

3.0 Describe the inter-relatedness of living and non-living elements within a forest environment.

3.1 Describe the various forms of plant species growing in our forest: more particularly, the Boreal forest.

The forms of plant species that grow in our Boreal forest can be separated into a number of ways. We will use a system of vascular/non-vascular and then evolve into species/seeds and then naked seeds/enclosed seeds. We will discuss these further with annuals, biennials and perennials, herbaceous versus woody, and shrubs versus trees.

A vascular plant is a plant that has a “plumbing” system in which fluids can move throughout the plant – much like humans possess. This vascular system enables the movement of nutrients, repair chemicals and just about anything needed for the plant’s survival and growth. Most plants are vascular in nature. Plants that are non-vascular (mosses, lichens) are older on the evolutionary scale and have very limited means of moving material throughout the plant.

Vascular plants can be split into two groups: those producing spores (such as ferns) and those producing seeds. The term spermatophyta means “seed-producing” and includes the majority of plants. The seed-producing plants are broken down into “Gymnosperms” which means naked seeds, and “Angiosperms” which means enclosed seeds. The Gymnosperms include the conifers (cone-bearing trees) and are older on the evolutionary scale. The conifers have no “true flowers” and include most of the species we call evergreen such as fir, spruce and pine. The conifers also include larch which is deciduous (leaf or needle dropping), but is a deciduous, coniferous, Gymnosperm. The Gymnosperms have their seeds in a cone or some other arrangement in which they are exposed to the air or environment.

The other category of seed-producing plants are the Angiosperms which have true flowers and are the most advanced on the evolutionary scale of plants. The seeds are produced by the flowers and are covered up in various ways. The way that the seed is covered up greatly helps the plant to spread the seed. For example, pin cherry or apples have seeds that are eaten and spread by various means. The Angiosperms are the most common form of plants and they have over 250,000 plant species on Earth compared to over 700 for the Gymnosperms.

Another breakdown of plants is by their life span. Annuals are plants that germinate, grow, produce seeds and die all in the one season; they therefore don’t become very large plants. Compare an annual to a biennial which produces its seeds in the second year and then dies; such as a turnip or parsnip. These, too, don’t get to be very large in size. The third class of Angiosperms found in the forest is those of perennials, which are the type that produce seeds and live indefinitely. Some perennials can produce seed every year (once they’ve started to produce seed) and some will only produce seeds under certain conditions of health, age, nutrition level or

site. Perennials can be broken down into woody plants or herbaceous plants. Woody plants are trees with wood as their stems, such as white spruce, trembling aspen or blueberry. All other plants are termed herbaceous, which is any plant whose stem withers away to the ground after each season's growth. Herbaceous plants, as well, don't get to be very large. The category of woody plants in the Boreal forest can be broken down into shrubs and trees. A shrub is a woody plant, generally less than 5 meters in height at maturity and is usually multi-stemmed. A tree is also a woody plant, normally with one main stem and is over 5 meters tall. The major difference is the height of the plant. An example of a shrub could be a highbush cranberry, while a tree could be a jack pine or a trembling aspen.

3.2 List some abiotic factors within a forest ecosystem.

The term abiotic means non-living. The factors that are termed abiotic contribute significantly to a forest ecosystem. The abiotic factors that will be discussed briefly are solar radiation, temperature, atmospheric moisture, climate, soil and fire.

3.3 Identify the role that abiotic factors contribute to sustaining plant and animal populations.

The solar radiation in a forest ecosystem greatly affects the ecosystem by the intensity and duration of the solar radiation. Solar radiation facilitates photosynthesis, which allows plants to survive and convert light energy into chemical energy. Does the ecosystem have lots of sunlight reaching the understory, or is most sunlight intercepted by the crown canopy of taller trees? Is there lots of light on the forest floor, or is the sunlight only available through the canopy at certain times of the day? Does the ecosystem have more sun from the south, or is the forest facing north and availing of less solar radiation? In our hemisphere, slopes facing south will get more solar radiation than any other direction.

Those slopes facing east will get the morning sun and those facing west will get more radiation later in the day. Here in the northern hemisphere our north-facing slopes have the least amount of solar radiation.

Temperature is important for the occurrence of a lot of life forms. Areas with hot and cold extremes have limited life forms for both plant and animal life. The annual average temperature for Saskatchewan is around 0o C, but the seasonal averages will vary significantly. In Saskatchewan, we have a short-growing season, around 100 days frost-free a year. We also have the extremes of -40o C to +37o C, which is a very wide range. This wide range limits a lot of plant growth. The limit is usually the cold winter temperature and not the higher summer temperature. The ability of a plant to withstand certain cold winter temperature is referred to as hardiness. There are maps which will indicate these hardiness zones and some of the species that can live there. Worthy of note is that most plants can move up to the higher (warmer) class, but they can't go to a lower class.

Atmospheric moisture is important with respect to its timing, amount and form. For example, if we had the bulk of moisture in the winter, or for three days in the summer, it would not be very beneficial for plant growth. In Saskatchewan we normally get enough moisture for plant growth in our forest ecosystem, which is why a forest naturally grows there – it doesn't require irrigation. Compare this to irrigation of crops, which is not a natural process or because we are planting crops not native to our ecosystem. The type of moisture could be in the form of snow, sleet, mist, rain or hail. Is the melted snow the only source of moisture? If we got three days of solid rain for the whole summer, the first few hours of rain would be of the most use to plant growth, the rest will runoff and end up in the streams or ponds.

Climate is the combination of the three factors already described: radiation, temperature and moisture. Climate that is associated with lots of sunshine and little precipitation would be how we regard the south-west of Saskatchewan, while it would be a little cooler with more moisture in northern Saskatchewan.

The soils of Saskatchewan's forest ecosystem reflect the vegetation that exists there, and that in turn, reflects the biodiversity of wildlife that's there. Most soils are made by deposits such as by wind-blown (Aeolian), lake deposits, mountain or glacial stream deposits. Most of Saskatchewan was covered by ice and as the ice retreated the soils were formed by one of these ways. Another method of soil formation is by weathering, which is wearing away by the natural elements of moisture, wind, heat and decomposition. The rate of decomposition is important because it determines how fast the soil will be produced. Decomposition of once living material requires ample oxygen, moisture and temperature. Areas that have an abundance of oxygen, moisture, high temperatures and microorganisms hence will decompose plant parts very rapidly – breaking them down into components that are commonly known as organic matter. A tropical rain forest would decompose dead plant parts very rapidly because of the abundant supply of oxygen, moisture, high temperature and microorganisms. The tropical plant can decompose and make organic matter, but this organic matter gets used very quickly by the plants that exist there. Places such as bogs, marshes and the tundra have carbon that is not fully decomposed (because some features are in limited supply, such as high temperature) and is of very little use for plant growth. This organic matter that stays on top of the soil acts like a mulch – keeping in moisture longer, provides oxygen and keeps a healthy soil temperature favorable to plant growth. This organic matter, acting like a mulch, is ideal for plant growth if it is 10 centimeters thick. More than 10 centimeters it becomes a poor medium for plant growth because it can't furnish many nutrients to the plant and the plant's roots can't become firmly anchored in the organic matter.

Fire is an abiotic factor that has much influence on the forest ecosystem and it's very dependent upon the type, frequency, timing, amount and intensity of the fire. Some plant species are very dependent upon fire for reproduction purposes by either using the heat to open up their cones (i.e., Jack pine) or encouraging suckering/sprouting on existing plants or by just burning away competing vegetation to allow other plant species to grow on the burnt site. A lot of the Boreal forest has adapted to regenerate easily after a forest fire.

It is fairly easy to briefly describe the above abiotic factors upon which the life and growth of the forest depend. It is very difficult to discuss and understand the sum total of all the interactions among these environmental factors. The plant lives in the total complex of the environment – and a change in any one factor of this complex may well cause a changed requirement of the plant for other factors. These environmental factors are interdependent and interrelated and make the ecosystem very complex.