

Succession

Real World Ecosystems
Backgrounder
Grade Level: 5-8



Primary succession is the process whereby bare rock and soil may gradually be replaced by a variety of organisms, both plant and animal, which are best suited to the climate of the area. These organisms establish together a **climax community** (the type of community that is best suited to the conditions in an area and which is established at the end of the process of succession). Succession may be triggered by any one of a number of natural or human-made events. For example, there may be floods or windstorms or forest fires. When a natural community is disturbed by an event such as clearing land to build homes, or when land is cleared for farming, a sort of predictable recovery process begins.

Primary succession occurs when living things populate a barren or sterile area such as the island of Surtsey, off the Icelandic coast. In 1963, an underwater volcanic eruption led to the formation of a lava-based island that gradually poked out of the sea. Over the next couple of years, more lava accumulated until the surface above the water was over three square kilometres. As time went on and the cooling of the lava occurred, bacteria and fungi carried by the wind, and other simple organisms such as insects which could feed on them, accumulated gradually.

Birds, of course, were attracted by the insects, and when the bird droppings were left behind, they often contained the seeds of grasses and other small plants. Generations of such small organisms living

and dying on Surtsey caused more soil to accumulate, and of course, made a useful seedbed for other plants. Primary succession takes a very long time, but it is well underway on Surtsey.

Other examples of places where primary succession could occur would include new sand dunes or rock which is left barren after a **glacier** (A large mass of ice that survives from year to year, moving slowly down mountain slopes into valleys) retreats.

For example, if a fire destroys part of a **coniferous forest** area in northern Alberta right down to the bare rock below, the organic content from dead leaves and roots under the soil will likely have been burned as well. That would mean that all plant life has been wiped out, and, therefore, all food sources for **herbivores** (an organism that eats only plants in order to obtain carbon atoms and energy) or **first-order consumers** (also known as herbivores, or first-level consumers, they feed on plant material) is gone. If there is no food, animals will either leave the area, or they may be driven out or killed during the fire itself.

Coniferous forest: Also known as the taiga, or boreal forest. It extends in a broad band across North America, Europe, and Asia to the southern border of the arctic tundra. Conifers are also commercially important as a source of timber for the papermaking, building, and furniture industries.

Such changes in the population of animals in an area having to do with food supply and competition for food are biological factors. Changes in a body of water such as its degree of saltiness or acidity are examples of chemical changes. Related to both biological and chemical changes are physical changes which may include changes in temperature, light availability to plants or rainfall.

However, the carbon-rich scorched soil is an excellent seedbed, so before too long, spores and seeds of plants from other unburned areas may be carried into the area by the wind or on the fur of passing animals. If spores fall into the cracks between soil particles or into the cracks of rocks, they may begin to germinate if there is little moisture available.

Did You Know? Pioneer Species

If damage to an ecosystem has been caused by fire, carbon from burned wood is returned to enrich the soil. Some plants actually are helped by fire, as intense heat is required to open their seeds. This is the case for jack pine and for fireweed. The seeds of fireweed are activated by the intense heat of the fire and they thrive in bright sunlight. Cones bearing the jackpine seeds are forced open by the heat and drying effect of fire. Young jack pine seedlings thrive in the sunlight, too, so once the area becomes shadier and more populated, fewer jackpines inhabit the space.

Lichens (an organism consisting of algae and fungi living together in a mutually beneficial relationship. It often appears as a coloured patch on the surface of bare rock) can actually secrete weak acids which help to dissolve the surface of rocks and thereby create, over many years and many generations, a little soil in which seeds from other plants may take root. Gradually, lichens, mosses, and ferns live out their life cycles in the thin soil, and, as they die, they help to create and fertilize some new organic soil material.

Grasses and their relatives will frequently be next to show up, and, when the seeds and new plants enter the area with the help of wind, water, or passing animals, they find a hospitable seedbed waiting.

As generations of these smaller plants invade the area, their roots help to hold the moisture that allows the larger plants to survive. Also, as the soil is warmed by the sun while the new plants are small, the **germination** of seeds is assisted.

Airborne seeds such as those of dandelion, thistle and milkweed may parachute into an area newly opened by fire and live out several generations. As their remains gradually fill in and enrich the soil, other **species** may arrive, carried on the fur of passing animals, carried by rain, or wind. These are the pioneer species that thrive in a newly opened area, but which may die out when other plant species arrive in a similar fashion, having found the conditions now to their liking.

Once the larger plants such as shrubs and trees begin to grow, they provide shelter so that certain other plant types which prefer the shade can survive. Keep in mind that some of the organisms that may have preferred to inhabit the area after it was newly burned and cleared off may not survive in the area once it fills in and becomes shaded again.

Remember that plants are referred to as producers because they require only the energy of sunlight and the raw materials available in the soil and the atmosphere in order to produce food. Right after a forest fire, when there may be no producers left in some areas that burned, there will be no food for herbivores or first-order consumers. During the fire, consumers will have fled the area if at all possible, but otherwise, some of the consumers may have died in the fire.

Green Thumb: Wetlands Are Useful Water Cleaners

The flow of water through wetlands areas is very slow. Materials suspended in the water will settle to the bottom of the wetland. Water that is flowing out of a wetland area is often cleaner than that which entered since some wetland organisms such as cattails absorb pollutants like heavy metals, fertilizers, and pesticides.

Consumers will not immediately repopulate the burned area, as there would be no cover or protection from predators, and there would be no food even for first-level or first-order consumers to eat. Once small plants begin to grow, however, smaller animals can find food and shelter, so they will return to the area. Larger **secondary consumers** and, finally, **tertiary consumers** will return as producer populations, such as jackpine, increase in size and number and their needs for shelter and food can once again be met.

Second-order consumers: *Organisms that feed upon first order, first level, or first-order consumers or herbivores. They are also known as secondary and second-level consumers.*

Third-order consumers: *Also known as third-level or tertiary consumers. Organisms that feed upon second-level or secondary consumers.*

Gradually, a community of plants and animals is established that is well suited to the conditions in the area. This is called a climax community. The process whereby these communities replace each other one after the other is referred to as succession. If, as in this case, even the producers are burned to the extent that roots are destroyed beneath the soil's surface, the recovery process is known as **primary succession**. The group or collection of plants and animals best suited to the conditions of soil, water, and climate in the area makes up the climax community.

Did You Know? Restricted Occupation

During periods when the prairie climate was hotter and drier than it is today, human occupation was restricted completely to areas along the banks of rivers, streams, and lakes.

If not all the trees and other plants have been wiped out, there may be some seeds that escape the fire. These can immediately begin the regrowth process. This is known as **secondary succession**. Fortunately, most succession is of the secondary type. Secondary succession is often similar to a response to an injury, only in this case, the injury is to a community. If only

some of the producers and consumers are damaged or driven out of an area, recovery is usually faster. The food sources are still there for some organisms, so not all of them leave or are wiped out.

Similarly, if a portion of a forested area has been destroyed, the result will be increased light reaching the ground. Younger trees starting to grow, as well as shrubs that may populate the area, have thinner bark and make accessible winter food supplies for some animals such as moose or rabbits. Deer would be attracted for similar reasons, and the droppings of these animals become food for certain insects such as beetles, which in turn become food for birds attracted to the area. The birds may utilize for their nests the hair of some of the mammals who have come into the area.

It should be remembered that if some substances in the **environment** are absorbed but not needed or used by the plants which absorb them, some of these substances, such as salt, might actually be harmful to the plant. Similarly, if fish absorb mercury from the water they swim in, the fish may be damaged or may even die. Such harmful substances in the air are **pollutants**.

Did You Know? Riparian Areas

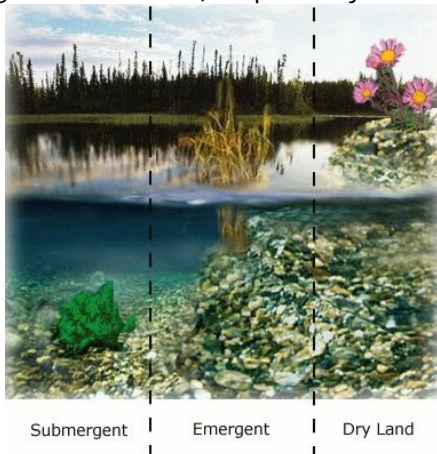
Riparian areas exhibit an abundance of water and plant communities that are different from the drier uplands and which are the transition zones between land and water.

Aquatic Ecosystem

It may take thousands of years, but an area of land that is covered by a body of water such as a pond or slough (A channel in which water moves sluggishly, or a place of deep muck, mud or mire. Sloughs are wetland habitats that serve as channels for water draining from surrounding uplands and/or wetlands) may gradually become filled in with vegetation and thereby change entirely in character. Near the edges of a pond, for example, pioneer plants such as cattails, reeds, and floating mats of weeds may live out several generations. As their remains accumulate over the years, the edges of the pond become filled in and shallower. The fact that more sunlight can now

reach the bottom of the small body of water encourages the growth of plants that do not mind having their “feet wet.” So, more reeds, mosses, willows, and other water-loving plants move in, thus increasing the amount of accumulating organic matter, which in turn helps to fill in the space where water once was. Eventually, there is no open water remaining. Through such a process of secondary succession, an aquatic community may be transformed to a wetland, or in communities further north, to a black spruce forest.

Depending upon whether aquatic plants grow completely underwater or have their roots or lower stems underwater, they are termed **submergent** (plant bodies that grow completely underwater) or **emergent** (plants that grow with their roots underwater and the top portion of the plant emerging from the water) respectively.



Key Points to Remember

- The process of succession is basically the same process, no matter the ecosystem or community in which it occurs.
- Depending upon the original environmental conditions in which the ecosystem exists, the **process of succession leads to a stable community situation which is likely to remain pretty much as it is in terms of biotic and abiotic factors since the plants and animals that live there are well adapted to their surroundings.**
- Situations of great environmental disturbance such as fire or flood may trigger successional changes. But some changes are accidental and others are the result of a purposeful act.

Think About...

- How do plants in a wetland affect other organisms in the ecosystem?
- What would happen to other organisms if all producers died off in the wetland? Suggest a possible cause for such an event.
- Of what benefit may fire be to a forest ecosystem?