

Our Forests Are Changing
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Introduction

At present, we enjoy a large surplus of hardwoods in Virginia. Growth exceeds harvest by a wide margin. But the big picture for hardwoods is changing. I will discuss what is happening, or what I think is happening, in Virginia. Some of these things may also be happening in North and South Carolina. I will discuss the present imbalance in age class distribution, the decrease in quantity and quality of growing stock resulting from poor harvesting practices, and the gradual change in species composition on our better hardwood sites, from fast-growing, valuable, less shade-tolerant species to slower-growing, usually less valuable, and more shade-tolerant species.

Present Hardwood Forests

To start, it might be helpful to describe briefly the kinds of hardwood stands we presently have in Virginia. In the western, mountainous part of the state, we have vast acreages of even-aged, heavily-stocked hardwood stands. Scattered, older, residual trees occur in many of these stands. These forests originated after the heavy logging that occurred in western Virginia during the late 1800's and early 1900's. This logging was done for both lumber and for the charcoal wood needed for Virginia's large iron industry. Logging was usually followed by severe forest fires which killed back residual trees and brush and created ideal conditions for even-aged stands to develop. The stands on most of the roughly two million acres in the Jefferson and George Washington National Forests, as well as much of the 3 million acres of privately owned forest land in western Virginia, originated in this way. The majority of these forests are dominated by oak, except on lower slopes, coves, and north slopes where yellow-poplar is often dominant. On the driest, poorest sites, pine is often present in both pure stands and stands mixed with oak. Oak accounts for 56 percent, yellow-poplar 14 percent, and red maple 7 percent of present hardwood growing stock. The mountains, with a third of the forest land, account for 42 percent of present hardwood growing stock.

Many of these stands are now mature and the rest are approaching maturity. Logging in the mountains has increased considerably in the last few years. Hardwood stumpage prices are the highest ever. In addition, there has been a lot of oak mortality in recent years in many of these heavily-stocked, oak-dominated stands. Dry weather has been a major factor, but insect defoliation has also played a role. We have had gypsy moths in Virginia for 10 years now, and they are still spreading south and southwestward through the state. A lot of oak timber has already been killed by gypsy moths in the northern mountains of Virginia.

In Eastern Virginia, we also have a lot of hardwood forest, 39 and 19 percent of total hardwood growing stock is in the piedmont and coastal plain respectively. Much of this forest also originated from extensive, heavy logging around the turn of the century. Old field pine stands, many originating on land abandoned after the Civil War, made up a large part of this harvest. Following logging, former pine stands were replaced by hardwood or pine-hardwood stands.

Individual stands are smaller than in the mountains. They often contain two age classes due to older trees left from the first harvest. As in the mountains, upland sites are usually dominated by oaks, with yellow-poplar, sweet gum, and several other species often dominant on moist, more fertile sites on lower slopes, terraces, and stream bottoms. Oak accounts for 43 percent, yellow-poplar 20 percent, red maple 8 percent, and sweet gum 8 percent of present hardwood growing stock.

We have an overbalance of mature and maturing hardwood stands in Virginia today. Most of our hardwood stands are over 50 years old. This is the reason for the present large hardwood surplus we enjoy. But as these mature stands are harvested (or die), we will probably be facing a hardwood shortage someday.

Loss of Pine Forests

We have had large decreases in the acreage of natural pine stands in Virginia. According to FIA data, in 1940 pine stands occupied about a third of Virginia's 15 million acres of forest land. Many of these pine stands had originated on abandoned fields. But in the past 50 years, we have lost 70 percent of our natural loblolly stands, 60 percent of our Virginia pine stands, and over 90 percent of our shortleaf pine stands. All together, the loss of natural stands of these three species amounts to about 3.9 million acres. Partially offsetting this loss are about 1.4 million acres of loblolly pine plantations, leaving a net loss of about 2.5 million acres.

This is bad news for the pine wood using industry, but good news for hardwood users, because most of these former pine stands are now young hardwood stands. Pine stands, especially old field pine stands, are usually clearcut, or at least cut heavily enough to permit the regrowth of a vigorous, new, essentially even-aged stand. The replacement stands are sometimes a mixture of pine and hardwood, but in most cases, replacement stands are pure or nearly pure hardwood. Later, I will get back to this source of new hardwood stands from harvested pine stands.

Harvesting and Regenerating Hardwood Stands

Harvesting has a major impact on future stocking, species composition, and productivity. On private (non-company) land, much of the harvesting in hardwood stands is by high-grading, cutting only the larger and more valuable trees: "take the best and leave the rest". This is especially true in the mountains, but even in the coastal plain and piedmont, many stands are high-graded. Sometimes an acceptable stand will remain following a first high-grading of an even-aged stand, but after 2 or more high-gradings there is not much of value left, either in residual trees from the original stand or in regeneration. The many excellent hardwood stands we have in Virginia today - heavily stocked, high quality, and high yielding - were regenerated by clearcutting often followed by fire. High-grading does not produce these kinds of stands. High-grading eventually leaves a stand occupied largely by poor quality and low value trees, but this is not the only problem. High-grading also favors regeneration of slower growing, more shade-tolerant species over regeneration of oaks and yellow-poplar.

The main reason for so much high-grade harvesting is the poor market for small and low-grade hardwoods in most of Virginia. However, there has been so much criticism of clearcutting on television and in the press that many landowners prefer partial harvest, or "selective cutting", which usually means high-grading.

The National Forests have done much better. Until a few years ago, they were doing an excellent job of clearcutting and were beginning to break up their extensive areas of heavily-stocked, mature, oak-dominated forests. But because of public reaction against clearcutting, they are not doing any today, except perhaps to salvage timber killed by gypsy moth or in anticipation of mortality from gypsy moth.

Oak Regeneration

Oak seedlings grow slowly, and are only moderately shade tolerant. Without sufficient sunlight, they die before they are large enough to compete successfully if the overtopping stand is clearcut or heavily disturbed. Only large, "advance", oak regeneration is capable of growing

rapidly enough following clearcutting or heavy disturbance to capture a position in the canopy of the next stand. In Virginia, large, advance oak regeneration (at least 1 inch ground line diameter) is usually scarce under mature oak stands on better than average sites. The main reason for this scarcity of oak regeneration is the subcanopy of shade-tolerant species such as red maple, black gum, dogwood, American holly, rhododendron, mountain laurel, hornbeam, redbud, striped maple, etc. which develops under hardwood stands on sites capable of growing quality oak sawlogs. The density of the shade-tolerant subcanopy is related to the density of the overstory. Where the overstory is very dense, the understory is often sparse; but where the overstory is thinned out by high-grading or mortality, the shade-tolerant understory is stimulated and becomes very dense -dense enough to prevent oak regeneration from surviving and developing, even though considerable sunlight may be coming through the upper canopy.

How Did Our Present Oak Stands Become Established

How did our present oak stands develop and why didn't they have problems with shade-tolerant understories? Conditions must have been different in the past when they became established. The main difference was probably fire frequency. Fire prevention and control programs started about 1930 and by 1950 were well in place and effective. In Virginia, we have been unusually successful in our fire prevention programs, and fire protection has been good for our present hardwood forests. Fire protection deserves much of the credit for the vast acreages of excellent hardwood forest we have today, because wildfires wreak havoc in young and immature hardwood stands and cause butt rot and quality degrade even in mature stands.

This same fire protection that has safeguarded our present oak forests is preventing the regeneration of new oak forests by allowing subcanopies of shade-tolerant species to develop. Oak is well-adapted to a periodic fire regime, and oak regeneration on better quality sites may be dependent on fire. Only on fair to poor sites, which are too dry or too infertile to grow quality oak saw logs, can we expect to get enough large, advanced oak regeneration to perpetuate oak-dominated stands. On these poor sites, the subcanopy of small, shade-tolerant trees is largely replaced by a low shrub cover of huckleberry, blueberry, and other mostly ericaceous species, and overstory canopies are not as dense. The result is that enough sunlight gets through to the ground for oak seedlings to accumulate from periodic bumper crop years. Seedlings that survive usually die back and resprout several times. Slowly, over a period of 10 to 20 years or more, they develop large enough root systems to be able to compete successfully when the overstory is removed by logging, fire, blow down, etc.

The loss of American chestnut during the 1920's also played an important role in the present dominance of oak on upland sites. Chestnut often formed pure and nearly pure stands on upper slopes and ridges, and these chestnut stands were replaced largely by oaks. Also, deer were almost extinct in Virginia when our present oak stands were regenerating. Today, there are areas in Virginia where there are so many deer that tree regeneration of any sort is scarce in the understory.

Complete clearcutting will almost always result in well-stocked stands of high-quality, fast growing trees (within the capabilities of the site), but species composition in these new stands will depend primarily on what was already present in the understory when the previous stand was clearcut. Yellow-poplar is an exception because it develops quickly from seed stored in the litter. However, it grows only on the better sites. There are other species which develop quickly from seed, such as big tooth aspen and sweet gum, and ash and sycamore on the moist and high quality sites where they will grow well. On most of the middle and upper slopes and ridge tops of Virginia, the upland oaks (black, scarlet, northern red, southern red, white, and chestnut), which require large, advanced regeneration, are the fastest growing and highest yielding species we can hope for. They have dominated these upland sites, along with pines, for thousands of years. But in the future, we can expect hardwood forests with fewer oaks and more of the shade-tolerant species, species which are already present in the subcanopy under

our present day oak dominated forests. This paper is about timber production, but I should mention that the loss of oaks will have a serious impact on many wildlife species.

Many oak stands in the piedmont and coastal plain to someday produce stands with a major component of beech.

At the higher elevations in the mountains, sugar maple and white pine will increase, as will hemlock, unless eliminated by the hemlock adelgid. All three of these species are locally abundant in the understories of mature and maturing oak dominated stands.

Yellow-poplar will also increase, even though it is not shade tolerant. In Virginia, the transition from oak dominated stands on the middle and upper slopes to yellow-poplar dominated stands on lower slopes and in coves is fairly abrupt as you move downslope. There is usually a narrow transitional band of mixed oak and yellow-poplar, and as oaks decline, yellow-poplar may take over many of these transitional sites and even move further upslope. The determining factor in whether a particular spot on the slope is dominated by oak or yellow-poplar, assuming a regeneration pool that includes both species, is the comparative height growth of oaks and poplar. Where the site is good enough for yellow-poplar to outgrow oaks, yellow-poplar will dominate. Moving upslope, a point is reached where oaks will outgrow yellow-poplar and then oaks will dominate. Loss of oak will probably result in yellow-poplar moving upslope until a point is reached where other species besides oak can outgrow yellow-poplar. Yellow-poplar frequently becomes established in small openings where a few large trees are harvested or die. In the 1950's and 1960's, we used to do a lot of marking for selective harvesting in mature oak forests on good sites. Going back and looking at such former openings, we often find a lot of poplar saplings and poles, but not many oaks. The reason we seldom find oak is that probably there was not large, advance oak regeneration present when the openings were made. The reason yellow-poplar is often common in these openings is that it grows rapidly from seed stored in the duff. This suggests that yellow-poplar will continue to benefit from openings created in oak stands by partial harvests or mortality.

The process I am describing will take time; oaks will not decline as rapidly as pine has in Virginia. And even on the best sites, oaks will not completely disappear, because in most stands, there is at least a small amount of advance oak regeneration large enough to compete successfully, and in most stands, there will be at least a few oak stumps that will be small enough or young enough to resprout. But if present conditions continue (the virtual elimination of fire and harvesting predominantly by high-grading), it seems inevitable that species composition will shift away from oaks toward shade-tolerant species. The resulting stands will be slower growing and produce lower volume yields than the oak dominated stands of today.

The Value of Pine Stands for Producing Hardwood Stands

Some of the best opportunities we have for regenerating well-stocked stands of hardwoods of desirable species, including oaks, occur where pine stands are clearcut.

In Virginia, large, advance oak regeneration is frequently present in the understory of pine stands. Often there are sufficient numbers to produce well-stocked oak stands. Thoreau observed this over a hundred years ago in the woods around Walden Pond in Massachusetts. He seldom found vigorous oak seedlings under oak stands, but almost always could find them under pine stands. Blue jays are apparently largely responsible for carrying acorns into pine stands and burying them. There may be no better way to develop large, advance, oak regeneration than to grow a crop of pine. Site preparation, and aerial spraying a few years after planting, severely sets back any shade-tolerant subcanopy that may be present. Pine canopies permit more sunlight to penetrate than do heavily stocked oak stands, especially after thinning. Acorns that germinate in pine stands, consequently, have a good chance to

survive and slowly grow until they are large enough to compete successfully following clearcutting.

In eastern Virginia, in the Coastal Plain and Piedmont, practically all uplands and suitable bottomlands were at one time cleared and farmed or grazed. When abandoned, they usually seeded to pine stands. While the pine stands were maturing, oaks and other hardwoods became established in the understory, as we see happening today. It seems likely that most of the older oaks that dominate upland hardwood stands in eastern Virginia today originated in former old field pine stands. After all, it has been only in the past 60 to 200 years that most of the fields were abandoned.

Many of the almost 4 million acres of natural pine stands that have been lost in Virginia over the past 50 years now support well-stocked hardwood stands. Many of these stands contain a lot of oak. But we have already lost most of our natural pine stands, so this source of new hardwood stands will soon run out. In the future, it might be a good strategy to deliberately let some clearcut pine stands regenerate to hardwoods, where soils are suitable and desirable advance regeneration is already present in the understory. And where mature hardwoods are harvested, and a dense understory of undesirable, shade-tolerant species is present, it might be good strategy to site prepare and convert to pine. This would amount to a form of crop rotation. There are probably many small private landowners, who want to grow hardwoods as well as pine, who would be agreeable to this. Most of the pine planting is done in eastern Virginia, where topography is more favorable for intensive forest management, which would make it easier to promote such a crop rotation strategy.

But this won't be enough. To regenerate the young hardwood stands we will need in the future, we will also have to provide for good hardwood regeneration in many of the hardwood stands we are now high-grading. Clearcutting will be necessary. Where acceptable advance oak regeneration is not already present, it will be necessary to first develop such regeneration prior to clearcutting by use of prescribed burning or herbicides to eliminate the shade-tolerant subcanopy. Prescribed burning, on sites where it can be safely used, should do much the same thing that wildfires did in the past. But if we are going to use prescribed burning toward the end of the rotation to develop advance oak regeneration, starting 10 to 20 years before final harvest, we will have to learn how to do it without butt-scarring and degrading the overstory crop trees.

Several fires may be necessary, with periods of 3 to 5 years between fires. This will be easier to do on the gentler terrain in the Piedmont and Coastal Plain than the steep slopes in the Mountains.