2.0 The Study of Plant /Tree Processes Typical of 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 common forms of respiration need oxygen, for without oxygen the organism could not capture the necessary energy. Sometimes, flooded areas can kill certain plants because there is a lack of oxygen at the plant's roots, which means that 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, which is released through the process of respiration. Scientists tell us that 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 of this would be:
If you had 20 L of gas and your car broke down and wouldn't start, those Ls of gas (or stored energy) would be no good to you because you can't use it.

c) Reproduction is the process of producing offspring, seeds, or clones to keep the species alive. This process needs a healthy system or the offspring will not survive.

- A tree will reproduce
  -----when the tree is very healthy and 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 mechanically thinned out or fertilized, they will reproduce at a younger age
  -----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 nutrients 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) **Assimilation** is the process where organisms take the food from photosynthesis and use it within the plant for further growth and development.

- Some plants are more efficient that 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. The chloroplasts of the leaves are kept by the tree for further use through its plumbing system.

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-lived compared to the eucalyptus plantation which is mature at 5 to 8 years.

- Longevity is important, for short-living plants have some disadvantage if they are to reproduce in an environment that is competitive.

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 experience different growth rates because of different niches and because of their ability to use the site for growing.
- They 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
-----health status

- Once seeds are produced they are dispersed by wind, gravity, animals, and birds.
- After they are dispersed 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 genetic duplication of the parent that may grow from a certain plant part.

- clones are dependent upon what part of the tree they originate from such as:
  --**sprouts**-- new growth from a cut stump like White Birch or Balsam Poplar
  --**suckers**-- new growth coming from roots such as the Trembling Aspen
  --**layering**-- 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) which is called a **Coppice Forest**.

--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 for coppicing:

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

Disadvantages to a tree species for coppicing:

- All clones have the same genetic make-up. They are all well-adapted to the site, but if something goes wrong it can be disastrous.
- In time of infection and infestation that disaster may not be overcome by its genetic make-up.
- If one clone plant can't recover and dies, then all plants in that clone will likely die too.

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

2.3 Self-pruning and self-thinning

Another name for **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:

- These trees have a long trunk free of branches such as Trembling Aspen and Jack Pine.
- Their tree branches have fewer knots and in lumber manufacturing this makes the tree more commercially valuable.
- Their lower branches drop off by the tree because the tree has no use for these branches or leaves in that location.
- The shading of their branches is the main cause of self-pruning but an injury can cause this as well.
- The tree will drop its branches a lot younger in life then other trees.
- 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 characteristics in trees are:

- The trees will reduce the number of stems they have very quickly when competition and shading occurs.
- These trees will usually have low numbers at maturity and are very competitive.
- Very often a lot of smaller trees die on the site.
- These trees often kill their own clones due to competiveness.
- They will have high stem numbers, will be very crowded and are generally longer living.
- Trembling Aspen, Balsam Poplar, Jack Pine, and Pin Cherry are all good self-thinners.
- Balsam Fir and White Spruce are poor self-thinners

2.4 "Tolerant" and "Intolerant" 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 shade. If they are given full sunlight then the tree will grow in the new light.

Shade intolerant trees can't live in the shade and would die if they became fully shaded.

Numerical Value	Rating	Species
1-2	very shade intolerant	Trembling Aspen, Willow, Pin Cherry

3-4	shade intolerant	Jack Pine, Tamarack, Larch
5-6	intolerant/tolerant	Balsam Poplar, White Birch
7-8	shade tolerant	White Spruce, Black Spruce
9-10	very shade tolerant	Balsam Fir
*These numbers	are not exact and are used	as a comparable illustration.**

b. Moisture tolerant means that some plants can tolerate 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 is an indication that the site is soil rich.

Lots of plant species would want to be on richer sites but it may not be possible because:
--the plant's genetic processes may not be best suited for this site
--the plant may not be as competitive on this site as other plant species which are more suited to this site

2.6 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 clearcut, fire, blowdown, insect outbreak or anything that will get rid of the existing overhead vegetation

Physiological features 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 tolerants:
-----are able to withstand and may live for a long time in the shade

Physiological features 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 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 many 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, clearcut, or insect infestation.