Restocking and successfully regenerating harvested areas are two of the legal requirements for maintaining managed forest land status. This presentation discusses the key components of achieving restocked and successfully regenerated stands on your property.

(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 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; old growth trees produce more seed than 2nd growth
- 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

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 400 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
- Species mix – depends on which tree species are left along timber edges and as leave trees, how far seeds travel (Fdc seeds generally fall within 100 m of seed tree, Cw seeds don't travel as far, Dr seeds are very light and can travel considerable distances) and how large your harvested area is (shady or open = shade tolerant or shade intolerant species)
- 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
- 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

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(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 (see recommended tree species guide for CDFmm or CWHxm and silvics table)

Douglas-fir (Fdc) is generally the preferred and most productive (fastest growing) species because it will tolerate a relatively wide range of site conditions.

Lodgepole pine (Plc) grows on drier and nutrient poor to very poor sites but also in nutrient poor to very poor wet sites.

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

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

White pine (Pw) grows best on sites that are most suitable for Fdc but grows more slowly than Fdc. Pw is root disease resistant but susceptible to white pine blister rust.

Western hemlock (Hw) is not a suitable species in the CDFmm biogeoclimatic subzone. In the CWHxm biogeoclimatic subzone it is most productive on moist to very moist and nutrient poor to medium sites. It does not grow well on sites dominated by salal.

Red alder (Dr) is more productive in the CWHxm biogeoclimatic subzone than in the CDFmm biogeoclimatic subzone. It grows best on nutrient rich and slightly moist to moist sites.

Big leaf maple (Mb) is most productive on slightly dry and nutrient rich sites and on flood plain sites.

(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:

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 (calliper) 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
- 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) 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 400 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 400 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 400 crop trees per hectare are required 10 years following restocking at the successfully regenerated point.
- 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

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

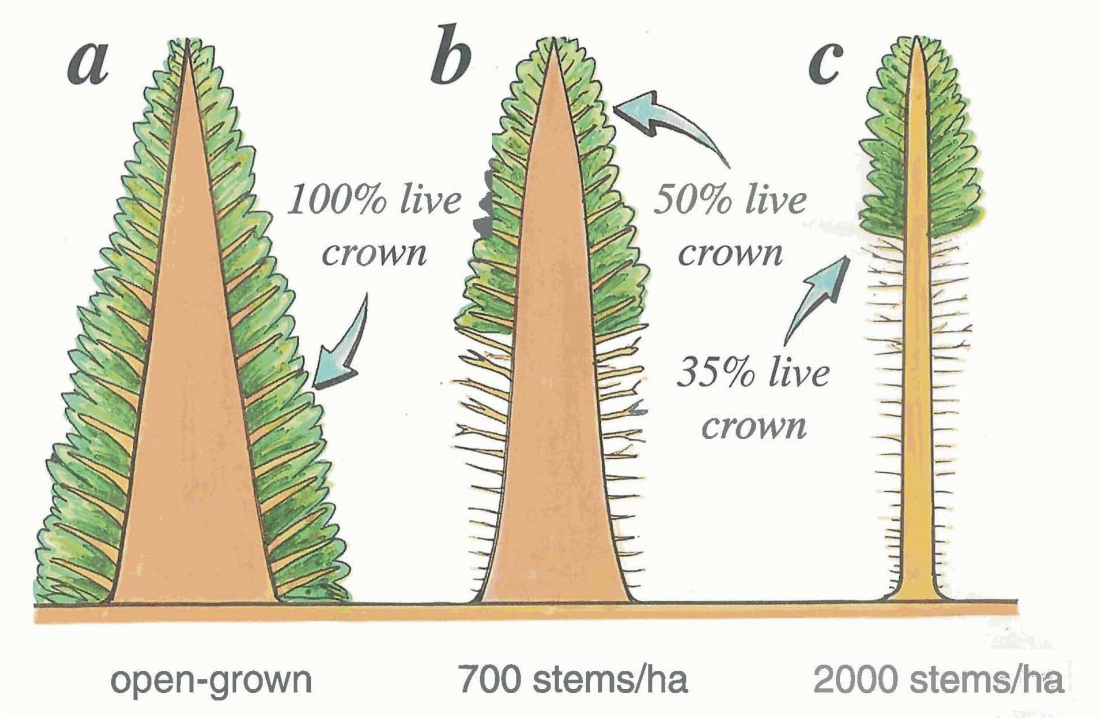

Figure 1. Effect of stocking density on crown development (from A Discussion of Wood Quality Attributes and Their Practical Implication, 1994)

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(f) Deer browse protection

Browse damage to conifer seedlings by black-tailed deer (and elk on Vancouver Island) is the most common type of mammal damage on the coast.

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 are sometimes also browsed but are more often able to recover.

There are a number of methods to protect seedlings from deer 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

(g) 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.

Most common brush species in the CDFmm and CWHxm are:

- salal on moderately dry to wet and mainly poor sites
- bracken fern on moderately dry to fresh and nutrient poor to medium sites
- salmonberry or thimbleberry on fresh to wet nutrient rich sites
- maple and alder on moderately dry to wet nutrient rich sites
- invasive plants include Scotch broom, Canada and other thistles

You are required to have a successfully regenerated stand (of a minimum 400 well distributed crop trees) within 15 years of harvest. "Successfully regenerated" means the crop trees have to be 150% 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.

Some vegetation management options:

Treatment	Tools	Vegetation	Comments
Manual cutting	Machetes, brush hooks, handsaws, brush saws, chainsaws	Salmonberry Thimbleberry Broom Alder (< 5 cm diameter) Maple cherry salal	• 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	Bracken fern, 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	Salmonberry Thimbleberry salal 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.