An Assessment of the Red Maple Resource in the Northeastern United States

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ABSTRACT: *The red maple resource in the northeastern United States has exhibited dramatic gains in the past 3 decades in terms of stem numbers and net volume. Growing stock and sawtimber volumes have displayed extraordinary growth compared to other species, and red maple is replacing important market species that have historically been used in the Northeast. The increase in red maple has salient implications for foresters, primary and secondary manufacturers, and wood technologists. Data from the USDA Forest Service's (USFS) Forest Inventory and Analysis program were used to provide a regional assessment of the red maple resource. The analysis includes the location, concentration, volume, quality, and current utilization of red maple in the USFS's 13-state Northeastern Region. Study results indicate red maple is a significant and increasing component of northeastern forests, with Pennsylvania, New York, and Maine holding the largest volumes of red maple. Red maple, expressed as a percentage of USFS hardwood tree grades, is distributed primarily in grades 3 and lower. Finally, development of innovative markets and novel products, understanding consumers via consumer behavior research, and innovative silvicultural treatments will be required to increase the utilization of red maple. North. J. Appl. For. 22(3):181–189.*

Key Words: Red maple, growing stock, sawtimber, volume, concentration, utilization.

Red maple (*Acer rubrum* L.) has exhibited striking gains in growth over the past 3 decades. Growing stock and sawtimber volumes have shown extraordinary growth when compared to several other species, and in the forest, red maple is replacing important market species that historically have been used in the northeastern United States. This suggests that new market and product opportunities should be developed for this abundant, often low-quality resource. For more than 20 years, foresters have noted the dramatic increase in red maple (Heiligmann et al. 1985, Godman and Mattson 1976). Information about red maple's location, concentrations, volumes, quality, and current utilization is needed.

During the past 3 decades, research has been directed toward the utilization of abundantly available and minimally used species (Luppold and Baumgras 2001, Braiewa et al. 1985). When developing products for a market, preferences for and the quantities of a species can be primary considerations in the decision to locate forest products manufacturing plants. Concentration and location of an available resource are viewed as being extremely significant and a primary facility location constraint (Youngs and Hammett 2001, Desrochers 2000, Husain et al. 1998, McKeever and Spelleder 1998, Graham et al. 1997, McKeever 1997). Porter (1998) states that having an abundant supply of a particular resource can lead to a comparative advantage for businesses. Moreover, for a company to optimize productivity, a reliable resource supply is a component of the optimization process. Providing industry decision-makers with relevant information about the volumes available may assist in developing new opportunities for red maple.

The objectives of this study were to identify the location, concentration, volume, quality, and current utilization of red maple in the Northeastern Region (Figure 1), using data from the USDA Forest Service (USFS) Forest Inventory and Analysis (FIA) survey program. This information can lead to more efficient resource use and improved investment decisions regarding facility location. Several studies have shown that the extent to which a species is harvested, over time, generally is related positively to its abundance in the resource base (Luppold and Baumgras 2001, Wharton et al. 1998, Widmann et al. 1998). Using this as a criterion, observers have noted that red maple appears to be underutilized in New York (Wharton et al. 1998). This study sought to verify this finding and expand this observation over a broader region.

Overview

Solid hardwood products such as pallets, frame stock for upholstered furniture, and railroad ties, serve as important

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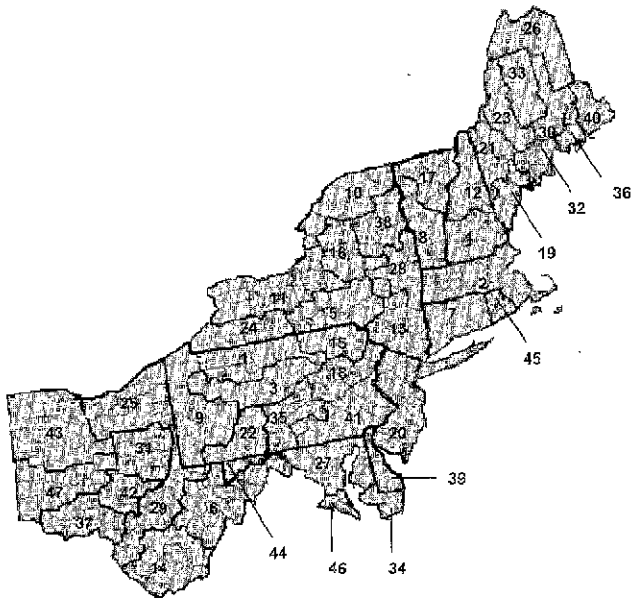

Figure 1. USFS FIA survey units of the Northeastern Region. Numbers indicate rank by growing stock volume of red maple.

markets for lower grade hardwoods. More recently, pulp markets also have increased the use of hardwoods as evidenced by the 106% increase in hardwood pulpwood production in the southern United States between 1976 and 1995, compared to a 22% increase for softwood pulpwood over the same period (Bumgardner et al. 2001). Similarly, in the Northeast, hardwood pulpwood production increased by over 80% compared to about 19% for softwood from 1975 to 1995 (Irland et al. 2001).

There is increasing interest in focusing on the value-added utilization of small-diameter and lower grade hardwoods. Economical production of higher valued products (e.g., dimension parts for furniture and cabinets) from low-grade lumber is feasible with the introduction of novel production systems (e.g., Serrano and Cassens 2000, Bratkovich et al. 2000, Lin et al. 1995, Reynolds et al. 1983). However, implementation of new production systems can be a challenge and require investment in new facilities and/or equipment. In addition, drying, materials handling, and the marketing of small component pieces present further challenges.

Red maple certainly falls within the low-value and low-grade parameters, and we note some contributing factors concerning the growth of this species in the eastern deciduous forest. Past high grading and fire suppression have been suggested as two of the principal factors in this species' augmentation. Red maple is intermediate in shade tolerance (Haag et al. 1989), a prolific seeder (Ahlgren 1979, Abbott 1974), a vigorous sprouter (Burns and Honkala 1990, Voss 1985, Lees 1981, Flinn and Wein 1977), and has an extraordinary ability to compete (Johnson et al. 1987, Voss 1985). This species' attributes, in combination with high grading, allowed it to gain a foothold in today's forest (Heiligmann et al. 1985, Godman and Mattson 1976, McGee and Hooper 1970). Red maple is resistant to acid rain and ozone damage, is abundant as an associate species in several forest types, is not a preferred food source of deer, and occurs on a wide range of sites (e.g., wet to dry) (W.H. McWilliams, Pers. Comm., USDA Forest Service, 2002). Historically, fire played an integral role in shaping the eastern forest, but in the absence of fire, red maple has flourished and established itself as a primary component (Cole et al. 1990, Burns and Honkala 1990, Blair and Brunett 1976).

Several characteristics suggest why red maple is not favored for high-end utilization, such as for factory-grade lumber (e.g., furniture) or veneer. Red maple is susceptible to defects and disease. Individual stems exhibit poor growth form with multiple stems when originating from a coppice source (Erdmann et al. 1985). However, prices paid for high-grade red maple are quite respectable when compared to other species. The Hardwood Market Report (2002) of Apr. 13, 2002 reports that green FAS 4/4 soft maple lumber brought $870 FOB per thousand board feet (mbf) in the Appalachian region. The market price for green FAS 4/4 hard maple and red oak brought $1,220/mbf and $960/mbf, respectively. In the northern hardwood region, soft maple, hard maple, and red oak brought $850/mbf, $1,225/mbf, and $1,095/mbf, respectively. In the early 1970s, red maple commanded prices similar to red and white oak, hard maple, and not far below that of cherry (Luppold and Bumgardner 2002). Opportunities exist for both managing and manufacturing red maple for higher value forest products.

Alternative markets for low-value hardwoods may include engineered wood products (EWP) such as oriented strandboard (OSB) or laminated veneer lumber. EWP have an advantage over value-added solid wood hardwood markets because of lower processing costs and the potential for a more complete utilization of the raw material. EWP could lead to increased opportunities for red maple utilization as well as economic development by locating new facilities in areas with high concentrations of red maple. Obviously, factors such as EWP market demand, transportation, and economic feasibility are critical considerations. In the near future, red maple roundwood consumption might be limited by the recent closure of pulp and paper mills and paper lines in several northeastern states. In such instances, novel approaches will be required to use this expanding forest resource.

Methods

The data used were from the USFS FIA program for the 13 states in the Northeastern Region. FIA is federally mandated and conducts forest resource inventories to continually provide information for regions, states, and areas within those states (i.e., survey units). Forest resource data is periodically collected, analyzed, and reported by FIA.

FIA data include volumes of growing stock and sawtimber trees by species and diameter class. FIA also maintains a Timber Products Output (TPO) database that includes, but is not limited to, product output for individual states by product type (e.g., sawlogs, veneer logs etc.) and species. For this study, FIA inventory and TPO data from the late

1980s and early 1990s were analyzed. For eight of the region's 13 states, the inventories are relatively recent (1997–1999), while five states were surveyed between 1989 and 1995 (Table 1). As a result, these data do not represent forest conditions at a common point in time. When practical, results are presented at the state (and sometimes survey unit) level. However, to demonstrate other important trends, it was necessary in some cases to use the most recent data available and aggregate state data.

Results

Northeastern Region Forestland

The Northeastern Region (Figure 1) is comprised of 153 million ac and of this total, 92.9 million ac (60%) are classified as forestland. Private ownership represents 73.8 million ac, the forest industry owns 8.4 million ac, the National Forest system holds 2.4 million ac, and other public ownership is 8.3 million ac. New York, Pennsylvania, Ohio, Maine, and West Virginia have the most acreage of red maple, and consequently, also possess relatively large volumes of red maple.

Stand Size, Growing Stock, and Sawtimber Volumes of Red Maple

Growing stock volume and stem quantities of a species are important indicators of its current and future availability. Growing stock is defined as "all live trees of commercial species greater than 5 inches (in.) in diameter at breast height (dbh), except rough or rotten trees" (Hansen et al. 1992).

The findings of this research point toward red maple becoming an increasingly significant component, in both stem numbers and volume, of the northeastern forest. Red maple, as a percentage of all hardwoods, is nearly 20% of the total number of live hardwood trees in the Northeast. The percentage of red maple stems in the 6–8 in. diameter class is more than 23% of the total (Table 2).

Stand Size Classification Volumes

Strong growth trends are observed for most red maple stand size classifications. Currently there are 11,933 million cubic feet (mcf) of red maple sawtimber, 5,558 mcf of poletimber, and 485 mcf in the sapling/seedling classification in the Northeast (Table 3). Red maple exhibited a 268% increase in the sawtimber classification (e.g., stands dominated by sawtimber-size stems 11 in. dbh and greater), increasing from 3.2 to 11.9 billion ft^3 between FIA surveys. Red maple represents 18% of this total. Red maple in the poletimber classification (e.g., stands dominated by stems between 5.0 and 10.9 in. dbh) increased by 98% (Table 3). With future growth of these trees, we could expect to see significant increases in volumes of trees 16 in. dbh and larger; tree diameters most often harvested for sawtimber. In the sapling and seedling class, red maple volume increased nearly 521% between surveys. The total volume of red maple across all stand size classes increased by nearly 193% to 18 billion ft^3 between surveys (Table 3).

Table 1. FIA state inventory dates.

State	Previous inventory	Recent inventory
Connecticut	1985	1998
Delaware	1986	1999
Maine	1982	1995
Maryland	1986	1999
Massachusetts	1985	1998
New Hampshire	1983	1997
New Jersey	1987	1999
New York	1980	1993
Ohio	1979	1991
Pennsylvania	1978	1989
Rhode Island	1985	1998
Vermont	1983	1997
West Virginia	1975	1989

Growing Stock Volumes

Currently, red maple comprises about 18 billion ft^3 or 19% of the total hardwood growing stock volume in the Northeast. This includes nearly 28% of the 6-in. dbh class, more than 25% of the 8-in. class, and 23% of the 10-in. class (Table 4). The volume of hardwood growing stock in the Northeast increased by nearly 26% between surveys; red maple increased approximately 35%. Volume increase of red maple growing stock ranged from 4% in Rhode Island to 164% in Ohio. In seven of the 13 northeastern states, red maple growing stock volumes increased at least 30% during the 11- to 14-year period between FIA inventories. Pennsylvania, New York, and Maine had substantial quantities of red maple growing stock, an aggregate total of nearly 10.2 billion ft^3 at the time of each state's latest survey. In addition to Ohio, Vermont (54%) and West Virginia (53%) exhibited phenomenal increases of red maple (Table 4). While the total percentage increase of red maple exceeds the aggregated hardwood total by a modest margin, one should focus on the smaller diameter classes where red maple quantities and volumes are most prevalent. This is particularly prominent in Maine, where the 6-inch class is more than 17% red maple, and the 8- and 10-in. classes exceed 24 and 22%, respectively (Table 4).

Increases in red maple growing stock volumes, when compared to that of other commercially important tree species, illustrate important trends in the changing composition of the northeastern forest. In the eight northeastern states with the largest volumes of red maple growing stock, all but New Hampshire had increases in red maple growing stock that exceeded the increases for hard maple, red oaks, and white oaks (Figure 2). In New York and Vermont, hard maple increased nearly as much as red maple. However, in Pennsylvania, Massachusetts, Maine, and Ohio, red maple increases exceeded that of other species by a relatively wide margin. Pennsylvania and New York had the largest volume increases of red maple from the preceding survey (Figure 2).

Two of the survey units with the largest volumes of red maple growing stock are located in north-central Pennsylvania (the Allegheny and the North Central); combined, they contain nearly 2.4 billion ft^3 (Table 5, Figure 1). The Allegheny survey unit has an average of over 475 ft^3/timberland acre; the Connecticut survey unit averages 408 ft^3/ac. It should be noted that several of the survey units

Table 2. Number of live red maple trees[a] by state and diameter class (most recent survey).

State	Tree dbh class (in.) 2–4	6–8	10–12	14–16	18–20	21–29	>29	Total
Maine	1,520,072	291,355	88,125	19,865	4,554	1,576	132	1,925,679
Pennsylvania	1,200,024	330,424	118,946	38,030	9,143	3,341	397	1,700,305
New York	1,007,116	276,490	106,724	32,906	8,404	3,361	547	1,435,545
West Virginia	716,214	125,737	37,941	12,804	3,198	1,392	131	897,417
NewHampshire	394,474	115,107	40,625	9,514	2,474	804	72	563,070
Ohio	384,977	71,064	24,149	8,450	2,820	1,311	296	493,067
Massachusetts	218,705	75,270	33,959	9,112	2,268	752	115	340,182
Vermont	188,715	61,997	28,473	10,036	2,440	881	253	292,798
Maryland	191,738	33,565	12,929	5,138	2,045	1,302	362	247,079
Connecticut	145,447	41,061	20,254	7,683	2,242	677	207	217,591
New Jersey	113,516	28,125	10,296	3,198	860	630	123	156,748
Rhode Island	45,632	9,447	3,759	1,126	219	111	42	60,336
Delaware	42,270	8,371	3,194	1,676	708	300	29	56,550
Red maple % all hardwoods—NE region	18.9	23.5	20.1	16.6	14.0	13.4	13.8	19.6

[a] Thousand trees.

Table 3. Volume of red maple growing stock[a] by stand size class, Northeastern Region.

	Sawtimber	Poletimber	Sapling/ seedling	Nonstocked	Total
Previous survey	3,242.5	2,813.0	78.1	2.0	6,135.6
Most recent survey	11,932.7	5,558.1	484.6	1.5	17,976.9
Percentage change	268.0	97.6	520.5	–25.0	192.9

[a] Million cubic feet.

Table 4. Percentage of red maple growing stock volume by diameter class, change in red maple growing stock volume, and total red maple growing stock volume by state.

State	Tree dbh class (in.) 6	8	10	12	14	16	18	20+	Percentage change[a]	Total red maple volume[b, c]
Pennsylvania	11.1	17.2	19.1	16.1	13.8	8.6	5.5	8.6	36.9	4,447.9
New York	10.6	17.3	19.2	16.1	12.8	8.4	5.1	10.5	38.9	3,448.8
Maine	17.6	24.5	22.2	14.3	9.0	5.3	2.6	4.5	23.5	2,328.1
West Virginia	13.2	17.2	17.7	14.7	12.4	9.6	5.9	9.3	53.1	1,521.2
New Hampshire	13.8	22.9	23.7	14.3	10.7	5.4	4.3	4.8	11.9	1,307.3
Vermont	9.3	15.9	20.4	15.1	14.6	8.8	5.4	10.5	54.4	1,045.1
Massachusetts	9.5	18.0	21.3	19.0	12.2	7.5	5.8	6.8	15.8	1,040.3
Ohio	10.5	14.9	15.4	14.9	12.9	9.1	7.2	15.3	164.5	964.3
Connecticut	7.5	12.7	19.8	14.7	13.7	12.1	5.9	13.7	8.9	692.1
Maryland	7.4	10.3	12.7	12.7	13.1	8.0	7.3	28.6	23.8	675.8
New Jersey	9.9	17.0	17.5	14.6	12.1	7.1	5.6	16.3	40.2	368.3
Delaware	5.2	9.0	10.9	12.0	14.3	13.9	8.1	26.5	43.6	163.9
Rhode Island	10.6	17.4	23.0	16.1	11.9	8.9	4.3	7.8	4.1	97.1
Red maple % all hardwoods—NE region	27.9	25.7	23.0	19.3	17.7	14.8	13.5	13.0		19.3

[a] Change from previous survey.
[b] Most recent FIA analysis.
[c] Million cubic feet.

with the largest quantities of red maple are located in New York, Pennsylvania, and southern New England. The top 15 survey units in red maple growing stock volume account for nearly 60% of the total red maple volume in the Northeast.

Sawtimber Volumes

Sawtimber volume of red maple exceeds 38 billion board feet (bbf), more than 14% of the total hardwood sawtimber volume. Eight states contain more than 2 bbf of red maple sawtimber, with the top four states each exceeding 3 bbf. Combined, Pennsylvania and New York contain nearly 18 bbf (Table 6). The largest relative proportions of red maple sawtimber are in the smaller diameter classes. For example, in the 12- and 14-in. diameter classes, red maple comprises 17% and 16% of total hardwood sawtimber volume, respectively (Table 6). Red maple sawtimber volume in the Northeast increased by nearly 58% between surveys while all hardwoods combined increased about 39%.

In six states, more than 15% of the sawtimber volume is comprised of red maple: Massachusetts (24%), Maine (nearly 21%), New Hampshire (almost 19%), New York (near 19%), Pennsylvania (16%), and Vermont (nearly 16%). Interestingly, Ohio possesses a relatively large volume of red maple sawtimber, about 2.5 bbf, earning it the fifth-place rank just behind West Virginia (Table 6).

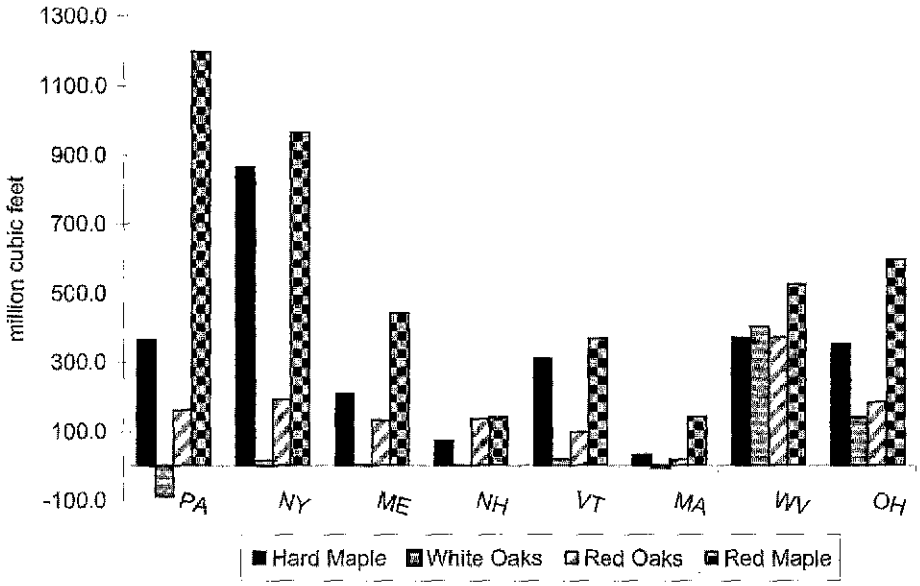

Figure 2. Change in growing stock volume for red maple and selected commercial species between the two most recent forest inventories. For ME, NH, and VT, this includes all red oaks and white oaks. For remaining states, it includes only northern red oak and white oak.

Table 5. Top 15 Northeastern Region survey units for red maple growing stock: volume, total timberland acreage, and cubic feet per acre of red maple (most recent survey).

Rank	State and survey unit	Red maple volume[a]	Total timberland[b]	Cubic feet per acre[c]
1	Pennsylvania, Allegheny	1,473.4	3,100.2	475.3
2	Massachusetts, Massachusetts	1,040.3	2,631.3	395.4
3	Pennsylvania, North Central	903.3	2,717.6	332.4
4	New Hampshire, Southern	820.4	2,148.5	381.8
5	New York, South Central Highlands	776.3	2,393.3	324.4
6	West Virginia, Northeastern	712.1	4,450.7	160.0
7	Connecticut, Connecticut	692.1	1,696.1	408.1
8	Vermont, Southern	619.0	2,218.8	278.9
9	Pennsylvania, Western	533.7	2,569.7	207.7
10	New York, St. Lawrence-N. Adirondack	526.8	2,504.6	210.3
11	New York, Lake Plain	524.8	2,397.1	218.9
12	New Hampshire, Northern	486.7	2,360.2	206.2
13	New York, Catskill-Lower Hudson	477.9	2,181.4	219.1
14	West Virginia, Southern	472.5	4,139.2	114.2
15	Pennsylvania, Northeastern	463.8	1,418.5	326.9

[a] Million cubic feet.
[b] Thousand acres.
[c] Red maple growing stock volume/total timberland acres in survey unit.

As previously noted, the increase in red maple sawtimber volume between inventories exceeds gains reported for red maple growing stock in the Northeast. Seven of the 13 northeastern states experienced a 50% or greater increase in red maple sawtimber volume between successive inventories (Table 6). Most of the gain in red maple sawtimber was in the 12- to 16-inch dbh classes, reflecting both ingrowth to the sawtimber-size class and growth of small sawtimber trees.

Utilization Considerations

Utilization opportunities for red maple sawtimber are determined in part by wood quality. Tree-grade classifications reported by FIA can be an important indicator of red maple quality. Tree grades 1, 2, and 3 represent trees predicted to yield factory-grade lumber (Hanks 1976). Tree grades are correlated with lumber-grade yields; higher-grade trees yield greater proportions of higher lumber grades, which are valued by the furniture, cabinet, and millwork industries. Grade 4 trees are not suitable for factory-grade lumber but will yield roundwood suitable for fiber (e.g., pulpwood and engineered wood products) or industrial products, such as railroad ties and timbers. Grade 5 trees have limited utilization potential aside from fuelwood and limited quantities of fiber. Grade 5 tree form is given to trees of sawtimber size that do not contain a gradable butt log for sawn products and contains more than two-thirds rot and decay (E.H. Wharton, USDA Forest Service, 2002).

Tree diameter also affects tree grade. USFS tree grade rules have minimum diameter requirements; for example, a tree must be at least 16 in. dbh to qualify for grade 1. The

Table 6. Percentage of red maple sawtimber volume by diameter class, change in red maple sawtimber volume, and total red maple sawtimber volume by state.

State	Tree dbh class (in.)							Percentage change[a]	Total red maple volume[b, c]
	12	14	16	18	20	21–29	>29		
Pennsylvania	26.7	25.6	17.1	11.3	6.9	10.5	1.9	64.8	9,805.1
New York	27.8	23.7	16.1	10.2	7.5	11.0	3.6	57.1	8,142.7
Maine	37.9	24.7	15.3	7.7	5.7	8.2	0.4	17.6	3,537.6
West Virginia	24.2	23.2	19.1	12.6	7.3	12.1	1.6	121.8	3,185.7
Ohio	22.0	20.6	14.9	12.8	8.5	15.3	5.8	180.2	2,458.0
Vermont	25.0	26.2	16.9	10.6	5.9	9.6	5.6	71.2	2,292.1
Massachusetts	34.4	23.8	15.0	11.9	4.8	7.0	3.2	40.1	2,110.1
New Hampshire	34.1	27.1	14.2	11.4	5.6	7.6	-	24.6	2,007.8
Maryland	14.3	18.2	10.6	10.6	8.9	22.9	14.6	41.0	1,846.3
Connecticut	22.5	21.9	20.9	10.1	9.3	8.7	6.6	17.6	1,660.6
New Jersey	24.2	21.3	13.1	10.1	7.1	20.9	3.3	95.0	861.2
Delaware	14.9	18.4	19.0	11.0	16.9	19.8	-	105.5	501.4
Rhode Island	31.6	23.8	18.0	8.8	5.4	5.0	7.5	3.7	202.6
Red maple % all hardwoods—NE region	17.5	16.3	13.6	12.5	11.7	11.4	12.9		14.4

[a] Change from previous survey.
[b] Most recent FIA analysis.
[c] Million board feet, International ¼-inch rule.

smaller diameters of red maple are a factor limiting its presence in the higher tree grade classifications. Only red maple sawtimber in Maryland has more than 10% of the total volume in grade 1. When observing the grade 1 classification, it is not surprising that red maple constitutes only 4% of this category in relation to all hardwoods in the Northeast (Table 7). Eight of the 13 states had less than 5% of their red maple sawtimber volume in grade 1 trees. Grade 2 has less stringent quality requirements and a tree must be at least 13 in. dbh. Only New Jersey, Maryland, and Connecticut have more than 30% of red maple sawtimber collectively in grades 1 and 2 (Table 7). As a comparison, select red oak species are nearly 21 and 30% of grades 1 and 2, respectively, versus 4 and 16% for red maple (Table 8). The tree grade distribution of hard maple (primarily sugar maple) is very similar to that of red maple.

Grade 3 trees represent the largest share of red maple sawtimber in the Northeast, and the percentage in grade 3 ranges from 32% in Maryland to more than 59% in New Hampshire (Table 7). Given the relatively high percentage of sawtimber volume in the 12-in. dbh class (Table 6) and the 13-in. dbh minimum requirement for grade 2 trees, it is not surprising that grade 3 trees represent a large share of red maple sawtimber. This is actually the case for most species (Table 8). Red maple constitutes about 16% of all grade 3 trees in the Northeast (Table 7).

Perhaps the greatest challenge in utilizing and managing the red maple resource is the significant volumes of grades 4 and 5 red maple sawtimber. Eleven of the 13 northeastern states had at least 25% of red maple sawtimber combined in tree grades 4 and 5; Pennsylvania's 9.8 bbf of red maple sawtimber was 42% grades 4 and 5. Nearly 48% of Ohio's red maple is in grades 4 and 5. Maryland, West Virginia, Vermont, and New York also have relatively high proportions (over 30%) of red maple sawtimber in grades 4 and 5 (Table 7). Two questions arise: What products can use appreciable quantities of lower-grade red maple; and what silvicultural regimes can be implemented to favor a more desirable species or red maple with enhanced quality attributes?

Timber Product Output in the Northeastern Region

The total hardwood and softwood production from this 13-state area reported from the most recent USDA Forest

Table 7. Percentage of red maple sawtimber by tree grade (most recent survey).

State	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Pennsylvania	2.2	12.3	43.2	28.2	14.1
New York	4.8	17.1	46.4	11.7	20.0
Maine	4.3	15.6	53.2	11.4	15.5
Ohio	2.1	9.7	40.3	25.7	22.2
Vermont	4.4	19.8	43.2	12.5	20.0
Massachusetts	4.4	20.0	50.1	7.0	18.5
New Hampshire	2.9	15.3	59.4	7.0	15.5
Maryland	12.6	19.2	32.1	21.9	14.2
West Virginia	5.1	11.3	49.9	33.6	–
Connecticut	8.5	23.6	42.4	3.1	22.4
New Jersey	8.9	25.2	36.9	5.2	23.8
Delaware	7.9	21.4	42.5	20.2	7.9
Rhode Island	2.1	26.2	56.8	8.8	6.1
Red maple % all hardwoods —NE region	4.0	9.9	16.1	16.3	21.7

Table 8. Percentage of selected commercial species sawtimber volume by tree grade, Northeastern Region (most recent survey).

Species	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Species total[a]
Red maple	4.4	15.8	45.5	17.6	16.7	36,893.4
Hard maple	8.1	20.8	42.9	14.3	14.0	24,802.6
Select red oaks[b]	20.8	29.6	33.1	11.3	5.3	22,896.7
Yellow-poplar	23.6	22.8	28.3	22.0	3.3	19,666.8
Select white oaks[c]	12.8	24.4	39.8	17.2	5.8	14,739.2
Ashes	16.5	25.7	41.1	6.8	9.7	10,972.7
Black walnut	6.9	21.9	46.5	12.9	11.8	1,212.7

[a] Million board feet, International 14-inch rule.
[b] Includes northern red, Shumard, and cherrybark oak.
[c] Includes white, swamp white, bur, swamp chestnut, and chinkapin oak.

Service TPO data was 1,885 mcf. Of this total, hardwood production was 1,337 mcf and red maple production was only 79 mcf (Table 9). In the product categories, red maple represents double-digit proportions only in composites. Only 6% of the total hardwood roundwood received at all mill types was red maple. It is revealing to compare this red maple utilization figure with total growing stock and sawtimber estimates, where red maple is 19% and 14% of the total hardwood volumes, respectively. In addition, red maple comprises nearly 20% of the number of live hardwood trees (Table 2). One can conclude that red maple is underutilized as a raw material. In the next section, we present regional examples of entrepreneurship and innovation that could lead to increased use of red maple.

Regional Utilization Examples

Regional resource utilization can be viewed as a jigsaw puzzle, with a variety of industries requiring different raw material requirements or puzzle "pieces." Consider an area with several hardwood sawmills using higher-grade logs; an EWP facility that uses smaller, lower-density hardwoods, such as yellow-poplar and cucumbertree; and a pulp mill for lower grades of higher density species, such as oaks and hickories. These "pieces" satisfy the puzzle requirements of those particular industries.

Mountain Forest Products, owned by the Pittston Coal Company, recently was established to process hardwoods from company lands located in extreme southwestern Virginia. The management objective is to reverse past high grading practices by removing the least valuable trees, thus leaving a more valuable residual stand. Mountain Forest Products also accepts gatewood at a company-built facility. This processing facility was built, according to company management, because, "We started looking for something to do with the low grade and there were no local markets" (Douglas 2000). Mountain Forest Products eventually plans to merchandise 300,000 tons of hardwood chips per year in conjunction with 20 mmbf of sawn material, namely ties and flooring stock (Douglas 2000). One can view this facility, which processes oak, hickory, poplar, and maple, as a complement to an oriented strand lumber plant located nearby in Hazard, KY. This facility uses low-density species but does not provide a market for high-density hardwood species also common to the area.

Another example of resource utilization change is found in West Virginia, where two large OSB mills and a laminated veneer facility began operation in the mid-1990s. It has been stated that the quantity of yellow-poplar tops left in the woods after harvesting in central West Virginia could supply three OSB mills of 50 mmsf capacity, which is roughly the size of one of the OSB mills located in West Virginia (Walker 1996). Generally, OSB mills favor lower-density species. The specific gravity (oven-dry weight, green volume) of red maple (0.49) is about 20% greater than yellow-poplar (0.40) (Forest Products Laboratory 1987). Red maple's specific gravity may exceed some EWP raw material parameters.

A wood composites business utilizing low-grade hardwood, primarily red maple, was opened in Bangor, Maine in 2002. Engineered Materials of Maine could eventually employ up to 75 full-time workers in a 40,000 square-foot production facility to manufacture glue-laminated red maple into beams. The beams are produced to match standard

Table 9. Timber product output[a] for the Northeastern Region, 1996.

	Sawlogs	Veneer logs	Fuelwood	Pulpwood	Composites	Other products	Total
Red maple	43.3	2.1	27.1	5.3	0.4	0.4	78.6
All other hardwood	464.6	30.4	399.9	343.7	1.6	17.9	1,258.1
All softwood	259.8	2.6	53.3	216.4	0.2	16.1	548.3
Total	767.7	35.1	480.3	565.4	2.2	34.4	1,885.0
			Red maple as a percentage of all hardwoods				
	8.5	6.5	6.3	1.5	20.0	2.2	5.9
			Red maple as a percentage of total				
	5.6	5.9	5.6	0.9	18.2	1.2	4.2

[a] Million cubic feet of roundwood.

dimensional framing lumber (Society of Wood Science and Technology 2002).

Conclusion

This study demonstrates the increasing influence of red maple in the eastern deciduous forest. This species also is a prominent component of both the sapling-seedling and poletimber classifications and will remain so for the foreseeable future. The number of red maple stems in the smaller diameter classes was discerned to be nearly one-quarter of those classifications. When considering growing stock and sawtimber volumes, red maple comprises nearly one-fifth and over one-seventh of the hardwood resource in these classifications, respectively.

Among the northeastern states, Pennsylvania, New York, and Maine in particular have considerable quantities of red maple. The largest concentration of red maple is in north central Pennsylvania, south central New York, and southern New England. These concentrations suggest opportunities to supply raw material for fiber or engineered wood facilities, where red maple potentially could become a low-cost resource. There may be opportunities for increased utilization of red maple sawlogs, particularly if substitute species like sugar maple become more expensive. For this to be achieved, novel red maple timber management practices should be developed to complement current timber stand improvement techniques. It appears that these states' industries also will need to develop new utilization approaches to make use of this resource.

Looking forward, we expect increasing proportions of red maple sawtimber-sized trees to be red maple. Harvesting proportionately more sawtimber trees of other species would tend to accelerate the growth of sawtimber represented by red maple. This suggests opportunities on at least three fronts: (1) products that use considerable quantities of red maple; (2) silvicultural regimes and manipulations to favor a more desirable species; and (3) silvicultural regimes to improve red maple quality.

Selected research has been conducted on the latter, as Erdmann et al. (1985) discussed a silvicultural technique to improve sawlog quality, and presented various methods of commercial thinning (Erdmann 1987). Forthcoming USFS research will emphasize those resource attributes important to the furniture, millwork, and engineered wood products industries, as well as those attributes most likely to affect red maple harvesting and utilization. Future research should focus on consumer perceptions of red maple and new products or applications to increase utilization. There is limited utilization of lower quality hardwoods in the appearance-grade lumber markets. Marketing interventions should be devised and implemented to enhance market acceptance of this lesser-used species.

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