Complexities of Hardwood Roundwood Supply and Demand
William Luppold and Matthew Bumgardner

Abstract: While roundwood (sawlogs, pulpwood, etc.) can be treated as intermediate products in the production process that converts stumpage to primary forest products, hardwood roundwood often is traded in identifiable markets. Markets for hardwood roundwood exist because of variations in the value of this material within and among hardwood stands due to differences in species mix and bole quality. Further, individual trees can be processed or merchandized into numerous products with each product going to a different primary processor. Because the merchandizing process has an underlying profit motive, the characteristics of hardwood roundwood markets in a given area influence what sites will be harvested and what trees will be removed. In this paper, we examine the industries that use hardwood roundwood, characterize the attributes of the material used, and describe different methods by which roundwood is distributed. There are three broad categories of hardwood roundwood markets: esthetic, industrial, and fiber. While roundwood used to manufacture products for esthetic application may account for only a small portion of total roundwood harvested, the value of these products has a distortional influence on what sites will be disturbed. Also, because of the skewed value of hardwood material, the potential value distribution of a given stand may be determined largely by a small percentage of trees in that stand.

Key Words: Hardwood, markets, roundwood

INTRODUCTION
Roundwood products have traditionally been classified in generic groupings such as pulpwood, sawlogs, and veneer logs (USDA For. Serv. 1958, 1965, 1982) and assumed as intermediate steps in the production process. While such terminology and assumptions are convenient for accounting purposes and applicable to most of the softwood consuming industries, they may imply an oversimplification of hardwood markets. Hardwood trees tend to grow in mixed-species stands, numerous types of hardwood roundwood can result from a single stand, and resulting hardwood roundwood can be actively traded in a multitude of markets. Understanding markets and their characteristics are important when evaluating their impact on forest ecosystems because they determine what sites will be harvested and what trees will be removed.

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The objectives of this paper are to examine: hardwood roundwood supply, characteristics of roundwood consumption by major hardwood industries, and variations in the price of roundwood and related stumpage. We also provide examples of how local variations in timber resources and changing markets can influence roundwood demand. It is hoped that the information presented here will benefit individuals attempting to understand hardwood markets and/or predict future hardwood resource use on a regional or subregional basis.

**Hardwood Stumpage and Roundwood Supply**

Most hardwood timber is privately held with more than 70% controlled by nonindustrial private owners (Smith et al. 2001). This ownership may allow hardwood stumpage and roundwood supplies to be more market driven than supplies of softwood that are greatly influenced by decisions made by corporations and government owners of timber (both U.S. and Canadian). The distribution of species, quality, and esthetically important growth characteristics (ring count, color, consistency of ring count, roundness of bole, etc.) varies within and among regions.

Hardwood roundwood can be obtained from growing stock or nongrowing stock portions of the timber resource. Growing stock can be divided into sawtimber size material (over 11.0 inches dbh) and poletimber. Nongrowing stock is comprised of saplings, cull trees, and cull sections of trees, tops, limbs, and roots. Trees classified as cull have poor form, presence of rot, or short bole length. Quality roundwood can be obtained from trees with short butt logs and some nongrowing stock sections such as crotch and burl can be processed into valuable lumber and veneer.

Table 1 presents estimates of roundwood removals by major product and roundwood category (USDA For. Serv. 2002). This information was developed using timber product output studies conducted in 1996 or prior years and may not totally reflect current consumption. Greater use of satellite pulp chipping operations and development of new technology in engineer product manufacturing may have increased the proportion of nongrowing stock used.

**Table 1. Hardwood roundwood consumption by product and source**

<table>
<thead>
<tr>
<th>Resource</th>
<th>Sawtimber</th>
<th>Veneer</th>
<th>Pulp</th>
<th>Composites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total volume consumed (mil. cu. ft.)</td>
<td>1,902.0</td>
<td>145.9</td>
<td>2,189.4</td>
<td>242.6</td>
</tr>
<tr>
<td>Proportion of sawtimber (%)</td>
<td>87.2</td>
<td>94.7</td>
<td>49.0</td>
<td>53.2</td>
</tr>
<tr>
<td>Proportion of poletimber (%)</td>
<td>3.4</td>
<td>0.3</td>
<td>37.5</td>
<td>38.4</td>
</tr>
<tr>
<td>Proportion of nongrowing stock (%)</td>
<td>9.4</td>
<td>5.0</td>
<td>13.5</td>
<td>8.4</td>
</tr>
</tbody>
</table>

1 Estimates based on timber product output studies and inventory removal estimated during or prior to calendar year 1996.
The Current Hardwood Market

The hardwood industry is a diverse collection of processors that use hardwood roundwood of differing quality and value. Historically, hardwood materials have been most valued for esthetic or “appearance applications, thus fashion considerations have a significant influence on the use and value of species. Hardwood roundwood also can be used for the production of industrial products such as pallets or for the production of paper and engineered wood products.

Table 2. Primary hardwood industries, principal products manufactured, value range of roundwood purchased, and potential volume of roundwood requirements that could be supplied by nongrowing stock trees

<table>
<thead>
<tr>
<th>Industry Category of Timber</th>
<th>Category of roundwood products consumed</th>
<th>Timber output quality</th>
<th>Quality category of wood commonly consumed</th>
<th>Value range of roundwood primarily consumed</th>
<th>Potential use of nongrowing stock resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face veneer mills (slicer)</td>
<td>Esthetic</td>
<td>Veneer</td>
<td>Veneer logs</td>
<td>High to very high</td>
<td>Slight</td>
</tr>
<tr>
<td>Face veneer mills (rotary)</td>
<td>Esthetic</td>
<td>Veneer</td>
<td>Veneer or sawlogs</td>
<td>Medium to high</td>
<td>Slight</td>
</tr>
<tr>
<td>Large sawmill (grade mill)</td>
<td>Esthetic or industrial</td>
<td>Sawlog</td>
<td>Sawlogs</td>
<td>Medium to high</td>
<td>Low</td>
</tr>
<tr>
<td>Large sawmill (industrial)</td>
<td>Industrial or esthetic</td>
<td>Sawlog</td>
<td>Sawlogs and bolts</td>
<td>Low to medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Medium Sawmill</td>
<td>Esthetic or industrial</td>
<td>Sawlog</td>
<td>Sawlogs and bolts</td>
<td>Low to high</td>
<td>Low to medium</td>
</tr>
<tr>
<td>Plywood mill</td>
<td>Esthetic or industrial</td>
<td>Veneer</td>
<td>Sawlogs and bolts</td>
<td>Low to medium</td>
<td>Low to medium</td>
</tr>
<tr>
<td>Pulp mill</td>
<td>Fiber</td>
<td>Pulp</td>
<td>Cull logs, bolts, tree-length logs, chips, mill residue</td>
<td>Very low to low</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Engineered products mills</td>
<td>Fiber</td>
<td>Composite</td>
<td>Cull logs, bolts, tree-length logs, roundwood residue</td>
<td>Very low to low</td>
<td>Low to high</td>
</tr>
</tbody>
</table>

Face veneer is sliced or peeled from logs to be used in appearance applications such as paneling and furniture. In general, sliced face veneer is produced from the highest quality logs of fashionable species while manufacturers of peeled face veneer.
may use lower quality logs or logs of less valuable species. The face veneer industry is heavily influenced by international demands for logs and veneer (Luppold 1994). On a volume basis, the face veneer industry is small but the relatively small volume masks the impact that this market can have in areas containing high-quality timber.

Eastern hardwood sawmills range in production size from less than 100,000 to more than 40 million board feet (bf) per year (Luppold 1995). These mills used approximately 1.9 billion cubic feet of timber in 1996 (Table 1). Most large mills (yearly production greater than 5 million bf) use higher grade logs and are termed “grade mills” because their principal product is lumber for appearance applications.

Intermediate mills (annual production volume of 2 to 4.9 million bf) tend to process lower grade logs but may be designated as grade mills in northern regions (Luppold et al. 2000). Small sawmills (less than 100,000 to 2 million bf per year) tend to be circle mills or portable band mills and normally use low-value logs or logs of less desirable species to produce industrial products and/or ungraded lumber.

Hardwood plywood manufacturers peel logs on large lathes and use this material to produce interior stock for standard-size panels or flooring blanks, containers or container materials, and specialty products. In general, hardwood plywood is manufactured using lower density species such as yellow-poplar and sweetgum, but specialty manufacturers may use other species, including maple and oak.

Hardwood pulp has traditionally been used to manufacture sheet paper, tissue paper, or packaging materials. Hardwood pulpwood consumption has increased over the last 30 years and in 1996 nearly 2.2 billion cubic feet of hardwood roundwood was consumed as pulpwood (Table 1). Nearly all species of hardwood can be pulped, but denser hardwood species usually are preferred.

Engineered wood products are materials formed by press gluing thin sections of wood that have been formed by flaking or veneering. They are made from low density hardwoods (yellow-poplar, aspen, etc.) and southern pine. The newer OSB mills can use crooked roundwood and limbs, though laminated veneer lumber and parallel laminated lumber require logs that are fairly uniform and straight.

**Relative Valuation of Hardwood Roundwood and Stumpage**

As the discussion of primary processors suggests, hardwood roundwood markets are numerous due to the different combinations of species and products. Likewise, there can be a considerable range in the price of hardwood products due to variations in quality and fashion trends. By contrast, there are fewer commercial softwood species and fewer markets for softwood products. One way to demonstrate differences between hardwood and softwood products and prices is the Maine stumpage report (Maine For. Serv. 2002) as it provides detailed information for a state with diverse timber-consuming industries (Table 3).
Table 3. Value of hardwood and softwood roundwood products in Maine by value range, state average for 2001

<table>
<thead>
<tr>
<th>Value range (dollars/MBF)</th>
<th>Softwood products</th>
<th>Hardwood products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20</td>
<td>Red and white pine pulpwood</td>
<td>Aspen and mixed hardwood pulpwood</td>
</tr>
<tr>
<td>21 to 50</td>
<td>Hemlock, mixed softwood and spruce/ fir pulpwood; cedar boltwood</td>
<td>Aspen sawlogs</td>
</tr>
<tr>
<td>51 to 100</td>
<td>Hemlock, cedar, and red pine sawlogs</td>
<td>Beech and red maple sawlogs; Aspen, red maple, ash, and yellow birch boltwood; Aspen veneer log</td>
</tr>
<tr>
<td>101 to 150</td>
<td>Spruce/fir and white pine sawlogs</td>
<td>White birch, ash, yellow birch sawlogs; Sugar maple, white birch, and red oak boltwood; Red maple veneer logs</td>
</tr>
<tr>
<td>151 to 200</td>
<td></td>
<td>White oak and sugar maple sawlogs</td>
</tr>
<tr>
<td>201 to 300</td>
<td></td>
<td>Red oak sawlogs and ash veneer logs</td>
</tr>
<tr>
<td>301 to 400</td>
<td></td>
<td>Yellow and white birch veneer logs</td>
</tr>
<tr>
<td>401 to 550</td>
<td></td>
<td>White oak, red oak, and sugar maple veneer logs</td>
</tr>
</tbody>
</table>

1 Developed from Maine For. Serv. (2002). International ¼-inch log scale, assuming 2 cords of pulpwood roughly equivalent to 1,000 bf.

Table 3 reveals that the overall range in hardwood stumpage price is considerably wider than that for softwood prices, and that hardwood sawlogs and veneer products have a considerable price range depending on species. In Maine, prices of softwood pulpwood stumpage range upward to $50 per thousand board feet (MBF) while prices of softwood sawlog stumpage prices range from $51 to $150 per MBF. Hardwood pulpwood prices are in a narrow range, but hardwood sawlog prices range from less than $50/MBF for aspen to more than $200/MBF for red oak. Veneer log prices range from less than
$100/MBF for aspen to more than $500/MBF for sugar maple. The price of hardwood boltwood (short logs that are merchandised primarily in New England markets) ranges from less than $50/MBF for mixed hardwood to less than $150/MBF for red oak, sugar maple, and white birch.

The range in hardwood sawlog and veneer log prices in Table 3 relates not so much to the inherent quality of these logs but to their use as described in the previous section. Aspen sawlogs and veneer logs are used primarily by engineered wood products industries. Aspen lumber is the lowest valued northern species (Hardwood Mar. Rep. 2002). In Maine, most red maple veneer logs are consumed by industries that peel rather than slice (plywood and rotary cut face veneer). By contrast, red oak sawlogs tend to be processed into lumber and red oak veneer logs are either sliced or rotary cut for face veneer.

Another aspect of hardwood product prices is that there seems to be no long-term interrelationship between the price of different hardwood species or species groups. For the most part, the price of higher value hardwood products does not seem to be cointegrated over time (Luppold et al. 2001). The lack of cointegration suggests no structured pattern of species substitution.

Examples of Localized Changes in Roundwood Demand

It is sometimes assumed that changes in the production of primary hardwood products are uniform across the eastern hardwood regions. However, we assert that the hardwood resource and demand for this resource varies by location. We support our point by examining changes in regional and subregional hardwood lumber production from 1965 to 2000, and demonstrate how growth in the markets for lower value hardwood roundwood also has varied by region.

In developing new estimates of eastern hardwood production (Luppold and Dempsey 1989) it was found that hardwood lumber production had not changed uniformly among regions between 1965 and 1986. While production increased by 25% and 35% in the northeastern and north-central regions, respectively, production decreased in the south central region and remained constant in the southeast. Luppold and Dempsey attributed these changes in production to changes in international and domestic demand and emphasis on pine production in the south, though a contributing factor to these changes could be the greater increase in sawtimber volumes in the north versus the south during this period (Smith et al. 2001).

A second study by Luppold and Dempsey (1994) examined nine hardwood regions identified in terms of states proximate to one another with similar species composition. In this study, the Central States (Ohio, Indiana, Illinois, Missouri, and Iowa), the Lake States, and a region that included Kentucky and Tennessee had the largest increase in production of lumber while regions to the south and east of these states had smaller or negative increases in production. Again, these findings were linked to changes in the domestic flooring and cabinet industry and to international demand for white oak, both of which affected price and production in the Central States and Kentucky/Tennessee.

An example of how prices for specific groups of species can influence roundwood demand in a given state is sawlog production in Maine. The 21-percent decline in
hardwood production in Maine\(^1\) from 1979 to 1989 (versus the 32-percent increase in national production during the same period) and the subsequent rebound in lumber production apparently hinge on the markets for red oak versus hard maple and other northern hardwoods that are abundant in this state. The 1980’s were the age of red oak as oak dominated furniture fashions (Frye 1996) and the price of No. 1 Common oak was second only to that of black walnut and black cherry. Maple prices declined through much of this period and were about 60% of the value of red oak by the end of 1987 (Luppold et al. 2001). By the end of 2000, the price of No. 1 Common color select hard maple was nearly 50% higher than that for similar grades of red oak. This helped boost Maine's sawlog production by 77% from 1987 to 2000.

The data from Maine also point out how a structural shift in production technology can influence demand for a specific roundwood product. Aspen has been a relatively low-value hardwood species that generally has been consumed as pulpwood. In the 1980’s, OSB plants were built in Maine resulting in a 20-fold increase in aspen sawlog (as opposed to pulpwood) production from the late 1970s to the late 1980s (P. Lammert, 2002, pers. commun.).

**SUMMARY AND CONCLUSIONS**

Although roundwood can be considered as an intermediate step between harvesting and primary processing, hardwood roundwood can be traded actively in relatively complex markets. As the relative value of different hardwood roundwood products has become more divergent, there has been added incentive to separate product by quality, species, diameter, color, or other characteristics.

The three broad categories of hardwood roundwood markets -- esthetic, industrial, and fiber -- can include materials that emanate from the growing stock or nongrowing stock portion of forests. Pulpmills and hardwood sawmills consume the greatest volume of hardwood roundwood, but veneer mills, plywood mills, and engineered wood product plants can be important consumers in a specific subregion. However, most consumers of hardwood roundwood other than pulpmills are difficult to define in finite groups.

There are numerous hardwood roundwood markets due to different combinations of species and products, and a considerable range in the price of hardwood products. The ranges in the price of hardwood roundwood products are greatest within the sawlog and veneer log portion of the market due to the relative value of different species and the impact of growth characteristics (ring count, color, consistency of ring count, roundness of bole, etc.) in different markets. Another aspect of hardwood product prices is that there seems to be no long-term interrelationship between the price of different hardwood species or species groups.

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\(^1\) Hardwood lumber production was estimated by subtracting the aspen component for what was used primarily to manufacture OSB from total sawtimber production.
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