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Influence of Markets on the Composition of Central Appalachian Forests

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Abstract

Timber harvesting has been disturbing Central Appalachian hardwood forests since colonial times, but its most profound influence on forest composition has occurred during the last 130 years. Between the end of the Civil War and the Great Depression, the lumber industry went from state to state harvesting relatively large portions of the timber resource. This disturbance and the slash fires that occurred after harvesting frequently resulted in even-aged timber stands and an increase in northern red oak. During the Depression, harvesting decreased and marginal farm lands were abandoned. Mill size declined because of a scarcity of timber, and selective cutting based on diameter and species became common. While shade intolerant and mid tolerant species regenerated on abandoned farmlands, the implementation of selective cutting after 1929 generally favored the regeneration of shade-tolerant species. In 1973, the adoption of floating exchange rates ushered in an era of international trade. During this period, timber that regenerated during and after the era of heavy cutting grew into commercial size, and consumption by baby boomers resulted in an increase in demand for hardwood products. The markets that resulted further emphasized selective cutting based on timber quality and species. Today, the composition of hardwood forests reflects the history of harvesting disturbances and the changing market structures that promoted them.

Key words: Forest composition, hardwoods, hardwood markets

Introduction

During the last 130 years, timber harvesting has had a continual and profound influence on the composition of hardwood forests. Nowhere is this more apparent than in the Central Appalachian region of the eastern United States.[3] In this paper we analyze how harvesting and the market mechanisms that drive harvesting have affected and continue to affect forest composition in this region.

In this analysis, it is assumed that firms operating within forest-product markets attempt to maximize profits. We also assume at any given time there are established manufacturing and marketing procedures that set operational boundaries for harvesting practices. These practices continue until economic events force industry to reevaluate the market/resource situation and adopt new production technologies, harvesting procedures, and marketing practices. It also is assumed that these economic adjustments occur primarily during or after periods of declining profits in which firms are forced to reevaluate their competitive position within the market. When economic events are relatively mild and short lived, small changes in production and marketing that occur are best examined as cycles (Luppold et al. 1998). More dramatic economic events force industry to make even greater changes and are best examined as eras. Embodied in these assumptions is that economic events influence harvest patterns, but these patterns are predicated on the composition, quantity, and quality of timber available at the onset of an era.

It is further assumed that markets influence forests through harvesting by determining which trees are cut. Harvests affect forest composition directly through the removal of some or all standing trees. They affect the long-term process of regeneration indirectly by perturbing the distribution of biological resources. Research has shown that harvest patterns determine the long-term success of hardwood regeneration (Trimble 1973). While time and location-specific economic incentives (i.e., product prices and production costs) determine what portion of the canopy is removed at a harvesting site, the overall market determines long-term harvesting activities on a landscape level during a market era. However, because an extensive period is needed for hardwood timber to regenerate and mature, harvesting during a given era has the greatest impact on forest composition and related production and marketing practices in future eras.

Over the past 130 years three distinct eras were initiated by economic events and characterized by resource availability and harvesting practices (Fig. 1, Table 1). The dates in Table 1 are approximate because hardwood-processors need time to make the transition from one era to the next. Also, cycles continued to occur within each era, but these changes followed the harvesting pattern that was initiated at the beginning of an era. Finally, we reemphasize that the characteristics of the timber resource at the beginning of each era influence the predominant harvesting pattern.

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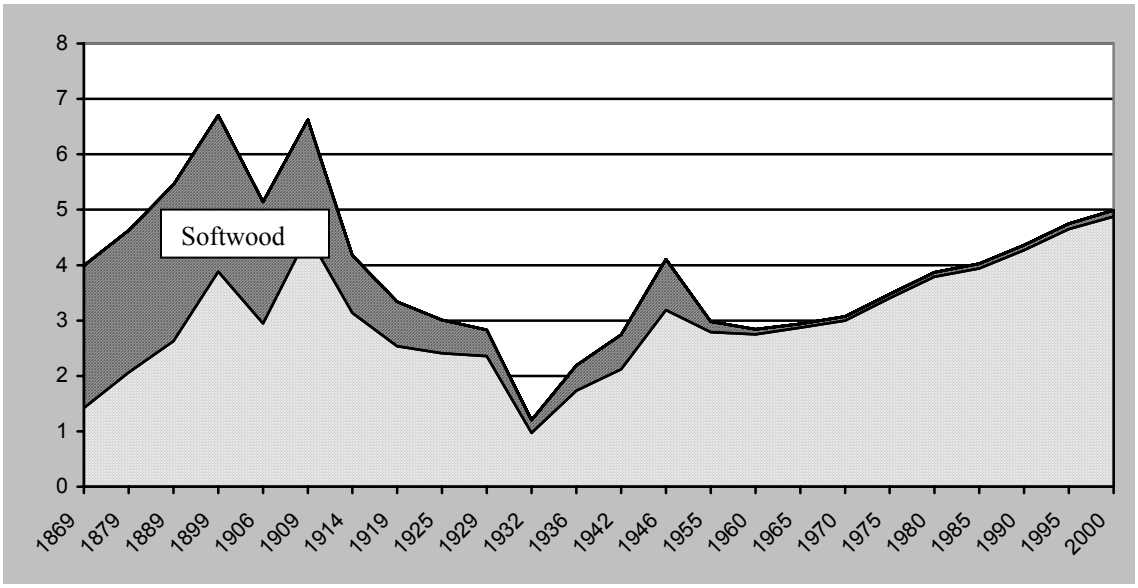
[3]The Central Appalachian Region includes Tennessee, Kentucky, Ohio, West Virginia, Pennsylvania, and New York.

Era of Heavy Cutting

Heavy cutting in the Central Appalachian region began with the onset of the Civil War and continued until 1929. East wide, lumber production increased by nearly 550 percent, peaking in 1909 (Steer 1948) as demand for lumber surged due to increased industrialization, urbanization, and immigration. Harvesting and production technology that existed during peak production years (steam donkeys, locomotives, and large band mills) allowed sawmills to grow to a size such that an area could be "logged out" in less than a decade (Clarkson 1964). In some areas, initial harvesting focused on specific high-value species such as spruce or white pine. Subsequent harvests were less discriminating as numerous species were removed (Carvell 1986). As a result, the era of heavy cutting often was characterized by partial harvests followed by more complete harvests decades later. The relatively large quantity of softwood produced in the Central Appalachian region in the 19th century reflects a much different forest than exists today.

Figure 1. Hardwood and softwood lumber production in the Central Appalachian region, 1869 to 2000. The x-axis is spaced unevenly due to limited data prior to 1906, the desire to show the magnitude of production decline resulting from the Depression, and the unavailability of state-level data from 1946 to 1954**.**



Source: 1869 to 1946, Steer 1948; 1955 and 1960, USDC Bureau of the Census, Current industrial reports 1956 and 1961; 1965 to 2000, USDC Bureau of the Census, Current industrial reports 1966, 1971, 1976, 1981, 1986, 1991, 1996, 2001 estimated adjusted for underreporting errors as identified in Luppold and Dempsey 1989 and 1994.

Table 1. – Dominant market disturbance characteristics for the three market eras in the Central Appalachian region of the eastern United States.

Era 1 (1869 to 1929) – The end of the Civil War and the large increase in immigration allowed the U.S. economy and population to rapidly grow. Initially, softwood species were harvested in large volume as the building activity increased. The timber resource was considered nearly endless, resulting in heavy nonsustainable harvest levels. Still, harvesting could occur in a two-stage process with the more valuable species harvested first and less valuable species removed a decade later. Large-scale harvesting facilitated the regeneration of mid-tolerant and shade intolerant species.
Era 2 (1932 to 1969) – The Great Depression caused a major reduction in demand. The smaller mills that survived during this era obtained timber through selective removal of wider diameter logs from the residual stands that were too young or left untouched during the previous era. The furniture industry was the dominant user of eastern hardwoods. Selective harvesting favored the regeneration of shade-tolerant species.
Era 3 (1973 to 1999) – A change in the international monetary system brought about floating exchange rates ushering in an era of international trade. International demand increased for both high-quality sawlogs and veneer logs as exports of lumber, sliced veneer, and logs increased. The emerging even-aged forests that regenerated after the era of heavy cutting provided an ample resource that resulted in selective harvesting based on the quality and value of the timber. Continued selective harvesting favored the regeneration of shade-tolerant species.

Softwood lumber produced during this era was used for construction while hardwood lumber was used to produce furniture, barrels, wagon spokes, handles, and others products. The relative magnitude of harvesting during this era is underestimated by lumber production levels (Fig. 1) because the level of tree utilization was considerably lower than today, i.e., large amounts of timber were left on the forest floor as slash or were otherwise underutilized. During this era, only small areas of forests that were immature, less accessible, or not for sale were left undisturbed.

Hardwood lumber production did not exceed softwood production until the late 1890s (Steer 1948). Oak was the most common hardwood lumber produced during the era of heavy cutting, but there is little information on the species group of oak produced. The lone year in which oak production was separated (1905) indicated that the volume of white oak lumber produced exceeded that of red oak by nearly 3 to 1 (Steer 1948). New York was the only state in the region in which red oak production exceeded that of white oak.

Lumber production in the Central Appalachian region peaked at 6.7 billion board feet in 1899 (and 6.3 billion board feet in 1909) and then declined. The two characteristics of this era that influenced future forest composition were near complete overstory removal and uncontrolled slash fire associated with land clearing. Clearcut harvesting allowed multiple species to

regenerate, particularly those that are mid-tolerant. The combination of overstory removal followed by wildfires also increased promoted red oak regeneration (Brose et al. 2001).

The Depression through 1973

By 1929, much of the accessible timber in the Central Appalachian region had been harvested as lumber production declined by 57 percent from 1909. However, harvest decreased by an additional 58 percent between 1929 and 1932 with the onset of the Depression. The collapse of the agricultural economy during this period also hastened the abandonment of marginal farmlands. Today, much of this abandoned land in West Virginia is occupied by yellow-poplar.

A major difference between the era of heavy cutting and this second era was the realization by industry that timber supplies were not endless. Only small pockets of timber that had not been disturbed during the previous era were available for harvest (Carvell 1986). The diminished timber base could not continue to supply large band mills (Clarkson 1964). The remaining "smaller" sawmills used the limited volume of available timber. Because higher prices were paid for longer and wider lumber, larger diameter timber was preferred, thus encouraging the practice of diameter-limit cutting.

In the 1940s hardwood lumber production increased reaching a post-Depression high in 1946. The volume of hardwood lumber produced remained relatively constant during the 1950s, 1960s, and early 1970s. In contrast with previous decades, hardwood represented 70 percent of the lumber produced in the Central Appalachian region in 1950 and has yet to drop below this proportional level.

In the 1950s and 1960s, the furniture industries were the principal users of hardwood lumber (USDC Bur. of the Census 1961, 1966, 1971) as walnut, maple, and cherry were the major appearance species (Frye 1996). Yellow-poplar lumber was commonly stained to match walnut and cherry veneers or used as core stock and cross ply material with expensive face veneers. Yellow-poplar's versatility made it a relatively expensive lumber and timber species. In the 1950s, it was common to remove yellow-poplar from a stand but leave the oaks and other species Red oak was emerging as a major component of the inventory during this period (Wray 1952), but it remained a relatively low-value species.

Although hardwoods have traditionally been associated with appearance products, they also have been used for localized construction application, industrial products such as mine props and pallets (during and after World War II), and fine papers. Increased pulpwood production brought about limited clearcut harvesting, but diameter- limit cutting remained the predominant practice. The combination of diameter-limit cutting and different valuation of species resulted in harvesting regimes that removed only part of the canopy. This practice favored the regeneration of shade-tolerant species such as maple, beech, and blackgum.

Post 1973 Era

Implementation of floating exchange rates has been the most significant economic event influencing harvesting activities in the Central Appalachian region since 1973. Previously the rate of exchange between currencies was negotiated periodically between central banks. Floating exchange rates allowed currencies to be valued by currency markets and their implementation coincided with a 475-percent increase in hardwood lumber exports between 1973 and 2000 (Luppold and Araman1987; Emanuel and Rhodes 2003). Much of the initial increase in exports was high-quality lumber to Western Europe and Japan (Luppold and Araman

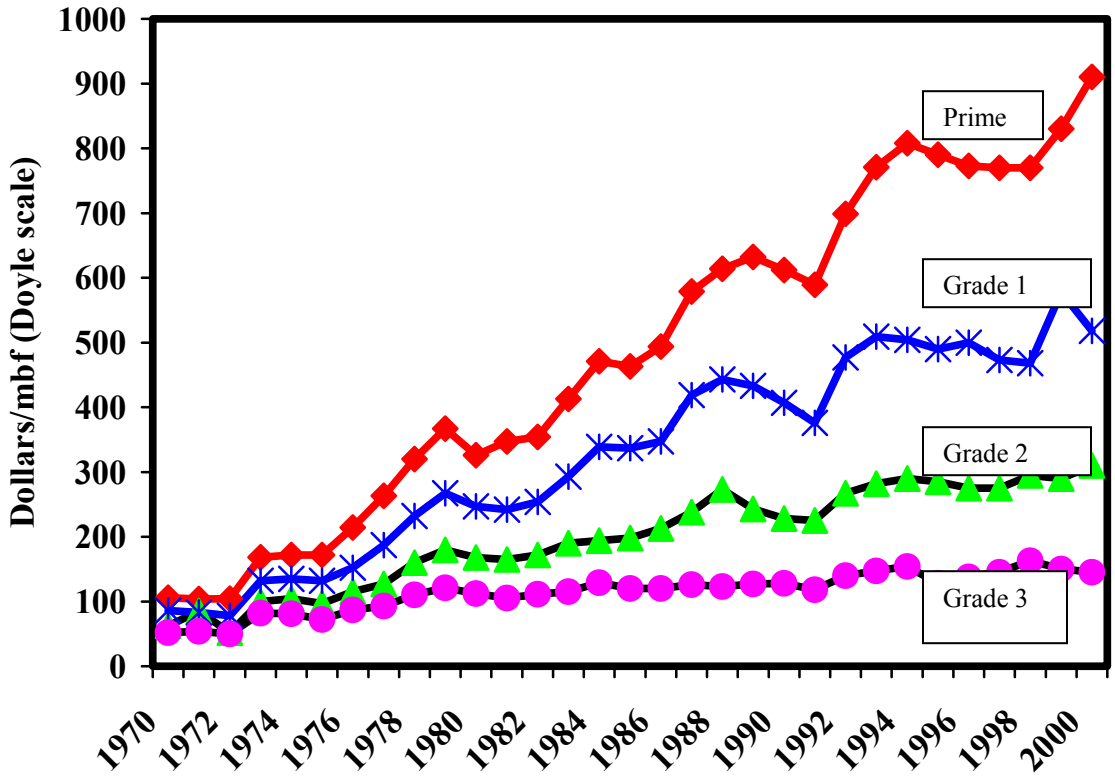
1987), resulting in a change in lumber merchandising practices. Before 1973, higher grades of hardwood lumber (FAS, 1F, and Select) were commonly priced and sold in combination with lower grades of lumber. The advent of export markets resulted in a premium being affixed to the price of higher grades of lumber. Also international demand for hardwood veneer and veneer logs sharply increased the demand for and price of high-quality hardwood sawtimber.

Another major change that occurred in the early 1970s was the acceptance of red oak as an appearance species by the furniture industry. We contend that this increased use of red oak occurred because low prices and ample inventories of this species no longer could be ignored by a furniture industry seeking to minimize production costs.

As a result of these changes in international and domestic demand, hardwood lumber production increased, the average size of sawmills grew, and the level of technology used by these sawmills became increasingly complex. Most of the technology adopted by mills increased the yield of higher-grade lumber that could recover from higher quality logs. These changes in production technology and the increased demand for veneer and veneer logs increased the demand for higher quality hardwood timber. As a result, selective cutting became more of a function of quality (bole clarity). This increase in demand was initially satisfied by increased sawtimber inventories as the forest that regenerated during and after the era of heavy cutting began to mature. However, the continued demand for higher quality logs by sawmills, veneer mills, and export markets caused a change in the relative value of logs by grade (Fig. 2).

By the end of the 20th century, more hardwood lumber and related products were being produced, consumed domestically, and exported than at anytime in U.S. history. While producers of industrial products such as pallets and railroad crossties used significant volumes of hardwood lumber and pulp and manufacturers of engineered wood product used large volumes of roundwood, demand for higher quality lumber and veneer logs drove harvesting activities in most areas of the Central Appalachian region. The demand for high-quality timber was in stark contrast to the increasing supply of lower grade timber that had been left in the forest, or shade-tolerant species that regenerated in uneven-aged stands promoted by repeated selective cutting.

Figure 2. Red oak sawlog prices in Ohio, by grade, 1970 to 2000



Source: Ohio Agricultural Statistical Service (1970 to 2001).

Conclusion

Harvesting disturbance differs from bio/physical disturbance in that it is predicated on the value of the resource as determined by the demand for wood products. The actual volume of timber removed in a given year or from a given site is influenced by timber removal and conversion technology, type of roundwood markets near the resource, and efficiency of the market in distinguishing among various wood products. Although harvesting is constrained by the availability of the resource, it is shifted by economic events, controlled by preexisting demand and supply situations, and augmented by technological changes. In short, the market adapts to what is in the woods contingent on the underlying economy and availability of wood and nonwood substitute products.

The profit maximizing behavior inherent in the market system creates interesting dilemmas. Underutilization of a species or group of roundwood products can lead to biological abundance and low prices for decades. However, in the long run, these low prices may result in new technologies or marketing plans that exploit this abundance and lead to overutilization and economic scarcity as reflected by higher prices. For example, the disturbance pattern that led to its successful regeneration of red oak before the Depression has been replaced by one that favors

competing species. Harvesting patterns are based on current market conditions, rather than biological conditions needed to sustain this species (Lorimer 1993).

Another dilemma is that the higher the quality stands, the greater the potential of some form of high grading. This in itself does not pose a problem, but high grading in the absence of treatments needed to sustain species composition can reduce the economic value of a stand. And while hardwood lumber production was higher during the last part of the 20th century than during earlier periods, better timber utilization (a greater percentage of the standing timber transformed into product) and the transition from softwood to hardwood forests that occurred after the era of heavy cutting have allowed hardwood sawtimber inventories to continue to increase (Smith et al. 2001). Still, decades of selective removals of specific species in a patchwork manner have resulted in a complex mosaic of stand conditions for forests in the eastern hardwood region.

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