Operational Summary for Vegetation Management

Willow Complex

Willow Complex

This operational summary provides information about vegetation management in the willow complex. This complex is dominated by upland willows (*Salix scouleriana*, *Salix discolor*, *Salix bebbiana*, and *Salix sitchensis*). Well-developed examples of the complex almost exclusively contain willow species with only minor components of Sitka alder (*Alnus viridus* spp. *sinuata*), fireweed (*Epilobium angustifolium*), blueberries (*Vaccinium* spp.) and grasses.

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:

- Dry Alder Complex
- Ericaceous Shrub Complex
- Fireweed Complex
- Mixed-shrub Complex
- Pinegrass Complex
- Wet Alder Complex

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Operational Summary for Vegetation Management

Willow Complex

Managing competing vegetation during reforestation can be challenging. Combinations of plants that thrive in seral ecosystems are often well suited to dominating sites following harvesting or wildfire. While many treatment methods for limiting the growth and spread of these vegetation complexes have been explored, efficacy has varied widely. This is due in part to the widely varying mix of parameters from site to site, including the number, health and structure of the competing plants on site, site conditions and timing 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 during the past decade by ecologists, silviculturists, and vegetation management specialists on 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.

This operational summary provides information about vegetation management issues in the willow 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.

Species Composition

Various willow species, most commonly the upland willows (*Salix scouleriana, Salix discolor, Salix bebbiana*, and *Salix sitchensis*), dominate this complex.

Well-developed examples of this complex almost exclusively contain willow species, with minor components of Sitka alder (*Alnus viridis* ssp. *sinuata*), fireweed (*Epilobium angustifolium*), blueberries (*Vaccinium* spp.) and grasses.

Occurrence

The willow complex is found on severely disturbed sites in the IDF, ICH, MS, ESSF, SBS, and BWBS zones, most often following wildfire. This complex typically occurs on not satisfactorily restocked (NSR) backlog sites.

This complex can also occur on the wetter productive alluvial bottomlands. This riparian variant, too wet to manage for any crop other than cottonwood, is highly valuable wildlife habitat.

Willows are adapted to a wide range of soil and moisture conditions, ranging from moist Regosolic and Gleysolic soils on alluvial sites, to well-drained, coarse-textured upland soils including Luvisols and Brunisols.

Reproduction

On upland sites, the willow complex is established from wind-borne seed dispersed in early to mid-summer. The seeds remain viable for only a short period. For germination to occur, moist, exposed mineral soil and full sunlight are required.

Once established, willows are particularly resistant to mechanical damage and can produce abundant resprouts from the root collar. Stem and root fragments will root naturally if buried in moist soil.

Rate of Development

The growth rate of willow sprouts greatly exceeds that of crop seedlings. Annual height growth of willow sprouts averages 1–3 m/year following manual cutting. Cut or damaged stems produce up to 60 new stems per cut stem, greatly increasing the number of stems per hectare after each manual cutting.

At higher elevations, willow has slower growth rates. The upland willows may only reach 4–5 m in height after 15 years when developing from seed. After that time, the species growth tapers off quickly to a maximum height of 10 m.

Treatments that Affect Development

The following factors and treatments favour the development of the willow complex:

- severe wildfires, which expose large areas of mineral soil
- prescribed burning
- treatments that expose mineral soil, such as the summer use of brushblades and V-plows
- nearby willow seed sources and mechanical site preparation (MSP) treatments immediately **before** seed dispersal

- mechanical site preparation treatments that mix stem and root fragments into the soil.

The following factors hinder the development of the willow complex:

- plant species — either native or domestic — that provide continuous ground cover
- drier sites can inhibit willow seed germination.

Interaction with Crop Trees

Although common in the Interior and wet or alluvial sites on the Coast, willow competition is most widespread in the northern SBS and in the BWBS. In these zones, willow is abundant and dominates sites due to frequent fires. Following a disturbance, willow grows rapidly, outgrowing its competitors and forms dense thickets that inhibit the natural regeneration of conifers.

No direct benefits of willows on conifer growth have been reported.

Willow plays a major part in rehabilitating severely damaged sites (e.g., wildfire areas). It also contributes to the development of soil organic layers so that other species can establish and develop.

Willow species are an important year-round browse species for wildlife. Moose browse on twigs in winter and new shoots and leaves in summer. Willow species are also a valuable summer and winter food source for deer and of some importance for elk. Willow provides important food and habitat for small mammals and birds, and is a major source of early spring pollen for bees and other insects.

Retaining forage species such as willow is recommended where crop trees are not directly affected, and in riparian areas. Floodplains with this complex are generally too wet for conifer production.

Silvicultural System

Increased light levels following overstory removal favour willow establishment and growth. Mature or decadent willow trees will produce epicormic or basal sprouts, and increase their seed production when exposed to increased light levels. Following partial cutting, willow re-establish poorly because they are highly shade intolerant, short-lived, and require exposed mineral soil seedbeds.

Advance Regeneration

Willow dominated sites must be promptly reforested after harvesting. Hence, preserving acceptable advance regeneration may contribute to successful reforestation.

Method of Reforestation

Planting is required on these sites.

Timing

When harvesting or burning drier upland sites in areas prone to willow invasion, prompt reforestation with large stock will minimize the need for follow-up brushing treatments.

5. Vegetation Management Strategies for Current Sites

Site Preparation

General

Willow is seldom widespread on recently harvested sites, except along stream sides and areas of recent disturbance such as avalanche slopes. Therefore, vegetation management strategies for these sites should limit willow establishment by seed to avoid future brush problems. Control of existing willow thickets is necessary when MSP or severe fire creates suitable seedbeds.

Mechanical

In general, mechanical site preparation will increase the abundance of willow on site. The more extensive and intensive forms of MSP may promote germination of willow seed. Winter operations expose less mineral soil thereby minimizing establishment by seed germination.

High-impact MSP such as blading or V-plowing, which exposes large areas of mineral soil, should be avoided when seed sources are nearby. Where blading is required, the treatment should be timed for **early August** to miss seed dispersal.

Mounding, a less extreme form of MSP, will raise conifer seedlings above surrounding competition, increase soil temperatures and enhance establishment of more tolerant crop species such as spruce.

Screefing

This treatment will damage willow stems, causing them to sprout. Screefing exposes mineral soil, thus aggravating willow competition over the long term.

Prescribed Fire

Aerial parts of willow are easily destroyed by fire. However, resprouting after fire is vigorous and willow cover can exceed pre-treatment levels within a few years. The intensity and duration of the burn may affect the vigour and intensity of sprouting.

Severe burns will set back existing willow but will expose mineral soil, which in turn will promote willow invasion. Eradication of willow is unlikely, regardless of fire intensity.

Chemical

Chemical treatments have produced variable results because of the wide range of responses of different willow species.

Glyphosate (applied in mid-summer if no conifers are on site or in fall to cut stumps) or a spot application of hexazinone appears to be effective. Foliar application of 2,4-D ester and glyphosate have produced mixed results. Triclopyr ester applied as a foliar, cut-stump or basal bark treatment can give effective control of willow.

Seeding

Seeding may be used to enhance grazing opportunities or to rehabilitate sites where mineral soil exposure has been excessive. A grass/legume mix seeded following an MSP treatment more effectively controls willow competition than a grass/legume mix seeded following a prescribed fire. This treatment should be carefully monitored because the impact of the grass/legume competition on crop trees is not well known.

Livestock Grazing

This treatment may be generally used to meet site preparation objectives since willow is palatable to sheep.

Planting

Timing

Delays in planting reduce regeneration success and increase the need for follow-up brushing treatments.

Stock Type

Large stock types (PSB 415 or greater) with good vigour and large diameter should be used where willow competition is expected to be intense. In a typical willow complex, snowpress is less of a problem than is competition.

Species Selection

Where appropriate, choose a fast-growing crop species. In some zones, choosing lodgepole pine over white spruce will often allow the crop to outgrow willow competition, and eliminate the need for a follow-up brushing treatment.

Willow thickets are used by small mammals for cover. The presence of willow canopies therefore often increases small mammal damage to conifer crop trees. Hares and voles prefer lodgepole pine to spruce.

Brushing

General

Following harvesting, willow develops rapidly when root systems remain intact. Plans for brushing must be made early. In most cases there is a two-year window to implement ground spray programs — as either site preparation or crop-tree release — or sheep grazing before the willow is too tall to treat from the ground.

Manual

Willow clumps can be cut with brushsaws, but this treatment will reduce neither willow density or cover until the crop tree canopy closes.

Once young willow saplings are established, a single manual cutting is usually ineffective due to the rapid growth of numerous stump resprouts. A single manual cutting will produce a significantly greater number of resprouts than a herbicide treatment. Cutting in late summer may slightly reduce the ability of willow to resprout. When lodgepole pine or a similar rapidly growing conifer crop is established, two or more brushing entries may allow the crop trees to outcompete the surrounding vegetation.

Chemical

Glyphosate, hexazinone, triclopyr ester, and 2,4-D ester can control willow. Glyphosate, applied as either a broadcast foliar spray or on cut stumps, produces variable control. Though effective, hexazinone can damage crop seedlings, particularly pine. A surface soil organic layer can make hexazinone ineffective. Application of 2,4-D ester as an early foliar treatment has provided moderate control. Basal or cut-stump application of triclopyr is effective on willow.

Livestock Grazing

Sheep browsing can successfully control young willow, provided the willow plants are not taller than 1.5 m. Grazing must be monitored to prevent crop damage, and repeat entries are often required.

General

Often abundant live vegetation or snags make site preparation mandatory to facilitate planting. Whether existing regeneration is worth preserving is an important consideration when viewing a backlog site. If advanced regeneration is completely absent or not worth preserving, an MSP treatment over the entire area may be appropriate. If scattered regeneration is worth saving, a spot treatment and “fill-planting” can be carried out.

When a backlog site is site prepared, it may physically resemble a recently harvested area. However, the vigorous willow root systems often remain intact and will aggressively resprout.

Mechanical

Backlog willow complexes are typically found on areas where wildfires have occurred, under the standing or downed snags. Willows on these sites are often 10–25 years old and well established. Either summer or winter MSP operations are required to windrow or bunch the snags and associated vegetation.

Summer operations uproot the willow stems and expose extensive mineral soil, thus increasing the chance of new willow seed germination. Site degradation, such as soil compaction, may also occur. Where MSP treatment is feasible, seeding a grass/legume mix is recommended (following the MSP) to reduce willow re-invasion.

Winter operations, often using two caterpillars with a cable stretched between, can pile snags and shear off the aerial portions of willow, but the roots can resprout the following spring.

The Madge Rotoclear has been found to knock down deciduous stands with stems up to 14 cm in diameter. Where this equipment is used, branches, twigs, and smaller stems are mixed into the soil to a depth of 15 cm. This treatment can shift the vegetation community to dense grasses.

Prescribed Fire

While aerial parts of willow are easily killed by fire, sprouting from willow root crowns following fire usually increases willow cover within a few years. If mineral soils are exposed by fire, they provide ideal seedbeds for willow.

Chemical

Chemical site preparation is effective following low-impact MSP if willow has resprouted. It is also effective in open willow brushfields with no standing or downed debris. Glyphosate, hexazinone, and triclopyr ester are suitable. Refer to *Site Preparation, Chemical* (Section 5).

Manual

Manual cutting following low-impact MSP or in open willow brushfields may be considered. However, manual control is not recommended for control of vigorous established clumps of willow.

"Brown-and-Burn"

This treatment may reduce willow sprouting but creates the ideal willow seedbed.

While the willow complex may be considered a silvicultural challenge, it is an important winter range or browse resource for wildlife species. Therefore, enhancing willow growth may be appropriate on some sites.

Among the non-chemical treatments, selection of fast-growing crop species, large planting stock, seeding with a grass/legume mix, and grazing treatments are leading choices for reducing vegetation competition on recently harvested sites. There are many factors to consider in the selection of the treatments. The backlog sites usually have well developed willow complexes and hence resprouts present special problems as outlined in Section 6, *Vegetation Management Strategies for Backlog Sites*.

Among the chemical treatments, both glyphosate and hexazinone can provide two or more years of control from willow competition.

Glyphosate is useful for both site preparation and conifer release broadcast applications. However, control of willow with glyphosate is erratic. High application rates are often necessary to achieve control.

Application of hexazinone using spot guns provides excellent control of willow, while broadcast application is less effective. Hexazinone, a soil-active herbicide, requires adequate rainfall to carry it into the soil profile. Hexazinone can damage conifers, lodgepole pine being particularly sensitive. A broadcast foliar spray of 2,4-D ester or triclopyr ester delivers variable results. Triclopyr ester applied as a cut-stump or basal bark treatment provides very effective control.

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.

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.

Park, A. 1993. Guidelines for maintaining biodiversity during juvenile spacing. B.C. Min. Env., Lands and Parks, B.C. Min. For., and Can. For. Serv., Pacific For. Centre. Victoria, B.C.

Porter, G.L. 1990. Willow species of disturbed sites in the Sub-Boreal Spruce zone of north-central British Columbia. For. Can. and B.C. Min. For., Victoria, B.C. FRDA Handb. No. 004.

Province of British Columbia. 1993. Provincial seedling stock type selection and ordering guidelines. B.C. Min. For., Silv. Br., Victoria, B.C.

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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