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# Of Clearcuts and High-Grading

## A Hardwood Forestry Primer for Industry

At the request of several readers—and at the risk of oversimplifying silvicultural science—we bring you this primer on hardwood forest management. It is intended for members of the industry who don't fully understand the origin and management of the hardwood resource, and to correct some commonly held misconceptions about "good" forest management. We are an industry under constant challenge from a largely urbanized population that doesn't understand or appreciate what we do. Industry members should understand and be able to defend our sustainable management of the forests.

Let us begin with a review of basic tree physiology and ecology concepts (how an organism functions, and how it relates to its environment) that drive forest management strategies.

### Basic Physiology & Ecology

*Shade tolerance*

Different species thrive under different growing conditions. One of the greatest variances between species is in their tolerances to shade. A sugar maple can survive for decades in the shade of a dense overstory canopy, for example. Its growth will be very slow in that shade environment, but it will respond quickly when exposed to full sunlight. By contrast, shade-intolerant species, such as birch, cherry and aspen, cannot survive in low-light environments. Table 1 roughly groups commercial hardwood species by their level of shade tolerance, although the lines are blurred and opinions vary on the exact placement of each species on the spectrum.

***Continued on page 19.***

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## In This Issue



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*Continued from page 1.*

*Forest succession*

Shade tolerance is an important driver in the process of forest succession. Hardwood forests are perpetually in a state of change, from birth to maturity to death to renewal. Following a heavy disturbance (wind storm, fire, insect/disease infestation, clearcut), the forest will typically come back in shade-intolerant species. These species often have windblown seeds and very aggressive growth rates that allow them to outcompete other species in the race to reforest the tract and close the canopy. These "first-successional" species, however, are generally not long-lived species, and because they cannot reproduce in their own shade, they are not long for the forest stand. Each time one of these trees dies, an established intermediate or shade-tolerant seedling/sapling responds to the new burst of sunlight and quickly grows up to fill in the canopy. Over time, absent another major disturbance (or management actions to alter the natural process), the forest succeeds from shade-intolerant to shade-tolerant species.

***Table 1. Shade tolerance of North American hardwoods (Introduction to Forest Science, Raymond A. Young).***

| Very Shade Tolerant | Shade Tolerant | Intermediate | Shade Intolerant | Very Shade Intolerant |
|---|---|---|---|---|
| Beech<br>Sugar Maple | Blackgum<br>Hickory<br>Red Maple | Alder<br>Ash<br>Basswood<br>Yellow Birch<br>Sweetgum<br>Northern Red Oak<br>Southern Red Oak<br>White Oak | Paper Birch<br>Cherry<br>Yellow Poplar<br>Sycamore | Aspen<br>Black Locust |

*Even-aged vs. uneven-aged forests*

The forest that grows back after a complete disturbance is considered an even-aged forest, since all of the trees originate at essentially the same time. Note that this concept relates to the ages of the trees, not their sizes. So, even as bigger trees die and are replaced by smaller understory trees, the forest is still considered even-aged if those smaller shade-tolerant trees were established about the same time as the early successional canopy trees.

After many decades without another complete disturbance, a forest will develop three or more age classes and become what's known as an "uneven-aged" forest. Importantly, much of the eastern hardwood forest of the United States remains even-aged, by definition, having been established following the clearings of the late-1800s and very early 1900s as the expanding nation moved west.

### Management Mimics Nature

The forester's role is to manage for a desired species mix and a maximum yield, whether the desired output is timber income, wildlife habitat or aesthetics. You might guess from the above discussion that the chief way to do this is to employ management tools that exploit the best characteristics of a given species for a given site while minimizing competition from other species.

For the sake of this article, we'll omit an in-depth discussion on site selection. Just be aware that site conditions (aspect, slope, soil, moisture, climate, etc.) work hand-in-hand with shade tolerance and natural growth rates to determine which species is/are best suited (most competitive) on a given site.

Hardwood forestry operations seldom employ tree planting, herbicides or fertilizers in regeneration, as are employed in softwood forestry and plantation management. It's simply not cost-effective to make huge financial investments in hardwood stand regeneration and establishment when the returns on those investments might not be realized for 100 years or more. Foresters, then, must devise regeneration and harvesting tools that mimic those natural processes that favor the desired species. It's important to note that the selection of a harvesting system has almost everything to do with what the forester wants for the next forest, and thus, these systems are more precisely termed "regeneration systems" than harvesting systems. Four systems (with multiple variations) are generally utilized:

*Clearcutting*

Clearcutting is ugly but effective provided there is sufficient understory regeneration present or a sufficient seed source nearby to re-establish the stand.

Forest preservationists argue that clearcutting is only utilized by timber companies because it is easy and cheap (no marking required, less skill needed in harvesting, less expensive than other harvesting methods). The reality is that clearcutting is the most effective way to regenerate shade-intolerant Paper Birch, Cherry, Yellow Poplar and Aspen. It also can work very effectively for Oak in some situations (where sufficient Oak regeneration is present and competition from faster-growing intolerants is minimal).

Clearcutting opponents also decry the erosion they say results from clearcutting. In most hardwood forests, however, clearcutting has a *smaller* probability of causing erosion than other types of harvesting systems. Why? Erosion is the result of soil disturbance, not simply exposure of the forest floor to rain. In fact, undisturbed forest floor is very resistant to erosion. With clearcutting, loggers only need to enter the forest with heavy equipment once, and they are not necessarily constrained to repeatedly re-using the same logging trails, which can result in compacting and deep rutting of soils under the wrong conditions.

*Seed-Tree*

The seed-tree method is essentially a silvicultural clearcut that leaves behind scattered, good-quality mature trees as a seed source for regeneration. Once regeneration is established, a second harvest is conducted to remove the seed trees. This method is principally used in softwood forest management (such as western larch and southern pines) accompanied by intensive site preparation work to knock back competing vegetation and expose some bare soil on which the seeds can fall and germinate.

*Continued on page 21.*

*Continued from page 19.*

*Shelterwood*

The shelterwood system is designed to benefit the intermediately shade tolerant species that can neither compete in clearcuts nor regenerate in the shady environments of single-tree selection systems (discussed next). The first cut of a shelterwood harvest leaves sufficient numbers of mature trees to provide both a seed source for regeneration and enough shade to discourage the establishment of early successional, shade-intolerant species. Once large seedlings/small saplings of the desired species are established, the overstory is removed in a second cut and the established regeneration quickly closes in the canopy and shades out competing intolerants.

While still an even-aged regeneration system, shelterwood harvests have the benefit of creating less of a visual impact than the more aggressive seed-tree and clearcut systems. Among the downsides are that the system requires at least two entries with harvesting equipment and the landowner must postpone receipt of a good deal of income by leaving good quality, high-value trees in the stands. This also introduces the risk that some of these residual trees will be lost to windthrow, disease and pests before they can be extracted during the second cut.

*Single-Tree Selection*

As the name implies, single-tree selection silviculture identifies individual trees or small clusters of trees for removal on rotational intervals of 10 to 25 years. Decisions on which trees to cut are most often focused on maximizing stand growth and tree vigor, and creating a diversified mix of tree species, ages and size classes. Traditionally, foresters have paid considerably less attention to market conditions for logs than most people would guess. Of the four regeneration systems discussed, single-tree selection is the only uneven-aged management system.

For all of its visual appeal, single-tree selection is not an effective tool for regenerating intermediate and shade-intolerant species. While foresters can slow the natural succession process by actively cutting out certain trees, over time, single-tree selection will generally move a forest towards late-successional, shade tolerant species. Single-tree selection also requires considerably more care; trees have to be felled and extracted without damaging the remaining trees. On the upside, however, single-tree selection has minimal visual impacts and thus is the least objectionable method to the public and forest preservationists.

### Cutting Out Bad Forestry

With this understanding of tree physiology and regeneration systems as background, it becomes easier to see why two of the practices occasionally employed in single-tree selection hardwood forest management—*diameter-limit cutting* and *high-grading*—fall short of the best practices we should be using.

Diameter-limit cutting is perhaps the most misunderstood management tool we hear discussed in the industry. Practitioners of diameter-limit cutting argue that by taking only trees above a certain diameter (the diameter "limit"), they are leaving the smaller trees to grow larger. The higher the limit, the theory goes, the more environmentally responsible the cut. Intuitively, this seems like a logical, conservative approach that prevents overcutting, but focusing on one metric (tree diameter) is short-sighted and does lasting damage to the forest. "High-grading" is a closely related harvesting concept often described as "take the best and leave the rest." These practices capture short-term gains at the expense of long-term forest productivity, especially when applied on even-aged forests.

We've already established that many eastern hardwood stands—although they contain a variety of tree sizes and qualities—are even-aged. The observed diversity in tree size and quality in these stands is largely a function of genetics. While micro-environment can play a role, some individuals are simply genetically superior with regards to growth rate and form. Diameter-limit cutting in an even-aged stand, then, tends to remove trees with superior growth genes, while high-grading cuts out trees of genetically superior form *and* growth. Often the poorly formed, suppressed trees left behind are unable to respond well when exposed to light. Repeatedly removing the biggest and best trees from the forest—and removing them as a future seed source—downgrades stand genetics, and, thus, the potential to grow large, high-quality trees in the future.

Proper single-tree selection forestry, by contrast, removes a mix of merchantable and non-merchantable stems to achieve a pre-determined residual stand density that maximizes growth while maintaining sufficient density to keep the residual "crop trees" growing up and not out. Fundamentally, it flips high-grading on its head and says, instead, "*leave* the best, *take* the rest." The most poorly formed, stunted trees are typically removed (although in practice this requires sufficient low-grade timber markets to make it economically feasible). Large, good quality trees (and smaller trees with the potential to become large, good quality trees) are left as a seed source, and because they have the greatest potential to grow exponentially in value as they move into larger size classes, such as from sawlogs to veneer logs.

### Final Thoughts…

Hardwood industry foresters live and work at the intersection of forest biology, government policy, public opinion, forest products markets and scientific understanding. Every one of these drivers is in constant flux, yet the impacts of policy and management decisions are typically not realized for decades. The removal of fire and clearcutting from our "toolbox," for example, will ultimately reduce the Oak component of eastern hardwood forests. By the time we reach that point, and the public allows us to reintroduce these tools, it'll take another 50 years to make noticeable improvements in the Oak component. Thus, basic forest management concepts, like those discussed in this article, are much more easily understood than applied with effectiveness on the landscape.

Still, industry foresters have managed to manage our hardwood forests with the best available science for a century, within the constraints of policies and markets, and their record of sustainability is something about which our industry should be proud.