PRODUCT RECOVERy FROM TREE GRADE 1 NORTHERN RED OAK ON MENOMINEE TRIBAL LANDS

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Abstract—Since 1854 the Menominee Tribal people have practiced some level of forest management on their lands. In April of 2000, Menominee Tribal Enterprises (MTE) forestry staff along with federal, state, and university researchers began a comprehensive study of value in northern red oak (*Quercus rubra* L.). One of the objectives of this study was to relate tree characteristics to lumber yield and grade, and total tree value of mature and old growth northern red oak. During winter 2001, 69 northern red oak (tree grade 1) study trees were identified and harvested from three habitat types on Menominee Tribal lands. Sample trees averaged 111 years old (82 to 181 years) and 22 inches in d.b.h. (14 to 33 inches). Results of the mill yield study showed that almost 70 percent of the value of the tree grade 1 northern red oak trees was in the first two logs. Approximately 40 percent of the tree grade 1 logs were veneer quality. Almost one-third of the veneer logs came from 20- to 24-inches diameter trees. Over one-half (53 percent) of the total veneer value came from butt logs. The total value of all products derived from the northern red oak grade 1 trees increased with age and diameter.

INTRODUCTION

Approximately 65 percent of the 220,000 acres of Menominee Tribal forestland is managed using uneven-aged silvicultural methods in northern hardwood forest types dominated by sugar maple (*Acer saccharum* Marsh.). Within this area, northern red oak is a dominant and featured species on AFVib, AFVib(Ha) and ATM habitat types (Kotar and others 1988). Quality oak can be grown on these dry-mesic to mesic sites of medium fertility using even-aged silvicultural methods.

Hardwood forests on the Menominee Reservation are uniquely different from similar forest types throughout the Great Lakes Region (40 miles west of Green Bay, Wisconsin). Trees are grown to larger diameters and achieve older ages than many other managed forests. For example, northern red oak on Menominee can grow to over 30 inches in diameter and attain ages of 180 years or more.

Menominee forest managers were interested in how tree value changes with time in forests where individual trees are often left to grow for long periods of time which approach the biological upper limit for northern red oak. Their questions focused on whether there is an optimal age or diameter where total tree value is highest. Additionally, they wanted to know if there was a balance between tree value increases due to tree growth and grade improvement, and value loss due to wood decay, discoloration, and other grade defects.

The purpose of this study was to determine how the economic value of individual northern red oaks varies by tree characteristics. We evaluated the relationship between tree diameter, height, age, and other measures of the tree's vigor on product recovery and total tree value.

METHODS

During April 2000 we visited several sites on Menominee lands to develop criteria for the selection of northern red oak trees. Due to sawmill availability for processing logs we limited our study to evaluating total value in tree grade 1 northern red oaks (Hanks 1976). Each tree was also in tree vigor class 1 (as defined by Menominee foresters, vigor class 1 represents trees with no visible signs of biotic or abiotic damage (table 1)). Menominee foresters located 69 trees from 4 different compartments that represented three different habitat types (table 2). For each sample tree the following parameters were recorded: tree

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Table 1—Classification criteria for tree vigor class 1 trees according to Menominee Tribal Enterprises—criteria used to select the study trees

Vigor class	1
Qualifications	Good growing stock
Risk of mortality	"+" no risk "+" roots firm "+" lower/upper bole sound "+" all large, high crotches strong "+" no windfall or main stem breakage anticipated
Crown class	"+" dominant or codominant
Crown size	"+" full crown concentrically
Crown density and leaf condition	"+" good silhouette "+" healthy leaf "+" occasional dead branch in outer crown "+" permits natural pruning
Bole length and form	"+" useable length commensurate with site "+" d.b.h./length ratio good "+" no useable length stoppers on bole Note: if useable length falls short of average then reduce tree vigor by one class
Rot and decay within useable length	"+" cull loss seldom > 3 percent to 7 percent, never > 14 percent "+" slight crook or sweep will cut out "+" heart rot is negligible

Table 2—Summary of northern red oak tree characteristics. Habitat type is according to Kotar and Burger (1989)

Habitat type	Study trees	Average d.b.h.	D.b.h. range		Average stand BA	Average age	Age range	
			Minimum	Maximum			Minimum	Maximum
	no.	*inches*	*- - - - - inches - - - - -*		*ft²/acre*	*years*	*- - - - - - years - - - - - -*	
AFVib	31	19.7	13.7	26.5	91	93	82	101
AQVib(Ha)	25	20.3	15.8	25.5	108	101	84	126
ATM	13	29.0	24.3	33.5	58	175	163	181

AFVib = Acer-Fagus/Viburnum habitat type; AQVib(Ha) = Acer-Quercus/Viburnum (Hamamelis phase) habitat type; ATM = Acer-Tsuga/Maianthemum habitat type.

number, site number, habitat type, d.b.h. (0.1-inch), crown class, tree vigor, bark vigor, lean, defect position on tree, defect description, length, width, and diameter of defect (nearest 1.0-inch). Around each study tree a variable-radius 10-factor basal area prism plot was established. Within each prism plot the species, d.b.h. (0.1-inch), tree grade, and crown class were recorded for all species 5.0 inches d.b.h. and larger. Each northern red oak tree had a 2.0-inch thick "cross-section" removed from each stump once the trees were felled. These samples were sent to the United States Forest Service, Northeast Research Station, Princeton, WV lab where they were aged by counting tree rings. These cross-section disks were subsequently used by other researchers to compare methods of measuring disk and heartwood area (Wiemann 2002).

In February 2001, Menominee logging crews chainsaw-felled the study trees and used specially designed log bucking guidelines to maximize log grade recovery. These veneer log bucking guidelines were developed by two consulting hardwood marketing specialists retained to work on this project. Bucking specifications focused on length of clear faces and scaling diameter as important factors in determining log length or the first buck point. Each log was identified with a number painted on both ends that identified the tree from which the log came and its position in the tree. The length of each log was measured to the nearest (0.1-foot.). Veneer, sawlogs, hardwood bolts, and pulpwood products were taken to the Menominee Tribal Enterprises mill at Neopit, WI. The mill has a dual band headrig with a circular gang re-saw configuration. Each of the logs was scaled and graded in the mill yard by a certified log scaler. The following data were recorded for each log: log number, the small end diameter of the log (nearest 1.0-inch), the gross scale (Scribner Dec. C), the reason for any grade/volume deduction, net scale (Scribner Dec. C), and log grade.

The 69 study trees yielded 212 factory grade sawlogs which were processed through the sawmill in approximately 14 hours. All boards were cut to 4-quarter (1.0-inch.) thickness. Each board sawn from a log was marked with the log number before it reached the edger, where it was edged for optimum lumber value. When all grade boards had been removed from the log, the heart of the remaining log was "boxed" into a cant, where it was graded and any remaining grade lumber was re-sawn. Once all grade lumber had been recovered from each cant we recorded the log number, cant thickness (nearest 1.0-inch), and net volume in board feet in each cant. A NHLA certified lumber grader graded each board using the Northern Hardwood and Pine Association grading rules. For each board we recorded: log number, sawing order, board thickness and net volume by grade. The grades used were: FAS, IF, SEL, #1COM, #2ACOM, #3ACOM, and BG (below grade). Veneer logs (123) were sold as 1 lot using a competitive sealed-bid process.

RESULTS

The 69 northern red oak study trees ranged in diameter from 13.7 to 33.5 inches d.b.h. and averaged 21.6 ± 4.7 inches d.b.h. (table 2), and tree age averaged 111 ± 32 years. The youngest oak sampled was 82 years old and the oldest was 181 years.

Each study tree was manufactured into veneer logs, dimension lumber, cants and hardwood and pulpwood bolts. The value of the veneer logs was determined through a competitive bid process (table 3). Marion Plywood Corporation submitted the highest bid which totaled $23,776. The total net volume of the 123 veneer logs was 18,330 board feet (Scribner Decimal C scale). The sawn lumber was valued using reported lumber prices from the *Hardwood Market Review* for the week that sawing was completed. A grand total of 14,529 board feet millscale were sawn from the 212 factory grade sawlogs. Of this total footage 21 percent of the volume was recovered in the two highest value lumber grades, FAS and 1F. A total of 220 cants were produced from the 212 factory grade logs with a total volume of 7,683 board feet and value of $2,107.

Table 3—Summary of total product value by habitat type. Habitat type is according to Kotar and Burger (1989)

Habitat type	Study trees	Veneer		Lumber		Cant		Total product	
		Volume	Value	Volume	Value	Volume	Value	Volume	Value
	number	*bf Dec C*	*$*	*bf*	*$*	*bf*	*$*	*bf*	*$*
AFVib	31	5,630	7,551	5,272	3,724	3,024	828	13,926	12,103
AQVib(Ha)	25	4,949	6,875	4,747	3,655	2,698	741	12,394	11,271
ATM	13	7,660	9,350	4,510	3,501	1,961	538	14,131	13,389
Total	69	18,239	23,776	14,529	10,880	7,683	2,107	40,451	36,763

AFVib = Acer-Fagus/Viburnum habitat type; AQVib(Ha) = Acer-Quercus/Viburnum (Hamamelis phase) habitat type; ATM = Acer-Tsuga/Maianthemum habitat type.

The distribution of logs (N=335) by diameter class (fig. 1) shows that the number of veneer logs increased with diameter up to the 20.0-inch (d.b.h.) class and then begins to decrease. The diameter class with the highest proportion of veneer logs was the 28.0-inch class (43.8 percent). Veneer logs and grade 1 sawlogs accounted for approximately 43 percent of all logs. Logs that graded veneer also met grade 1 sawlog specifications. Most of the veneer (87 percent) came from trees with diameters (d.b.h.) between 16 and 28 inches. Trees in the 20.0-inch d.b.h. class (20.0 to 23.9 inches) produced the greatest number of logs (N=106) and the most veneer (28 percent of all veneer logs).

Number of quality logs (i.e., veneer and grade 1 sawlog) dropped beyond the first log position (fig. 2). Substantial reductions in number of logs occurred beginning in the third log position, and quality logs were practically absent in the fourth and higher log positions. Most tree grade 1 northern red oaks had 4 logs (mean=4.6 ± 1.1 logs per tree) and half of them had a fifth log. Veneer grade logs dominated the first and second log positions.

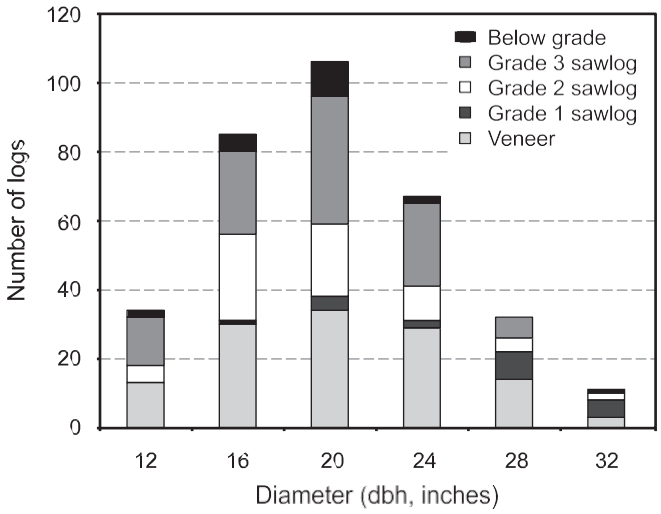

Figure 1—Distribution of logs by grade and tree diameter (d.b.h.) for tree grade 1 northern red oak logs (N = 335).

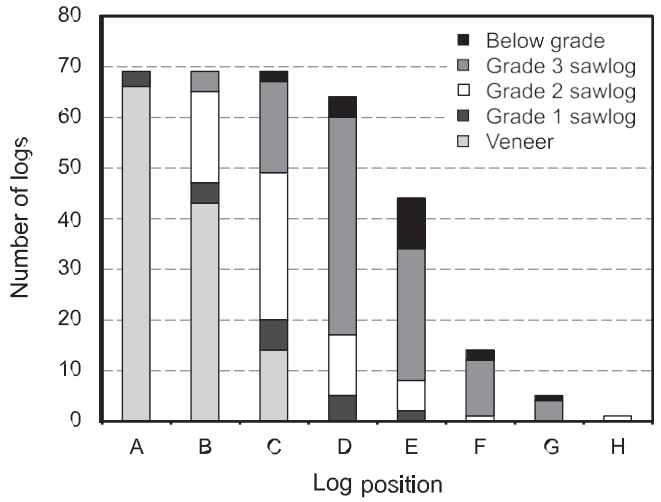

Figure 2—Distribution of logs by grade and log position (A = first or butt log, B = second log, etc.) for tree grade 1 northern red oak.

The distribution of total tree value (veneer + sawlog + cant revenues) by log position for tree grade 1 northern red oak shows the butt log (Log A) contributed 40 percent of the total tree value on average (fig. 3). The first two logs in northern red oak comprised 69 percent of the tree's value on average. Logs averaged 11.1 ± 2.1 feet in length. Log length was fairly constant for logs from the first three log positions, but then gradually decreased to an average length of 9.1 feet in the seventh log position. The average small end diameter was 18.1 inches for the butt log. Slightly over half (53 percent) of the total veneer value was from butt logs, 36 percent came from second logs.

A plot of red oak ages indicated three cohorts, or age classes in our sample of tree grade 1 northern red oak, i.e., one class at 175 years, one near 120 years and the third at 90 years (fig. 4). Age was significantly related to tree d.b.h. (r^2=0.594; p<0.0001). The greatest variation in age for a given d.b.h. was in the range of d.b.h. from 19 to 26 inches, where ages varied by 40 to 100 years depending on d.b.h..

Total tree value included the actual revenue from the competitive sale of the veneer logs and all of the other revenues, which were determined using regional market price averages at the time of product manufacture for the milled lumber. Total value per tree (fig. 5) was significantly (r^2=0.815; p<0.0001) related to tree d.b.h. and age.

DISCUSSION

The results of our northern red oak investigation indicate that tree diameters of 20.0 to 24.0 inches cam be produced in 90-100 years on Tribal Lands. These diameter classes yield the greatest volume of high value products (veneer, grade #1 sawlogs). While northern red oak on the sites investigated do grow longer and get larger in size, the percentage of high value products within individual trees decreases over time.

The implication for future forest management is significant because high volume and quality northern red oak can be grown over a much shorter timeframe than is currently being done. One of the practical recommendations from this study would be to shorten target rotation lengths to less than 100 years. As a result of shortening the length of time to manage for a smaller diameter northern red oak tree, significant financial gains can be realized.

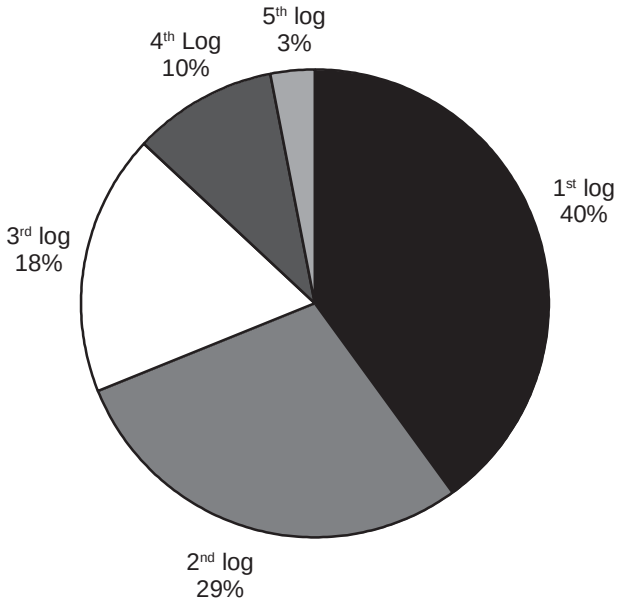

Figure 3—Distribution of tree value for the first five log positions in tree grade 1 northern red oak. Value is the sum of veneer and sawn lumber revenues.

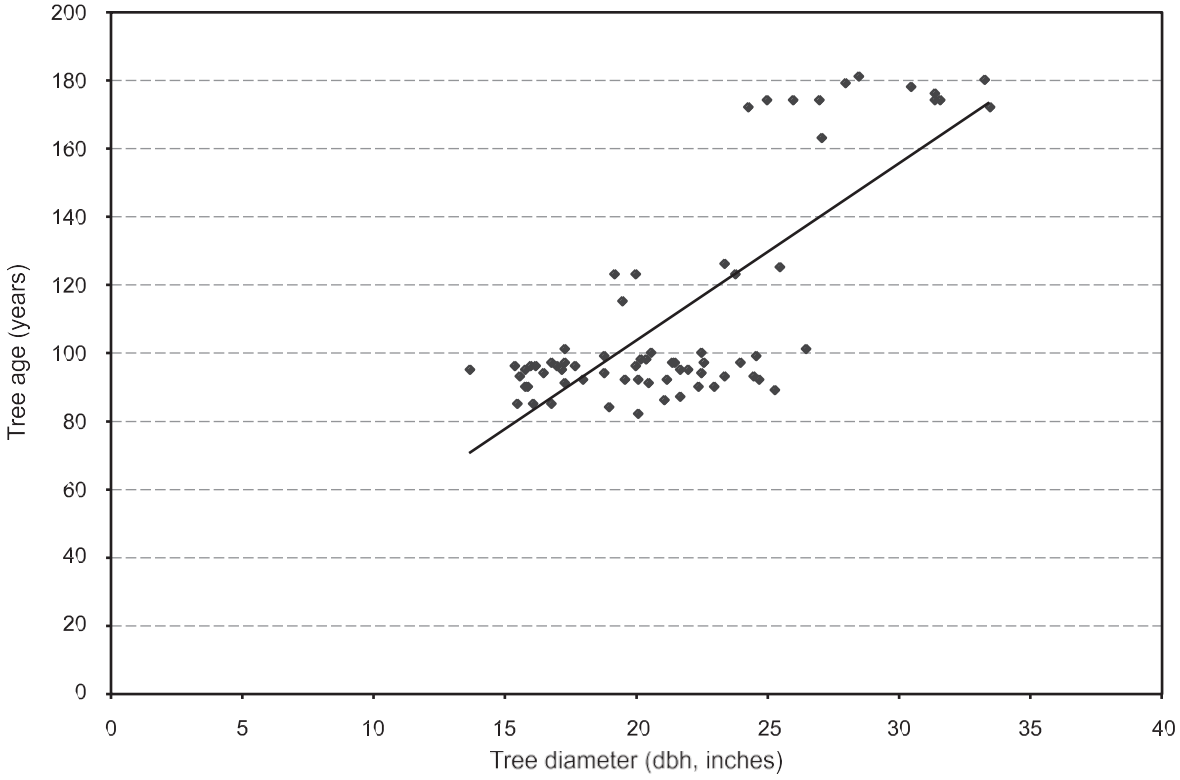

Figure 4—Observed and predicted regression line of tree age by tree diameter (d.b.h.) for tree grade 1 northern red oak.

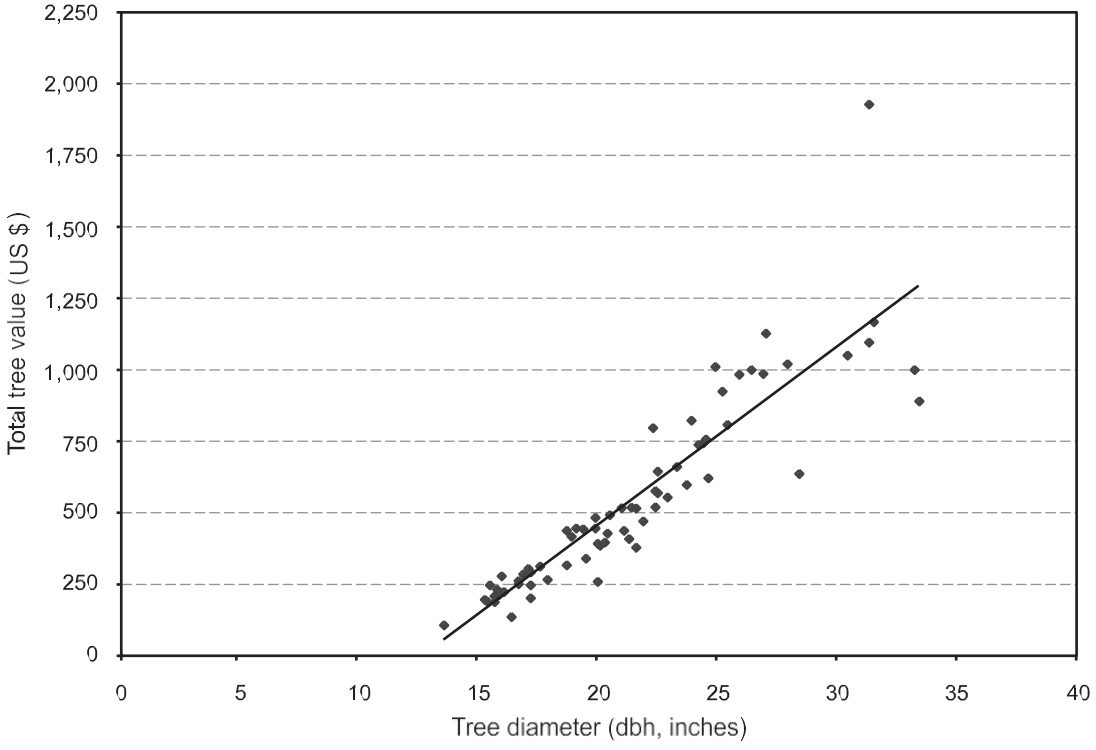

Figure 5—Observed and predicted regression line of total tree value for tree grade 1 northern red oak in relation to tree diameter (d.b.h.). Value is the sum of revenue from veneer, lumber, cants and for each log.

With the large premiums that are paid for veneer logs, it would seem to make economic sense to market these logs through a competitive sealed-bid process rather than saw them in the mill to produce 4-quarter (1.0-inch thickness) sawn lumber.

While this study did not evaluate yields from other than 4-quarter sawn lumber there is a premium in the marketplace for 8-, 12-, and 16-quarter sawn lumber. This is a manufacturing decision that should be evaluated to improve sawmill profitability.

LITERATURE CITED

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