

## 2.0 Plant /Tree Processes in the Boreal Forest

### 2.1 Processes common to most boreal plants

- a) All plants, animals, or anything living must have **respiration** which is the changing of energy from one form to another so that it can be used for a variety of purposes.

Most forms of respiration need oxygen for without oxygen the organism would not have energy. Flooded areas can kill certain plants because there is no oxygen at the plant's roots, which means respiration can not take place.

- b) **Photosynthesis** is the manufacture of food in the presence of light, carbon dioxide and water. This food, which is mainly sugar, is actually energy, and is released by respiration. Respiration is more important than photosynthesis because if we can't change stored energy to a form we can use, then that energy is of no use to us.

An example is:

If you had 20 L of gas and your car broke down and wouldn't start, the Liters of gas(or stored energy) would be of no use to you because you can't use it.

- c) **Reproduction** is the process of producing offspring, seeds, or clones to keep the species alive.

- A tree will reproduce

-----when the tree is very healthy, mature enough and large enough to crown

-----when the tree is stressed to the point of death

- A tree will not reproduce

-----when trees are thinned out by a machine or fertilized

-----when the trees are growing on a rich site

-----when trees are growing very close together and have a small crown

-----when trees have too much competition for food and sunlight

-----when a tree is severely scarred or goes through a lot of damage, it will produce a lot of seeds to keep the species going but these seeds will not be of the best quality and so many won't germinate

c) Organisms can take the food made by the process of photosynthesis

- Some plants are better than others in some processes because of
  - genetics
  - by the way the plants are built
  - because of where the plant is growing
- Balsam Fir is wasteful of its water use because this species usually grows on a rich site where there is a lot of water.
- Plants are also good recyclers of nutrients within themselves. When leaves are shed in the fall, the tree usually sends out its waste products to the leaves before it sheds.

C  
R  
O  
W  
N  
  
T  
R  
U  
N  
K  
  
R  
O  
O  
T  
S

Leafy trees have broad crowns to gather sunlight and allow air to circulate.

Conifers have tapered crowns to withstand winds, cold and heavy snow.

The tree's new growth is from materials made in the leaves using the power of the sun.

The trunk is a pipeline connecting the roots to the leaves.

Foresters measure a tree by its diameter at breast height.

**SPREADING ROOTS**  
About as much of a tree is below ground as above.

**TAP ROOT**

**SOIL GRAINS**  
Tiny root hairs only .01mm across live only for a few days.

**DECIDUOUS:** Having broad leaves, shed in winter.

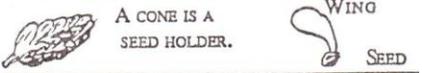
**UPPER SIDE**  
Has waxy waterproof surface turned to collect solar energy.  
Veins

**UNDER SIDE**  
Has a lighter surface with breathing holes (stomata) to absorb carbon dioxide gas and breathe out oxygen and water vapour. (transpiration)



**CONIFEROUS:** Having cones and needle-like leaves.

The tree can open or close its breathing pores which are spaced along the needles.  
Because the narrow stiff needles expose far less surface to the air, the tree can survive strong winds, low or high temperatures, and the lack of water from drought or frozen ground.  
A single vein runs inside each needle.



ALL TREE SEEDS ARE DESIGNED TO BE SPREAD EITHER BY THE WIND OR ANIMALS.

**HOW A TREE RECORDS ITS OWN LIFE HISTORY.**

Each year a tree makes new layers of cells.

Every growth ring has two distinct parts.

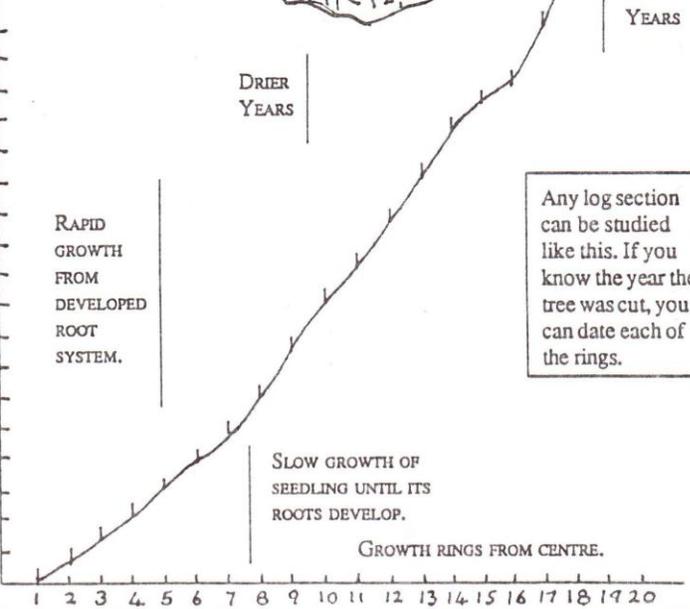
- The cells in it look like this:
- (1) The outer bark is the tree's dead skin and acts like a suit of armour.
  - (2) The inner bark is cork. It insulates and carries food from the crown.
  - (3) The cambium layer is where the growth takes place. It makes both inner bark and sapwood cells from carbohydrate carried down to it from the leaves.

Summer Wood  
Slower Growth  
Spring Wood  
Rapid Growth

The sapwood, which makes up most of the tree, lifts the water and nutrients up to the leaves.

The hard, dead, heartwood supports the trunk.

45  
40  
35  
30  
25  
20  
15  
10  
5  
M



WARM WET YEARS

DRIER YEARS

RAPID GROWTH FROM DEVELOPED ROOT SYSTEM.

SLOW GROWTH OF SEEDLING UNTIL ITS ROOTS DEVELOP.

GROWTH RINGS FROM CENTRE.

## 2.2 Longevity and Growth Rates in the Boreal Forest

**Longevity** is how long something is normally able to live—one day, one month, or three hundred years.

- Trees and shrubs can be short-lived and long-lived.

A pin cherry tree is short-lived at 20 to 30 years but would be long-living compared to the eucalyptus plantation which is mature at 5 to 8 years.

- Longevity is important, because short-living plants may have some trouble if they are to reproduce in an environment in which they have to compete for food and sunlight.

- **Rate of growth** is very important because no two species grow at exactly the same rate.

---Two different species growing side by side on the same site might grow at different rates because of different needs and because of how they use the site for growing.

---Two species can also have different growth rates because of genetics. The Trembling Aspen are short-lived but have fast growth rates.

## 2.3 Different means of reproduction by most plants

a. A plant's main goal in life is to produce seeds. Reproduction takes a lot of plant effort:

-----reproduction of flowers

-----pollination

-----fertilization

-----growth

-----how healthy it is

- Once seeds are produced they are carried by wind, gravity, animals, and birds.
- After they are spread there is no guarantee that the seed will land on a good seed bed or that it will germinate.
- Some trees produce a lot of seeds (over a million seeds in a good year).
- Seed production after the appearance of flowers (or cones) can range from weeks for willows and Trembling Aspen to three years for some species of Pine and Spruce.

**b. Clones** are the exact duplication of the parent that may grow from a certain plant part.

--**sprouts**—is new growth from a cut stump like White Birch or Balsam Poplar

--**suckers**—is new growth coming from roots such as the Trembling Aspen

--**layering**—is new growth coming from a branch growing underground and coming back up to form a tree such as a Black Spruce

**c)** Sometimes forests grow where all the trees have the same parent (all clones).

--Some plants reproduce when some leaves have been separated from the parent plant. Then these leaves could produce another plant (clone).

--When the twigs break off from the parent and fall to the ground, these twigs could produce a clone if that twig had buds on it before

it fell. Some pieces of Trembling Aspen that have been cut for firewood have grown twigs on their bark.

Advantages to a tree species where all the trees have the same parent (clones)

- A fire will burn the above-ground material and not the roots which could provide for suckers which will help the tree to take over this fire-killed site very quickly and it doesn't usually let other species to grow on the site.
- Sharing an existing root system with the parent tree.
- There will be growing space for the new clone.
- It can survive on the site.
- It can happen very quickly.
- Less energy from the parent.
- There is a head start on anything coming from the seed origin.

Disadvantages to a tree species where all the trees have the same parent (clones):

- All clones have the same genetic make-up. They are all well-adapted to the site, but if something goes wrong it could be bad for the forest site.
- If an infection or a bug disease came into the forest that forest may not be strong enough to get over this disaster.
- If one clone plant can't recover and dies, then all plants in that clone will likely die too.

The best forest is when the forests are being produced by seeds which will have seeds of different genetics. They are then able to handle troubles in the forest and then are able to adapt so that the most species can survive.

### **2.3 Self-pruning and self-thinning**

**Self-pruning** is **natural pruning** which means that a tree will get rid of its lower branches by natural means.

Some characteristics of this process are:

- Trees have a long trunk free of branches such as Trembling Aspen and Jack Pine.
- Their tree branches have fewer knots and for sawmills this is the kind of tree that they want for their business.
- The lower branches drop off by the tree because the tree has no use for these branches or leaves.
- The shading of their branches is the main cause of self-pruning.
- Branches will not grow back on the tree trunk where they once were even if more sunlight is allowed to get there.
- Trees can't stand any amount of shade to any parts of their living crown.

**Self-thinning** trees are:

- reducing the number of stems they have very quickly when there is competition and shading
- usually low in numbers at maturity and are very competitive
- often a lot of smaller trees that die on the site
- often the type that kill their own clones due to competition have high stem numbers, which will be very crowded and are generally longer living

- Trembling Aspen, Balsam Poplar, Jack Pine, and Pin Cherry are all good self thinners

## 2.4 “Tolerant” and “Intolerant” trees with respect to Shade

a. **Tolerant** means “able to put up with” shade or moisture.

**Shade tolerant** means that the tree is able to withstand and may live for a long time in the shade. If they are given full sunlight then the tree will grow in the new light.

**Shade intolerant** are trees that can’t live in the shade and would die if they became fully shaded.

shade intolerant	Jack Pine, Tamarack, Larch
intolerant/tolerant	Balsam Poplar, White Birch
shade tolerant	White Spruce, Black Spruce
very shade tolerant	Balsam Fir
very shade intolerant	Trembling Aspen, Willow, Pin Cherry

b. **Moisture tolerant** means that some plants can stand moisture, rich sites and even grow well there.

**Moisture intolerant** means a species will grow on a dry site such as Jack Pine growing on dry, sandy soils. Tamarack Larch will grow on poorer sites and can stand wetter soils, but doesn’t do well on rich, forest sites.

**Site richness** is when species will only grow on rich sites. Tall ferns, Balsam Fir, and White Birch growing in a forest show that the site is soil rich.

## **2.5 Features of growth that are different from Shade Intolerant to Shade Intolerants**

### **Shade intolerants:**

-----don't like shade

-----like full sunlight which happens after a clear cut, fire, blow down, insect out break or anything that will get rid of the existing overhead vegetation

Features of shade intolerant trees are:

- produce a lot of seed
- produce seeds rapidly
- produce very small seeds which are distributed easily
- produce seeds younger in the tree's life
- are short-lived but are very fast growing
- put a lot of energy into reproduction
- mature trees won't have their own seedlings grow under the crown of the parent trees unless there is a lot of light in the understory

### **Shade tolerant:**

-----are able to withstand and may live for a long time in the shade

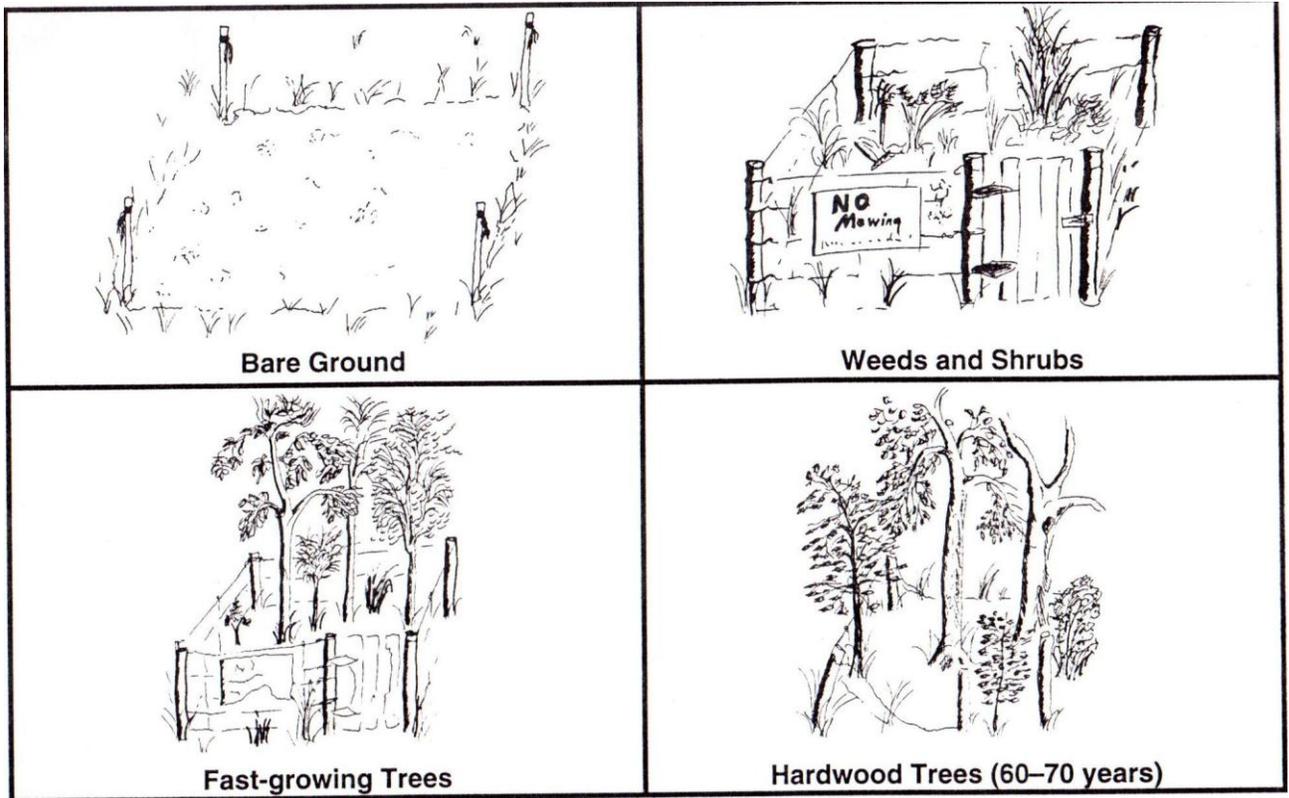
Features of shade tolerant trees are:

- produce low seed numbers

- usually produce seeds later in life
- don't put as much effort into reproducing
- usually more long-lived and slower growing
- have their own seedlings living in the understory

### **Climax Forest:**

- The forest is clear cut of White Spruce and Trembling Aspen
- White Spruce is planted within a year after clear cutting process.
- Trembling Aspen would grow suckers very quickly for it is shade intolerant.
- Trembling Aspen would soon overtake the White Spruce in height, size and number.
- White Spruce will tolerate the shade of the Trembling Aspen for a long time, growing taller each year but not at the same speed as the Aspen.
- When the trees are 60 to 70 years old, the Trembling Aspen will start to die out and the White Spruce will take over.
- If the forest floor is heavily shaded, then there might not be any Trembling Aspen in the understory but there could be White Spruce seedlings in the understory.
- If there are White Spruce in the understory then that is what the future forest will look like after the original crops of mature White Spruce die out.
- This means that the White Spruce species will occupy this site for generations unless something occurs such as disturbances of fire, clear cut, or insect infestation.



Example picture of “Succession” over the years...