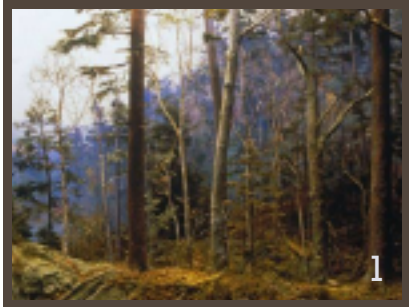
View Text Only

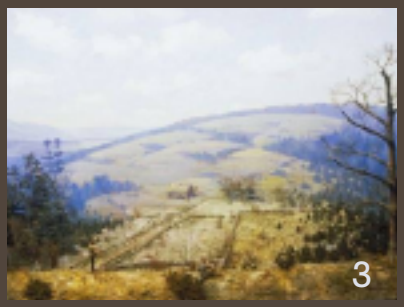
Everyone has heard of forest succession. After a disturbance, there is a somewhat predictable transition from the initial "pioneer plants," perhaps through several stages, toward a "climax forest"—the stable, old-growth condition that can last forever and regenerate itself in its own shade.

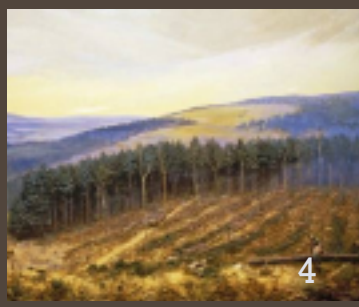
It's a Jungle Out There!

by Robbo Holleran

Forest diorama series depicts a central Massachusettes landscape, viewed over time.







1. Original, climax-type forest (Hemlock, beech, oak, pine) in Central Massachusetts. 2. Same view showing initial pasture clearing in mid 1700's. Note the complete removal of some forest portions, partial removal of other forests. Much of this landscape was cleared for farming by the mid 1800's. 3. Beginning of pasture abandonment in mid-late 1800's with pine regrowth. 4. Harvest of initial pine forest in early 1900's. What will grow back after this disturbance? Will this eventually look like the original picture?

Each soil/climate combination has its own community of trees to which it is "predestined" if the forest is allowed to develop for centuries. We learned this in high-school biology.

More modern views theorize that truly stable climax communities are quite rare and may be just theoretical. There is always some sort of disturbance, and so the forest continually responds in some dynamic state. Whether it is windstorms, fire, introduced species, or even slow climate change, there is always something going on. Here in northern New England, we tend to view hemlock—northern hardwoods, hemlock-spruce and hemlock-pine-oak as climax forests on different soils and climates. Western hemlock is a common component of western climax forests, with long-lived species such as redwood, Douglas fir, and cedars. Southern climax forests include a wide range of long-lived species, depending on soils, moisture, and climate. These are always mixes, and are constantly changing over time. Because most ecosystems experience some kind of disturbance, a true climax becomes merely a theoretical possibility. Modern ecological theory recognizes this dynamic progression that never achieves any stable "equilibrium."

While evidence of succession is fairly obvious, there is another process at work. My own competing theory is that the forest is more determined by its response to the previous disturbance. The key question, in my opinion, is: Are the changes in the current forest condition determined by its trajectory AWAY from the last disturbance, or TOWARD its climax state? Extreme disturbance, such as a hot wildfire or severe windthrow, can change the soil enough to dramatically alter this trajectory. There are reasonable examples of both theories, and they are not mutually exclusive, so the topic makes for great conversation among those who observe these things. The modern view of a "dynamic equilibrium" incorporates this perspective, to some extent. Of course, I hold to the importance of "disturbance response," or the article would merely be about forest succession.

Succession

To brush up on succession, the basic concept is that a forest changes over time, starting with some disturbance like fire, glacier retreat, major storm damage, or perhaps logging or land clearing for farming. Then, a transition occurs with initial colonization of pioneer species, transitional intermediate species and structures, and finally stabilizing in the climax community for that soil and climate. The implication, for some, is that the "climax forest" is good and everything else is less so. These "climax forests" can be an ecological goal, and there is strong political force that influences land management (particularly on public land) toward this end. Wilderness areas on national forests, along with other "no cutting zones" such as the Adirondack Park, make up substantial acreage in the United States.

Part of the myth that climax forests are "good" comes from the thought that everything "nature" does is "good" by some definition. Let me remind you, it is a jungle out there. Each tree is competing for sunlight with its neighbors. In some places, they compete for moisture or nutrients. Some live, some die. But just because trees are surviving does not mean they are healthy. As trees grow, the natural forest always gets crowded unless there is some disturbance. And so, competition for sunlight becomes the major factor stressing tree health, since sunlight is the source of energy and sugars for tree growth and health.

Disturbance is Part of the Ecology

In some forest types, the natural community is defined by the particular disturbance to which it is prone. Fire

and flooding are normal examples. Pitch pine-scrub oak, lodgepole pine, and ponderosa pine types are all maintained by fires of various intensity and frequency. Floodplain forest types with sycamore, silver maple, cypress, or gum are maintained by periodic floods. So this theory of ecological succession and natural communities recognizes that disturbance is a part of the ecology.

A related viewpoint on silviculture can be called "natural disturbance forestry." This consists of modeling harvesting practices to closely follow natural disturbance regimes. If wind and ice events tend to blow down clumps of a few trees or a few acres, then forestry practices can follow this method. In areas where forest fires or hurricanes create larger disturbances, then harvesting would mimic these techniques. The theory is that the resulting forest will be close to a natural forest in species composition and structure, while still being productive for timber and other wood products. And "natural" must be good.

My own perspective is that the managed forest provides a great level of benefits, more so than unmanaged forests. In general, we are managing "natural forests"—forests of native species, with mostly natural regeneration from nearby seed sources, and using some aspects of natural disturbance silviculture. But intensive management is essential with limited acres. Forestry goals of productivity, tree heath, and value growth are not the same as a "natural forest" in most cases. This gives us desired results of species composition, structure, and timber quality; and the managed forest is less prone to the drastic swings of natural disturbance. These are swings in the population of trees, understory plants, pests, and wildlife. We like things to be somewhat stable. On the other hand, I am glad that there are large tracts of relatively unmanaged land and large tracts of super-productive plantation forests. These are all part of the diversity of our forests, forest practice, and our culture.

Disturbance Response or Successional Tendency

All of our forest management techniques, whether plantations or variations on natural forests and natural disturbances, come back to support my view of "disturbance response" as more important than successional tendency. When we look at a forest, we are always seeing the result of the past disturbance. Was it cleared for farming? After farming, was it abandoned as a plowed field, partially grazed for a slow reforestation process, or was it planted to trees? These all jump out to me. Were there wind or ice storms, disease, or tree harvesting that shaped the forest we see today? Today's forests are always in some state of response to past disturbance. Of course, I work in a region that was mostly cleared for farming 150 years ago and has had various stages of timber harvesting over the past century. While there is little "old growth," or original undisturbed forest, we actually see a lot of hemlock-northern hardwoods and other communities that are considered climax types. But they are resulting from various disturbances.

Minnesota Dept of Natural Resources

Drought kill to understory

What about the expression "If you cut softwood, hardwoods will grow back; if you cut hardwoods, softwoods grow back"? There is just enough truth in this that the expression persists. Many of our softwood stands are pasture regrowth where softwoods grew (on rich farm soils) because of grazing pressure on hardwoods, competition with grass, and other factors. Pine and spruce are often found on well drained, abandoned pasture. When these are cut, either heavily or lightly, the regeneration is often mostly hardwoods due to these soils. When the softwoods finally mature, a hardwood forest will replace it. Cutting hardwoods to regenerate softwoods is less common in my experience, but let me give one example. In hardwood forests, spruce or hemlock can accumulate in the understory for decades. Harvesting the overstory can release these saplings and give the impression that they resulted from harvesting the hardwoods. Are these examples of succession or disturbance response? In each case, the forest moves toward its climax type for the soil and climate, and the previous overstory was merely transitional. But they are also examples of disturbance response, where the new growth is directly influenced by the amount of sun, shade, disturbance, and seed source.

Coping with Change

In a general sense, this is a discussion about how a system copes with change. The change can be mild or extreme, gradual or at a precise moment. The system can either be resilient or fragile. For forest ecosystems, what happens on the forest floor will influence what happens in the canopy in future decades or cen-

turies. New seedlings need certain conditions to get off to a good start. The proportion of sunlight and shade, moisture, soil pH and nutrients, duff and organic coverings, temperature, and seed source are all factors. In a mild disturbance like light-intensity logging, individual tree death from disease or wind damage, only shade-tolerant seedlings will survive. After a few more decades, they will be well established in the understory and have a chance at growing into the main canopy if an opportunity (another mild disturbance) arises. This is what we think of as creating our "climax forest."

More severe disturbances will establish other species. A hurricane or forest fire will expose subsoil and allow small seeds to flourish. The sunlight will allow shade-intolerants like birch or pine to succeed. Shade-tolerant species may be part of the mix, and often grow more slowly. Moderate disturbances allow species of "intermediate" shade tolerance to be successful. This points to the idea that the forest is moving "away from" the past disturbance, though it may also be "moving toward" some climax condition. Managed forests, by definition, have a cycle of planned disturbances (logging) of metered intensity to achieve some desired result. Climax species and structure might, or might not, be part of this objective.

After a severe disturbance like a clearcut, hurricane, or forest fire, can the climax forest type be changed, or just the pathway to it?

It is often assumed that the climax forest type, for any given region, will have the greatest species diversity. This, by definition, must be wrong. What we think of as "climax" species are the longest-lived trees that tolerate shade or the other stressors of that type, like fire or flood. Short-lived and shade-intolerant trees normally drop out of the mature and climax types, or occur only in small numbers where disturbance occurs. Tree species diversity will always be maximized at a moderate level of disturbance. Likewise, forest structure loses some measures of diversity in unmanaged situations.

Unmanaged forests also have some level of disturbance, such as fires, storms, drought, or disease. Even the "natural forest" may have enough disturbances so that true climax conditions are never achieved. Climate change is one example of slow change. Whether or not you are a believer in man-caused climate change, it is fairly obvious to me that the forests indicate both cooler and warmer periods in the past 1,000 years or more. Let me mention two examples. Southern Vermont, New Hampshire, and Massachusetts have a few rare black gum swamps. Black gum is a southern species, doing well in Maryland and further south, but surviving as far north as the Great Lakes. These rare swamps were probably colonized by black gum during a warmer period and have somehow persisted into colder conditions. It helps that these wet areas were avoided by farmers and loggers, and this species tolerates the wet soil, occasional flooding, and grows to over 600 years old in some cases. Another example is an island on the coast of Maine with jack pine, black spruce, tamarack, and alpine birch. These are far-northern species that have probably occupied this space since a much cooler period, perhaps the last glacier retreat. The coastal influence makes this warmer than nearby inland Maine. Somehow, these boreal species have persisted and not been replaced by other species like red maple and oak, even though these are present on the island. In each case, these are examples of relatively undisturbed "climax types," maintained through some change or disturbance.

As you look at forests in your backyard, your own woodlot, or as you travel the world, watch for evidence that the forest is changing. I think you will see that the forest is moving toward some stable climax condition, and that its condition is largely shaped by the previous disturbance. ■

Robbo Holleran *is a private consulting forester helping landowners meet their goals in Vermont and adjacent areas. His work has him outdoors about 150 days each year, plus play time. He is one of the authors of the new* Silvicultural Guide to Northern Hardwoods.