

SUCCESSION

SOMETIMES people coin a phrase that catches on, even though it might not be completely accurate. This is true of the term "balanced community." "Balance" infers stability—that there are no changes taking place. As you know, this just doesn't happen in natural communities. A community is a dynamic, active, changing environment with animals and plants interacting with one another all the time. There are long-term changes and short-term changes. Populations fluctuate. Consider the effect of bird migration on a forest in the Midwest. On May 10 there may be hundreds of Wilson's warblers flitting about in the tops of the trees. They may remain through the day and be gone on May 11, headed north toward their breeding grounds in Minnesota and Canada. The effect of hundreds of Wilson's warblers acting as second-order consumers in the forest for an entire day may be substantial. Still, they are here today and gone tomorrow. There is nothing static about this situation.

What should we consider a balanced community to be? Is the forest through which hundreds of Wilson's warblers pass considered balanced? The answer is yes. If the forest retains its basic characteristics for fairly long periods of time, it can be called a balanced, homeostatic community. In reality, any self-maintaining community is balanced. The fact that Wilson's warblers visit the forest for brief periods has little to do with the long-term condition of the forest.

Often, ecologists like to refer to a homeostatic community as one where changes do not destroy the character of the community. A grasslands community, for example, remains a grasslands community although the numbers of grazing animals may fluctuate dramatically. An oak-hickory forest remains an oak-hickory forest even though dramatic species differences can be noted from time to time. The ability of a community to retain its basic characteristics is the best explanation of a "balanced, homeostatic community."

A Climax Community

The grasslands community and the oak-hickory forest may retain their basic character for hundreds of years. Of course, if the grasslands are plowed and planted to wheat,

the situation changes drastically. So, too, with the forest if it is cut or if fire destroys it. Without such drastic changes, however, the grasslands and the oak-hickory forest (in some regions) have the ability to remain much as they have for centuries. Some communities are like this. They are dynamic environments, but their basic character remains unchanged.

Any community that can retain its character for many hundreds—or thousands—of years is called a **climax community**. The term "climax" refers to the **last** community or the **most stable** community for a particular area. Other examples of a climax community would be the rain forest, the cactus desert, the taiga, and the tundra. The next section of this work-text will help you understand how climax communities develop. But first, look at the illustration at the top of the following page.

How Communities Change

Communities can and do change. A particular coniferous forest may have remained stable over several hundred years, but it can catch fire from a single bolt of lightning or from a carelessly thrown cigarette or match and be completely destroyed.

If a forest is destroyed by fire or from lumbering, will it grow back as it was before? Will oaks and hickories grow in the ashes of a former oak-hickory forest? The answer to the first question is yes—eventually. The answer to the second question is no. Although this doesn't seem reasonable, it's a fact. If the soil of the forest is not completely destroyed by fire, for example, the first plants to appear will be soft-bodied plants such as grasses and flowering plants. These are eventually replaced by what are called **pioneer trees**—trees far different from the oaks and hickories that originally grew there. The pioneer trees provide an environment in which a new group of trees can grow.

After many more years, oak and hickory seedlings will begin to be seen in the area again. It may take 200 years for an oak-hickory forest to return to its original state after a fire or lumbering has destroyed it.

The replacement of one community by another is called **succession**. Succession is a very normal happening in nature and is evident in many places. Succession can be seen in an abandoned farm field. It can be seen at any pond, in any lake, and at any bog. It can be seen in a vacant city lot where plants and animals are mostly unmolested. Succession can even be seen where grasses and other plants grow in the cracks of sidewalks.

The interesting thing about succession is that it is usually an orderly, predictable process. Ecologists can predict what will happen in a given environment in 10 years, in 100 years, in 200 years. Almost all ponds and lakes, for example, follow a natural sequence of events that eventually end in the production of fairly dry land and a land community being established where a pond or lake once existed. This may be hard to believe, but it is precisely the case.

It was noted earlier that a forest community can be completely destroyed by lumbering or fire. When this happens in a hilly area, it is quite possible that the tragedy will be followed by serious soil erosion. Solid rock is usually found under the layer of soil. If the soil is completely stripped off the land, it will be centuries before it can return to its original state. But given time—perhaps 1000 years—the scars can be healed and a new forest can grow where only bare rock exists today.

This, too, may be hard to believe, but it is true. How does this progression of events occur? We will call the events taking place in a surprisingly orderly series of happenings **bare rock succession**.

As the rocks are laid bare by erosion, they are exposed to the atmosphere. The geologic processes of weathering can begin, and the rock is slowly broken down into smaller and smaller fragments. Many forms of weathering exist, and all are effective in reducing bare rock to smaller particles or chemicals in solution.

The first plants to appear on the bare rock are lichens. These hardy plants grow on the rock itself. They produce weak acids that assist in the slow weathering of the rock surface. The lichens also trap wind-blown soil particles. These eventually produce a very thin layer of soil—a change in environmental conditions that gives rise to the next stage in bare rock succession.

Mosses are able to grow in the soil provided by weathering and the lichens. They produce a larger growing area and trap even more soil particles. They also provide a moister environment on the rocks. The combination of additional soil and moisture establishes abiotic conditions that favor the next successional stage.

The seeds of herbaceous plants now invade what was once only a bare rock surface. Grasses and other flowering plants take hold. Organic matter provided by the dead tissue

of plant bodies is added to the thin layer of soil, while the rock continues to be weathered from below. More and more animals join the community as it becomes larger and more complex.

By this time the plant and animal community is a fairly complicated one. The next major invasion is by weedy shrubs, which are able to survive in the amount of soil and moisture provided. Time passes and the process of building soil is speeded up as more and more plants and animals invade the area. Soon trees take root and forest succession is evident. Of course, many years will pass before a climax forest grows here, but the scene is set for that very happening.

Of great interest in bare rock succession is the fact that each stage in the pattern dooms the community that existed before it. Mosses provide a habitat most inhospitable to lichens, the herbs will eventually destroy the moss community, and so on until the final climax stage is reached.

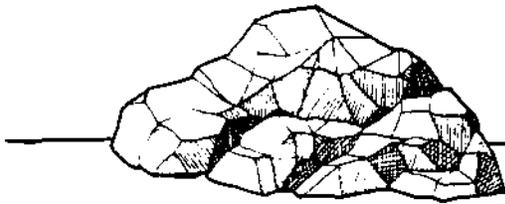
Intraspecies and interspecies competition and changes in other biotic and abiotic conditions greatly influence succession stages. When the final climax stage is reached, competition and other interactions still exist. However, a homeostatic balance exists so the climax community creates environmental conditions that favor its existence rather than dooming it.

In summary, ecologists have found that the succession patterns of different communities usually have the following characteristics in common:

- A change in the plant and animal community members. In general, as community members change, there is an increase in the number of species present as well as in the complexity of the community structure.
- An increase in organic matter from stage to stage.
- A tendency toward greater homeostatic stability as stages progress.

Each example of natural succession has identifiable stages. These stages change slowly over the years. The stages can be predicted. In each stage of succession, the dominant community creates environmental changes that doom it. The exception to this is the final or climax stage, which is self-renewing.

Bare Rock to Forest Soil



A. Bare Rock Exposed to the Elements



B. Rocks Become Colonized by Lichens



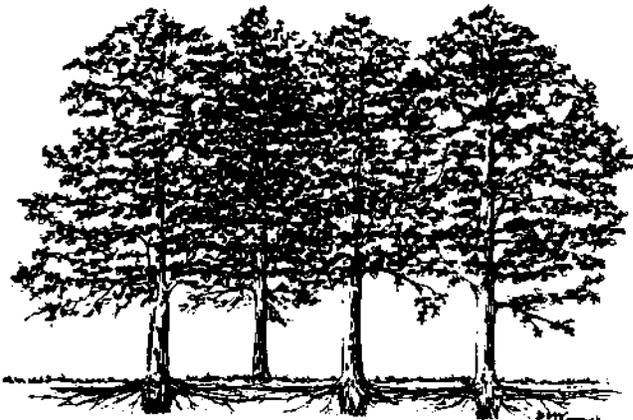
C. Mosses Replace the Lichens



D. Grasses and Flowering Plants Replace the Mosses



E. Woody Shrubs Begin Replacing the Grasses and Flowering Plants



F. A Forest Eventually Grows Where Bare Rock Once Existed

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Hundreds of Years