44.3F: Boreal Forests and Arctic Tundra

The boreal forest is characterized by coniferous trees, while the arctic tundra is characterized by permanently frozen soils.

Learning Objectives

- Recognize the distinguishing characteristics of boreal forests and arctic tundra

Key Points

- The boreal forest is found across most of Canada, Alaska, Russia, and northern Europe; the arctic tundra lies north of the boreal forest.
- The boreal forest has cold, dry winters and short, cool, wet summers with precipitation that takes the form of snow; due to this environment, evergreen coniferous trees are the dominant plants.
- The soil in boreal forest regions is usually acidic and contains little available nitrogen.
- Boreal forests have lower productivity than tropical or temperate forests; they also have less diversity, with only a tree layer and ground layer.
- Temperatures in the arctic tundra are cold year-round and precipitation is very low.
- Plants in the arctic tundra have a very short growing season of approximately 10–12 weeks, but during this time, growth is rapid; plants are low to the ground and the soil is permanently frozen.

Key Terms

- **permafrost**: permanently frozen ground
• arctic tundra: a biome found in the far Northern Hemisphere, north of the boreal forests, where the subsoil is permanently frozen
• boreal forest: a biome found in the Northern Hemisphere and characterized by coniferous forests consisting mostly of pines, spruces, and larches

Boreal Forests

The boreal forest, also known as taiga or coniferous forest, the world's largest terrestrial biome, is found south of the Arctic Circle and across most of Canada, Alaska, Russia, and northern Europe. This biome has cold, dry winters and short, cool, wet summers. Temperatures vary from −54°C – 30°C (-65°F – 86°F) throughout the whole year. The summers, while short, are generally warm and humid. In much of the taiga, -20°C (-4°F) would be a typical winter day temperature, while 18°C (64°F) would be an average summer day. The annual precipitation, from 40 cm -100 cm (15.7–39 in), usually takes the form of snow. Little evaporation occurs because of the cold temperatures.

The long and cold winters in the boreal forest have led to the predominance of cold-tolerant, cone-bearing plants. These are evergreen, coniferous trees such as pines, spruces, and firs, which retain their needle-shaped leaves year-round. Evergreen trees can photosynthesize earlier in the spring than can deciduous trees because less energy from the sun is required to warm a needle-like leaf than a broad leaf. This benefits evergreen trees, which grow faster than deciduous trees in the boreal forest. In addition, soils in boreal forest regions tend to be acidic, with little available nitrogen. Leaves are a nitrogen-rich structure that deciduous trees must produce yearly. Therefore, coniferous trees that retain nitrogen-rich needles may have a competitive advantage over the broad-leafed deciduous trees.

The net primary productivity of boreal forests is lower than that of temperate forests and tropical wet forests. The aboveground biomass of boreal forests is high because these slow-growing tree species are long-lived, accumulating standing biomass over time. Plant species diversity is less than that seen in temperate forests and tropical wet forests. Boreal forests lack the pronounced elements of the layered forest structure seen in tropical wet forests. The structure of a boreal forest is often only a tree layer and a ground layer. When conifer needles are dropped, they decompose more slowly than do broad leaves; therefore, fewer nutrients are returned to the soil to fuel plant growth.

Figure \( \PageIndex{1} \): Plants in the boreal forest: The boreal forest (taiga) has low-lying plants and conifer trees; it often consists of only a tree layer and a ground layer.
Arctic Tundra

The Arctic tundra, lying north of the subarctic boreal forest, is located throughout the Arctic regions of the northern hemisphere. The average winter temperature is -34°C (-29.2°F), while the average summer temperature is from 3°C – 12°C (37°F – 52°F). Plants in the arctic tundra have a very short growing season of approximately 10–12 weeks. However, during this time, there are almost 24 hours of daylight, so plant growth is rapid. The annual precipitation of the Arctic tundra is very low (about 15-25 cm), with little annual variation in precipitation. As in the boreal forests, there is little evaporation due to the cold temperatures.

Plants in the Arctic tundra are generally low to the ground. There is little species diversity, low net primary productivity, and low aboveground biomass. The soils of the Arctic tundra may remain in a perennially frozen state referred to as permafrost. The permafrost makes it impossible for roots to penetrate deep into the soil and slows the decay of organic matter, which inhibits the release of nutrients from organic matter. During the growing season, the ground of the Arctic tundra can be completely covered with plants or lichens.

The biodiversity of the tundras is low: there are 1,700 species of vascular plants and only 48 species of land mammals. Notable animals in the Arctic tundra include caribou (reindeer), musk ox, arctic hare, arctic fox, snowy owl, lemmings, and polar bears. Due to the harsh climate, tundra regions have seen little human activity, even though they are sometimes rich in natural resources such as oil and uranium.
Figure \(\PageIndex{1}\): **Caribou (reindeer) in the tundra**: Some populations of the North American caribou migrate the farthest of any terrestrial mammal, traveling up to 5,000 km (3,100 mi) a year.

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