10	0	0	19	0	0	0	50	0	40	0
SOIL		O	E	O	E	O	O	O	O				O							
SUBGROUP (CSSC 1978)		.DYB	.DYB	.DYB	.DYB	.DYB	.GL	.HFP	.HFP				.GL							
FAMILY PARTICLE SIZE		CL	FL	FL	FL	FL	LS	LS	LS	SL	FSI	FL	LS	FL	FL	S	FL	FL	CL	FL
ROOTING DEPTH (CM)	24.3	15	30	35	20	30	15	30	24				20							
SOIL DRAINAGE		MW	MW	MW	W	W	W	W	W				W							
HUMUS FORM (MOF 81)		O.RD	O.HR	O.HR	O.RD	O.RD	O.RD	O.RD	O.RD	O.R	O.R	O.R	O.TD	O.R	O.R	O.R	O.R	O.R	O.RD	
HUMUS THICKNESS (CM)		2	5	6	3	4	4	14	10	1-5	2-8	1-3	7	3-5	3-5	3-7		17	5-10	
*** SURFACE SUBSTRATE **																				
DECAYING WOOD	11.1	3	0	7	5	5	15	20	30				15							
GROUND BEDROCK	0.9	0	8	0	0	0	0	0	0				0							
COVER COB. & STONES	0.0	0	0	0	0	0	0	0	0				0							
(%) MINERAL SOIL	13.2	7	0	0	0	0	0	25	5				82							
ORG. MAT.	62.8	90	92	93	35	85	85	55	65				0							
*** SITE HISTORY ***																				
YEAR LOGGED (19__)		82	84	84	82	82	78	78	73				70							
YEAR BURNED (19__)		84	84	84	82	82	80	80	75	74	74	73H	71	72	72	70	70	70	70	70
YEAR PLANTED (19__)			85	85	84	84				75	75		72		73					
YEAR BRUSHED OR NSR (Z)							Z84		Z79											

TABLE 3. Environmental attributes of the seral (<7 years since burned) SBSj1/07 (Devil's club) ecosystem

	Burned SBSJ1/07 Devil's club Ecosystem								
Years Since Burned		1		2		4		6	
Plot Number	Mean	822 9119	822 9137	820 5892	822 9194	822 9116	822 9191	822 9115	822 9121
*** LOCATION ***									
GEOGRAPHIC		AGNS	CHUC	AHBA	HODD	TSAC	LODI	HODD	HART
LOCATION CODE		PTRD	HFRD	UCRK	AFRD	HFRD	LAKE	AFRD	HWAY
NTS MAP SHEET		93J	93J	93G	93J	93J	93G	93J	93J
		15 E	9 D	8 A	15 D	15 E	8 H	15 G	15 E
LONGITUDE (DEGREES)		122	122	122	122	122	122	122	122
(MINUTES)		5302	2556	0418	4700	5534	0408	4248	5609
LATITUDE (DEGREES)		54	54	53	54	54	53	54	54
(MINUTES)		5303	3100	2000	5819	5635	2314	5613	5510
*** ENVIRONMENT ***									
ELEVATION (M)	875.0	820	870	1050	840	880	1030	790	720
SLOPE GRADIENT (%)	14.1	20	15	7	12	5	22	25	7
ASPECT (DEGREES)		310	55	300	250	22	310	70	35
MESO SLOPE POSITION		LW	UP	MD	UP	MD	MD	MD	MD
EXPOSURE		WI	WI	WI		WI		WI	WI
SURFACE SHAPE		CV	CC	ST	ST	ST	ST	CC	CC
MOISTURE REGIME		M	M	SHG	M	M	M	SHG	SHG
NUTRIENT REGIME		M	M	M	M	PM	M	PM	PM
TERRAIN		M B	M B	M B	M B	M B	C V	L B	L B
COARSE FRAG. (%)	10.3	15	7	10	11	20	19	0	0
SOIL		O	BR	O	BR	O	BR	O	O
SUBGROUP (CSSC 1978)		.DYB	.GL	.HG	.GL	.GL	.GL	.GL	.GL
FAMILY PARTICLE SIZE		FL	FL	CL	FL	FL	LS	FSI	FC
ROOTING DEPTH (CM)	19.9	15	15	10	32	20	32	5	30
SOIL DRAINAGE		MW	MW	I	MW	I	MW	P	I
HUMUS FORM (MOF 81)		O.HR	O.HR	O.LD	O.RD	A.RD	O.RD		O.RD
HUMUS THICKNESS (CM)	5.9	4	4	4	4	12	4	0	15
*** SURFACE SUBSTRATE **									
DECAYING WOOD	4.4	8	10	3	2	2	3	5	2
GROUND BEDROCK	0.0	0	0	0	0	0	0	0	0
COVER COB. & STONES	0.0	0	0	0	0	0	0	0	0
(%) MINERAL SOIL	0.3	2	0	0	0	0	0	0	0
ORG. MAT.	85.8	90	90	20	98	98	97	95	98
*** SITE HISTORY ***									
YEAR LOGGED		82	84	82	81	80	80	78	79
YEAR TREATED		84	84	83	81	81	80	79	79
YEAR PLANTED			85	84	81	83			82
YEAR BRUSHED OR NSR (Z)							Z83		

TABLE 4. Environmental attributes of the seral (<5 years since burned) SBSj1/08 (Horsetail) ecosystem

Years Since Burned	Burned SBSJ1/08 Horsetail Ecosystem	1		3		4	
Plot Number	Mean	822 9122	822 9139	820 5894	820 5893	822 9123	822 9136
*** LOCATION ***							
GEOGRAPHIC LOCATION CODE		WHIS PTRD	CHUC HFRD	LODI LAKE	LODI LAKE	WHIS PTRD	WHIS PTRD
NTS MAP SHEET		93J 15 F	93J 9 D	93G 8 H	93G 8 H	93J 15 F	93J 15 F
LONGITUDE (DEGREES)		122	122	122	122	122	122
(MINUTES)		5220	2513	0311	0316	5141	5154
LATITUDE (DEGREES)		54	54	53	53	54	54
(MINUTES)		5300	3110	2405	2405	5420	5340
*** ENVIRONMENT ***							
ELEVATION (M)	880.0	780	850	1020	990	830	810
SLOPE GRADIENT (%)	7.0	0	10	6	6	18	2
ASPECT (DEGREES)		999	75	245	255	38	130
MESO SLOPE POSITION		LV	TO	MD	MD	LW	TO
EXPOSURE		SA	WI		WI	WI	WI
SURFACE SHAPE		ST	CC	ST	ST	CC	CC
MOISTURE REGIME		SHG	HG	M	M	SHG	SHG
NUTRIENT REGIME		E	PM	SM	SM	PM	M
TERRAIN		L B	O V	M B	M B	M B	M B
COARSE FRAG. (%)	10.8	0	0	10	40	0	15
SOIL SUBGROUP (CSSC 1978)		O .HG	R .HG	BR .GL	O .HG	O .G	O .HG
FAMILY PARTICLE SIZE		FSI	CL	FL	CL	FC	CL
ROOTING DEPTH (CM)	21.7	35	15	20	40	10	10
SOIL DRAINAGE		I	VP	MW	W	I	I
HUMUS FORM (MOF 81)			P.SL	O.RD	O.LD	P.SL	P.SL
HUMUS THICKNESS (CM)	10.8	0	8	5	5	30	17
*** SURFACE SUBSTRATE **							
DECAYING WOOD	6.0	5	10	5	5	3	8
GROUND BEDROCK	0.0	0	0	0	0	0	0
COVER COB. & STONES	0.0	0	0	0	0	0	0
(%) MINERAL SOIL	0.0	0	0	0	0	0	0
ORG. MAT.	74.8	95	90	25	50	97	92
*** SITE HISTORY ***							
YEAR LOGGED (19__)		82	84	82	82	81	79
YEAR TREATED (19__)		84	84	82	82	81	81
YEAR PLANTED (19__)			85	83	83	83	83
YEAR BRUSHED OR NSR (Z)							

APPENDIX 7. Vegetation composition of mechanically site prepared ecosystems

TABLES

TABLE 1. Vegetation composition of the seral (<8 years since mechanically site prepared) SBSj1/06 (Queen's cup) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSj1/06 Queen's cup Ecosystem		4		7
Plot Number	Average Value		820 5898	822 9113	822 9168
No. of Species Per Plot	32.3		31	28	38
Species Code	%P	MC	%C	%C	%C
B1 Layer					
POPU TRE	33.3	20.0		60	
ABIE LAS	33.3	1.7			5
B2 Layer					
SPIR BET	100.0	8.5	.5	20	5
RUBU IDA	100.0	5.0	5	.1	10
VACC MEM	100.0	2.7	2	5	1
ABIE LAS	100.0	2.2	.5	1	5
RUBU PAR	100.0	1.8	.5	1	4
POPU TRE	66.7	8.4	.1	25	
AMEL ALN	66.7	3.5		.5	10
LONI INV	66.7	2.2	.5		6
PICE ENE	66.7	1.7	3		2
PINU CON	66.7	1.7	1		4
CORN SER	66.7	1.0		2	1
RIBE LAC	66.7	0.7		1	1
SORB SCO	66.7	0.7		1	1
SAMB RAC	66.7	0.4	1		.1
ROSA ACI	33.3	4.0			12
POPU BAL	33.3	1.0			3
SALI X	33.3	0.7	2		
ALNU VIR 2	33.3	0.3			1
C Layer					
EPIL ANG	100.0	28.5	40 63	.5	45
GYMN DRY	100.0	0.4	.1 32	1	.1
CORN CAN	66.7	6.8	20 63	.5	
RUBU PED	66.7	5.3	15 63		1
ARAL NUD	66.7	3.7		10	1
CLIN UNI	66.7	3.3	5 63	5	
LINN BOR	66.7	2.7	3 63		5
CINN LAT	66.7	1.0	1 53		2
HIER ALB	66.7	0.7	1 43		1
CALA CAN	66.7	0.5	.5 33		1
ANAP MAR	66.7	0.1	.1 53		.1
GALI TRF	66.7	0.1		.1	.1
TARA OFF	66.7	0.1	.1 12		.1
CARE MAL	33.3	0.7			2
ORTH SEC	33.3	0.7		2	
TIAR TRI	33.3	0.7			2
DISP HOO	33.3	0.3		.1	
LYCO COM	33.3	0.3		1	
ORYZ ASP	33.3	0.3			1
POAC EAE	33.3	0.3		1	
D Layer					
PLEU SCH	100.0	8.4	5	.1	20
PTIL CRI	100.0	0.4	1	.1	.1
POLY JUN	66.7	12.3	7		30
MOSS	33.3	6.7			20
DICR ANU	33.3	0.7			2

TABLE 2. Vegetation composition of the seral (<9 years since mechanically site prepared) SBSj1/01 (Oak fern) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSJ1/01 Oak fern Ecosystem		3	4			5		6		8
Plot Number	Average Value		822 9114	820 5875	822 9146	822 9165	822 9187	822 9802	822 9135	822 9189	822 9129
No. of Species Per Plot	31.8		26	38	25	39	34	35	25	39	25
Species Code	%P	MC	%C	%C	%C	%C	%C	%C	%C	%C	%C
B1 Layer											
POPU TRE	11.1	1.7								15	
POPU BAL	11.1	0.2								2	
SALI X	11.1	0.1					1				
ABIE LAS	11.1	0.1								.5	
B2 Layer											
RUBU IDA	100.0	11.2	5	3	15	10	1	.5	35	1	30
LONI INV	100.0	6.8	1	.5	5	10	1	.5	8	10	25
RUBU PAR	88.9	2.8	1		3	5	.5	.5	.1	5	10
PICE ENE	88.9	2.1	.5	.5	1		.5	.5	5	1	10
VACC MEM	88.9	1.6	.5	.5	.5	1	.5	.5	10	1	
RIBE LAC	66.7	2.4	5		5	8	1			1	2
SAMB RAC	66.7	1.1	.5	.1	2	1			2		4
ABIE LAS	66.7	0.5	.1	1	.1	1		.5	2		
RIBE LAX	66.7	0.5	1	.5	.5			1	.1		1
SALI X	55.6	1.9		.5		1		.5	5		10
PINU CON	44.4	0.6		.1		1		4		.5	
SPIR DOU	33.3	1.1		.1		.1	10				
VIBU EDU	33.3	0.6	1			3				1	
POPU TRE	33.3	0.4					.5	.1			3
SPIR BET	33.3	0.4				.1		.5		3	
SORB SCO	33.3	0.3	2	.1					1		
VACC OVA	22.2	0.3	3		.1						
ROSA ACI	22.2	0.2					1			1	
ALNU VIR 2	11.1	0.1	1								
C Layer											
EPIL ANG	100.0	43.3	60	30	65	40	20	15	45	35	80
GYMN DRY	100.0	3.6	1	1	1	10	.5	.5	8	2	8
TIAR TRI	100.0	2.0	.5	.5	1	2	1	.5	.1	2	10
CORN CAN	88.9	5.4	.5	1		.1	15	2	10	5	15
RUBU PED	88.9	2.5	.5	3	.5	2		.5	4	2	10
CALA CAN	77.8	2.0		2		2	.5	.5	5	3	5
STRE ROS	77.8	1.3		.5	.5	2	.5		4	1	3
LINN BOR	66.7	1.2		2		.1	3	1	2	3	
ANAP MAR	55.6	1.0				.1	1		2	3	3
HIER ALB	55.6	0.8			.1		.5	.5	2		4
EQUI ARV	44.4	3.0				18	8			.5	.1
CINN LAT	44.4	2.6		.5		15			8		.1
TARA OFF	44.4	0.2				.1	.5	.5		1	
GALI TRF	44.4	0.1			.5		.1			.5	.1
POAC EAE	33.3	1.3	10		2			.1			
LYCO ANN	33.3	0.5				.1			1	3	
HIER ACI	33.3	0.4		.1				.5		3	
DRYO ASS	33.3	0.3		.1	.5				2		
VERA VIR	33.3	0.2		.1				1		1	
CARE X	33.3	0.2	1	.5				.5			
RUBU PUB	33.3	0.1				.1		.5		.5	
CARE MAL	22.2	0.6					3				2
ATHY FIL	22.2	0.2			1	1					
CLIN UNI	22.2	0.2	.5		1						
SMIL STE	22.2	0.2			.5						1
VALE SIT	22.2	0.2	1	.5							
ACHI MIL	22.2	0.1		.1						1	
ARAL NUD	22.2	0.1	.5				.5				
PYRO ASA	22.2	0.1					.5			.5	
STRE AMP	22.2	0.1	.5	.1 2							
PETA PAL	11.1	1.7				15					
AGRO SCA	11.1	0.2					2				
THAL OCC	11.1	0.2								2	
VAHL ATR	11.1	0.2		2							
HIER PIL	11.1	0.1				1					
D Layer											
POLY JUN	77.8	28.2		10	.5	8	60		80	25	70
PLEU SCH	77.8	4.5		2	.5	3		5	5	20	5
PTIL CRI	33.3	3.3				20		5		5	
RHYT TRI	11.1	1.3				12					
BRYU M	11.1	1.1					10				
MOSS	11.1	1.1				10					
MARC POL	11.1	0.2				2					
DICR ANU	11.1	0.1				1					

TABLE 3. Vegetation composition of the seral (<8 years since mechanically site prepared) SBSj1/07 (Devil's club) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSJ1/07 Devil's club Ecosystem		1		4	7
Plot Number	Average Value		822 9103	822 9197	820 8842	822 9125
No. of Species Per Plot	35.5		26	50	29	37
Species Code	%P	MC	%C	%C	%C	%C
B2 Layer						
RUBU IDA	100.0	14.0	20	10	6	20
RUBU PAR	100.0	11.0	15	18	10	1
LONI INV	100.0	6.5	5	6	5	10
RIBE LAC	100.0	5.3	5	9	1	6
PICE ENE	100.0	3.0	.5	1	.5	10
OPLO HOR	75.0	2.0	2	1	5	
SALI X	75.0	1.4		.5	.1	5
RIBE LAX	75.0	0.5		.5	.5	1
CORN SER	50.0	6.5	25	1		
ABIE LAS	50.0	1.0		1		3
SAMB RAC	50.0	0.4	.5		1	
SORB SCO	50.0	0.4			.5	1
VIBU EDU	50.0	0.3		1		.1
ROSA ACI	25.0	2.5				10
AMEL ALN	25.0	0.8				3
POPU TRE	25.0	0.5				2
SPIR BET	25.0	0.5				2
VACC MEM	25.0	0.5				2
ALNU INC 2	25.0	0.3		1		
POPU BAL	25.0	0.3		1		
SORB SIT	25.0	0.3		1		
C Layer						
EPIL ANG	100.0	47.5	5	35	65	85
GYMN DRY	100.0	18.0	2	15	40	15
TIAR TRI	100.0	4.8	1	3	5	10
GALI TRF	100.0	2.3	.1	3	1	5
CORN CAN	75.0	4.0		10	1	5
ANAP MAR	75.0	3.1		2	.5	10
ACTA RUB	75.0	0.5	.5	.5	1	
RUBU PED	50.0	3.3		3		10
EQUI ARV	50.0	2.0		8		.1
LINN BOR	50.0	1.5			1	5
AGRO SCA	50.0	1.0		2		2
ATHY FIL	50.0	1.0		2	2	
STRE ROS	50.0	0.9		.5	3	
CINN LAT	50.0	0.8		2		1
PETA PAL	50.0	0.5		1		1 5
MITE NUD	50.0	0.4	.5	1		
SMIL RAC	50.0	0.4	1		.5	
STRE AMP	50.0	0.4	.5	1		
TARA OFF	50.0	0.1	.1	.5		
EQUI PRA	25.0	3.8	15			
THAL OCC	25.0	2.5	10			
SMIL STE	25.0	1.3				5
DRYO ASS	25.0	1.0			4	
EPIL CIL	25.0	0.5		2		
POAC EAE	25.0	0.5	2			
ARUN DIO	25.0	0.3		1		
ASTE MOD	25.0	0.3		1		
CARE AEN	25.0	0.3				1
DISP HOO	25.0	0.3	1			
EQUI SYL	25.0	0.3		1		
HIER ACI	25.0	0.3				1
POA PAL	25.0	0.3		1		
RUBU PUB	25.0	0.3		1		
SENE CIO	25.0	0.3		1		
VALE SIT	25.0	0.3	1			
VERA VIR	25.0	0.3				1
VIOL A	25.0	0.3	1			
D Layer						
POLY JUN	75.0	24.5		20	3 63	75
PLEU SCH	75.0	6.3		10	5 63	10
PTIL CRI	75.0	6.3		10	10 63	5
MNIU M	50.0	5.3		20	1 53	
BRAC HYL	25.0	2.5		10		
BARB LYC	25.0	1.3		5		
RHYT TRI	25.0	0.8			3 63	
MARC POL	25.0	0.3		1		

TABLE 4. Vegetation composition of the seral (<8 years since mechanically site prepared) SBSj1/08 (Horsetail) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSJ1/08 Horsetail Ecosystem		2	5	6	7	11	12
Plot Number	Average Value		822 9193	820 8880	822 9192	822 9169	822 9188	820 5882
No. of Species Per Plot	36.3		32	28	35	50	41	40
Species Code	%P	MC	%C	%C	%C	%C	%C	%C
B1 Layer								
SALI X	50.0	2.8			1		6	10
POPU TRE	33.3	1.0				5		1
PICE ENE	33.3	0.6					.5	3
ALNU INC 2	16.7	3.0					18	
ALNU VIR 2	16.7	1.7						10
POPU BAL	16.7	1.3						8
ABIE LAS	16.7	0.1			.5			
B2 Layer								
PICE ENE	100.0	3.4	.5	.5	1	7	.5	11
RIBE LAC	100.0	3.3	5	1	5	3	3	3
LONI INV	83.3	10.8	10		15	20	15	5
RUBU IDA	83.3	5.7	15	5		10	1	3
RIBE LAX	83.3	1.2	.5	5	1	.1	.5	
RUBU PAR	66.7	8.3	35		10	3		2
SAMB RAC	66.7	0.4	.5	1	1	.1		
ROSA ACI	50.0	3.2				12	2	5
VACC MEM	50.0	0.5		1	1	1		
ALNU INC 2	50.0	0.4	2		.1	.1		
SPIR DOU	33.3	2.5				5	10	
SALI X	33.3	1.0		5		1		
ABIE LAS	33.3	0.8		.1		5		
SPIR BET	33.3	0.7				1		3
VIBU EDU	33.3	0.3	1			1		
SPIR AEA	16.7	0.5						3
CORN SER	16.7	0.3	2					
SHEP CAN	16.7	0.3						2
TSUG HET	16.7	0.3						2
SORB SIT	16.7	0.2			1			
C Layer								
EPIL ANG	100.0	31.7	60	35	58	20	15	2
EQUI SYL	100.0	4.0	1	5	10	2	5	1
GALI TRF	100.0	1.7	3	.1	2	1	2	2
CALA CAN	83.3	5.7	2		5	10	2	15
GYMN DRY	83.3	3.5	2		15	1	1	2
ATHY FIL	83.3	2.8	3		7	1	.5	5
CORN CAN	83.3	2.0	1	2	3	1	5	
EQUI ARV	66.7	2.0	1		5	3		3
TIAR TRI	66.7	0.9	3	.5	2	.1		
POAC EAE	66.7	0.7		.5	1		.5	2
PETA PAL	50.0	2.2				2	3	8
RUBU PUB	50.0	1.8				7	2	2
RUBU PED	50.0	1.2		2			3	2
VIOL A	50.0	1.2	1				5	1
CERA NUT	50.0	0.4				.1	.5	2
ANAP MAR	50.0	0.3	1		1	.1		
TARA OFF	50.0	0.1		.1		.1	.5	
CARE X	33.3	2.0		2				10
POA PAL	33.3	1.8	1			10		
CARE MER	33.3	0.6			3		.5	
GEUM MAC	33.3	0.6					3	.5
STRE ROS	33.3	0.4			2		.5	
HIER PIL	33.3	0.3				.1		2
ACTA RUB	33.3	0.3	1				1	
LINN BOR	33.3	0.3		1			1	
EQUI PRA	33.3	0.2		.5			.5	
AGRO THU	16.7	1.7				10		
CARE AEN	16.7	1.3						8
VALE SIT	16.7	1.3			8			
AGRO SCA	16.7	0.8				5		
GALI BOR	16.7	0.8						5
VERA VIR	16.7	0.5			3			
CARE ATR	16.7	0.3						2
EPIL CIL	16.7	0.3				2		
SMIL RAC	16.7	0.3			2			
URTI DIO	16.7	0.3			2			
ACON DEL	16.7	0.2	1					
AGRO PYR	16.7	0.2	1					
ANTE NEG	16.7	0.2		1				
ASTE MOD	16.7	0.2				1		
CARE ROS	16.7	0.2				1		
CINN LAT	16.7	0.2	1					
ELYM GLA	16.7	0.2				1		
HIER ALB	16.7	0.2		1				
LUPI ARC	16.7	0.2					1	
MITE NUD	16.7	0.2				1		
THAL OCC	16.7	0.2	1					
TIAR UNI	16.7	0.2						1
D Layer								
PTIL CRI	100.0	10.5	2	1 6	10	5	20	25
POLY JUN	66.7	11.7	10		20	10	30	
PLEU SCH	66.7	11.2	2	5 6		20	40	
MNIU M	66.7	5.8	5			10	5	15
BRAC HYL	50.0	5.0	5		20			5
POLY COM	16.7	8.3		50 8				
AULA PAL	16.7	3.3						20
RHYT TRI	16.7	2.5				15		
MNIU INS	16.7	0.8			5			
PELT APH	16.7	0.3					2	

APPENDIX 8. Environmental attributes of mechanically site prepared ecosystems

TABLES

TABLE 1. Environmental attributes of the seral (<8 years since mechanically site prepared) SBSj1/06 (Queen's cup) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSJ1/06 Queen's cup Ecosystem	4		7
Plot Number	Mean	820 5898	822 9113	822 9168
*** LOCATION ***				
GEOGRAPHIC		GRIZ	HODD	WANS
LOCATION CODE		LKRD	AFRD	LKRD
NTS MAP SHEET		93G 9 G	93J 15 F	93G 16 A
LONGITUDE (DEGREES)		122	122	122
(MINUTES)		1010	4805	0557
LATITUDE (DEGREES)		53	54	53
(MINUTES)		4222	5803	4522
*** ENVIRONMENT ***				
ELEVATION (M)	882.3	955	930	762
SLOPE GRADIENT (%)	15.0	10	25	10
ASPECT (DEGREES)		270	180	225
MESO SLOPE POSITION		MD	MD	MD
EXPOSURE			FR	WI
SURFACE SHAPE		ST	CV	ST
MOISTURE REGIME		SM	SM	SM
NUTRIENT REGIME		M	M	SM
TERRAIN		FGT	C V B	
COARSE FRAG. (%)	14.7	8	15	21
SOIL SUBGROUP (CSSC 1978)		O.DB	O.GL	O.HFP
FAMILY PARTICLE SIZE		LS	FL	LS
ROOTING DEPTH (CM)	33.3	30	40	30
SOIL DRAINAGE		W	MW	W
HUMUS FORM (MOF 81)		O.RD	O.RD	O.RD
HUMUS THICKNESS (CM)	6.2	0.5	10	8
*** SURFACE SUBSTRATE **				
DECAYING WOOD	12.7	15	8	15
GROUND COVER (%) BEDROCK	0.0	0	0	0
COB. & STONES	1.7	5	0	0
MINERAL SOIL	2.3	5	0	2
ORG. MAT.	85.0	80	92	83
*** SITE HISTORY ***				
YEAR LOGGED		79	81	76
YEAR TREATED		80	84	77
YEAR PLANTED		83	85	81
TYPE OF MSP		DS SF	T	W

Key to Types of Mechanical Site Preparation

Symbol	Method
BS	blade scarification
CD	chain drag scarification
DS	drag scarification
PB	pile and burn
SF	shark fin
T	trail
W	windrow

[a] See Meidinger *et al.* 1983 and Walmsley *et al.* 1980 for definitions of codes and environmental attributes.

TABLE 2. Environmental attributes of the seral (<9 years since mechanically site prepared) SBSj1/01 (Oak fern) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSJ/01 Oak fern Ecosystem	3	4			5		6		8
Plot Number	Mean	822 9114	820 5875	822 9146	822 9165	822 9187	822 9802	822 9135	822 9189	822 9129
*** LOCATION ***										
GEOGRAPHIC		HODD	GRIZ	HOLA	GRIZ	WANS	GRIZ	STON	NAVA	WILL
LOCATION CODE		AFRD	LKRD	NACK	LKRD	ACRK	LKRD	LAKE	HBRD	OFRD
NTS MAP SHEET		93J	93G	93G	93G	93G	93G	93H	93H	93G
		15 F	9 G	9 B	9 G	16 B	9 G	5 E	5 E	9 G
LONGITUDE (DEGREES)		122	122	122	122	122	122	122	122	122
(MINUTES)		4606	0858	1125	0943	0954	1122	5500	5910	1023
LATITUDE (DEGREES)		54	53	53	53	53	53	52	53	53
(MINUTES)		5750	4329	3451	4327	5017	4234	2539	2540	3805
*** ENVIRONMENT ***										
ELEVATION (M)	951.1	820	980	1080	970	820	960	975	1015	940
SLOPE GRADIENT (%)	6.1	5	0	11	12	2	3	10	4	8
ASPECT (DEGREES)		80	999	110	300	260	200	320	300	330
MESO SLOPE POSITION		MD	LV	UP	MD	MD	LW	MD		MD
EXPOSURE		WI		WI	WI			WI	WI	WI
SURFACE SHAPE		ST		CC	ST	ST	ST	ST		ST
MOISTURE REGIME		M	SHG	M	M	M	SM	M	M	M
NUTRIENT REGIME		M	SM	M	M	M	M	M	SM	M
TERRAIN		L B	M B	M B	FGT	M B	FGB	M B	FGT	L B
COARSE FRAG. (%)	27.7	10	15	15	40	28	30	23	78	10
SOIL		E	GLBR	O	O	PZ	O	O	O	O
SUBGROUP (CSSC 1978)		.DYB	.GL	.DYB	.HFP	.GL	.DYB	.HFP	.DB	.HFP
FAMILY PARTICLE SIZE		FSI	LS	CL	SS	LS	LS	LS	SS	L
ROOTING DEPTH (CM)	26.1	30	5	25	30	35	30	30	30	20
SOIL DRAINAGE		MW	I	W	W	W	W	W	W	MW
HUMUS FORM (MOF 81)		O.RD	O.TD	O.RD	O.HR	O.RD	O.RD	O.RD	O.RD	O.RD
HUMUS THICKNESS (CM)	7.8	10	5	10	7	1	2	12	15	8
*** SURFACE SUBSTRATE **										
DECAYING WOOD	4.4	3		5	8	2	7		1	5
GROUND BEDROCK	0.0	0		0	0	0	0		0	0
COVER COB. & STONES	0.7	0		0	0	0	0		5	0
(%) MINERAL SOIL	0.7	0		0	5	0	0		0	0
ORG. MAT.	94.6	97		90	87	98	93		95	95
*** SITE HISTORY ***										
YEAR LOGGED (19__)		80	79	81	79	79	79	72	68	75
YEAR TREATED (19__)		82	80	81	80	79	80	78	78	76
YEAR PLANTED (19__)		82	83	84	83	81	83	80	81	
TYPE OF MSP		T	PB	PB	DS SF	PB	DS SF	PB	PB	W

Key to Types of Mechanical Site Preparation

Symbol	Method
BS	blade scarification
CD	chain drag scarification
DS	drag scarification
PB	pile and burn
SF	shark fin
T	trail
W	windrow

[a] See Meidinger *et al.* 1983 and Walmsley *et al.* 1980 for definitions of codes and environmental attributes.

TABLE 3. Environmental attributes of the seral (<8 years since mechanically site prepared) SBSj1/07 (Devil's club) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSJ1 /07 Devil's club Ecosystem				
		1		4	7
Plot Number	Mean	822 9103	822 9197	820 8842	822 9125
*** LOCATION ***					
GEOGRAPHIC		HODD	CHUC	GRIZ	WILL
LOCATION CODE		AFRD	HFRD	LKRD	OFRD
NTS MAP SHEET		93J 15 F	93J 9 D	93G 9 G	93G 9 G
LONGITUDE (DEGREES)		122	122	122	122
(MINUTES)		4810	2730	1000	1010
LATITUDE (DEGREES)		54	54	53	53
(MINUTES)		5801	3005	4226	3846
*** ENVIRONMENT ***					
ELEVATION (M)	940.0	930	890	950	990
SLOPE GRADIENT (%)	13.3	10	14	27	2
ASPECT (DEGREES)		85	40	340	120
MESO SLOPE POSITION		LW	MD	LW	CR
EXPOSURE				WI	
SURFACE SHAPE		CC		CV	CV
MOISTURE REGIME		SHG	SHG	M	M
NUTRIENT REGIME		PM	M	M	M
TERRAIN		L B	M B	FGB	LGB
COARSE FRAG. (%)	25.5	7	60	35	0
SOIL SUBGROUP (CSSC 1978)		O .GL	GLE .DYB	O .DB	O .HFP
FAMILY PARTICLE SIZE		FL	LS	LS	CL
ROOTING DEPTH (CM)	28.3	35	38	30	10
SOIL DRAINAGE		MW	I	MW	MW
HUMUS FORM (MOF 81)		O.RD	O.YR	H.TD	O.RD
HUMUS THICKNESS (CM)	5.0	8	4	0	8
*** SURFACE SUBSTRATE **					
DECAYING WOOD	7.5	5	2	20	3
GROUND BEDROCK	0.0	0	0	0	0
COVER COB. & STONES	0.0	0	0	0	0
(%) MINERAL SOIL	3.8	0	10	5	0
ORG. MAT.	89.3	95	90	75	97
*** SITE HISTORY ***					
YEAR LOGGED (19__)		81	78	79	74
YEAR TREATED (19__)		84	83	80	77
YEAR PLANTED (19__)		85	84	83	
TYPE OF MSP		BS	T	DS SF	W

Key to Types of Mechanical Site Preparation

Symbol	Method
BS	blade scarification
CD	chain drag scarification
DS	drag scarification
PB	pile and burn
SF	shark fin
T	trail
W	windrow

[a] See Meidinger *et al.* 1983 and Walmsley *et al.* 1980 for definitions of codes and environmental attributes.

TABLE 4. Environmental attributes of the seral (<8 years since mechanically site prepared) SBSj1/08 (Horsetail) ecosystem

Years Since Mechanically Treated	Mechanically Treated SBSJ1/08 Horsetail Ecosystem						
		2	5	6	7	11	12
Plot Number	Mean	822 9193	820 8880	822 9192	822 9169	822 9188	820 5882
*** LOCATION ***							
GEOGRAPHIC LOCATION CODE		HODD AFRD	PITO NCRD	LODI LAKE	TASP CKRD	NAVA HBRD	BEAV FSRD
NTS MAP SHEET		93J 15 G	93G 9 G	93G 8 A	93G 16 A	93H 5 E	93G 16 H
LONGITUDE (DEGREES)		122	122	122	122	122	122
(MINUTES)		4106	0753	0752	0457	5843	0230
LATITUDE (DEGREES)		54	53	53	53	53	53
(MINUTES)		5423	4050	2124	5025	2748	5550
*** ENVIRONMENT ***							
ELEVATION (M)	901.8	755	970	1225	770	990	701
SLOPE GRADIENT (%)	6.0	17	3	10	1	5	0
ASPECT (DEGREES)		290	225	100	150	70	999
MESO SLOPE POSITION		TO	LV	MD	LV	LW	TO
EXPOSURE					WI		
SURFACE SHAPE		ST	CC	ST	ST	CC	CC
MOISTURE REGIME		HG	HG	HG	SHG	HG	HG
NUTRIENT REGIME		M	PM	M	PM	SM	M
TERRAIN		M B	M B	M B	L B	FGT	F T
COARSE FRAG. (%)	14.5	38	15	34	0	0	0
SOIL SUBGROUP (CSSC 1978)		O .G	O .LG	O .G	O .G	O .G	O .HG
FAMILY PARTICLE SIZE		LS	FC	LS	FC	S	FC
ROOTING DEPTH (CM)	21.7	20	20	35	5	35	15
SOIL DRAINAGE		I	P	I	P	I	I
HUMUS FORM (MOF 81)		O.RD	O.RD	O.RD	O.YD	O.RD	.YD
HUMUS THICKNESS (CM)	7.5	6	13	5	5	6	10
*** SURFACE SUBSTRATE **							
DECAYING WOOD	5.7	2	3	2	25	2	0
GROUND BEDROCK	0.0	0	0	0	0	0	0
COVER COB. & STONES	0.0	0	0	0	0	0	0
(%) MINERAL SOIL	0.2	0	1	0	0	0	0
ORG. MAT.	82.5	98	70	98	75	98	100
*** SITE HISTORY ***							
YEAR LOGGED (19__)		C76	C79	C76	C76	C72	C71
YEAR TREATED (19__)		M82	M80	M78	M77	M73	M70
YEAR PLANTED		P83	P84	P79	P80	P74	N71
TYPE OF MSP		W	W	PB	W	CD	BS

Key to Types of Mechanical Site Preparation

Symbol	Method
BS	blade scarification
CD	chain drag scarification
DS	drag scarification
PB	pile and burn
SF	shark fin
T	trail
W	windrow

[a] See Meidinger *et al.* 1983 and Walmsley *et al.* 1980 for definitions of codes and environmental attributes.

APPENDIX 9. Volume of key species in burned seral ecosystems

FIGURES

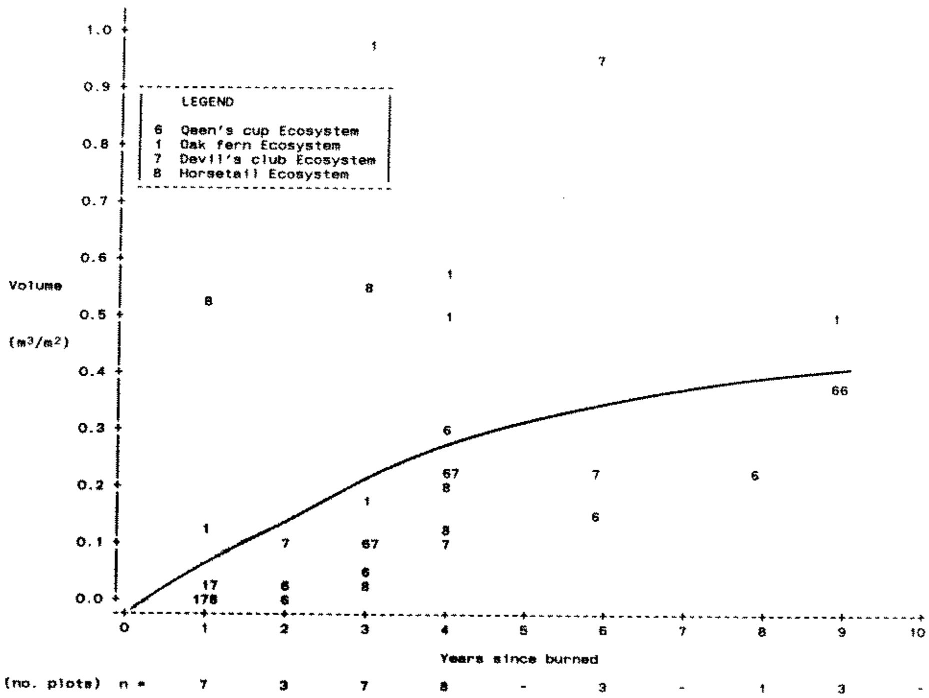

FIGURE 1. Volume of *Epilobium angustifolium* in four seral ecosystems after burning[a,b].

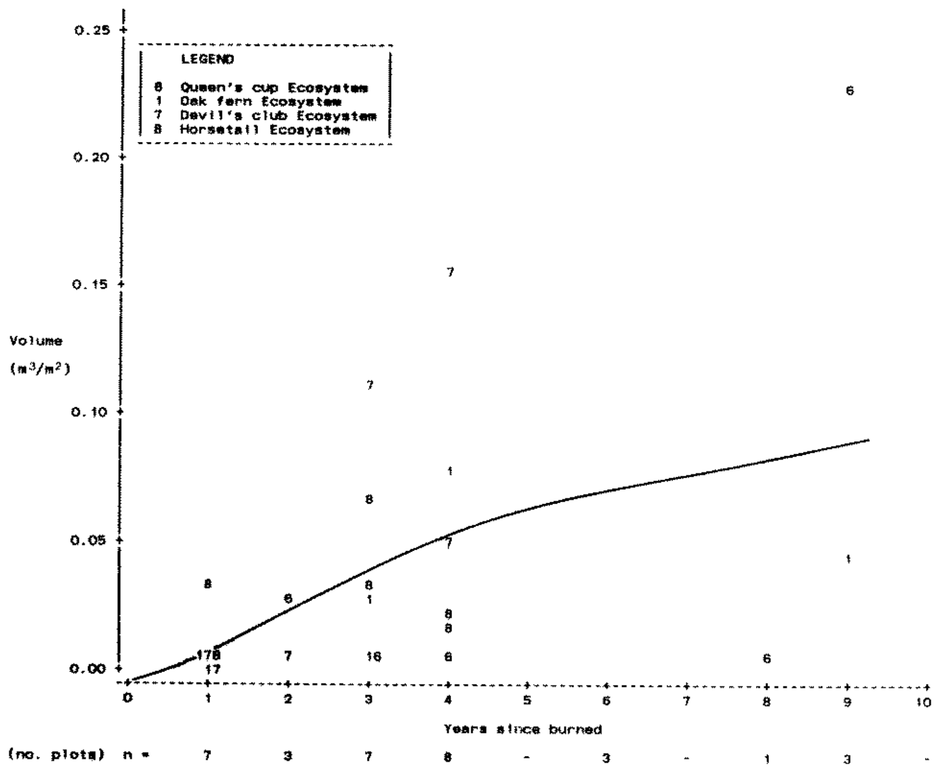

FIGURE 2. Volume of *Lonicera involucrata* in four seral ecosystems after burning.

[a] The scale on the X axis for this graph is larger than the others in this appendix.

[b] **All lines are hand fitted and reflect general trends in abundance.**

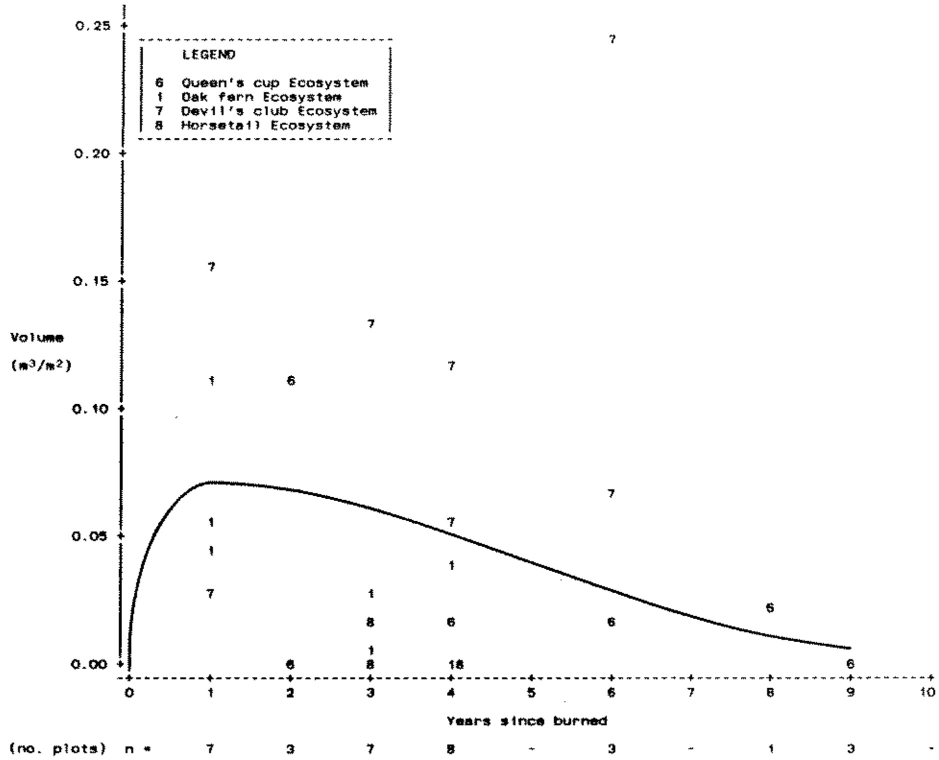

FIGURE 3. Volume of *Rubus parviflorus* in four seral ecosystems after burning.

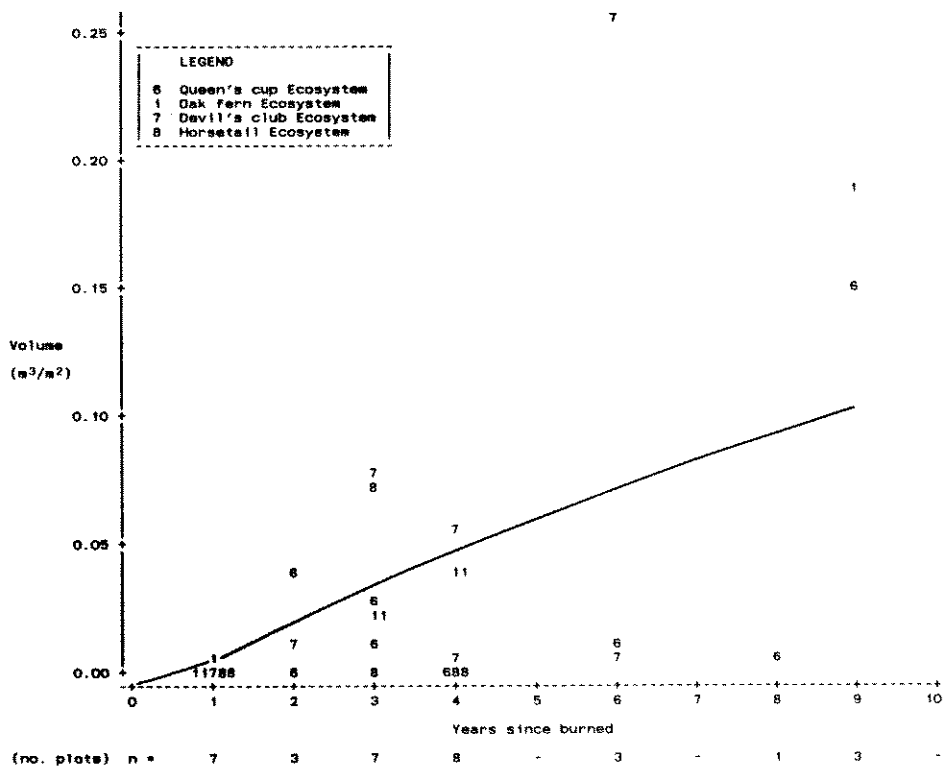

FIGURE 4. Volume of *Rubus idaeus* in four seral ecosystems after burning.

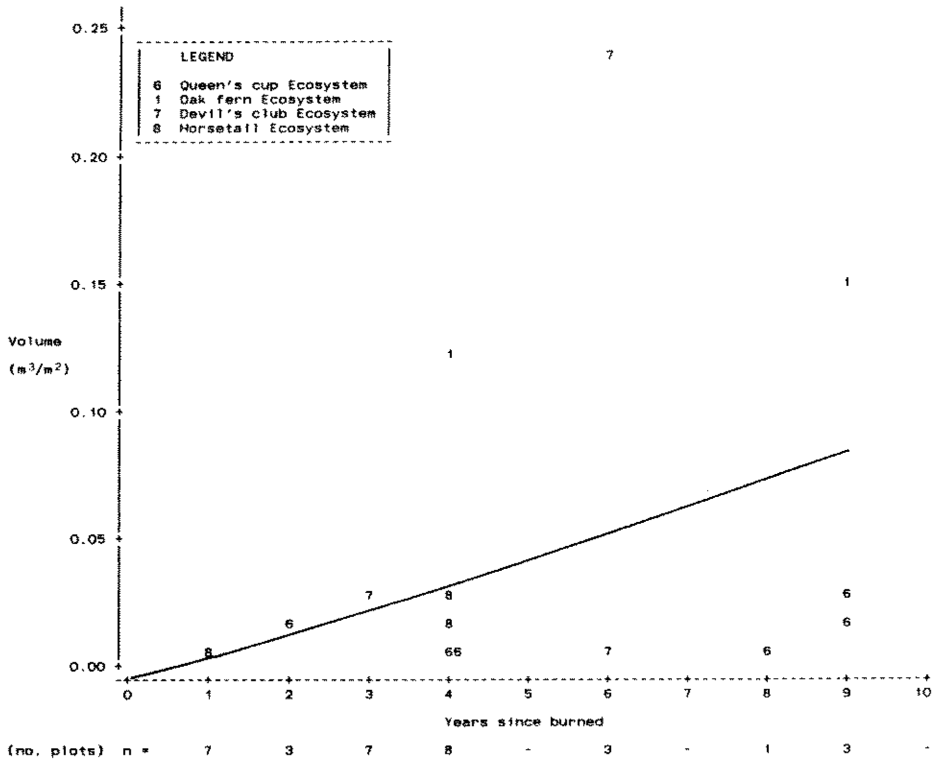

FIGURE 5. Volume of *Salix* spp. in four seral ecosystems after burning.

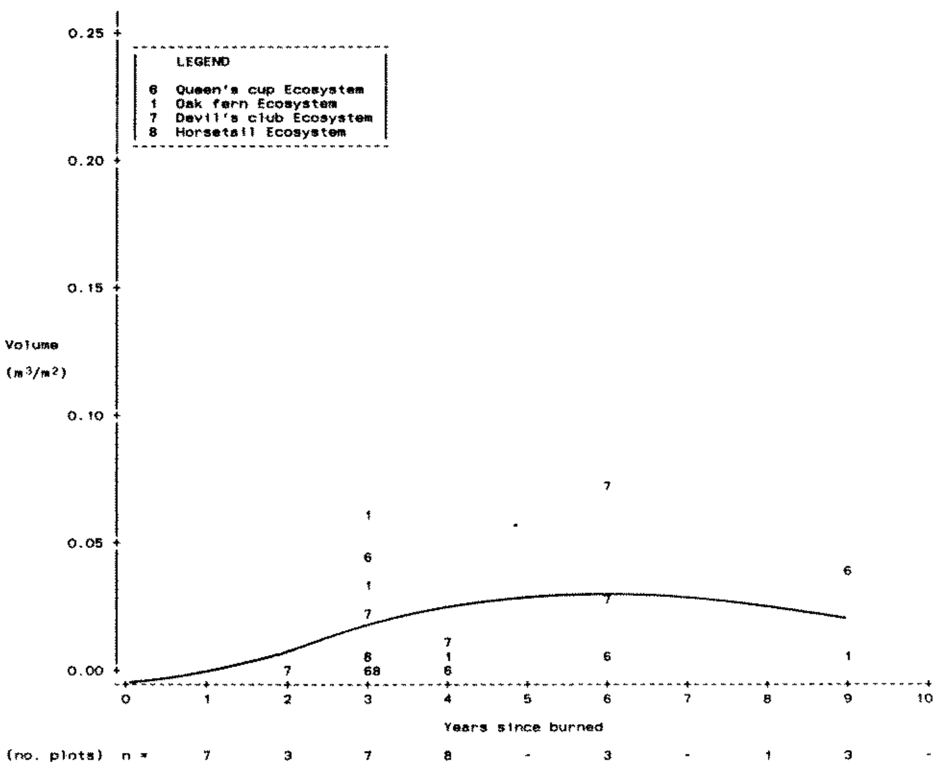

FIGURE 6. Volume of *Ribes laxiflorum* in four seral ecosystems after burning.

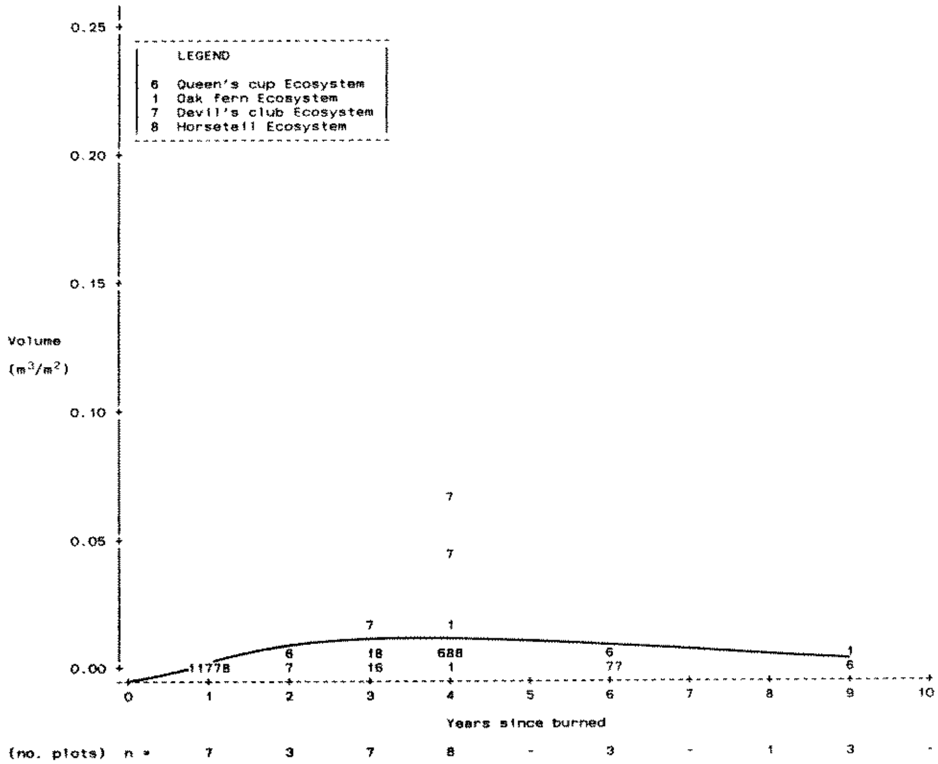

FIGURE 7. Volume of *Ribes lacustre* in four seral ecosystems after burning.

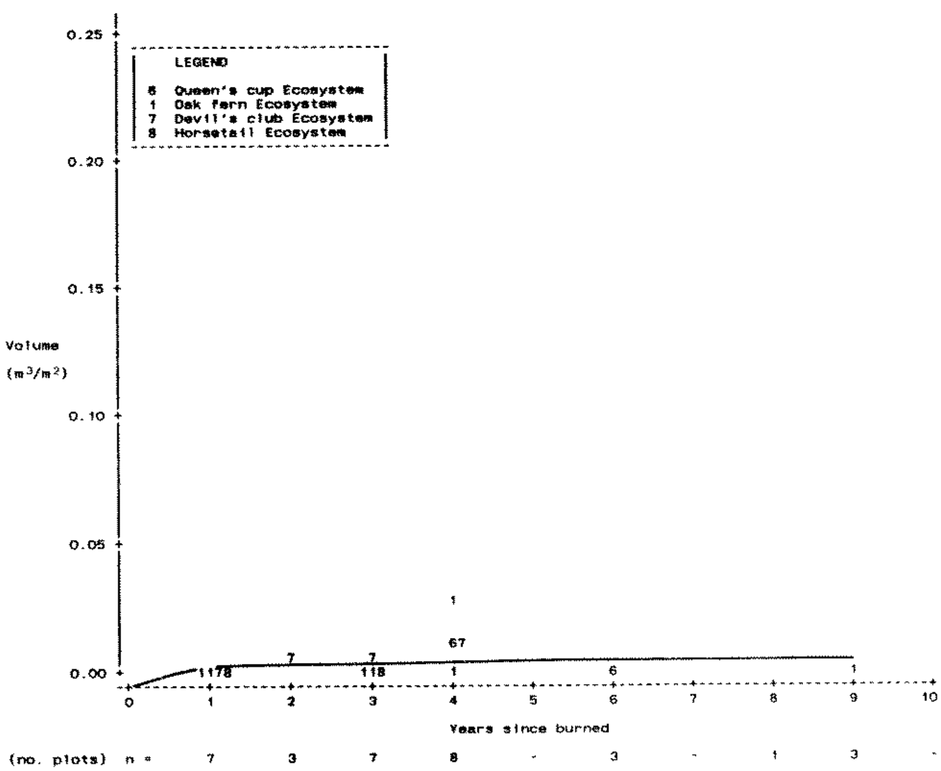

FIGURE 8. Volume of *Vaccinium membranaceum* in four seral ecosystems after burning.

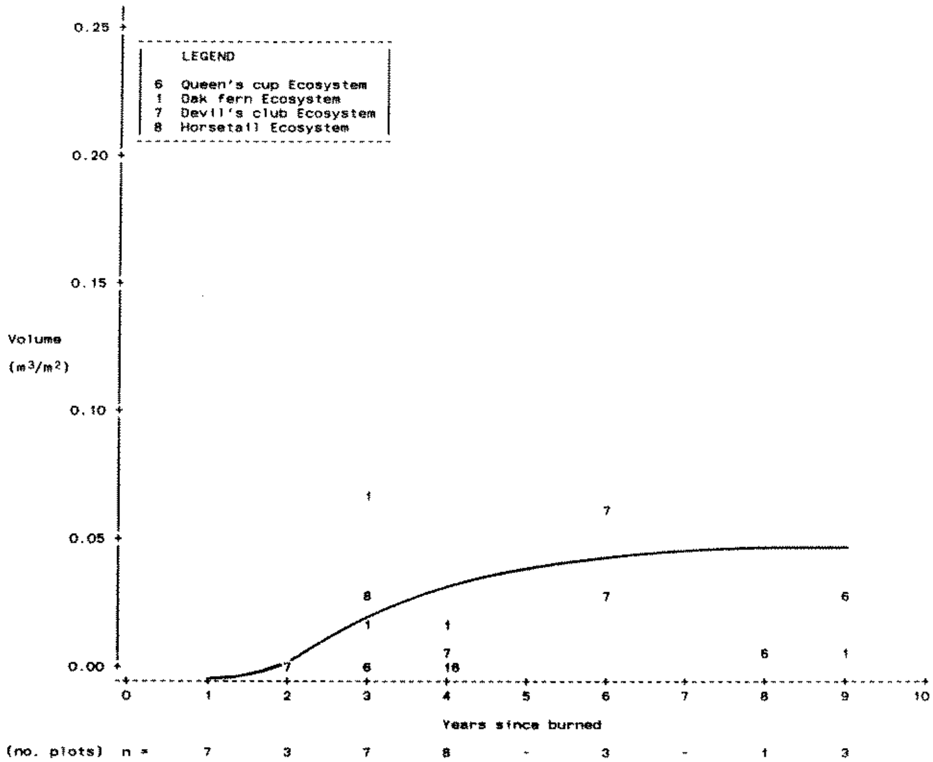

FIGURE 9. Volume of *Sambucus racemosa* in four seral ecosystems after burning.

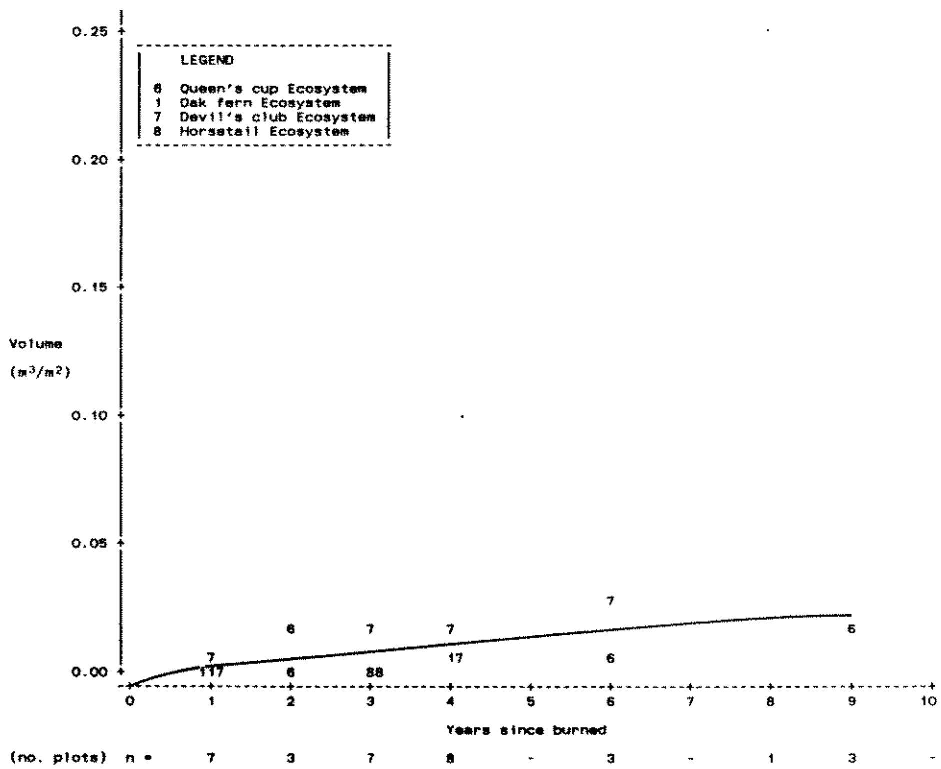

FIGURE 10. Volume of *Viburnum edule* in four seral ecosystems after burning.