PRIVATE MANAGED FOREST LAND COUNCIL

Reforestation

Reforestation is one of the key management commitments from landowners defined under the Private Managed Forest Land Act, and is required on areas where timber has been removed through harvesting or natural processes, such as fire, insects, diseases, or other causes. This presentation discusses the key components of reforestation on your property.

Reforestation is a process that starts with a sound understanding of the ecology of the site and includes all of the steps necessary to achieve the legislated obligation of a successfully regenerated stand.

1. Site Assessment and Ecological Classification:

The first step in the reforestation process is a detailed site assessment that looks at the soil characteristics, plant and tree species present, slope, aspect, soil moisture, nutrient status, forest health issues, wildfire risk, wildlife habitat, riparian features, and other resource values. The information gathered in the assessment will be used in conjunction with one of the Regional Site Identification Field Guides developed by the B.C. Ministry of Forests to guide the ecological classification of the site. In B.C., the standard for classifying forest sites includes Biogeoclimatic Zones (BEC)[1] and ecological site series[2].

2. Reforestation Strategy:

Once the site assessment has been completed a reforestation strategy can be developed. Ideally, the reforestation strategy will be part of a larger plan called a Site Plan or Silviculture Prescription that is completed prior to harvesting a site. This ensures that an appropriate silviculture system and harvest method can be selected that will provide favourable conditions for establishing a healthy new stand.

The reforestation strategy will consider the appropriate regeneration method (natural versus planting), suitable tree species, planting stock, micro sites to plant, planting density, protection from forest pests and pathogens, and stand tending treatments.

a) Natural regeneration versus Planting

There are a number of things to consider when deciding to naturally regenerate or plant your harvested area

Factors limiting natural regeneration:

- Good seed supply – Douglas-fir (Fd) seed crops are irregular with 1 medium and 1 heavy seed crop every 5-7 years; even during heavy seed years only 25% of trees produce a lot of cones; Ponderosa Pine (Py) have good seed crops every 4-5 years.
- Many seeds are consumed by insects, birds and mammals
- Seed bed suitability – seeds germinate best on mineral soil
- Unfavourable environment for seed germination and survival
- Competing plant species

1. Biogeoclimatic Zone - groups of ecosystems under the influence of the same regional climate.
2. Site series - ecosystems that have similar soil moisture and soil nutrients and have plants species that are indicative of the potential vegetation community that can occupy a site at maturity.

For details go to: www.for.gov.bc.ca/HRE/becweb/resources/maps/index.htm

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Other considerations include:

- Regeneration delay - time for new trees to get established and grow could be quite long versus the legal requirement to achieve restocking within 5 years (at 600 well distributed trees/ha) and successful regeneration within 15 years
- Seedling distribution – clumpy distribution with naturals with heavier concentrations in disturbed areas (skid trails), along timber edges and near leave trees versus the legal requirement to have well distributed stocking.
- Species mix – depends on which tree species are left along timber edges and as leave trees, how far seeds travel (Fd seeds generally fall within 100 m of seed tree, Western Red Cedar (Cw) seeds don't travel as far, Lodgepole Pine (Pl) seeds tend to stay in the cone until heat/fire opens them). It also depends upon the size of the openings created and whether species on site are shade tolerant (Fd, Cw) or shade intolerant (Py, Lw).
- Leave tree/Seedling quality – if the trees you leave behind are poor quality, the new forest is likely to be of poor quality; if leave trees are spindly or have very small crowns they may break or die before they can produce seeds

Many (but not all) of the limiting factors and other considerations can be overcome or manipulated by planting:

- Seedlings are grown from improved seed sources (superior traits such as fast growth or disease resistance)
- You can choose the appropriate species mix
- Seedlings are planted in a uniform pattern throughout the harvested area or specific areas can be fill planted.
- Best possible microsites can be selected for planting to ensure seedling survival and growth
- Preferably seedlings are planted soon after harvest so they can grow more quickly than competing brush species
- You can choose the time of year to plant to ensure the best success

(b) Species acceptability/Selection

There are two criteria in determining species selection for your harvested areas:

1. species have to be listed on your management commitment
2. species should be ecologically suited to the area you are managing

Douglas-fir is intermediately shade tolerant, and can grow in the open or in the undertorey of a stand. It will generally tolerate a relatively wide range of site conditions.

Lodgepole pine grows on drier and nutrient poor to very poor sites

Western redcedar grows on moist to wet and nutrient medium to rich sites.

Grand fir grows on moist, but not wet, and nutrient rich sites.

White pine grows best on sites that are most suitable for Fd but grows more slowly than Fd.

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(c) Stock type/size

You have to assess your site before ordering seedlings to determine the appropriate stock size and type. There are generally two types of seedlings grown at the nursery, though very few bare root seedlings are still grown and more than likely you will be selecting container stock:

Container (plugs)	**Bare root (transplant)**
Smaller root system but can grow preferred stock size to match site factors	Larger, fibrous root system most suitable on sites with heavy brush competition
Smaller stem diameter but can grow stock size to match site factors	Larger stem diameter (caliper) most suitable on sites with snow press, heavy brush competition or animal damage
Easier and cheaper to grow in nursery 410/412B $0.24 - $0.28/seedling 412A $0.35 - $0.50/seedling 415B $0.27 - $0.35/seedling 415D $0.35 - $0.50/seedling 512A $0.47 - $0.55/seedling 615 $0.60 - $0.65/seedling	Less likely to be available as surplus stock $0.35 - $0.50/seedling
Easier and cheaper to plant	Difficult to plant well, more expensive to plant

Note: prices vary by species, and do not include seed costs and storage. If ordering less than 500 seedlings prices may be higher

Stock size considerations:

- Large plugs are better able to withstand animal damage and vegetation competition because larger stems and root systems
- Larger plugs are less prone to frost heaving in fine textured soils
- Shorter plugs are more suitable in shallow soils, and easier to plant in very coarse textured soils (lots of cobbles or stones)
- 2 year old container stock is not recommended because seedlings get root bound and are more susceptible to insect, diseases and nutritional problems at the nursery which result in poor development on the site and eventual toppling of trees years after planting

When ordering seedlings you need to provide the nursery with the general location of the harvested area, biogeoclimatic zone and elevation so they grow seedlings from seeds of an appropriate seedlot.

Also note that if you plan to have the nursery grow the seedlings for you then you have to order the seedlings two falls before you want to plant (ie. order seedlings Oct 2009 to plant in the spring of 2011). If you want to try and purchase surplus stock (not advisable if you require larger stock because there is generally a limited selection) then you should start contacting your nursery in January (or even December-year prior to) of the year you want to plant.

A list of nurseries is available at www.for.gov.bc.ca/nursery/extensn/bcdirectory.htm

(d) Planting site selection

Planting on the most appropriate microsites for the ecological and climatic conditions on your site will ensure the best survival and growth of the seedlings.

Limiting Factor	Planting Site/treatment
Wet site	Prefer raised microsites/ do not screef forest floor
Frost prone sites	Prefer raised microsites/ do not screef forest floor
Brushy sites	Prefer raised microsites / screef forest floor
Dry sites & drought prone sites	Prefer mineral soil Plant early in the spring
Hot dry sites	Avoid raised microsites and prefer flat areas and sides of depressions (not bottom of depressions); prefer east side of stumps
Hot dry sites where late spring frosts are uncommon	Plant as early as possible in spring

(e) Planting density

There are two things to consider when deciding on your planting density (trees/ha):

1. PMFLC Regulation(section 31) requires a minimum of 600 well distributed trees/ha throughout the disturbed area by age 5 and that has to be maintained until age 15
2. the volume and value of the wood you want to produce from your trees

Minimum Stocking and Risk Management

- You should be planting more than the minimum requirement. If you only plant 600 trees/ha and even only 10% of your trees die you will not meet your minimum stocking requirement and you will have to fill plant. Remember that 600 crop trees per hectare are required 10 years following restocking at the successfully regenerated point. This may mean planting to a target of 1200 crop trees per hectare on some sites.
- The drier, wetter, or brushier the site, or you have a deer browse problem, or you are relying on natural regeneration the more likely you are to have some mortality and therefore patchier stocking
- So the density at which you plant depends on how much risk you want to take that your plantation will fail

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Tree Quality

- The more widely spaced the tree the more live crown or live branches and more taper it will have
- The number and size of live branches (or knots) affect the strength and appearance of the wood. The poorer quality the wood the more limited the products that can be produced and the lower the value of the wood

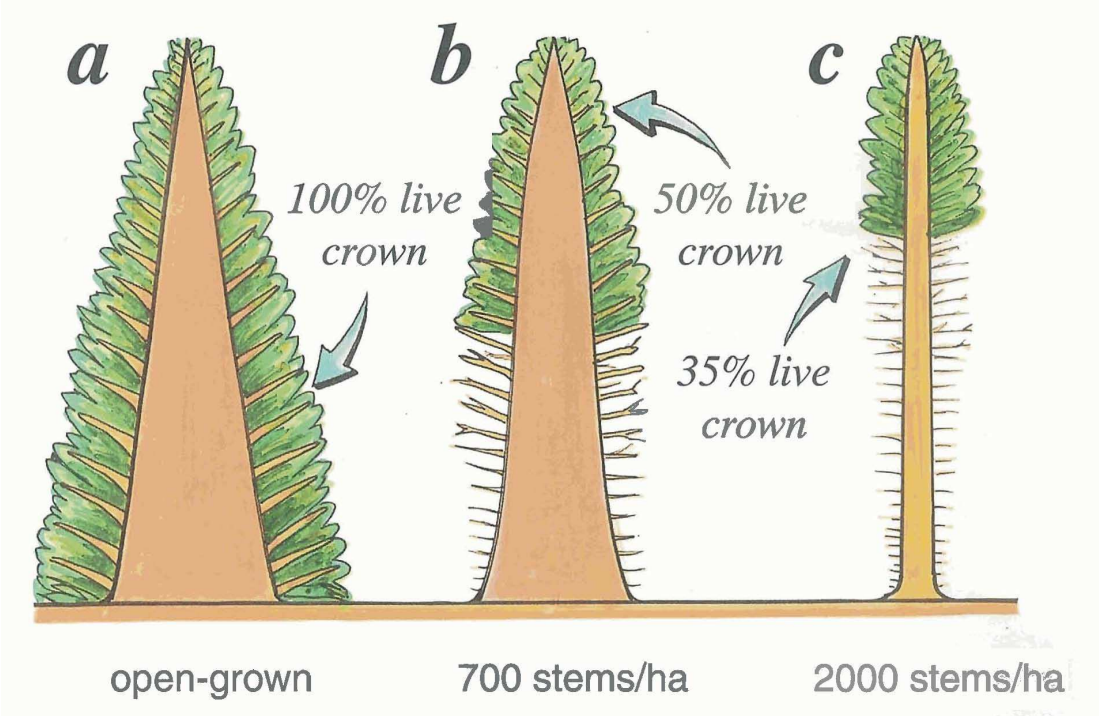

Figure 1. Effect of stocking density on crown development (from A Discussion of Wood Quality Attributes and Their Practical Implication, 1994)

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(f) Forest Pests and Pathogens

Some examples of potential forest pests and pathogens are presented here, though they focus on only a few that are present in the southern interior, and is by no means a comprehensive list. A good resource for information on forest pests is the BC Ministry of Forests Illustrated Guide to Pests: www.for.gov.bc.ca/rsi/ForestHealth/guide

Western Spruce Budworm

- Feeds primarily on Douglas-fir, but is also found on True firs (Grand fir, Amabalis fir), Larch and Spruce species.
- Trees of all ages are susceptible, and mortality is often associated with suppressed or younger trees, particularly in multi-layered stands. Larvae prefer current foliage, but will feed on older foliage if current foliage is depleted.
- Effects of budworm defoliation include stem deformities, loss of incremental growth, and tree mortality. It can also predispose trees to other forest health problems such as root diseases and Douglas-fir bark beetle.
- Short term management strategies include the application of a naturally occurring biological insecticide Bacillus thuringiensis var. kurstaki (B.t.k.), though it is applied with aircraft and is not practical for small scale applications.
- Long term management strategies focus on lowering stand density, having fewer canopy layers (ie. removing the understorey through controlled burns or spacing), and promoting species diversity. This will increase tree resilience and decrease susceptibility.

Douglas fir Tussock Moth

- Feeds primarily on Douglas-fir, but is also occasionally found on Ponderosa Pine and Western Larch if adjacent to infested Douglas-fir.
- Trees of all ages are susceptible, and it has the potential to cause significant mortality, because the mature larvae will feed on older foliage.
- Effects of Tussock Moth defoliation include stem deformities, top kill, and tree mortality. It can also predispose trees to other forest health problems such as root diseases and Douglas-fir bark beetle.
- Short term management strategies include the application of Nuclear polyhedrosis virus (NPV) or Bt.k., though it is applied with aircraft and is not practical for small scale applications.
- Long term management strategies, as with spruce budworm, focus on lowering stand density, having fewer canopy layers (ie. removing the understorey through controlled burns or spacing), and promoting species diversity. This will increase tree resilience and decrease susceptibility.

White Pine Blister Rust

- The primarily hosts are western white pine (Pw), limber pine and whitebark pine. The alternate hosts include most species of Ribes (currants and gooseberries).
- Trees of all ages are susceptible, but mortality occurs most rapidly on juvenile trees.
- Effects of blister rust include spiked tops and tree mortality when the canker is located on the stem.
- Management strategies include the planting of rust resistant Pw stock, and the removal of ribes shrubs on site.

Armillaria Root Disease

- All conifers and all ages are susceptible to armillaria, though some species have a lower susceptibility (Cw, Lw)
- The disease may be restricted to scattered individual trees, or may produce extensive infection centres.
- Infected trees display crown symptoms which include reduced leader and branch growth, thin chlorotic foliage, and distressed cone crops.
- Other signs include large quantities of resin exuding around the lower bole, and mushrooms (fruiting bodies) appear in clumps around the root collar.
- Management strategies include the planting of less susceptible species such as Cw and the removal of stumps after harvesting, if the site and soil conditions permit.

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Deer browse

Browse damage to conifer seedlings by deer and elk can be common in lower elevation stands.

Deer feed on both dormant seedlings (winter browsing) and growing seedlings (summer browsing).

Deer find freshly planted red cedar seedlings particularly tasty and often browse them beyond the point of recovery.

Douglas-fir is sometimes also browsed but is more often able to recover, and bounces back better than other species such as Ponderosa Pine.

There are a number of methods to protect seedlings from deer/elk browsing:

Technique	Advantage	Disadvantage
Advanced planning (most effective for low and moderate deer populations) • reduce edge effect • manage forest cover • manage aspect • manage species composition	No additional cost	May not be effective if populations increase
Obstacle planting (in amongst slash)	Cheap	may not be enough places to hide seedlings; deer may still find seedlings
Mechanical barriers over seedlings	they work some are reusable	some are quite expensive to purchase • Sinocast $1.70 3 ft, $2.00 4ft + $0.50 stake + installation ($1.70/Sinocast) • Vexar $3.00 installed maintenance required, often annually don't biodegrade (Vexar) some don't stand up well in windy areas
Commercial repellents	they work	some have to be applied twice a year; labour intensive to spray each seedling, but may be able to spray selected trees; some have odour
Deer resistant cedar seedlings	No follow-up treatment/maintenance	not commercial available for 5 years deer may eat them if nothing else available
Fertilizers containing sulphur	May make seedling unpalatable for long enough that the seedlings grow above deer height	? $0.09/fertilizer bag + $0.05 each for planting cost

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(g) Stand Tending

Brushing

Not all brush or competing vegetation is bad. But competing vegetation can interfere with the establishment, survival and growth of the trees by reducing the availability of light, water and nutrients or by interfering with the seedlings physically or chemically.

Some common competing herb and brush species in the IDF and ICH are:

- Pinegrass, Snowberry, Alder, Thimbleberry and fireweed
- invasive plants include Purple Loosestrife, Canada and other thistles

You are required to have a successfully regenerated stand (of a minimum 600 well distributed crop trees) within 15 years of harvest. "Successfully regenerated" means the crop trees have to be 125% of the brush height within 1 m radius of the crop tree.

Prevention of brush problems is easier than treatment and can include minimizing soil disturbance (exposed soil) or cleaning off equipment before it gets to your property (remove invasive plant seeds).

The key to achieving "successful regeneration" is **monitoring** your plantation. Once the seedlings are planted, you should be walking through your harvested areas once every year for the first few years to assess brush development and seedling growth. This will allow you to promptly deal with any issues.

As discussed earlier, if correct species of seedlings are planted within the first year of harvest with the appropriate stock type the seedlings will become established before much of the competing vegetation and will be able to outgrow the brush, especially if the brush consists of species like thistles or fireweed.

Generally in areas where there is a significant component of brush around the crop trees and/or crop tree densities are low, treatments may be necessary to meet the successful regeneration requirement.

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Some vegetation management options:

Treatment	Tools	Vegetation	Comments
Manual cutting	Machetes, brush hooks, handsaws, brush saws, chainsaws	Thimbleberry Broom Alder (< 5 cm diameter) Maple	• Short term release of crop trees • Increases competition of some shrub species because increases number of stems (salmonberry, thimbleberry) • Deciduous species often vigorously resprout • Timing is important to minimize resprouting (cherry, alder) or seeding (Scotch broom)
Manual knocking down	hockey sticks	Pinegrass, fireweed	• Short term release of crop trees • Easy and effective prevention of vegetation press if area not extensive
Manual pulling		Broom Alder	• Easy and effective removal when vegetation is 0.5-1 m height
Manual girdling	Girdling tool, chainsaws	Alder > 5 cm diameter	• Variable effectiveness • Technique and timing is important to prevent resprouting
Chemical	Foliar backpack applicator Spray bottle	Thimbleberry Alder Maple	• Very effective • Timing critical with backpack applications for effective treatment and to prevent damage to crop trees • No treatment zones required adjacent streams • Follow Integrated Pest Management Act and Regulation**
Mechanical stumping	Backhoe	Maple	• Prevents sprouting if stump is completely pulled out and turned upside down

**More information on regulation and use of herbicides can be obtained at the Integrated Pest Management website www.env.gov.bc.ca/epd/ipmp/index.htm.

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Spacing and Thinning

Spacing and thinning treatments alter the stand density by reducing the number of stems per hectare, and are typically carried out for the following reasons:

- can aid in reducing a stands susceptibility to pests and pathogens
- concentrate the growing potential of the site onto fewer trees, thereby increasing the rate of growth in the stand.
- Modify species composition in a stand

Thinning treatments can be done at various stages in the development of a stand. The first thinning treatment is generally called juvenile spacing of pre-commercial thinning, whereby very young stems are removed (< 20 years old). Commercial thinning is carried out later in the life of the stand, when merchantable stems can be removed. Mechanical methods include using brush saws when juvenile spacing and chainsaws or harvesters when commercial thinning.

Pruning

Pruning refers to the removal of live or dead branches from trees and is carried out for the following reasons:

- to produce clear, knot-free timber for high value lumber or veneer
- to control the spread of pathogens such as white pine blister rust
- as a fuel management tool to remove branches that form a fuel ladder from the ground to the crown.

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Resources:

The following is a brief list of resource material for forest landowners:

- Managing Your Woodland – Small Woodlands Program of B.C.

  Link: www.woodlot.bc.ca/swp/Downloads/files/MYW.pdf

- Managing your woodland: a non-forester's guide to small-scale forestry In British Columbia

  Link: www.for.gov.bc.ca/hfd/pubs/Docs/Sil/sil100.htm

- Small Woodlands Program of B.C. – Agroforestry Guide

  Link: www.woodlot.bc.ca/swp/Downloads/files/AgroforestryGuide.pdf

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