Bigleaf Maple Complex

This operational summary provides information about vegetation management in the bigleaf maple complex. The dominant species in this complex is bigleaf maple (*Acer macrophyllum*), with a number of shrubs and ferns as major associates including: salmonberry (*Rubus spectabilis*), trailing blackberry (*Rubus ursinus*), blackberry (*Rubus leucodermis*), sword fern (*Polystichum munitum*) and bracken fern (*Pteridium aquilinum*). Other shrub species that may occur with varying abundance are red elderberry (*Sambucus racemosa*), devil's club (*Oplopanax horridus*), red-osier dogwood (*Cornus stolonifera*), salal (*Gaultheria shallon*) and stink currant (*Ribes bracteosum*). Red alder (*Alnus rubra*) is a minor component in some stands.

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:

- Cottonwood Complex
- Dry Alder Complex
- Ericaceous Shrub Complex
- Fern Complex
- Fireweed Complex
- Mixed-shrub Complex
- Pinegrass Complex
- Red Alder–Salmonberry Complex
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02/02

Operational Summary for Vegetation Management

Bigleaf Maple Complex

FOREST RENEWAL BC

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Operational Summary for Vegetation Complexes
Bigleaf Maple Complex

Foreword

Managing competing vegetation during reforestation can be challenging. Combinations of plants that thrive in seral ecosystems often dominate sites following harvesting or wildfire. While a wide range of options have been tested and used for managing competition, their effectiveness can vary widely. This is due to the potential influence of several factors on growth of both crop and non-crop species and on the nature of competitive and beneficial interactions. Treatment effectiveness is influenced by a number of factors, including the species involved, the site, and harvesting, site preparation and tending activities. In addition, while a number of alternative treatments may provide control of competing species, treatment costs, and the potential short-term and long-term impacts of each treatment options on site quality, wildlife habitat, and other values must be evaluated in relation to the potential benefits of the treatment.

Substantial work has been undertaken during the past decade by ecologists, silviculturists, and vegetation management specialists to identify the characteristics and range of treatment options that are effective for managing competing vegetation complexes. Until recently, knowledge about managing these vegetation complexes was scattered in numerous sources. This series of summaries provides a synthesis of the key information needed to effectively manage important vegetation complexes in British Columbia.

Introduction

This operational summary provides information about vegetation management issues in the bigleaf maple 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, vegetation response to treatments may vary.

1. Description

Species Composition

The dominant species in this complex is bigleaf maple (*Acer macrophyllum*), with a number of shrubs and ferns as major associates including salmonberry (*Rubus spectabilis)*, trailing blackberry (*Rubus ursinus*), blackberry (*Rubus leucodermis*), sword fern (*Polystichum munitum*), and bracken fern (*Pteridium aquilinum*). Other shrub species that may occur with varying abundance are red elderberry (*Sambucus racemosa*), devil's club (*Oplopanax horridus*), red-osier dogwood

(*Cornus stolonifera*), salal (*Gaultheria shallon*), and stink currant (*Ribes bracteosum*). Red alder (*Alnus rubra*) is a minor component in some stands.

Occurrence

Bigleaf maple is found at low to mid-elevations in the Coastal Douglas-fir (CDF) and Coastal Western Hemlock (CWH) biogeoclimatic zone of southwestern British Columbia. The northern limit of its range is found at Broughton Island near the mouth of Kingcome Inlet (50º51'N latitude). This range includes much of Vancouver Island, with the exception of the northern tip. Along the mainland coast, bigleaf maple is found along inlets and river valleys. This species can be found eastwards as far as Hope and Seton Portage (near Lillooet). Bigleaf maple is rarely found at elevations above 300 m and is most abundant at low and mid-elevations.

Bigleaf maple commonly occurs on sites with fresh to moist soil moisture regimes and medium to very rich nutrient regimes. However, it also grows on shallow rocky soils and can tolerate temporary flooding. Alluvial and colluvial soils near streams provide some of the best sites for growth of this species. Vigorous bigleaf maple is associated with soils that are moist and have high nutrient concentrations, high cation exchange capacities, high levels of base saturation, and low C:N ratios. Soils under bigleaf maple typically have higher concentrations of calcium and other cations due to the influence of maple litterfall.

While it is the most shade tolerant of the broadleaf tree species found in British Columbia, it is classed as moderate to intolerant. It is more shade tolerant than Douglas-fir but less shade tolerant than western hemlock and western redcedar.

2. Complex Development

Reproduction

Bigleaf maple can produce abundant seed from an early age. However, maple seed loses viability quickly and does not remain viable in the forest floor for more than 1 year. Birds, small mammals, and insects consume a large percentage of the seeds that are produced. Establishment of maple seedlings can occur on moist mineral or organic seedbeds. Partial shade, provided by a conifer overstorey that has been opened by self-thinning or tending, is ideal for seedling establishment. The optimum window for regeneration of maple from seed occurs following canopy thinning and lasts until understorey forbs and shrubs become well established.

Bigleaf maple is more commonly found as multi-stemmed clumps developing from a cut stump rather than from seeds. Bigleaf maple sprouts vigorously from dormant buds following cutting. Trees of any age or size have the capability to sprout. However, larger diameter and taller stumps generally produce larger numbers of sprouts and more vigorous growth of sprouts. Individual stumps can produce 50 or more sprouts that can reach 5 m or more in height and a crown width of 6.5 m within 3 years. Over time, the number of stems declines due to self-thinning and breakage of lateral stems resulting in mature trees with between 3 and 5 stems.

Bigleaf maple does not produce root suckers and does not usually reproduce by layering. However, there is some evidence that layering may occur to a limited extent in some stands.

Rate of Development

While bigleaf maple seedlings grow well in full sunlight and in partial shade, survival and growth are very poor under heavy shade. Dense overstorey cover and dense shrub and herbaceous layers substantially reduce survival and growth of maple seedlings. Maple seedlings grow much more slowly than maple sprouts, with initial rates of height growth often below 30 cm per year during the first 5 years. In exceptional cases, young maple seedlings can grow more than 1 m per year. Browsing from deer and elk can seriously damage bigleaf maple seedlings. When protected from browsing and growing on good sites with little competing vegetation, height growth of transplanted nursery grown seedlings can exceed 30 cm in first year, 50 cm in second, and 100 cm in subsequent years.

Following cutting of mature trees, stump sprouts can grow between 2 and 4 metres per year during the first few years. Sprout clumps can attain a crown diameter of 5 m within 2 years. Within 4 years a single stump can produce a bigleaf maple sprout clump that covers an area as large as 100 m^2.

Bigleaf maple has rapid juvenile height growth rates, which tapers off after age 30. On good sites, rotation lengths of 40 to 50 years are considered to be feasible for coppice origin stands. Bigleaf maple can grow to 32 m in height and can live for 250 years or longer. Under a mature maple stand, on moist rich sites, the understorey is typically dominated by sword fern and salmonberry.

Treatments that Affect Development

Bigleaf maple regenerates largely from re-sprouting of stumps that existed prior to harvesting. Once established, the bigleaf maple complex is relatively long-lived and few other species can readily colonize and outcompete it. However, bigleaf maple is a potentially valuable tree and can produce high value hardwood products on relatively short rotations (less than 50 years).

Development of the bigleaf maple complex is favoured on fresh and moist rich sites when maple is present in the stand prior to harvest.

Treatments or factors that can impede or delay bigleaf maple complex development include:

- dry site or soil conditions
- complete shading by dense overstorey canopies
- leaving maple stems standing without cutting
- cutting of maple with stump heights below 30 cm, 2 years or more prior to harvesting of the rest of the conifer stand
- cutting of mature maple stems in May or June
- very intense burns

- pulling and inverting maple stumps during harvesting or site preparation
- thinning of shoots within sprout clumps
- glyphosate applied as a foliar spray in late summer
- triclopyr ester applied as a foliar spray (in water) in spring or late summer
- basal bark application of triclopyr ester to sprouts or young stems
- cut stump application of glyphosate, triclopyr ester, or 2,4-D
- heavy browsing by dear and elk.

Interactions with Crop Trees

Due to the rapid growth of stump sprouts following cutting of maple and removal of the overstorey canopy, this species can pose serious competition for young conifer plantations. Light levels beneath maple coppices can be less than 1% of full sunlight, which is too low for survival of most conifers. Bigleaf maple can also cause physical damage to conifer shoots, resulting in leader breakage, and loss of buds and needles as they grow up through the maple canopy or as lateral branches break off of the maple stump. Heavy leaf litter can also smother germinants and small conifers.

Light levels beneath young maple stands can be below 15%, and can result in substantial reductions in growth and survival of overtopped conifers. Shade-intolerant species, such as Douglas-fir, will not survive at these low light levels. Due to the low light levels in the understorey, bigleaf maple can significantly reduce cover and growth of other vegetation. However, light levels underneath untended maple canopies are also generally too low for survival or growth of even shade-tolerant conifer species. In the absence of tending, 200 evenly distributed bigleaf maple coppices per hectare can completely dominate a site within 10 years following harvesting.

Side shade from bigleaf maple patches into adjacent openings will likely influence only a narrow region along the edge of the dripline of the patch, extending less than 30% of maple height on the north side, less than 15% of maple height on the east and west sides, and 0 m on the south side of a maple patch.

Beneficial effects of bigleaf maple include its ability to increase soil pH and the content of calcium and other cations, decrease soil bulk density, and increase organic matter content of forest soils. Rates of decomposition of forest floor litter can be also be more rapid under bigleaf maple than under nearby conifer-dominated stands. There is, however, little evidence of direct benefit to associated conifers on sites where maple and conifers grow together.

As observed with red alder, a canopy of bigleaf maple may reduce the frequency of spruce leader weevil (*Pissodes strobi*) attack on Sitka spruce saplings. Side shade from adjacent patches or strips of maple may reduce leader weevil damage for a distance of 5 to 10 m to the north of the strip. Bigleaf maple is resistant to laminated root rot (*Phellinus weirii*) and growing a rotation of bigleaf maple on a site may help to sanitize the stand.

Beneficial effects of salmonberry, swordfern, and other species commonly found in this complex may include the control or reduction of soil surface erosion, the contribution of large amounts of soil organic matter to the site, and the exclusion of other competitive species.

3. Non-timber Values

Bigleaf maple is valued for its visual appeal, including its fall colours, distinctive architecture, and leaves. Bigleaf maple trees support abundant and diverse epiphyte communities on branches and stems. These epiphytic communities are comprised of various species of mosses, lichens, ferns, and vascular plants. The litter from bigleaf maple accelerates litter decomposition and supports a much greater diversity of soil fauna than is typically found in coniferous stands. Bigleaf maple is a secondary forage species in the spring and summer for black-tailed deer and is also browsed by elk. Small mammals and birds eat maple seeds. Maple is also used by cavity nesting birds, particularly hairy woodpeckers. Studies suggest that having a small component of maple within conifer-dominated stands may have a positive effect on bird populations.

Salmonberry, an associate of the maple complex, is an important forage species for many coastal animals: elk, deer, moose, and mountain goats browse foliage; birds and bears consume berries; nectar in the early-appearing flowers are a critical initial food source for humming birds.

The rapid aboveground and belowground growth of bigleaf maple and salmonberry can provide stream bank stability when disturbance has caused a loss of bank integrity. The litter of both species contributes detritus to streams.

4. Pre-harvest Considerations

Silvicultural System

Following clearcutting, shelterwood, or selection harvesting, established bigleaf maple will respond to the increased light levels. Opening of the canopy following establishment cutting in the shelterwood system can provide ideal conditions for seedling regeneration.

The silvicultural system chosen must consider the level of understorey light, the amount of maple existing prior to harvest, and the shade tolerance of the desired crop species.

Pre-harvest Control

Cutting maple 2 years or more prior to removal of the conifer stand to stump heights shorter than 30 cm can substantially reduce the number of sprouts and their subsequent rates of growth. However, since this treatment is unlikely to kill established bigleaf maple, its effectiveness is likely to be limited. Cleaning treatments, involving removal of maple in younger stands with denser overstorey canopies are likely to be far more effective for reducing the abundance of bigleaf maple, where this is desired.

Some studies suggest that cutting mature maple trees during May and June can result in significant mortality due to exhaustion of carbohydrate reserves in the root system during flowering, leaf expansion, and stem growth.

Girdling of maple 2 or more years prior to harvesting of a stand may also reduce the abundance and vigour of maple in the regenerating stand. Girdling of mature bigleaf maple trees is very difficult, but can be accomplished using a chainsaw or power girdling tools. Since maple can readily bridge narrow girdles, a wide band of bark (20 cm or more in width) should be removed.

Advanced Conifer Regeneration

The retention of advanced conifer regeneration may reduce some of the competitive impacts of bigleaf maple. Advanced regeneration of sufficient size may be better able to remain in the upper canopy and withstand, or prolong, the duration before the light competition from maple becomes significant. High levels of advanced regeneration may also provide some shading of the site, thereby reducing establishment of new maple seedlings and rates of sprout growth.

Method of Reforestation

Natural regeneration of conifers is not recommended on sites where this complex occurs. Delays in seedling establishment are likely to allow for the full development of the re-sprouting maple before the majority of crop tree seedlings are large enough to withstand its competitive impacts. Crop tree seed falling beneath the maple canopies will not have enough light to germinate and any seedling that does germinate may be smothered by leaf litter.

Since the competition-free window is relatively short, planting is generally the most effective means for rapidly establishing a crop of desired tree species. Plantations should be established prior to site domination by the maple so that they can take advantage of available growing space.

Timing

In order to minimize the impacts of the bigleaf maple and other vegetation that typically develops rapidly on sites occupied by this complex, planting should occur as soon after harvest or site preparation as possible.

5. Vegetation Management for Current Sites

Site Preparation

General

Although it may create ideal seedbed conditions for regeneration, mechanical site preparation (MSP) (i.e., ground disturbance) is likely to have little effect on maple regeneration since seed predation and other factors exert greater influence on maple regeneration from seeds.

Soil disturbance that causes mineral soil exposure will provide a suitable seedbed for salmonberry, red alder, and other species that can invade sites where this complex is found. It may also stimulate the germination of buried salmonberry seeds. Damage caused to existing salmonberry plants will stimulate re-sprouting and the spread of rhizome fragments of this species.

Mechanical

Uprooting of maple stumps can provide some level of effective control when all roots are pulled out of the ground or separated from the stump. Unless stump piles are burned, re-sprouting of stumps and stump piles and reestablishment of roots may still occur. This treatment may also result in soil disturbance that exceeds permissible limits and can be very expensive. Other forms of MSP will have no effect on maple re-sprouting.

Prescribed Fire

Successful burning of areas dominated by bigleaf maple may be difficult to achieve due to the moist nature of these sites and the lack of fine fuels. High impact burns can kill bigleaf maple, but may also cause site degradation. Light and moderate impact burns will have little impact on re-sprouting of bigleaf maple.

Light to moderate burning has been found to have little negative impact on existing salmonberry plants. The fire may remove the aboveground portion of the salmonberry but has little impact on the belowground rhizomes or buried seeds. Re-sprouting from undamaged rhizomes and establishment of new plants from seeds may cause an increase in salmonberry cover over that present prior to treatment. Only very intense burns that consume the majority of the organic layer as well as rhizomes and seed bank have been found to be effective in controlling salmonberry. However, regardless of the intensity of the burn, red alder is generally one of the first trees to become established on burned-over areas. Thus, burning may provide a very short competition-free window for establishing desired crop trees and may convert the plant community to a red alder–salmonberry complex.

Chemical

Chemical treatments can be used to control bigleaf maple, salmonberry, and red alder. A foliar application of glyphosate or triclopyr ester can control bigleaf maple, salmonberry, and red alder stems. For site preparation treatments, these herbicides can be applied at any time during the growing season.

Foliar applications of glyphosate (2.0 kg ae/ha) or triclopyr ester (1.4–5 kg ae/ha) may provide sufficient competition-free windows to ensure crop tree establishment and survival. When glyphosate is used, complete spray coverage of the foliage of the coppices is required in order to achieve effective control. Using lower concentrations of glyphosate in higher volumes of total spray solution appears to be important for optimum control. Effective control of maple sprout clumps has been reported with applications of glyphosate at a rate of 2 kg ae/ha in a total spray volume of 700 litres per hectare. Likewise, a 1% to 2% solution of glyphosate in water applied to wet the foliage surface will give effective control of maple.

Basal bark application of triclopyr ester, and stem injection or cut stump application with triclopyr ester or glyphosate can give effective control of bigleaf maple and red alder. Basal bark application of triclopyr is only effective on young stems and requires that the herbicide solution be applied to all sides of each shoot in the clump. Basal bark application of triclopyr ester does not work on mature maple due to its thick and impervious bark. Cut stump application of 2-4,D is only moderately effective for controlling bigleaf maple but is very effective for controlling red alder. Because of their selective nature, these treatments can be used to thin bigleaf maple and red alder to desired densities. Herbicides, particularly glyphosate, should not be used to thin maple shoots attached to the same stump, since the herbicide is likely to damage or kill untreated shoots. Some studies have shown that glyphosate applied to bigleaf maple using a cut stump treatment may impact on adjacent untreated stumps due to root connections.

Removing the bigleaf maple and red alder component of this complex may cause the release of salmonberry, ferns, and herbaceous vegetation which may compete with small seedlings.

Seeding

Seeding of cover crops will have no effect on the growth of sprouts from existing maple stumps but may reduce the likelihood of maple regeneration from seed. Where a suitable seedbed has been created (continuous MSP, broadcast burning, etc.) and existing salmonberry plants or rhizomes are not present, seeding of agronomic grasses or legumes may prevent or reduce the establishment of both red alder and salmonberry. If salmonberry rhizomes or established plants are already present on-site, the seeding of agronomic species may be ineffective since salmonberry may out-compete the agronomic species. While seeding with grasses can substantially reduce establishment of red alder, grass cover may result in increases in rodent damage to conifer seedlings.

Livestock Grazing

Bigleaf maple is reported to be palatable to horses and goats. However, repeated grazing of maple would be required for this treatment to be effective. Both red alder and salmonberry have low palatability and are not favoured by livestock.

Physical Barriers

Completely enclosing bigleaf maple stumps in heavy plastic or canvas bags that eliminate all light can be effective for control re-sprouting if these covers are maintained. However, a few small holes in these covers created by birds, weathering, or other factors can seriously reduce their effectiveness. Cost of installation and the need for regular maintenance of these covers makes widespread operational use of this treatment impractical.

Biological Control

Research indicates that cut stump application of the fungus *Chondrostereum purpureum* may be effective for controlling bigleaf maple. Development and registration of commercial formulation of this fungus is now complete. As of January 2002, Myco-Tech™ Paste, a formulation of *C. purpureum* strain HQ1, has been granted a one-year limited term registration for inhibition of stump sprouting on species including birch,

poplar/aspen, red maple, sugar maple, pin-cherry, and speckled alder in the boreal and mixed forest regions of Canada, east of the Rocky Mountains. Myco-Tech™ Paste is manufactured by Myco-Forestis Corporation. Input into the decision for full registration of the product is in progress.

Planting

Timing

In order to take full advantage of the competition-free window, crop tree seedlings should be planted immediately after harvest or site preparation. The longer the bigleaf maple complex can develop prior to crop tree establishment, the lower the likelihood of successful reforestation.

Stock Type

Large (415D or greater) vigorous stock with well-developed root systems improves seedling survival on these sites. Larger caliper seedlings may be better able to withstand mechanical damage from maple branches.

Species Selection

Sitka spruce, western redcedar, Douglas-fir, amabilis fir, grand fir, black cottonwood, or red alder are the preferable crop species on moist CWH sites. Douglas-fir, grand fir, western redcedar, black cottonwood, bigleaf maple, or red alder may be more suitable in the CDF.

If a silvicultural system that results in understorey light levels below 60% of full light is employed, western redcedar, western hemlock, grand fir, or Sitka spruce may be the more suitable choices. Douglas-fir, black cottonwood, bigleaf maple, or red alder should be used only where there is full sunlight and the microsite of seedling establishment is relatively free of competition. Red alder, black cottonwood, and Douglas-fir seedlings have a very low tolerance to the competitive impacts of salmonberry.

Sitka spruce should only be used if spruce leader weevil resistant genotypes are employed or on sites with a low weevil hazard.

Cluster Planting and Inter-tree Distance

Cluster planting involves planting conifers and controlling competition only within patches, while leaving the area between patches untreated. Cluster planting can provide some easing of post-establishment vegetation management costs and may provide an option for maintaining a mixture of bigleaf maple and conifers within a single opening.

The number of conifer seedlings planted and their spacing should be determined according to the conditions of the site and the associated stocking standards. Factors to consider include the size of the available cluster patches and their distribution, species selection, anticipated post free growing mortality, and the ability of the trees to self-prune within the cluster. Clusters should also be large enough to minimize problems with side shade from the maple and growth of maple crowns into the cluster.

Brushing

General

The need for brushing treatments will depend on the success and timing of the pre-harvest and site preparation treatments. Where maple coppices have been successfully controlled, follow-up treatments may be required to control the red alder–salmonberry complex that could develop in its place. Where pre-harvest or site preparation treatments have not been used to control bigleaf maple, a variety of brushing treatments can be used.

Manual

Cutting of bigleaf maple sprouts provides only short-term control of maple competition. Following cutting, stumps re-sprout vigorously with re-sprouts reaching the height of untreated sprouts within 2 or 3 years. Cutting of sprouts may also increase the number of shoots per stump. Season of cutting of young sprout clumps appears to have little effect on re-sprouting of bigleaf maple.

Thinning of shoots within individual clumps may provide a useful alternative to cutting of all shoots. Leaving one maple sprout per 25 to 40 cm of stem circumference for open grown maple or leaving 3 or more shoots on each stump where stump density exceeds 200 maple stumps per hectare appears to reduce re-sprouting vigour while increasing the amount of light reaching overtopped conifers. Follow-up thinning may be required in later years to maintain suitable understorey light conditions for growth of Douglas-fir and other conifers.

Manual cutting of salmonberry stimulates rapid re-sprouting from stem bases and rhizomes which can result in an increase in salmonberry crown closure on the treated site. Salmonberry plants cut in spring have been reported to re-sprout to a height of over 1 m by late summer. Since removal of salmonberry from the site through manual cutting is unlikely, cutting treatments should focus on maximizing the light available to the target crop tree during spring and early summer when conifer shoots are actively elongating.

Manual cutting of red alder is effective when trees are more than 10 years old. Trees younger than this can sprout vigorously with the most vigorous sprouting occurring following cutting of alder between 1 to 3 years old. For red alder control, the effectiveness of cutting increases when treatment occurs in mid-summer or when the cut stump is within partial or full shade. Stump heights below 10 cm have been shown to have fewer and less vigorous sprouts.

Girdling of mature bigleaf maple trees is very difficult, but can be accomplished using a chainsaw or power girdling tools. Since maple can readily bridge narrow girdles, a wide band of bark (20 cm or more in width) should be removed. Girdling of re-sprouts on stumps is likely to be effective but is generally impractical due to the large number of shoots requiring treatment (making cutting more practical). For red alder that are larger than 3 cm in diameter, a single girdle, located as low on the stem as possible that is at least 1.5 cm wide and that removes only the bark and cambium, is effective for killing red alder. Death of girdled trees can take two to three growing seasons.

Chemical

As described under “Site Preparation (Chemical)”, herbicide treatment may control bigleaf maple and other species for between 2 to 5 years. Foliar applications of glyphosate (2.0 kg ae/ha) or triclopyr ester (1–2 kg ae/ha) can provide effective control of bigleaf maple competition and of other species in this complex. Effective control of bigleaf maple using glyphosate requires thorough coverage of the foliage of maple clumps, which is best achieved by applying this herbicide at lower concentrations with higher volumes of water. Care must be taken to ensure that damage to the desired crop trees does not occur during application. Glyphosate application over plantations of Douglas-fir or Sitka spruce must be conducted in late summer or fall to minimize crop tree damage. Glyphosate herbicide will severely damage sprayed western redcedar, yellow-cedar, and western hemlock. Triclopyr ester applied in an oil carrier will severely damage conifers when over-sprayed. Foliar applications of triclopyr ester (in water) during dormant periods (late summer and very early spring) at rates below 2 kg ae/ha can be used for release of Douglas-fir, grand fir, Sitka spruce, and western hemlock.

Basal bark application of triclopyr ester, and stem injection or cut stump application with triclopyr ester, or glyphosate can give effective control of bigleaf maple and red alder. Basal bark application of triclopyr is only effective on young stems and requires that the herbicide solution be applied to all sides of each shoot in the clump. Basal bark application of triclopyr ester does not work on mature maple due to its thick and impervious bark. Cut stump application of 2,4-D is only moderately effective for controlling bigleaf maple but is very effective for controlling red alder. Because of their selective nature, these treatments can be used to thin bigleaf maple and red alder to desired densities. Herbicides, particularly glyphosate, should not be used to thin maple shoots within individual stumps, since the herbicide is likely to damage or kill untreated shoots. Some studies have shown that glyphosate applied to bigleaf maple using a cut stump treatment may impact on adjacent untreated stumps due to root connections.

6. Vegetation Management Strategies for Backlog Sites

General

There is little difference between the complex on current and backlog sites, other than in the size of the maple and other species. Similar vegetation management strategies employed on current sites can be applied to backlog sites with the exception that shrub and herbaceous vegetation may be much better established in gaps than would be the case in more recent clearings.

Where young stands of bigleaf maple and red alder are well established and these trees are in good condition, careful consideration should be given to accepting these as crop species, rather than attempting to convert established broadleaf stands to coniferous stands. Bigleaf maple and red alder can produce valuable wood products when trees are healthy and in good condition.

7. Summary

Any efforts at controlling bigleaf maple must recognize the potential future commercial value of wood and fibre from these trees as well as their contribution to biodiversity, wildlife habitat, aesthetics, and site productivity. Maintenance of a component of maple must be considered where this species is established.

Since the primary means of regeneration of bigleaf maple is by sprouting of maple stumps, attention should be focused on treatments that can effectively reduce the number of live stumps or the number and vigour of shoots on each stump.

Among non-chemical treatments, cutting of mature maple during May or June may help to reduce maple densities. Cutting stumps shorter than 30 cm, and cutting maple 2 years or more prior to harvest of the balance of the stand may reduce subsequent re-sprouting vigour. Where heavy browse from elk or deer is common, this may afford additional and effective control of bigleaf maple. Cutting of maple sprouts or of young red alder seedlings will provide only short-term control of competition due to rapid re-sprouting. Planting large conifer stock and thinning to reduce the number of shoots within maple sprout clumps may be an effective option for establishing conifers in this complex while maintaining a component of bigleaf maple in the stand.

Among chemical treatments, foliar application of glyphosate or triclopyr ester, basal bark application of triclopyr ester, or stem injection with glyphosate, triclopyr ester, or 2,4-D are effective for controlling bigleaf maple and red alder in this complex. Foliar application of glyphosate (1.5–2.1 kg ae/ha) or triclopyr ester (1–2 kg ae/ha in water) will give effective control of salmonberry for several years.

Maintaining a component of bigleaf maple and red alder within conifer stands will contribute to species and structural diversity and can, if maintained at appropriate densities, provide increased conifer yield as well as producing a component of hardwoods. However, if grown in intimate mixture with conifers, densities of bigleaf maple should be kept below 50 well-spaced stumps and red alder should be kept below 200 uniformly spaced trees per hectare in stands over age 10. On medium and poor sites, it is generally desirable to maintain between 50 and 100 well-distributed red alder to provide nutrient inputs that can enhance conifer yield. Likewise, it may be desirable to maintain a minor component of bigleaf maple on these sites. However, the ideal density of bigleaf maple to retain is currently unknown. As an alternative to maintaining low densities of bigleaf maple and red alder uniformly distributed through conifer plantations, these broadleaves can also be grown in patches. This patchy arrangement will provide a component of sawlog quality hardwoods. In developing plans for management of patchy arrangements of conifers and broadleaves, consideration must be given to potential differences in rotation lengths for the component species that may necessitate multiple entries.

Any proposed treatment of these sites should be assessed for its impacts on all competitive species in this complex. Control of only one competitor in the complex can potentially lead to site domination by one or all of the other competitors and result in higher competition for resources with the desired crop species than existed prior to treatment. In all cases, monitoring the non-crop species growth on these sites is essential in effective management.

On these sites, the potential use of bigleaf maple and red alder as crop species must be given serious consideration, particularly on sites with laminated root rot and on backlog sites where young stands of these potentially valuable trees are already well established.

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. 11.

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

Fried, J.S., J.C. Tappeiner, and D.E. Hibbs. 1988. Bigleaf maple seedling establishment and early growth in Douglas-fir forests. Can. J. For. Res. 18: 1226–1233.

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.

Hart, D. and P.G. Comeau. 1992. Manual brushing for forest vegetation management in British Columbia: A review of current knowledge and information needs. B.C. Min. For., Victoria, B.C. Land Manage. Rep. No. 77.

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.

Peterson, E.B., N.M. Peterson, P.G. Comeau, and K.D. Thomas. 1999. Bigleaf maple managers' handbook for British Columbia. B.C. Min. For., Victoria, B.C.

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

Tappeiner, J.C. II and J.C. Zasada. 1993. Establishment of salmonberry, vine maple and bigleaf maple seedlings in the coastal forests of Oregon. Can. J. For. Res. 23: 1775–1780.

Tappeiner, J.C. II, J.C. Zasada, D. Huffman, and B.D. Maxwell. 1996. Effects of cutting time, stump height, parent tree characteristics, and harvest variables on development of bigleaf maple sprout clumps. West. J. Appl. For. 11:120–124.

Thomas, K.D. 1999. The ecology and silviculture of bigleaf maple. B.C. Min. For., Resear. Br., Victoria, B.C. Exten. Note 33.

Thomas, K.D. and P.G. Comeau. 1998. Effects of bigleaf maple (*Acer macrophyllum* Pursh) on growth of understorey conifers and the effects of coppice spacing on growth of maple (MOF EP1121.02). B.C. Min. For., Resear. Br. Victoria, B.C. Exten. Note 24.