

Chapter 4

Ecosystems and Communities

Section Objectives:

- Identify some common limiting factors.
- Explain how limiting factors and ranges of tolerance affect distribution of organisms.
- Sequence the stages of ecological succession.
- Describe the conditions under which primary and secondary succession take place.

Life in a Community

- Various combinations of abiotic and biotic factors interact in different places around the world.



Life in a Community

- The result is that conditions in one part of the world are suitable for supporting certain forms of life, but not others.



Limiting factors

- Factors that affect an organism's ability to survive in its environment, such as the availability of water and food, predators, and temperature, are called limiting factors.

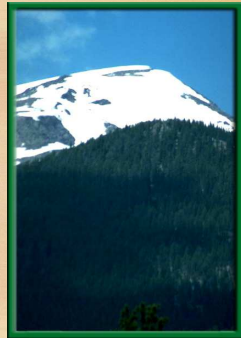
Limiting factors

- A **limiting factor** is any biotic or abiotic factor that restricts the existence, numbers, reproduction, or distribution of organisms.

Common Limiting Factors
Sunlight
Climate
Atmospheric gases
Temperature
Water
Nutrients/Food
Fire
Soil
Space
Other organisms

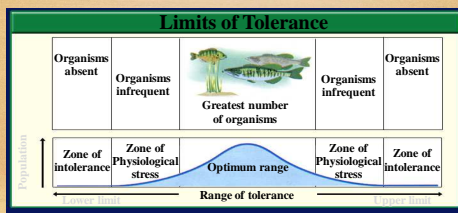
Limiting factors

- Factors that limit one population in a community may also have an indirect effect on another population.



Ranges of tolerance

- The ability of an organism to withstand fluctuations in biotic and abiotic environmental factors is known as **tolerance**.



Succession: Changes over Time

- Ecologists refer to the orderly, natural changes and species replacements that take place in the communities of an ecosystem as **succession**.
- Succession occurs in stages. At each stage, different species of plants and animals may be present.

Succession: Changes over Time

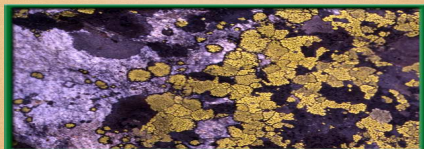
- As succession progresses, new organisms move in.
- Others may die out or move out.
- There are two types of succession—primary and secondary.

Primary succession

- The colonization of barren land by communities of organisms is called **primary succession**.
- Primary succession takes place on land where there are no living organisms.

Primary succession

- The first species to take hold in an area like this are called pioneer species.



- An example of pioneer species is a lichen, which is a combination of small organisms.

Primary succession

- Decaying lichens, along with bits of sediment in cracks and crevices of rock, make up the first stage of soil development.
- New soil makes it possible for small weedy plants, small ferns, fungi, and insects to become established.

Primary succession

- As these organisms die, more soil builds.



Primary succession

- After some time, primary succession slows down and the community becomes fairly stable, or reaches equilibrium.

Primary succession

- A stable, mature community that undergoes little or no change in species is a **climax community**.

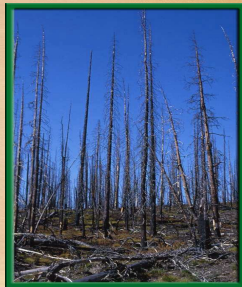


Secondary succession

- **Secondary succession** is the sequence of changes that takes place after an existing community is severely disrupted in some way.
- Secondary succession, however, occurs in areas that previously contained life, and on land that still contains soil.

Secondary succession

- Because soil already exists, secondary succession may take less time than primary succession to reach a climax community.



Section Objectives:

- Compare and contrast the photic and aphotic zones of marine biomes.
- Identify the major limiting factors affecting distribution of terrestrial biomes.
- Distinguish among biomes.

What is a biome?

- A biome is a large group of ecosystems that share the same type of climax community.
- There are terrestrial biomes and aquatic biomes, each with organisms adapted to the conditions characteristic of the biome.



What is a biome?

- Biomes located on land are called terrestrial biomes.
- Oceans, lakes, streams, ponds, or other bodies of water are aquatic biomes.



Aquatic Biomes

- Approximately 75 percent of Earth's surface is covered with water.
- Most of that water is salty.
- Freshwater is confined to rivers, streams, ponds, and most lakes.
- As a result, aquatic biomes are separated into marine biomes and freshwater biomes.

Marine biomes

- Different parts of the ocean differ in biotic and abiotic factors (salinity, depth, availability of light, and temperature) found there.
- One of the ways ecologists study marine biomes is to make separate observations in shallow, sunlit zones and deeper, unlighted zones.

Marine biomes

- The portion of the marine biome that is shallow enough for sunlight to penetrate is called the **photic zone**.



Marine biomes

- Deeper water that never receives sunlight makes up the **aphotic zone**.



Estuaries—Mixed waters

- An estuary is a coastal body of water, partially surrounded by land, in which freshwater and salt water mix.
- The salinity, or amount of salt, in an estuary ranges between that of seawater and that of freshwater, and depends on how much freshwater the river brings into the estuary.

The effects of tides

- Daily, the gravitational pull of the sun and moon causes the rise and fall of ocean tides.
- The portion of the shoreline that lies between the high and low tide lines is called the **intertidal zone**.
- Intertidal ecosystems have high levels of sunlight, nutrients, and oxygen.

In the light

- The photic zone of the marine biome includes the vast expanse of open ocean that covers most of Earth's surface.
- Most of the organisms that live in the marine biome are plankton.

In the light

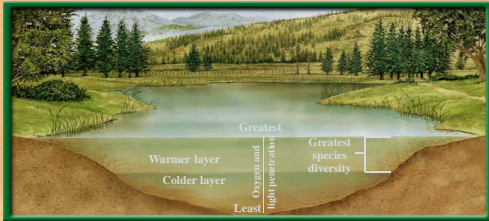
- Plankton are important because they form the base of all aquatic food chains.
- Baleen whales and whale sharks, some of the largest organisms that have ever lived, consume vast amounts of plankton.

Freshwater biomes

- Although the summer sun heats the surface of a lake the water a few feet below the surface remains cold.
- These temperature variations within a lake are an abiotic factor that limits the kinds of organisms that can survive in deep lakes.

Freshwater biomes

- Another abiotic factor that limits life in deep lakes is light.

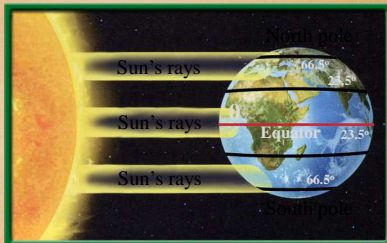


Other aquatic biomes

- Other places where land and water meet are called wetlands, but there are several different kinds of wetlands. Swamps have trees.
- Marshes do not, but both usually have water flowing through them.
- Other wetland areas, called bogs, get their water supply from rain. Water does not flow through bogs.

Terrestrial Biomes: Latitude and climate

- Latitude describes your position in degrees north and south of the equator.



Terrestrial Biomes: Latitude and climate

- At different latitudes, the sun strikes Earth differently.

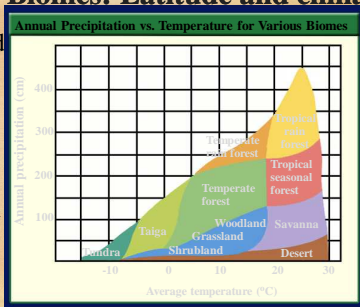


Terrestrial Biomes: Latitude and climate

- As a result, the climate—wind, cloud cover, temperature, humidity and precipitation in that area—are different.

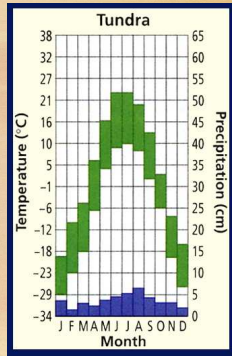
Terrestrial Biomes: Latitude and climate

- Latitude and climate are abiotic factors that affect what plants and animals will survive in a given area.



Life on the tundra

- The **tundra** is a treeless land with long summer days and short periods of winter sunlight.



Life on the tundra

- Because of its latitude, temperatures in the tundra never rise above freezing for long, and only the topmost layer of soil thaws during the summer.
- Underneath this top layer is a layer of permanently frozen ground called permafrost.
- The soil is lacking in nutrients.

Life on the tundra

- Lack of nutrients limits the types of organisms the tundra can support.
- The short growing season limits the type of plants found in this biome to grasses, dwarf shrubs, and cushion plants.



Life on the tundra

- Hordes of mosquitoes and black-flies are some of the most common tundra insects during the short summer.
- The tundra also is home to a variety of small mammals, including ratlike lemmings, weasels, arctic foxes, snowshoe hares, and even birds such as snowy owls and hawks.

Life on the tundra

- Musk oxen, caribou and reindeer are among the few large animals that migrate into the area and graze during the summer months.



Life on the taiga

- Just south of the tundra lies another biome that circles the north pole.
- The **taiga** (TI guh) also is called the boreal or northern coniferous forest.

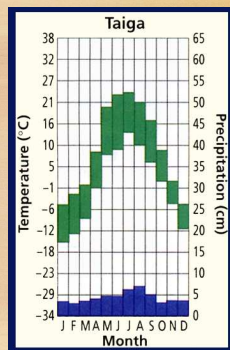
Life on the taiga

- Common trees are larch, fir, hemlock, and spruce trees.



Life on the taiga

- Because of their latitude, taiga communities usually are somewhat warmer and wetter than tundra.

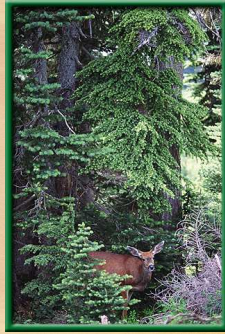


Life on the taiga

- However, the prevailing climatic conditions are still harsh, with long, severe winters and short, mild summers.
- The topsoil, which develops slowly from decaying coniferous needles, is acidic and poor in minerals.

Life on the taiga

- More large species of animals are found in the taiga as compared with the tundra.



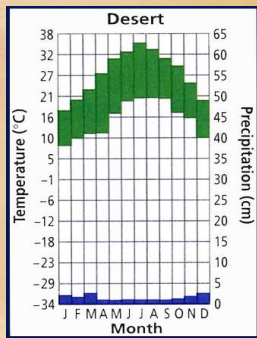
Life in the desert



- The driest biome is the desert biome. A **desert** is an arid region with sparse to almost nonexistent plant life.

Life in the desert

- Deserts usually get less than 25 cm of precipitation annually.



Life in the desert

- With rainfall as the major limiting factor, vegetation in deserts varies greatly.
- The driest deserts are drifting sand dunes.



Life in the desert

- Many desert plants are annuals that germinate from seed and grow to maturity quickly after sporadic rainfall.
- The leaves of some desert plants curl up, or even drop off altogether, thus reducing water loss during extremely dry spells.
- Many desert mammals are small herbivores that remain under cover during the heat of the day, emerging at night to forage on plants.

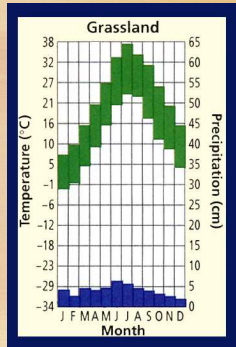
Life in the desert

- Coyotes, hawks, owls and roadrunners are carnivores that feed on the snakes, lizards, and small mammals of the desert.



Life in the grassland

- Grasslands are large communities covered with rich soil, grasses, and similar plants.



Life in the grassland

- Grasslands, occur principally in climates that experience a dry season, where insufficient water exists to support forests.
- Grasslands contain few trees per hectare.

Life in the grassland

- The soils of grasslands have considerable humus content because many grasses die off each winter, leaving byproducts to decay and build up in the soil.
- At certain times of the year, many grasslands are populated by herds of grazing animals.

Life in the grassland

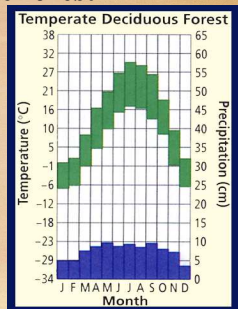
- Other important prairie animals include jack rabbits, deer, elk, and prairie dogs.



- Many species of insects, birds, and reptiles, also make their homes in grasslands.

Life in the temperate forest

- When precipitation ranges from about 70 to 150 cm annually in the temperate zone, temperate deciduous forests develop.



Life in the temperate forest

- **Temperate** or **deciduous** forests are dominated by broad-leaved hardwood trees that lose their foliage annually.
- The soil of temperate forests usually consists of a top layer that is rich in humus and a deeper layer of clay.



Life in the temperate forest

- The animals that live in the temperate deciduous forest include squirrels, mice, rabbits, deer, and bears.



Life in the temperate forest

- Many birds, such as bluejays, live in the forest all year long, whereas other birds migrate seasonally.



Life in rain forests

- There are two types of rain forests in the world—the temperate rain forest and the more widely known tropical rain forest.
- Temperate rain forests are found on the Olympic peninsula in Washington state and in other places throughout the world, such as South America, New Zealand, and Australia.

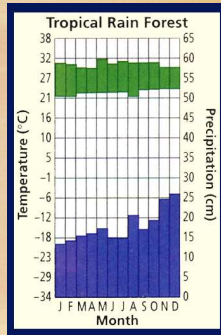
Life in rain forests

- As their name implies, **tropical rain forests** have warm temperatures, wet weather, and lush plant growth.



Life in rain forests

- The average temperature is about 25°C.



Life in rain forests

- Rain forests receive at least 200 cm of rain annually; some rain forests receive 600 cm.
- One reason for the large number of niches in rain forests is vertical layering.

A Tropical Rain Forest: Canopy

- The canopy layer, 25-45 meters high, is a living roof.
- The tree tops are exposed to rain, sunlight, and strong winds.
- A few giant trees called emergents pole through the canopy.

A Tropical Rain Forest: Canopy

- Monkeys frequently pass through.
- Birds, such as scarlet macaws, live on the fruits and nuts of the trees.



A Tropical Rain Forest: Understory

- In the understory, the air is still, humid, and dark. Vines grow from the soil to the canopy.
- Leaf cutter ants harvest leaves and bring them to the ground.
- Plants include ferns, broad-leaved shrubs, and dwarf palms.

A Tropical Rain Forest: Understory

- Insects are common in the understory.
- The limbs of the trees are hung with a thick layer of epiphytes, plants that get most of their moisture from the air.
- Birds and bats prey upon the insects.

A Tropical Rain Forest: Understory

- Tree frogs are common understory amphibians.
- Reptiles include chameleons and snakes.

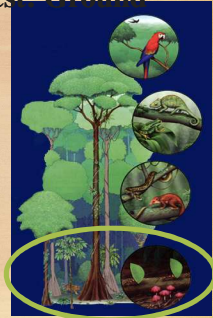


A Tropical Rain Forest: Ground

- The ground layer is a moist forest floor.
- Leaves and other organic materials decay quickly.
- Roots spread throughout the top 18 inches of soil
- There is great competition for nutrients.

A Tropical Rain Forest: Ground

- Mammals living on the ground include rodents and cats, such as the jaguar.
- Ants, termites, earthworms, bacteria, and fungi live in the soil and quickly decompose organic materials.

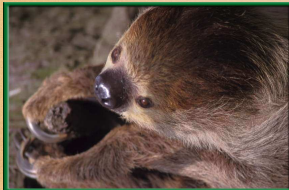


Life in rain forests

- Some rain forest plants are important sources of medicinal products and hardwood trees and have provided a source of income for people.

Life in rain forests

- Agricultural land is not common in rain forests.



Life in rain forests

- Soils in rain forests do not have substantial amounts of organic matter because leaf matter, which contains nutrients, disappears so quickly.
- Without organic matter, once rain forest soil is exposed and farmed, it becomes hard, almost brick-like, and nutrient-poor in a matter of a few years.
