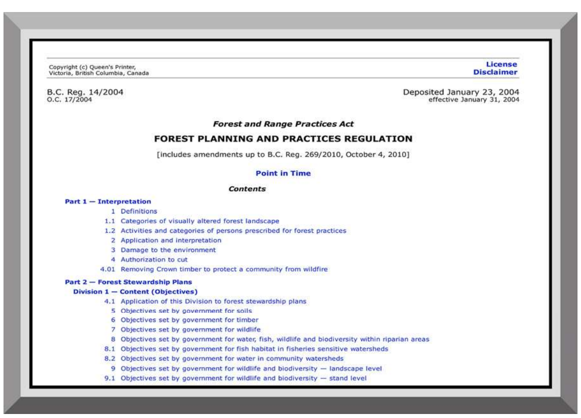
Chapter 13 - "Basic Silviculture Knowledge"

In this chapter, we'll talk about some basic silviculture knowledge, why we plant trees, general obligations for government and industry, basic seedling physiology, and an examination of soils and ground layers.

Silviculture is the branch of forestry that deals with establishing, caring for, and reproducing stands of trees for a variety of forest uses including wildlife habitat, timber production, and outdoor recreation.

British Columbia has laws to ensure that when public Crown land is logged, it gets reforested to certain minimum standards. The main legislation is the Forest & Range Practices Act. Within this Act, there's a regulation called the Forest Planning & Practices Regulation which specifies the actual reforestation expectations, such as stocking standards, content requirements for silviculture plans, the use of seed, the specifics of "free growing" status, and reporting requirements. Free Growing means that a plantation has reached a maturity level where the government basically says, "Good work," and the logging company has no further reforestation obligations. Other provinces have their own versions of this legislation. Interestingly, the Forest & Range Practices Act has been updated recently. Among other changes, the Chief Forester now has expanded authority to establish mandatory stocking standards across the province, which is being used to for the planting of climate-adapted species, which will hopefully ensure that the seedlings we plant today will be able to survive the climate that is predicted for several decades from now.



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Forest and Range Practices Act

FOREST PLANNING AND PRACTICES REGULATION

[includes amendments up to B.C. Reg. 269/2010, October 4, 2010]

Point in Time

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Figure 13.01
Forest Planning & Practices Regulations.

If you're really curious about detailed government standards with respect to forestry, you can find legislation posted online. Source: BC Government.

Stocking Standards

The plans that license holders operate under include detailed lists of stocking standards. Let's try to understand what they mean.

Preferred and Acceptable Species are the different species that are considered to be best suited to the site. Preferred species are those species that the forester would prefer to establish on the site. Acceptable species aren't the best species for the site, or may have less value as future crop trees, but they'll grow well enough. The combination of Preferred and Acceptable are the species that may legally be counted when doing surveys about the effectiveness of reforestation efforts.

The Target Stocking Standard (TSS) is the number of well-spaced preferred and acceptable trees per hectare that is expected to be able to eventually produce a free-growing crop.

The Minimum Stocking Standard for Preferred and Acceptable Species (MSSp+a) is the minimum number of well-spaced, preferred, and acceptable trees per hectare needed to achieve free growing status.

The Minimum Inter-Tree Distance (MITD) is the minimum acceptable horizontal distance between the centers of two trees. If the trees are on a slope, you can't measure up or down the slope. You have to imagine that the trees are grown to maturity, so you need to measure horizontally between the centers of the trunks.

The Minimum Height at Free Growing is the minimum height that a healthy, well spaced tree must be, in order to count in a Free Growing survey.

The Regen Delay Date is the date by which a minimum number of healthy, well-spaced, preferred and acceptable trees must be established on the way to reaching Free Growing status. There may be penalties for a logging company if they don't meet this date.

The Late Free Growing Date is the latest date by which a stand must be declared as Free Growing. This is commonly twenty years after logging has been done. There may be penalties for a logging company if they don't meet this date.

As you can see, the time frame for re-establishing a stand that's been logged covers a couple decades. The cycle from logging a stand to watching it grow back to maturity can take a life-time, because trees might not be logged until they're eighty years old. Planters are often present on the blocks for only a few days during this entire cycle. Don't let this mislead you about the importance of your work. Planters play a very significant role in the establishment of the new forest. If the trees aren't there, they can't grow. Natural regeneration from seeds on the ground complements the work that the planters do, but it's rarely enough to meet legal obligations. Trees must be planted to supplement natural regeneration.

Figure 13.02
A Stand of Trees.

A stand of trees is a group of trees of the same species that are growing in close proximity. This stand of alder trees is easy to distinguish from a distance, thanks to being surrounded by conifers.

Basic Seedling Physiology

Physiology is the study of how living things work. Seedling physiology relates to things that affect the survival and growth of seedlings. If you understand tree physiology, you can make better judgments about microsite selection, or about which species to plant if you're planting multiple species on your piece. You'll have a direct impact on seedling survival and growth.

Trees have a number of key requirements to ensure their continued survival. Let's examine these requirements. Water is obviously necessary. Water moves essential elements throughout the tree. Sugars are created when energy from sunlight is converted by photosynthesis. Nutrients come primarily from the soil and its organisms.

Mycorrhizae are types of good fungi that help the tree with absorption of water and nutrients. They also act as a defense against other harmful fungi. Hormones and enzymes are produced in the roots or leaves, and control the physiological processes of the tree.

Environmental Factors such as precipitation, temperature, sunlight, and soils affect each tree species. When selecting a microsite, planters have an opportunity to balance these factors to optimize seedling growth. Microsites can be high and dry, or low and wet. They can be cool or hot, exposed or protected from the sun and wind, and located in nutrient-poor or nutrient-rich soils. As a planter, you're going to have to understand what all of this means.

Tree Structure

Every tree has some parts in common, even a baby tree, which may be called a seedling.

Figure 13.03
Yellow Cedar Seedling.

Here's a very healthy looking Yellow Cedar seedling. This type of tree is typically planted at high elevations (over 600m) in parts of British Columbia.

The roots absorb nutrients and water, and anchor the tree. The roots are one of three growth sites on a tree.

Figure 13.04
Tree Roots on a Cliff.

The roots of a tree are typically not visible. However, in this photo, it's easy to see the root system of a mature tree growing on the side of a cliff. I was standing on a steep coastal block when I took this photo.

The leaves (or needles) are the site of photosynthesis and hormone production.

Figure 13.05
Needles on a Conifer.

Needles are the alternative to leaves, for a conifer.

The trunk provides support and a path for the transport of essential nutrients. The outside of the trunk is another growth site.

Twigs and branches, often called "laterals" in young seedlings, provide support for leaves, needles, and cones. The twigs are the third site for growth on the tree.

Figure 13.06
Laterals on a Young Seedling.

If you look closely at this photo, you can see that this seedling has several laterals at the base of the stem.

The Crown is the upper region of the tree.

The Bark protects the sensitive living tissues from weather and predation.

Figure 13.07
Bark on the Trunk of a Tree.

The bark protects the trunk of the tree.

Flowers and Cones are the male and female reproductive parts of the tree. There can be male or female cones, and male or female or unisex flowers. To really confuse things, some trees can be male or female, and other trees have the reproductive parts for both genders, and some trees can even self-pollinate. But this is a long and confusing story that varies significantly from species to species, so let's not worry about pollination.

Seeds are the part of the plant that contains the embryo. They are contained in cones, fruits, or flowers.

Unfortunately, planters have the potential to damage seedlings with poor handling. Each part of a young seedling is sensitive and critical to its growth and survival. This explains why there's such an emphasis placed on stock-handling by supervisors, checkers, and silviculture foresters.

Figure 13.08
A Forester, Auditing Seedlings.

This forester is assessing the health of a shipment of seedlings.

Shade Tolerance

Not all tree species require the same amount of sunlight to grow, as different species have different tolerances to shade. An awareness of this shade tolerance will allow you to choose the best microsite for the tree. Understanding this principle is key to selecting an appropriate species to plant in shaded areas. For example, pine is generally a poor choice to plant under a mature canopy, or immediately to the north of a very large cliff. All other things being equal, a more shade tolerant species like spruce would perform better. I use these two species as examples, because about 95% of the trees planted in the northern BC Interior, which is where many first-year planters work, are pine and spruce.

Three common species that are very shade tolerant are Balsam Fir, Cedar, and Hemlock.

Figure 13.09
Species that are Very Shade Tolerant.

These three species can survive quite well when they are growing in the shadows of competing grasses, vegetation, or other trees.

Two common species that are fairly shade tolerant are Douglas Fir and Spruce.

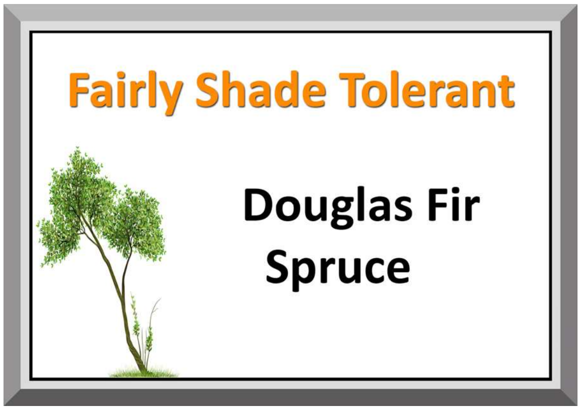

Figure 13.10
Species that are Moderately Shade Tolerant.

These two species are examples of trees that are moderately shade-tolerant.

Three common species that are not very shade tolerant are Pine, Birch, and Aspen. They like open spaces.

Figure 13.11
Species that are Not Shade Tolerant.

These species usually do much better when they are growing in open ground, with plenty of direct sunlight.

Environmental Factors Affecting Growth

When a silviculture forester is deciding how to reforest a site, he or she considers factors such as site preparation, species and density selection, timing of the planting, stock-type selection, and legal obligations.

Seedlings, once planted, can't just get up and move over a few feet to find a better spot. When you decide where to plant a tree, it's stuck there permanently. Hopefully, if you've picked a good spot and planted it well, it won't die for many decades. Since seedlings can't move to avoid environmental stress, they must be able to tolerate it to some extent.

For photosynthesis, seedlings need the light to be of sufficient intensity. The duration of light can trigger changes like winter dormancy. If seedlings don't have enough light, they won't have normal form, and they won't be able to germinate seeds.

Temperature affects growth in three ways. It affects enzyme and chemical reactions, which can only occur in a limited temperature range. Changes in temperature trigger bud and seed cycles.

Temperature extremes can injure seedlings. Interestingly, temperature extremes in the main upper part of the tree don't have a lot of effect. Seedlings are most sensitive to high temperatures in the narrow band from about a centimeter above ground level, to about a centimeter below the ground level. This is approximately where the seedling's "root collar" should be. Incidentally, the temperature of a young seedling isn't affected just by climate and weather. It's also affected by soil properties, the slope of the ground, and the aspect. The aspect is the direction that the slope is facing. Aspects that face south receive more sunlight, and are therefore warmer.

Frost may damage a seedling or reduce its growth. Frost is common at high elevations, or in depressions where cold air pools. It will damage young trees that have not gone through a physiological process known as hardening off. Frost may also cause frost-heaving, especially in fine-textured soils. If you're planting on a frost-prone site, you may be asked to plant on raised microsites to minimize frost problems.

Too much or too little water can be a problem. Drought tends to be a problem on southern exposures, or on rocky and coarse-textured soils. Excessive moisture obviously accumulates in low-lying areas, and soil that is too wet has too little oxygen for proper seedling growth. Tree roots need to breathe too. If you're planting in high-moisture areas, try to hit raised microsites, up out of the water as much as possible. If you're planting in a drought area, stay away from grass competition, find a shady microsite, and avoid elevated microsites as much as possible.

Seedlings can be affected by physical damage. Snow pack in the winter can bend trees, reducing their value and their ability to compete for sunlight, and also increasing the possibility that they might break. Heavy vegetation can choke out young trees. Animals and insects can also cause physical damage that might compromise critical tree structures.

Figure 13.12
Snow Press.

Snow press doesn't affect all trees. However, it can be a significant issue in some areas. There aren't a lot of things that foresters can do to eliminate the possibility of snow press.

The type of soil affects the nutrients. Finer soils are more nutrient-rich. Duff is also an important source of nutrients. Low nutrient sites can be managed by adding fertilizer, although planters in northern Interior BC don't usually plant fertilizer packs along with trees.

Basic Soils and Planting Media

Soils are made up of a mix of a mineral soil component, organic matter, water, and air. Having a mix of each of the four parts is important for good seedling growth. If you were to take an "average" or typical soil from within BC, you would probably find that it is composed of 46% minerals, 26% air, 22% water, and 6% organics. This type of typical "dirt" is often referred to as mineral soil by planters, although mineral soil is technically a specific component within "dirt."

Air is required for a number of biological processes, including the seedling's ability to metabolize sugars into usable energy.

As we already mentioned, water is also a biological requirement for a seedling, and is used for transporting nutrients within the plant.

Organic Matter (also known as duff) is beneficial in that it holds moisture and nutrients. It also acts as a bit of an insulator from temperature changes, and as a cementing agent. Organic matter is essential for site productivity. It consists of decomposed and un-decomposed litter, old root materials, and the biomass of soil organisms. The LFH layers, which I'll explain shortly, are all organic layers.

Within the soil category of mineral soil, there are both fine and coarse fragments. Coarse fragments would be things like small rocks and gravel or stones. Particulate science says that coarse fragments are generally at least 2mm in diameter. The quantity of coarse fragments in a soil, which is usually expressed as a percentage of the total soil volume, influences a number of soil factors such as drainage, nutrient holding capacity, rooting volume, and trafficability.

Let's look in more detail at the other category, the fines. Fine fragments can be further divided into three textures: sand, silt, and clay. Each texture has different properties which play different roles in seedling growth. Planters quickly learn about these texture types, because they can really affect the speed of your planting.

Sand is the coarsest of the three fine fragment textures. In terms of particulate science, sand grains are generally considered to be between 0.07mm and 2mm in diameter, and have a non-flat shape. Sand is non-sticky and non-moldable and therefore won't compact easily. It tends to be nutrient poor, but it provides good drainage and trafficability. Planting on a sandy block, especially with a tiny bit of moisture to help it hold its shape, is one of the greatest pleasures of a planter's career. Sand is very easy to plant in, but unfortunately, fairly rare.

Figure 13.13
Sand.

In our dream worlds, we spend our days planting on sandy beaches.

Silt is mid-range in texture, between sand and clay. Particles of silt are usually less than 0.07mm in size, smaller than sand, and are usually fairly rounded. Individual grains of silt are not distinguishable to the human eye. Silt is almost soapy and slippery to the touch, and slightly sticky. It's usually more rich in nutrients than sand. Silt is also quite nice to plant in.

Clay is the finest of the fine textures. The particle size is generally similar to that of silt (although often smaller), but the more important characteristic is that the particles are generally flat or plate-like in shape. Clay is sticky, moldable, and hard when dry. It's the most nutrient-rich of the three fine textures, and has the highest water holding capacity. Unfortunately for planters, it's not easy to plant in. You'll find it difficult to drive your shovel into clay, and you'll also have problems closing holes.

Loamy soils are a mix of all three fine-grained textures. They're considered to be ideal for seedling growth as they offer the advantages of all three textures. Loamy soils are usually good to plant in, and your shovel should go in almost as easily in sand.

Depending on the contract, there will be varying points of view about the suitability of organic matter as a planting medium. On the coast, planting in organics is highly encouraged for many species, but the coast is a lot different than the BC Interior. In Alberta, you'll find that organic matter is often acceptable or encouraged as a planting medium. In the BC Interior though, you'll find a range of planting specs. In some places, such as Kamloops, planting in mineral soil is currently mandatory. If you have a few inches of organics on top of mineral soil, you have to dig down through the organics before you're allowed to plant. This is called screefing. In many other places in the Interior, a healthy mix of organics and mineral soil is preferred, so long as you're not planting in chunky red rot. Basically, the requirements vary so much from location to location that you'll just have to see what the local forester is asking for.

You'll often hear reference to the LFH layers in the soil. LFH stands for "Litter, Fermenting, Humic." FH stands for just the latter two. Some people substitute the term "fibric" instead of fermenting, and the term "humus" instead of humic. Whatever the terminology, these initials refer to the layers of the forest floor, from non-decomposed and identifiable, to completely decomposed. Different foresters will have different requirements about the preferred depth of a planted seedling, and they often refer to these various layers as a guide to root placement.

The litter layer is the layer of sticks, twigs, chunks of wood, pieces of grass, leaves, and other detritus or garbage on the surface of the ground. In many regions, the litter should be kicked out of the way before you plant a tree in the ground. The litter layer is not decomposed, and it is the top layer in the LFH spectrum, sitting above the partially decomposed "fermenting" layer.

The fermenting layer consists of partially decomposed materials. You can identify it as a sort of peat moss layer but with partially identifiable components still visible. In most areas, foresters will allow or prefer for the top of the seedling roots to be located in the fermenting layer. The fermenting layer sits on top of the humic layer.

Humus is a brown or black material, often moist, which results from decomposition of plant and animal matter, and which forms the organic portion of soil. Planters will usually find it in a thin black layer of "peat moss," sitting on top of the mineral soil (if there is any mineral soil in the area). In the LFH spectrum, the humic layer is the bottom of the three layers, and completely decomposed. Moist humus is a very good planting medium for the roots of a seedling.

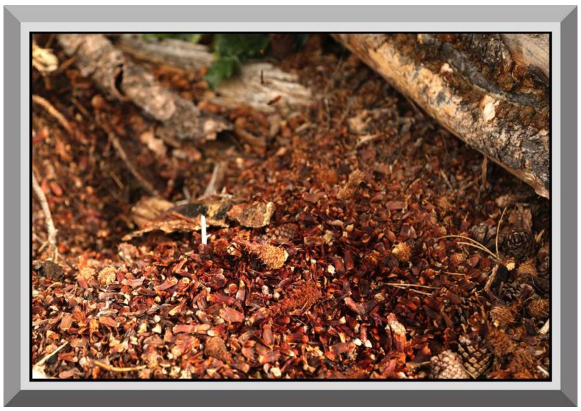

Figure 13.14
Cone Scales From a Squirrel Burrow.

Foresters won't want you to plant in the scale piles from squirrel burrows. These piles don't have the appropriate soil nurtients that trees need, and they are usually so dry that desiccation (drying out) would be a problem for the plug.

Figure 13.15
Screefing.

In some areas, foresters ask planters to "screef" through the top layers of litter and/or organics, to get down to mineral soil. This practice is most common in hot regions, such as the deserts around Kamloops.

Common Diseases and Insect Pests

Trees, like humans, can be susceptible to a number of diseases. These diseases can be related to fungal infections, or other issues. Trees can also be attacked by insect pests, which either eat the leaves or bore into the trunk and cause ancillary damage. And finally, drought can be an issue for trees, with various apparent manifestations (such as red flagging on cedar trees, which appears to be some sort of disease).

Herbicide spraying programs target grasses and brush that grows in competition with crop trees, not any diseases on the trees themselves. Pesticides and fungicides that are sprayed on trees at forest nurseries are intended to prevent the seedlings from being attacked when they are just starting to grow and at the most susceptible stage in their lives.

Some common diseases that affect trees (especially in British Columbia) include western gall rust, dwarf mistletoe, brown felt blights, and armillaria root rot. Some common insect pests that attack commercially harvested trees include mountain pine beetle, pitch blister moths, and sawyer beetles. First-year tree planters will occasionally hear mention of some of these problems by foresters, but don't really need to learn much in order to learn to plant properly. Pest and disease identification would be much more important if you were to eventually branch out into alternative forms of silviculture work, such as brushing and related saw work, or silviculture surveys. There is an appendix at the back of this book which describes all of the diseases and pests mentioned here.

Seasons

Since we briefly referred to frost and dormancy already, let me quickly mention something about seasons. Tree planting cannot be done year-round in Canada, so it's considered to be seasonal work. Many planters refer to the length of their employment in seasons, rather than years.

In the BC Interior, when you talk about things in a physiological sense, relating to the growth of the trees, planting is broken down into a Spring season from late April to mid-June, and a Summer season from mid-June until August. The trees planted each Spring season are grown in nurseries the previous year, and then put into frozen storage over the winter. They get thawed out just before the planters start to plant them, so those Spring trees are slowly waking up out of winter dormancy.

Figure 13.16
Box of Spring Seedlings.

These seedlings have been frozen, over-wintered, then thawed in time for spring planting. Boxes that have bag liners, and bundles that are laid sideways, are two signs that the trees were probably frozen for the winter.

Figure 13.17
Bundle of Frozen Trees.

Unfortunately for planters, sometimes the trees don't thaw properly in time for planting. This bundle (and many more like it) arrived on a planting site, completely frozen solid. It takes several days for a shipment like this to thaw properly.

The trees planted in the Summer season, however, are sown in February or March and grown in nursery beds until mid-June, so when they're delivered to planting camps in late June and July, they're not dormant at all. These trees are called "hot lifted" trees. They're fully awake, and growing as quickly as they can.

Figure 13.18
Box of Summer Seedlings.

This box of seedlings was hot-lifted and boxed just a few days before arriving on-site for planting. Boxes that don't have bag liners, with the trees standing vertically, probably contain seedlings that were hot-lifted.

Figure 13.19
Shade Tent Full of Summer Stock.

These boxes of trees were all hot-lifted. Rather than being stored in closed boxes in a cold reefer, which would be the case with spring trees, these trees are wide-awake and growing. The shade tent keeps direct sunlight off the trees, but lets enough light through for photosynthesis.

There isn't much visible difference between spring trees and hot-lifted trees. The boxes that the seedlings come in will usually have a bag liner for spring trees, but there won't be bags with summer trees. And you might occasionally get some frozen bundles with spring trees if the thaw request wasn't submitted early enough. Companies usually ask for the nurseries or storage facilities to start thawing spring trees approximately ten days before the trees are delivered to the planting site. Visually, spring and summer seedlings look the same.

In a physiological sense, there's a big difference between the Spring and Summer trees, but this distinction doesn't mean much to planters. Most planters just refer to the whole calendar period from April through August as a single work period. As an example, someone who started planting last year and who worked from early May until early August would say, “Last year was my first season.” When an experienced planter says, “I've planted for XX seasons,” they are really referring to the number of calendar years that they've planted.

There is also a small Spring Coastal season from late January to mid-April, and an even smaller Fall Coastal season from late August to early October. The number of trees planted on the coast is very small in comparison to the volumes in the Interior, so only a relatively small number of planters work these two seasons. My guess is that there are perhaps less than four hundred people who plant on the coast each year, and maybe more than six thousand people who plant in the Interior. Competition for the coastal jobs is fierce, so prices aren't as lucrative as they used to be. Applicants for coastal jobs usually need at least four or five seasons of experience in the Interior before they can hope to be considered for a job. Planting on the coast is much, much more difficult than planting in the Interior.

Figure 13.20
Spring Coastal Block.

Spring coastal blocks are usually found at lower elevations than fall blocks. They may be slightly flatter too, due to the low elevations. This is because the higher elevations might be under snow.

Figure 13.21
Fall Coastal Block.

Fall coastal blocks tend to be steeper, and at higher elevations. Of course, it's always dangerous to make generalizations. Many blocks will be exceptions to these observations!

For more photo and video resources associated with this chapter of the book, visit: www.replant.ca/training/basicsilviculture