

4.4: Fire Reading



Figure 1 Credit: US Fish and Wildlife Service

Ecologists describe “disturbances” as temporary changes in an ecosystem that causes the ecosystem to change in some way. Sometimes the effects of this change can be temporary, and sometimes the effects are permanent. Disturbances are sometimes important for ecosystems to stay healthy. Other disturbances can cause harmful changes to ecosystems. This handout examines a specific ecosystem disturbance: **FIRE!**

Fire as a disturbance. Although you may think of fire as a destructive disturbance, many ecosystems, like some grasslands, shrublands, savannas, and forests, rely on fire to maintain their communities of plants, animals, insects, and other organisms. Fires kill unwanted plants (weeds or invasive species), and stimulate growth in some species. This helps native species thrive and kills invasive species.

One example of an ecosystem that depends on fire to maintain its community structure and function is longleaf pine forests in the Southeastern United States. Longleaf pine (*Pinus palustris*) has developed growth strategies that make it able to thrive in an environment that experiences frequent fires. In the first few years of the tree’s life, the sapling grows minimally above ground, instead developing an extensive root system. Its needles form a thick, grass-like clump aboveground surrounding the bud (Figure 1). When a fire burns, the roots of the saplings are protected underground, while the aboveground buds are protected by the thick needle bundles. The fire burns leaf litter and kills other plants that compete for sunlight and nutrients. After a fire, the pines have less competition from other plant species for resources that help them grow. Once the tree is a few years old, it experiences a rapid growth spurt (up to 1.5 meters a year!) until it is tall enough to resist damage from future fires.

What happens when disturbances are stopped? Remember, disturbances are integral processes to ecosystems that the plants and animals have adapted to over many years. When something occurs to change either the frequency or intensity of those disturbances, it is likely the ecosystem will change, too. An example of this is fire suppression, where people decided to put out fires instead of letting them burn. In ecosystems like longleaf pine savannas that have adapted to frequent, low severity fires, this can cause changes in both the species composition and the



Figure 2 Credit: Bill Lea, USDA Forest Service

characteristics of the community. The lack of fires would allow many plants to grow close together and for leaf litter to accumulate on the forest floor. Together, this increase in organic matter results in a higher than normal fuel load that could cause a hotter, more severe fire than this ecosystem normally experiences. This could result in the death of longleaf pine seedlings as well as adult trees because they are not adapted to these kinds of fires. Over time, the plant community composition may shift from being dominated by longleaf pine trees in favor of other tree species that are better adapted to the new environment.

Pools and fluxes during fire. Fires are the combustion of organic material, from dead leaves and branches up to whole, living trees. When organic matter is burned, the carbon it contains returns to the inorganic pool in the form of CO₂. The amount of organic matter burned depends

on the severity and intensity of the fire and how much fuel there is for the fire to burn. In low severity fires, only some of the organic matter burns. For example, the organic matter in the roots and shoots of longleaf pine trees remains mostly intact because it is protected by the surrounding soil. However, high severity fires can combust a much greater portion of the organic matter in an ecosystem, returning large quantities of carbon to the atmosphere as CO₂. These kinds of fires often kill lots of adult trees. However, combustion also returns other elements, like nitrogen, that were stored in organic matter back to the soil, making them available for new plants.



Figure 3 Credit: PD-USGOV-USDA

better and appreciate the important role fire plays in maintaining many ecosystems. Instead, Smokey encourages us to prevent *Wild Fires*. Wild fires are those fires that occur at times of the year, or in certain places, that go against the objectives of land managers. These wild fires might threaten human communities or important natural resources (like clean water) that forests provide. This change in attitude toward fire as an important ecosystem process has caused managers to incorporate fire in their management strategies, sometimes even purposefully setting fires, to help insure forests continue to function in ways that protect the resources they contain and keep nearby human communities safe.

Changing Smokey's message. You may be familiar with Smokey the Bear, a mascot for fire prevention. Although Smokey began his campaign in the 1940s, his message as changed over time. From the 1940s until 2001, Smokey told us to prevent *Forest Fires*. Because of Smokey's successful campaign, forests in the United States went for long periods of time without fire. This caused fuel loads to accumulate in many forests. When a fire did start, either by a lightning strike or a campfire, the fires were more severe than usual and posed safety hazards to people who lived nearby. They were also more destructive to the ecosystems where they occurred.

In 2001, Smokey's message changed. His earlier message ("Only you can prevent Forest Fires") implied that *all* fires needed to be prevented. Now, thanks to science, we know



Figure 4 Credit: US Fish and Wildlife Service