Teacher Tune-up

Quick Content Refresher for Busy Professionals

What are ecological disturbances? And are people always involved?

Ecological disturbances are events that change ecological communities by removing organisms and altering the availability of resources. An ecological community is a group of species that live in the same place, and community ecology studies how the interactions between species—predation, competition, symbiosis, etc.—affect community structure. In community ecology, the term "stability" refers to the maintenance of a roughly constant number of each kind of organism; but the notion of an environment where everything remains in unvarying harmony is usually unrealistic. Ecologists have come to emphasize a so-called nonequilibrium model, which describes communities as constantly changing because of disturbances.

Some ecological disturbances are anthropogenic (caused by humans). People destroy natural habitat to develop cities and suburbs. They strip-mine mountains, clear-cut forests, dam rivers, pollute air and water, hunt and fish sometimes to excess, and alter the land through farming and livestock grazing. They transport invasive species into new environments, on purpose or by accident These invasive non-native species often prey upon, infect, or compete with native species, without having their own natural predators in the community to keep them in check. All these actions can cause varying degrees of disturbance to existing environments.

In contrast to anthropogenic disturbances, many disturbances aren't caused by humans. For example, earthquakes, volcanic eruptions, natural forest fires, creeks dammed by beavers, and periodic insect swarms are natural causes of ecological instability. Sometimes humans can also prevent naturally occurring disturbances such as fires (though short-term fire prevention can have unintended consequences when fuel stocks build up and lead to less frequent but more catastrophic fires).

Many disturbances, like fires, may be either natural or human-caused, depending on circumstances. And sometimes determining whether disturbances are natural may be a matter of debate or definition. For example, in an era of anthropogenic climate change (caused by the human production of greenhouse gases), it's increasingly unclear whether all droughts and storms should be considered simply "natural."

There have always been natural ecological disturbances. The growth of anthropogenic disturbances places increased burdens on ecological communities around the world. Many local ecosystems may not be able to recover fast enough, and their biodiversity may collapse.

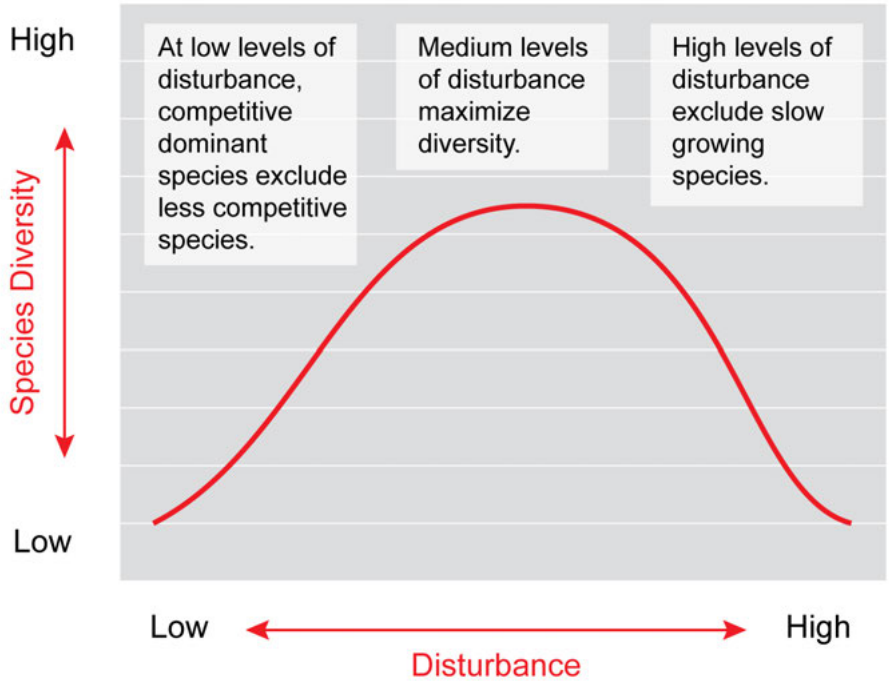
Examples of Natural & Anthropogenic Disturbances

- Fire
- Flood
- Wind
- Disease
- Severe Storms
- Volcanic Activity
- Drought
- Long-term Freezing
- Earthquake
- Overgrazing
- Pollution
- Insect Swarms
- Lightning
- Deforestation
- Urbanization
- Agriculture
- Invasive Non-native Species

Are disturbances necessarily bad?

If we take species diversity as an indicator of the general health and resilience of an ecological community, we can say that disturbances are not necessarily bad. Although sometimes disturbances can devastate a community, reducing its biodiversity, the result of disturbances depends on their intensity and frequency. The **intermediate disturbance hypothesis** states that moderate levels of disturbance can actually promote higher species diversity than we find in communities with either very high or very low levels of disturbance. Many terrestrial and aquatic studies support the intermediate disturbance hypothesis.

The intensity of a disturbance depends partly on the geographical size affected. For example, small-scale disturbances such as small, localized fires can create patches of different habitats, which can contribute to maintaining high species diversity across the larger landscape.



Intermediate Disturbance Hypothesis

What are ecological recoveries, and what kinds of organisms thrive at different stages in the process?

Ecological recoveries are a kind of ecological succession. Ecological succession is the sequence of community and ecosystem changes after some initiating event. When a new, lifeless terrain is formed (by a lava flow, for example, or a glacier that has scraped the landscape down to bedrock), the sequence is described as primary succession. When an existing habitat is disturbed (by fire, for example), its recovery is described as secondary succession.

Primary Succession

1. Consider the example of a volcano forming a new island or a large area of bare rock. The initial life forms will be prokaryotes and protists.

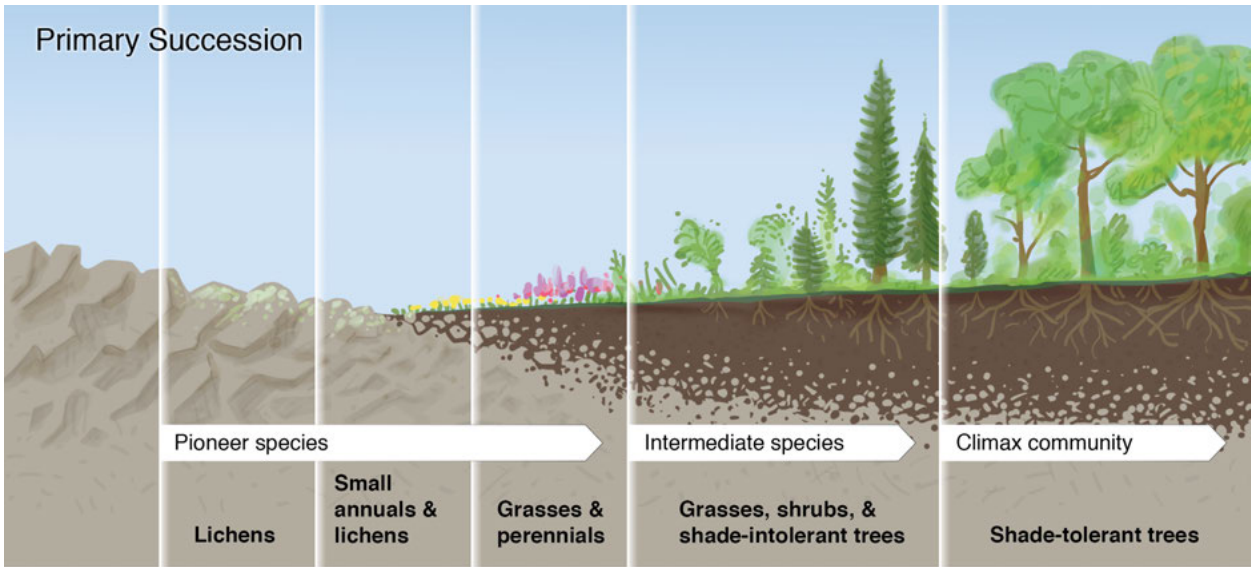
2. Next, opportunistic organisms such as mosses and lichens that produce windblown spores begin to colonize the rocky area. These early organisms are called pioneer species. (They are generally what are called “r-selected” organisms—more about r-selection below).

3. Soil develops as rocks weather down and early colonizers decompose.

4. The presence of soil enables grasses and other perennials to grow, and the grasses smother the mosses and lichens.

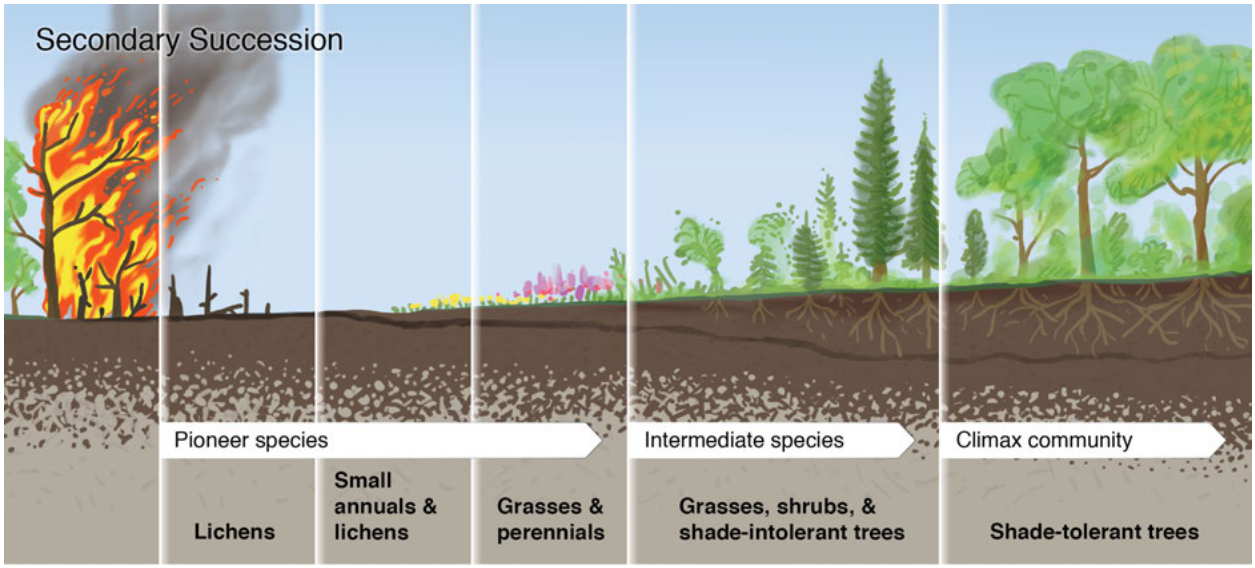
5. Grasses, shrubs and shade-intolerant trees begin to colonize the area. These successors to the pioneer species are called intermediate species. They sprout from seeds that initially arrive by wind or are carried by animals.

6. Taking advantage of the environment developed by pioneer and intermediate species, additional organisms like shade-tolerant trees move in to complete the climax community. This whole process may take hundreds of years.



Secondary succession

Secondary succession takes place following a major disturbance, such as a fire or flood. Farmland that has been abandoned also can undergo secondary succession. The stages of secondary succession are similar to those of primary succession with one important difference: soil. Primary succession always begins on a barren surface, while secondary succession begins in an area that already has soil.



Who thrives at which stages?

Different stages of succession favor organisms with different survival strategies. Ecologists often distinguish between r-selected species and K-selected species. The "r" stands for reproduction, and the K stands for carrying capacity (no, it's not a mistake, it's a German thing: *Kapazitätsgrenze* means capacity limit in German).

R-selected species generate lots and lots of offspring, without putting much individual investment into them, and those few that survive to adulthood lead short lives. Their populations spike and plummet through booms and busts. A couple of examples would be dandelions, scattering many seeds to the winds so that a few might take root, and mosquitoes, laying thousands of mostly-doomed eggs in pools of stagnant water so that some fraction of them might reach a fragile, brief adulthood. Such r-selected species make good pioneers, and are sometimes referred to as opportunistic.

K-selected species are adapted to live in numbers close to the carrying capacity of relatively stable environments. They max out their population and then keep it fairly steady, as long as no major disturbances change the carrying capacity of their environment. They have long lifespans, and put a big investment into relatively few offspring with a decent chance of survival. Examples include species like large trees that grow in mature forests, or large mammals like humans and elephants that put a lot of energy and time into caring for their young. K-selected species are sometimes called equilibrium species; they tend to do well in climax communities.

Characteristics of r- and K-selected populations

Characteristic	**r-selected populations (opportunistic)**	**K-selected populations (equilibrium)**
Maturation time	short	long
Life span	short	long
Death rate	high	low
Number of offspring	many	few
Size of offspring or eggs	small	large
Investment in parental care	low or none	high
Prominent stage of succession	pioneer communities	climax communities

Tags: ecological disturbance, disturbance, ecological recovery, recovery, succession, primary succession, secondary succession, intermediate disturbance hypothesis, r-selected species, K-selected species, anthropogenic, invasive species, ecological community, ecology, ecosystem