Fern Complex

This operational summary provides information about vegetation management in the fern complex. The fern complex occurs in two main forms, one characterized by bracken fern (*Pteridium aquilinum*) and the other characterized by lady fern (*Athyrium filix-femina*).

The fern complex characterized by bracken is comprised almost entirely of this species alone. Once a bracken fern complex develops, few other species can establish or survive in this association.

Complexes characterized by lady fern also include bracken and spiny wood fern. Minor components are fireweed, red raspberry, devil's club, red elderberry, and thimbleberry.

Topics covered in this summary include development of the complex and its interaction with crop trees; non-timber values and pre-harvest considerations; and management strategies for current and backlog sites.

Other Titles in this Series

Operational Summary for Vegetation Management:

- Bigleaf Maple Complex
- Cottonwood Complex
- Dry Alder Complex
- Ericaceous Shrub Complex
- Fireweed Complex
- Mixed-shrub Complex
- Pinegrass Complex
- Red Alder–Salmonberry Complex
- Reedgrass Complex
- Salal Complex
- Wet Alder Complex
- Willow Complex

02/02

Operational Summary for Vegetation Management

Fern Complex

British Columbia

Forest Practices Branch
Ministry of Forests

Forest Renewal BC

Table of Contents

National Library of Canada Cataloguing in Publication Data

Main entry under title:
Fern complex

(Operational summary for vegetation management)

Running title: Operational summary for fern complex.
Co-published by Forest Renewal BC.

ISBN 0-7726-4718-6

1. Fern – Control – British Columbia. 2. Weeds – Control – British Columbia. 3. Forest management – British Columbia. I. British Columbia. Forest Practices Branch. II. Forest Renewal BC. III. Series.

SB764.C3F47 2002 634.9'65'09711 C2002-960040-5

Cover photos: B.C. Ministry of Forests; TM Communications

Operational Summary for Vegetation Complexes
Fern Complex

Foreword

Managing competing vegetation during reforestation can be challenging. Combinations of plants that thrive in seral ecosystems often dominate sites following harvesting or natural disturbance. While many treatment methods for limiting the growth and spread of these vegetation complexes have been explored, the effectiveness of these methods varies widely. This is due to a varying mix of factors, including the number, health, and structure of the competing plants on site, site conditions, and timing and impact of forestry activities. In addition, while some treatments may provide suitable control, the cost in terms of site degradation, hazard to surrounding habitat or crop trees, or the cost of the treatment itself, may be prohibitive.

Much work has been undertaken in recent years by ecologists, silviculturalists, and vegetation management specialists in identifying the characteristics of, and the range of treatment options for, major competing vegetation complexes. Until recently, however, knowledge about managing particularly challenging vegetation complexes was scattered. This series summarizes the key information needed to identify and manage important vegetation complexes in British Columbia.

Introduction

This operational summary provides information about vegetation management issues in the fern complex. Topics include: complex development and interaction with crop trees; treatments that affect development of the complex; non-timber and pre-harvest considerations; and management strategies for current and backlog sites. Each complex includes several plant species and may be found over a wide range of ecosystems. As a result, response to treatments will vary within complexes, and prescriptions should be developed on a site-specific basis.

1. Description

Species Composition

The fern complex occurs in two main forms, one characterized by bracken fern (*Pteridium aquilinum*) and the other characterized by lady fern (*Athyrium filix-femina*).

The fern complex characterized by bracken is comprised almost entirely of this species alone. Once a bracken fern complex develops, few other species can establish or survive in this association. Other shrubs and herbaceous species constitute only a very minor component of the bracken-dominated fern complex.

Complexes characterized by lady fern also include bracken and spiny wood fern (*Dryopteris expansa*). Minor components are fireweed (*Epilobium angustifolium*), red raspberry (*Rubus ideaus*), devil's club (*Oplopanax horridus*), red elderberry (*Sambucus racemosa*), and thimbleberry (*Rubus parviflorus*).

Occurrence

Bracken-dominated complexes can develop within the CWH (dm, vh2, and xm subzones), the CDF, the ICH (vc, vk1, and wk1subzones), the IDF, the ESSF, and the SBS biogeoclimatic zones. Bracken-dominated fern complexes usually develop on heavily disturbed, dry to moist nutrient-poor to -medium sites.

Complexes dominated by lady fern can develop within the CWH (vm1, vm2, wm, ws1, and ws2 subzones), ESSF (vc, wc1, and wk2 subzones), ICH (dw, mc1, mc2, mk1, mw2, and vk1 subzones), and the SBS (mh, mk2, and vk subzones) biogeoclimatic zones. Lady fern forms of the complex usually occur on moist to wet, nutrient-medium to -rich sites. In the ICH wk1 and MS dm1, the fern complex can develop, but the site series upon which it can occur are considered non-forested.

2. Complex Development

Reproduction

The ferns that occur within this complex start to produce spores annually between the ages of 1 and 5 years. While wind is the main method for spore dispersal, gravity, animals, and water can also disperse spores. Fern spores are very resistant to environmental extremes and can remain viable in the soil for at least 1 year. However, their viability and germination rate deteriorates with age.

Spores will germinate on a wide variety of substrates under both light and dark conditions. Spore germination, however, rarely occurs within an established complex or under a closed canopy of any type of vegetation. The primary role of spores is to allow for long-distance colonization of recently disturbed sites, not for the maintenance of an established colony.

Vegetative reproduction is the primary means of expansion and perpetuation of established colonies. Bracken fern develops a large spreading rhizome system that can extend quite far from the parental plant. Lady fern rhizomes tend to remain close to the parent plant. Unlike bracken, large uniform stands of lady fern are populations of individual sporophytes rather than clonal communities. In both cases, individual plants can survive for an indefinite period due to continued re-sprouting.

Rate of Development

Once a fern spore germinates, it develops into a tiny prothallus that has male, female, or both reproductive organs. The prothallus depends on an adequate supply of water for survival and for the transport of sperm to egg for fertilization. It is the fertilized egg that develops into the large, leafy fern.

Ferns are perennial plants in which most or all of the fronds die back each fall and re-sprout in the spring from the rhizomes. Mature bracken and lady fern can reach a height of 2 m, but the average is between 30 to 150 cm in a single growing season. The majority of bracken biomass exists below ground in the rhizomes. These rhizomes can extend anywhere from 5 to 200 cm per year. Individual bracken rhizomes and colonies can survive for very long periods.

Factors Affecting Development

Most lady fern-dominated complexes are established under natural circumstances prior to canopy removal or disturbance. While bracken fern may exist within gaps beneath undisturbed canopies, it is usually after severe disturbance that bracken-dominated fern complexes develop. Both forms of the fern complex are very long-lived and few other species can readily colonize and out-compete them once established. It is important therefore to establish the desired crop trees before full complex development.

Treatments or factors that can favour the development of the fern complex include:

- increased light levels resulting from natural disturbances or harvesting
- harvesting, site preparation treatments, and other ground disturbance that sever, spread, and bury rhizome fragments
- light to moderate burning.

Treatments or factors that can impede or delay fern complex development include:

- complete or partial shading
- very intense burns (lady fern)
- dry site or soil conditions (lady fern)
- retained ground cover (bracken)
- vegetation control with herbicide, for example:
  - glyphosate applied as a foliar spray in early to late summer
  - for bracken: asulam (Asulox F®) applied at or just before 'full frond' and before the fronds turn brown.

Interactions with Crop Trees

The dense, low canopy of ferns in this complex results in severe competition for light and can also cause significant mechanical damage when the aboveground portions die back each fall (vegetation press). The resulting thick mats of organic material can also smother small seedlings and prevent the germination of crop tree seeds or cause the desiccation of germinants on top of the litter. These thick litter mats may also delay soil warming in the spring, slowing crop tree development.

Bracken may exclude potential competitors through the release of toxic chemicals (allelopathy) from its litter, rhizomes, and roots. While these chemicals inhibit the seed germination of many species, negative effects of these chemicals on the growth of planted conifers has not been unequivocally demonstrated. On drier sites, bracken may compete with crop trees for nutrients and moisture.

A primary beneficial effect of the fern complex is the contribution of organic matter to the soil and the control or reduction of soil surface erosion. Other beneficial effects may be the exclusion of other competitive species from the site.

3. Management Consideration for Other Resource Values

Fern fiddleheads and fronds are a source of food for white-tailed deer, mule deer, elk, moose, caribou, grizzly bear, black bear, mountain beaver, mountain goat, bighorn sheep, and blue grouse. The importance of this food source varies with season. Bracken is also often used as the outer shell of the mountain beaver nest. The low, dense cover within the fern complex may provide significant security and thermal coverage for a variety of small mammals, birds, amphibians, and reptiles.

4. Pre-harvest Considerations

Silvicultural System

Complexes dominated by lady fern are usually well developed under tree canopies that have high to moderate light penetration. While lady fern has the ability to tolerate low light levels, when the overstorey canopy is removed or destroyed, lady fern does not significantly increase in cover or height. Therefore, sites dominated by lady fern prior to harvest are relatively insensitive to the silvicultural system employed.

Like lady fern, bracken is also able to grow under a wide variety of light intensities. It will, however, achieve significant ground coverage only when light intensities reach 75% full light or more. As light intensity decreases with increasing crown closure, the bracken colony loses vigour, eventually shrinking to individuals surviving in canopy gaps. Disturbances that increase light intensity through the reduction of ground coverage by both overstorey and understorey vegetation create ideal conditions for bracken colonization. Bracken that existed within the pre-disturbance understorey can rapidly expand through rhizome extension upon release into full light conditions. The deep rhizomes of bracken can survive most soil disturbances and the exposed soil is readily available for sporophyte invasion.

On sites with the potential for the development of bracken-dominated fern complexes, silvicultural systems that employ some canopy retention resulting in moderate shading (<75% full light) of the site (e.g., shelter-wood, seed tree) may result in a reduced bracken cover. Silvicultural systems that create larger canopy openings and higher light levels (e.g., clearcut, patch clearcut, retention) may result in increased site occupancy by bracken.

Regardless of the silvicultural system used within this complex, consideration must be given to future vegetation and site management strategies aimed at reducing the competitive impacts of ferns.

Advanced Regeneration

The retention of advanced regeneration may reduce some of the competitive impacts of the fern complex. Advanced regeneration of sufficient size may be able to withstand or minimize the impacts of vegetation press and not be subjected to fern-induced light competition. High numbers of advanced regeneration may also bring about rapid crown closure, thus speeding the exclusion of ferns from the site.

Method of Reforestation

Natural regeneration may not result in sufficient stocking before the majority of crop tree seedlings are large enough to withstand the competitive impacts of the fern complex. Crop tree seed falling beneath a low continuous fern canopy may not have enough light to germinate, and any seedling that does germinate may suffer from smothering or mechanical damage due to the large amounts of litter produced with the annual aboveground die-back. Therefore, planting is the most effective means of rapidly establishing a crop of desired trees. Planted crop tree seedlings are able to rapidly achieve a height that can effectively compete with ferns for light, and they are able to develop a stem that is thick enough to withstand vegetation press.

5. Vegetation Management for Current Sites

Site Preparation

General

Any soil disturbance that causes damage to existing fern plants may stimulate re-sprouting and the spread of rhizome fragments.

Mechanical

Light- and medium-impact mechanical site preparation treatments (e.g., spot mulching, disc trenching) that destroy existing plants while exposing and mixing the upper mineral horizons may sever and spread bracken rhizomes throughout the treatment area. These rhizome fragments may quickly establish new plants. Lady fern, however, can be successfully controlled for at least 4 years with mechanical site preparation such as mounding. Treatments must ensure that the competition-free planting spot is large enough to minimize the impacts of peripheral vegetation falling onto the planted seedling.

High- to very high-impact mechanical site preparation can control the establishment of bracken. Repeated deep ploughing and rotary cultivation are very effective in controlling bracken. However, in most cases, treatment cost, as well as terrain and slash conditions, can limit the feasibility of these methods.

On wetter sites, heavy equipment must be used in a manner that does not damage natural drainage patterns, cause soil compaction, or create unproductive wet depressions.

Manual Scalping (Screefing)
Similar to light mechanical scarification, planter patch (usually, 30 cm × 30 cm) scalping may provide only a short competition-free window. After a short period of time, the cleared soil patches are soon re-vegetated by plants arising from the severed vegetation pieces within the patches, and by the rhizomes from the plants on the perimeter of the patches. As well, since the size of the patches is generally small, vegetation on the patch periphery can cause significant mechanical damage to the planted seedling.

Prescribed Fire
Prescribed burns that are light to moderate tend to have little damaging impact on existing fern plants. The fire may remove the aboveground portion of the fern while leaving the belowground rhizomes intact. The re-sprouting of the rhizomes and establishment of new plants may increase the coverage of ferns over that which was present prior to treatment.

Very intense burns that consume the majority of the organic layer, thus destroying rhizomes, may be effective in controlling lady fern. However, most lady fern-dominated complexes develop on sites with high moisture contents, so, achieving a high-intensity burn may not be possible. Very intense burns may be ineffective in controlling bracken since its deep rhizomes are protected from even the highest severity burn. Furthermore, sterile post-burn soils are an ideal substrate for bracken's abundant wind-dispersed spores to germinate. Bracken also uses its rhizomes to take advantage of sites left vacant by the destruction of other vegetation. Impacts on nutrient availability should also be considered when employing very intense burns as they may reduce the long-term availability of nutrients on the site.

Chemical
Foliar applications of glyphosate (1.5–2.1 kg ae/ha) have been successfully used for controlling the fern complex. Application during the late foliar period (late July to early September) has resulted in the greatest degree of setback. Timing of herbicide application is critical. If the treatment occurs too early in the growing season, it will cause top die-back without impacting the rhizomes. New fronds will rapidly develop and little change to competitive and mechanical damage impacts on crop trees will occur. If treatment is too late, it will have little impact on the rhizomes, and in the following spring, new fronds will develop as usual.

Asulam (Asulox F®) is also registered for the control of bracken. The recommended application rate is 5.5 litres/ha Asulox F® in 200 litres of water. Treatment must be done at or just before 'full frond' and before the fronds begin to turn brown. For site preparation, the site may be treated in the summer before the planting period.

Seeding with Cover Crop Species
The seeding of agronomic species may be ineffective when fern rhizomes or established plants are already present on-site. In these situations, ferns may be able to out-compete the agronomic species and dominate the site.

Biological Control

Livestock Grazing
Ferns have low palatability and are not favoured by livestock. Bracken is considered poisonous to domestic sheep and cattle. Trampling causes the greatest damage to ferns when livestock is used for vegetation control.

Other
Insects and disease do not readily infest ferns. Several biological controls have been tested on bracken but few have caused significant damage to this species. No biological agents are available for controlling ferns.

Planting

Timing
The success rate of reforestation efforts is reduced when the fern complex is developed before crop tree establishment. Hence, crop tree planting should be done immediately after harvest or site preparation to take full advantage of the window of reduced competition.

Stock Type
The use of large (415D or larger) vigorous planting stock with well-developed root systems can improve seedling survival and performance on fern-dominated sites. Seedling stock types that establish and quickly begin to grow following planting will maximize their root expansion, as well as stem diameter and height growth. This will allow the tree seedlings to take full advantage of the window of reduced competition created by harvesting or site preparation.

Species Selection
The fern complex occurs over a wide range of biogeoclimatic zones and subzones, thus, the species selection for these sites varies considerably. In all cases, the species that are chosen for reforestation on sites with, or that have the potential to develop, the fern complex should have rapid early growth in order to gain sufficient height and caliper to withstand the competition and physical damage that might arise from the vegetation community on-site. Generally, however, in the ESSF, sub-alpine fir (Bl) and/or Englemann spruce (Se) are preferred species. In the ICH, western redcedar (Cw) and/or spruce (Sx) are the preferred species and aspen (At) or cottonwood (Act) are productive broadleaf species. In the CWH, on most moist to wet sites, amabilis fir (Ba) and/or western redcedar are preferred, Sitka spruce (Ss) is preferred in the CWH wm, and red alder (Dr) is a productive broadleaf species in most of the subzones and site series where the fern complex can develop. On dry CWH sites, Douglas-fir (Fdc) and western redcedar are the preferred species and red alder is a productive broadleaf species. In the CDF, Douglas-fir is the preferred

species. In the SBS, spruce and/or Douglas-fir (Fdi) are the preferred species, with cottonwood and aspen being considered productive broadleaf species.

Fertilization

Fertilization at time of planting can help crop tree seedlings to establish on some sites. On nutrient-poor to -medium sites that have the potential for bracken fern domination, the use of the appropriate fertilizer at the time of planting may allow the seedlings to grow better to compete with bracken for limited resources and space. On lady fern-dominated sites, the use of at-time-of-planting fertilizers may be ineffective due to the higher nutrient status associated with these sites.

Brushing

General

The need for brushing treatments will depend largely on the success and timing of the initial planting. Since ferns are able to re-occupy a site from underground rhizome and re-sprouting from the base of the stem, most brushing techniques can provide only a short-term competition relief.

Manual (Physical)

Single-entry manual cutting of both lady fern and bracken stimulates re-sprouting from rhizomes and may result in an increase in fern cover on the treated site. To effectively control ferns, manual cutting is required for at least three entries over a growing season for several consecutive years. The timing of each entry within a growing season is critical to the success of the treatment. The first cutting should occur before the fronds fully expand, with the second cutting occurring 6 weeks after the first, and the third cutting after another 6 weeks. Cutting outside of these windows allows the ferns to build up their rhizome carbohydrate reserves and re-sprout more vigorously after treatment.

Release of the crop trees through bending ("hockey-stick") or pulling the fern fronds off or away from the seedlings in late summer to fall prior to the first snowfall may aid in the reduction of crop tree damage caused by vegetation press. Treatments of this type would have to be repeated yearly until the crop tree seedlings achieve sufficient height and stem caliper to withstand the effects of vegetation press.

Physical Barriers (Mulches)

Plastic mulches, when firmly anchored to the ground, can provide a microsite free of ferns for up to 4 years. Very tall ferns on the periphery of the mat, however, may cause some physical damage to the seedlings if the mats are too small. As a general rule, the ideal width of the plastic mat should be at least twice the expected height of the competing vegetation (e.g., if 70 cm tall bracken is expected, the mats should be 140 cm wide).

Chemical

As described under "Site Preparation (Chemical)," foliar applications of glyphosate (1.5–2.1 kg ai/ha) and asulam (Asulox F®) during late summer can provide sufficient competition-free windows to ensure crop tree establishment and survival. Care must be taken to ensure that damage to the desired crop trees does not occur during application.

Livestock Grazing

As described under "Site Preparation (Biological Control)," ferns are not favoured by livestock and grazing may be ineffective.

6. Vegetation Management Strategies for Backlog Sites

General

The fern complex changes very little over time. Since there is little difference between the complex on current and backlog sites, the same vegetation management strategies employed on current sites can be applied to backlog sites.

Thinning

Crop tree thinnings that reduce the overstorey canopy crown closure may create conditions favourable for fern growth. The increase in light penetration resulting from thinning may prevent the exclusion of ferns from the stand and may perpetuate the complex longer into, or through to, the next rotation.

7. Summary

Reduction of the competitive impacts of the fern complex must begin with proper site identification and recognition of the potential for complex development. For all subsequent treatments, one must consider the potential growth response of the complex under the resulting microsite environment. The success of any treatment will depend on its impacts on both the above- and belowground portions of all constituents of this complex. The efficacy of several treatments also depends on the density and coverage of ferns prior to harvest or treatment. In order to reduce fern competition and physical damage to the crop trees, the primary vegetation management strategy is prompt regeneration with healthy, tall, and large-diameter crop trees. Once the crop trees are above the fern canopy, crop tree growth should not be significantly impacted by the presence of ferns.

Efficacy of all potential control methods decreases the longer the fern complex occupies the site before crop tree establishment. Successful plantation establishment in this plant community is consistently associated with prompt initiation of reforestation activities after disturbance.

Bracken

On dry to moist nutrient-poor to -medium sites, there is potential for the development of the fern complex dominated by bracken. On such areas, prompt planting of vigorous, fast-growing crop trees immediately

following harvest may be sufficient in overcoming the competitive impacts and potential physical damage of invading bracken fern.

When the bracken-dominated complex develops prior to the establishment of crop tree seedlings, an effective series of non-chemical treatments is prompt planting of large vigorous crop trees immediately following harvest, followed by a physical release in the late summer or fall through bending or pulling the fern fronds from the crop tree seedlings. The physical release of the crop trees may be required yearly until the seedlings achieve a height and stem caliper large enough to withstand the competitive impacts and physical stress associated with the fern's presence.

An effective chemical treatment on bracken-dominated fern complexes is the foliar application of Asulox F® (5.5 litres/ha) and glyphosate (1.5–2.1 kg ae/ha) in the summer.

Lady Fern

On moist to wet nutrient-medium to -rich sites, with the potential for development of the complex dominated by lady fern, an effective series of non-chemical treatments is patch scarification (mounding), followed by a rapid planting of large vigorous crop trees and physical release in the late summer or fall through bending or pulling the fern fronds from the crop tree seedlings. The physical release of the crop trees may be necessary until the seedlings achieve a height and stem caliper large enough to withstand the competitive impacts and physical stress associated with the fern's presence.

An effective chemical treatment on lady fern-dominated complexes is the foliar application of glyphosate (1.5–2.1 kg ae/ha) in late August.

A combination of both chemical and non-chemical treatments has been shown to very effective in managing sites that currently have, or have the potential to develop, the lady fern-dominated complex. The most effective approach is implementation of a series of treatments starting with mechanical mounding of the site immediately after harvest, followed by an immediate planting with fast-growing crop species. Then, approximately 1 to 2 years after, a foliar application of glyphosate may be undertaken, if necessary. A chemical site-preparation with glyphosate (1.5–2.1 kg ae/ha) prior to planting may be necessary where the pre-harvest coverage of lady fern is extensive.

For More Information

Biring, B.S., P.G. Comeau, and J.O. Boateng. 1996. Effectiveness of forest vegetation control methods in British Columbia. For. Can. and B.C. Min. For., Victoria, B.C. FRDA Handb. No. 011.

Boateng, J.O. 1998. Herbicide field handbook (Revised). For. Can. and B.C. Min. For., Victoria, B.C. FRDA Handb. No. 006.

Coates, D., S. Haeussler, and J. Mather. 1990. A guide to the response of common plants in British Columbia to management treatments. For. Can. and B.C. Min. For., Victoria, B.C. FRDA Handb. No. 008.

Haeussler, S., D. Coates, and J. Mather. 1990. Autecology of common plants in British Columbia: A literature review. For. Can. and B.C. Min. For., Victoria, B.C. FRDA Rep. No. 158.

MacKinnon, A., J. Pojar, and R. Coupé (Editors). 1992. Plants of Northern British Columbia. Lone Pine Publishing. Vancouver, B.C.

Newton, M. and P.G. Comeau. 1990. Control of competing vegetation. *In* Regenerating British Columbia's forests. D.P. Lavender *et al.* (editors). UBC Press. Vancouver, B.C. pp. 256–265.

Pojar, J. and A. MacKinnon (Editors). 1994. Plants of Coastal British Columbia. Lone Pine Publishing. Vancouver, B.C.

Province of British Columbia. 1998. Provincial seedling stock type selection and ordering guidelines. B.C. Min. For., Silv. Br., Victoria, B.C.

Province of British Columbia. 2000. Establishment to free growing guidebook. B.C. Min. For., Silv. Br., Victoria, B.C.

Acknowledgements

The preparation of this summary was coordinated by Dr. Jacob O. Boateng (Forest Practices Branch, British Columbia Ministry of Forests, Victoria) and Dr. Phil Comeau (formerly of Research Branch, British Columbia Ministry of Forests, Victoria and now at the Department of Renewable Resources, University of Alberta, Edmonton). The assistance of the following people in the preparation of this summary is gratefully acknowledged: Allan Powelson of ALTRA Forestry Ltd. (Pender Island, B.C.), and Balvinder Biring and Lorne Bedford of the British Columbia Ministry of Forests, Victoria. TM Communications (Victoria) edited, designed, and produced the series.

Appendix – Key to Biogeoclimatic Zones of British Columbia

AT	Alpine Tundra	IDF	Interior Douglas-fir
BG	Bunchgrass	MH	Mountain Hemlock
BWBS	Boreal White and Black Spruce	MS	Montane Spruce
CDF	Coastal Douglas-fir	PP	Ponderosa Pine
CWH	Coastal Western Hemlock	SBPS	Sub-Boreal Pine–Spruce
ESSF	Engelmann Spruce–Subalpine Fir	SBS	Sub-Boreal Spruce
ICH	Interior Cedar–Hemlock	SWB	Spruce–Willow–Birch