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West Virginia Yellow-Poplar Lumber Defect Database

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Abstract

In West Virginia, yellow-poplar (*Liriodendron tulipifera*) is abundant and is a prime candidate for increased utilization in a variety of manufacturing industries. Computer simulations are a cost-effective tool for estimating potential cutting yields from lumber. They can be used to promote increased use of yellow-poplar in the furniture, cabinet, and architectural woodworking industries and may also lead to increased utilization of the lower grades of lumber. This paper describes the data collection methods and the format of the new West Virginia yellow-poplar lumber defect database that was developed for use with computer simulation programs. The database contains descriptions of 627 boards, totaling approximately 3,800 board feet, collected in West Virginia for grades FAS, FAS1F, No. 1 Common, No. 2A Common, and No. 2B Common.

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Introduction

Second-growth yellow-poplar (*Liriodendron tulipifera*) is plentiful in West Virginia. There are 10.5 billion board feet of growing stock, and annual growth exceeds annual removals by approximately seven to one (DiGiovanni 1990). Because yellow-poplar is abundant, it is a prime candidate for increased utilization in a variety of manufacturing industries. Also, the constantly rising prices of all lumber grades make appropriate grade selection even more important for industries that already use yellow-poplar.

The quality of yellow-poplar sawtimber is heavily weighted toward the lower quality sawlogs with 33 percent in Grade 3 logs and 37 percent in Construction Grade logs (DiGiovanni 1990). As a result, a large volume of No. 2 Common yellow-poplar lumber is being produced for which there is little market demand.

An understanding of potential cutting yields from yellow-poplar may lead to increased use in the furniture, cabinet, and architectural woodworking industries and may also lead to increased utilization of the lower grades of lumber. Computer simulations of rough-mill operations should give reasonable estimates of such yields. However, no suitable yellow-poplar lumber database with mapped defects existed, so one was created.

This paper describes the data collection methods and the format of the new West Virginia yellow-poplar lumber defect database. The database is available upon request on a 3.5-inch floppy disk that contains a "combined faces" file and a "better face only" file.

Table 1.—Composition of 4/4, kiln-dried yellow-poplar database

Grade[a]	No. of boards	Item	NHLA width	Length	Cutting area[b]
			Inches	*Inches*	*Percent*
FAS	120	Mean	7 9/16	139	92.05
		s.d.[c]	2	34 13/16	6.45
		Minimum	5 1/2	96	83.33
		Maximum	15 3/16	192	110.70
FAS1F	45	Mean	7 1/8	136 1/8	92.35[d]
		s.d.[c]	1 13/16	32 3/4	6.31[d]
		Minimum	5 1/2	96	83.33[d]
		Maximum	13 13/16	192	105.00[d]
No. 1	163	Mean	6 3/16	122 7/16	84.23
		s.d.[c]	1 1/2	41 3/8	10.03
		Minimum	3 3/8	48	66.90
		Maximum	12 1/4	192	119.58
No. 2A	163	Mean	6 5/8	134 9/16	65.12
		s.d.[c]	1 7/8	46 9/16	11.24
		Minimum	3 3/4	48	50.03
		Maximum	11 3/4	192	137.17
No. 2B	136	Mean	6 3/4	122 3/4	71.35[e]
		s.d.[c]	1 3/4	44 5/8	14.41[e]
		Minimum	2 11/16	48	50.09[e]
		Maximum	11 5/8	192	124.42[e]
Total	627	Mean	6 3/4	129 13/16	78.55
		s.d.[c]	1 13/16	42 5/16	15.15
		Minimum	2 11/16	48	50.03
		Maximum	15 3/16	192	137.17

[a]Graded according to NHLA Special Kiln-Dried Rule.
[b]"Cutting area" refers to the percentage of the surface measure of a board contained within the NHLA cuttings taken during grading.
[c]s.d. = Standard deviation of the sample.
[d]"Cutting area" for FAS1F boards was based on the NHLA cuttings taken on the better face of the boards.
[e]"Cutting area" for the No. 2B boards was based on sound cuttings.

Methods

The yellow-poplar database contains descriptions of 627 boards totaling approximately 3,800 board feet. Lumber was collected from two large distributors operating in central West Virginia. These companies obtain logs from as many as six counties. All boards were 4/4, graded green before kiln-drying, then surfaced on both sides, and carefully regraded using the National Hardwood Lumber Association's (NHLA) Special Kiln-Dried Rule (NHLA 1990).

A general description of the database boards by NHLA grade, width, length, and grade cutting surface area is shown in Table 1. Very little yellow-poplar is sold as Saps, Selects, or No. 3 Common, so these grades were not included in the study. Board widths and lengths were measured to the nearest 1/16 inch. Grade cutting surface area is the percentage of the surface measure of a board that is contained within the NHLA cuttings taken during grading.

The mean cutting surface areas shown in Table 1 are well above the minimums specified for each grade. For No. 1 Common and No. 2B Common, the means appear to exceed the minimum requirements for a higher grade. National Hardware Lumber Association grading rules specify minimum cutting yield, minimum cutting size, maximum number of cuttings, and type and size of any allowable defects for each grade. During the course of lumber grading, every attempt was made to maximize the cutting surface area. Whenever additional cuttings were permitted by the grade rules, these cuttings were taken if they resulted in an increased cutting surface area for a particular board. Many boards that could not meet the requirements for a particular grade had high cutting surface areas under the

Table 2.—Distribution of width and length by NHLA grade of 4/4 kiln-dried yellow-poplar database boards

Grade[a]	No. of boards	Board width group[b]	Board length group[c] A	Board length group[c] B	Board length group[c] C	Subtotals
FAS	120	A	0[d]	0[d]	0[d]	0[d]
		B	0[d]	48	52	100
		C	0[d]	13	7	20
			0[d]	61	59	
FAS1F	45	A	0[d]	0[d]	0[d]	0[d]
		B	0[d]	23	17	40
		C	0[d]	2	3	5
			0[d]	25	20	
No. 1	163	A	16	15	22	53
		B	30	43	32	105
		C	2	1	2	5
			48	59	56	
No. 2A	163	A	13	12	13	38
		B	25	28	55	108
		C	2	3	12	17
			40	43	80	
No. 2B	136	A	11	9	11	31
		B	28	29	35	92
		C	2	7	4	13
			41	45	50	
Subtotals	627	A	40	36	46	122
		B	83	171	191	445
		C	6	26	28	60
Total	627		129	233	265	627

[a]Graded according to NHLA Special Kiln-Dried Rule.
[b]Board width group: A = width ≥ 2½ and < 5½ inches.
B = width ≥ 5½ and < 9½ inches.
C = width ≥ 9½ inches.
[c]Board length group: A = length ≥ 4 feet and < 8 feet.
B = length ≥ 8 feet and < 12 feet.
C = length ≥ 12 feet and ≤ 16 feet.
[d]This width/length/grade combination not permitted under NHLA Special Kiln-Dried grading rules.

less restrictive requirements of a lower grade. The mean cutting surface area for No. 1 Common database boards is 84.23 percent, which is higher than the 83.4 percent minimum required for FAS. Many boards that otherwise yielded enough clear cutting surface area to make FAS or FAS1F were downgraded to No. 1 Common due to stain or discoloration, which are limited in FAS and FAS1F but not limited in the lower grades of yellow-poplar, resulting in the "high" mean cutting surface area. For No. 2B Common database boards, the mean cutting surface area is 71.35 percent, which is higher than the 66.7 percent minimum required for No. 1 Common. However, the cutting surface area for No. 2B Common boards is based on sound cuttings, not the clear cuttings that are required in the higher grades.

The distribution of boards by grade, width, and length is shown in Table 2. Although most of the lumber for this study was purchased as random width and random length, a conscious attempt was made to include a wide range of board widths and board lengths within each grade. The width and length group classifications used in Table 2 were created to assure that all general types of boards were represented in the database. The goal was to produce a database from which potential users could draw subsamples that represent their own board distributions.

Lumber Grading

Even though each board was purchased under a particular grade (graded green), the grade of each board was carefully

Table 3.—Range of board surface measure (SM), in percent, contained within NHLA cuttings for each NHLA grade and each subgrade

Grade[a]	NHLA cutting yield range	Subgrade	Subgrade range
	Percent of SM		*Percent of SM*
No. 2A	50.000 thru 66.665[b]	–	50.000 thru 55.555
&	(6/12 to 8/12)	0	55.556 thru 61.111
No. 2B		+	61.112 and greater[c]
No. 1	66.666 thru 83.332[b]	–	66.666 thru 72.221
	(8/12 to 10/12)	0	72.222 thru 77.776
		+	77.777 and greater[c]
FAS	83.333 thru 100	–	83.333 thru 88.888
&	(10/12 thru 12/12)	0	88.889 thru 94.443
FAS1F		+	94.444 and greater[c]

[a]Graded according to NHLA Special Kiln-Dried Rule.
[b]Cutting yield range actually extends into the range for higher grades and can exceed 100 percent without a board making a higher grade due to failure to meet other grade requirements such as minimum cutting size, cutting type (clear or sound cuttings), number of cuttings permitted, amount of stain or discoloration, etc.
[c]Actual cutting yield can exceed 100 percent of the surface measure of a board due to "rounding off" error when surface measure is estimated using a tally stick and because entire board length can be utilized in NHLA cuttings, but length is rounded down to the nearest whole foot when estimating surface measure.

recalculated in the laboratory to assure accurate grading. Grading was performed by two individuals in constant consultation with each other. When necessary, a certified NHLA lumber grader or the NHLA rules authority was consulted. Before grading, all boards were kiln-dried and then surfaced on both faces to a thickness of 0.8125 (13/16) inch. This greatly facilitated the process of measuring and locating defects on the faces of the boards compared to working with rough lumber. Boards were then carefully regraded using the NHLA Special Kiln-Dried Rule for rough, kiln-dried yellow-poplar. According to this rule, boards are graded as if they were air-dried. Any defects that result from drying affect the grading process and were included in the database, with the exception of warp, even though it is a defect according to the NHLA Special Kiln-Dried Rule. This contrasts with the NHLA Standard Kiln-Dried Rule which specifies that checks and warp shall not be considered defects. Other defects are clearly visible on rough lumber. Therefore, surfacing the boards before regrading and using rules for "rough" lumber should have had no affect on the resulting grades.

According to the NHLA rules for standard grades, 10 percent of the minimum-width boards in each grade are permitted to be ¼-inch scant. The NHLA Special Kiln-Dried Rule permits those boards to be an additional ¼-inch scant in width due to shrinkage during drying. Therefore, the minimum width permitted for FAS and FAS1F boards was 5-½ inches. The minimum width permitted for No. 1 and No. 2 Common boards was 2-½ inches.

In grading each board, every effort was made to determine the highest legitimate grade. Once that grade was determined, the grader selected the strategy that maximized the number of NHLA cutting units that could be obtained from the board while still maintaining the grade. For example, whenever an "additional" cutting could be taken that increased the yield of cutting units without lowering the grade of the board, the cutting was taken.

Subgrades

Once the NHLA grade and yield of the boards were accurately determined, each board was then assigned a "subgrade" (variable 0 in Appendix B) based on the percentage of the board surface measure contained within the cuttings (variable MMM.MM in Appendix B). A subrade of "–" was assigned to each board with a percentage yield MMM.MM in the lowest third of the range for the NHLA grade of that board. A subgrade of "0" was assigned to each board with a percentage yield in the middle third of the range for the NHLA grade of that board. A subgrade of "+" was assigned to each board with a percentage yield above the middle third for the NHLA grade of that board. The ranges for each subgrade are shown in Table 3. The number of boards in each subgrade is shown in Figure 1. The number of boards in each subgrade, by grade, is shown in Figure 2. These distributions are not entirely random. The subgrade designation was used merely to assure that all types of boards were included in the database.

Defect Codes

During grading, every defect on each face was identified on the surface of the board by a defect-type code (Table 4). Defects less than or equal to ½-inch in average diameter may be permitted in NHLA cuttings depending on the type, size, and number of the defects, and the type and size of the cutting. However, the equipment used to map

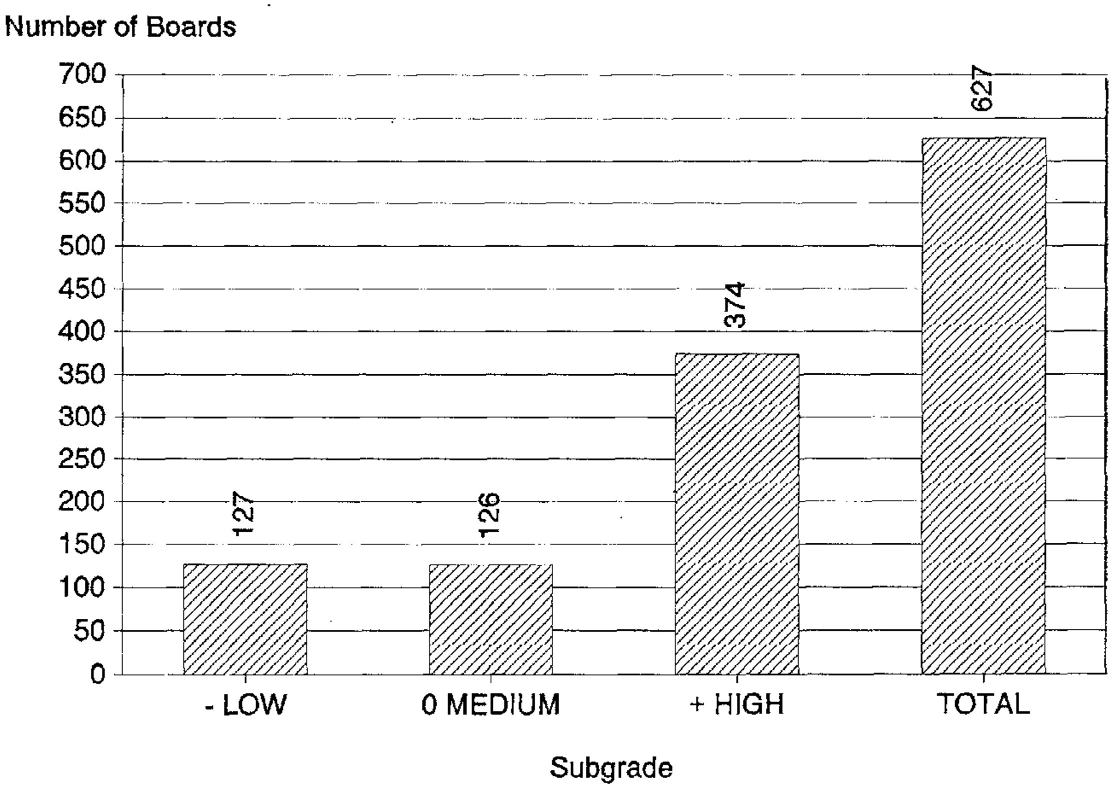

Figure 1.—Distribution of boards within each subgrade for yellow-poplar database.

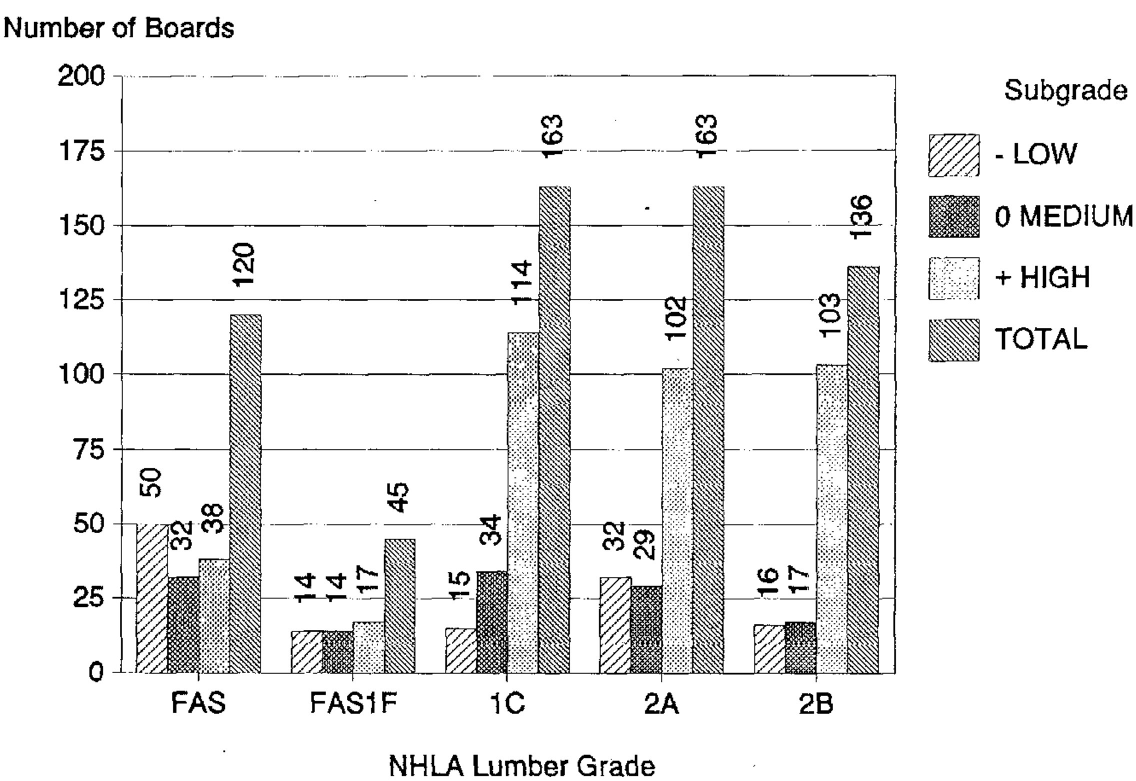

Figure 2.—Distribution of boards within each subgrade by NHLA grade for yellow-poplar database.

Table 4.—Defect-type codes used in the yellow-poplar database

Code	Description[a]
BP	Bark pocket
CB	Cross break
CH	Check
CR	Crook
DD	Discoloration (mineral), dark
DL	Discoloration (mineral), light
HO	Hole
KL	Knot, loose
KT	Knot, tight (includes burls)
KU	Knot, unsound
PI	Pith
RO	Rot
SH	Stain, heavy
SK	Shake
SL	Stain, light
SP	Split, end
WA	Wane

[a]Defect definitions can be found in Appendix A.

defects was accurate only to the nearest ¼ inch, and defect dimensions were automatically rounded up to the nearest ¼ inch during defect mapping (for example, any defect less than ¼-inch average diameter was recorded as ¼ X ¼ inch). However, the defect size often determines the acceptability or unacceptability of defects that are ½ inch or less in average diameter when using NHLA or other grade rules. Therefore, these defects were assigned a defect-size code, a single number or letter which indicated the actual average diameter of the defect in thirty-seconds of an inch. The numbers 1 through 9 correspond to 1/32 through 9/32. The letters A through G correspond to 10/32 through 16/32. For splits, cross breaks, and checks, this code refers to the maximum width of the gap, regardless of the length of the defect. Other defects greater than ½-inch average diameter are never permitted in NHLA cuttings and were, therefore, not assigned a size code.

Special Considerations

There are several characteristics of yellow-poplar lumber that required special consideration during the course of grading the boards. Bud traces, adventitious buds, and pin knots are names applied to the same characteristic, one that is very common in yellow-poplar. If the characteristic is sound (solid across the face) and light in color (not black), it is not considered a defect under NHLA rules. An informal survey of yellow-poplar users performed by the researchers revealed no application where these characteristics were considered to be defects, so they were not included in the database. When these characteristics were found to be unsound or black, they are defects according to NHLA rules and were included in the database and treated as unsound knots.

Stain and discoloration are characteristics that are limited only in FAS and FAS1F yellow-poplar boards and are not defects in the other grades. However, there are many applications where these characteristics are considered defects in the finished product. Therefore, stain and discoloration were recorded in the database. This allows the database user to make the decision as to whether stain and discoloration are defects.

Defect Mapping and Digitizing

After grading, the pertinent information about each board and its defects was recorded in the computer database. This was accomplished through the use of a Numonics Corporation 1224 Graphics Calculator.[1] This device uses a transverse arm mounted on rails to allow a pointer to move along the entire face of a board. Optically scanned lines communicated the pointer's precise position to the graphics calculator. The information recorded included board number, a board supplier identification code, NHLA board width, board rectangle width, board length, grade of the board as mapped in this study, surface measure, number of NHLA cuttings taken during grading, number of NHLA cutting units, and crook information. Defect information recorded included defect-type code, defect-size code, location on board rectangle, and face of defect location (better or worse face of board).

The input to the database from the graphics calculator consisted of pairs of X,Y coordinates on a ¼ X ¼-inch grid corresponding to the lower left (LX, LY) and upper right (UX, UY) corners of the smallest rectangles completely surrounding each defect. These defects were located within the board rectangle, defined as the smallest rectangle on the grid system that completely surrounded the board and any crook in the board. The ¼-inch grid system and a unique origin at (0,0), which was the same physical corner of the board regardless of which face was being mapped, were used to map all natural defects on each face of each board with the exception of crook. For the purposes of this study, crook is defined as a void along either edge of the board between the board outline and the rectangle on the grid system enclosing the board. Crook was assumed to be the same throughout the thickness of the board and was, therefore, only recorded with the defect information for the better face of each board.

Each natural defect was mapped according to the rectangle on the ¼-inch grid that completely surrounded it. This overestimated the size of nearly every defect. Diagonal defects and very large irregularly shaped defects such as crook, wane, checks, splits, pith, shake, stain, and discoloration were often mapped as a series of smaller rectangles to minimize the amount of clear area labeled as defective. However, in no instance was a large defect

[1]The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

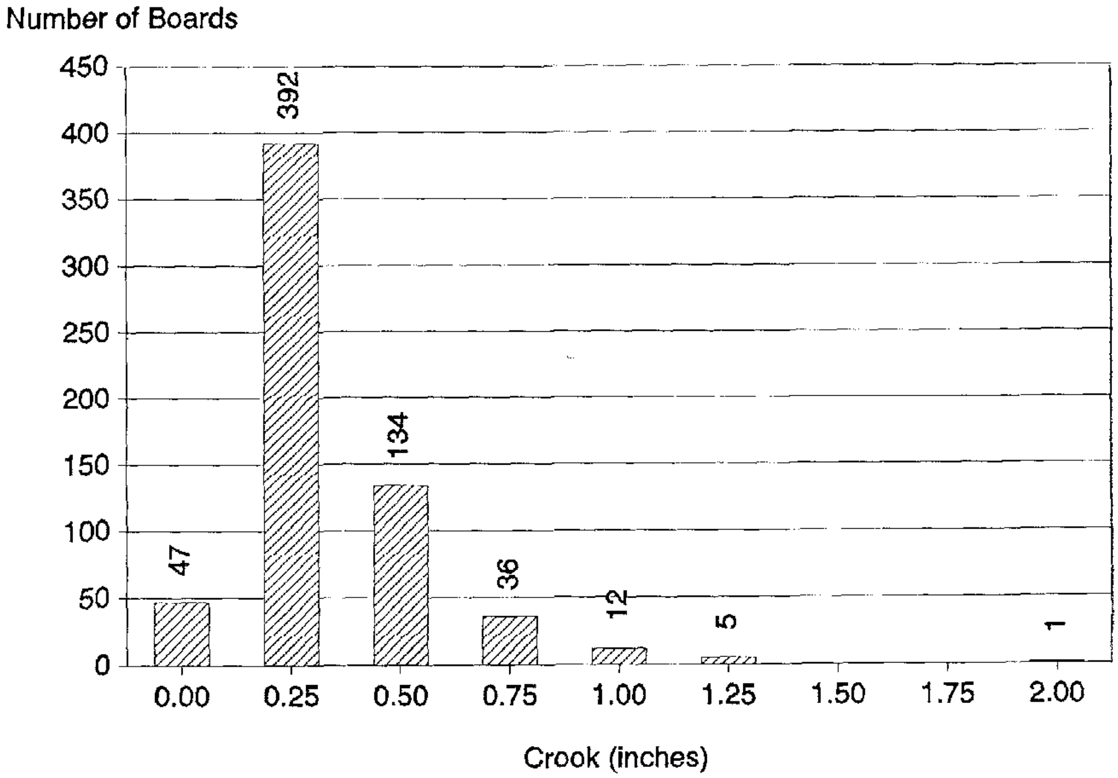

Figure 3.—Number of boards for each size class of crook when measured along the bottom edge of boards. (Crook was rounded up to the nearest ¼ inch.)

mapped as a series of subdefects in a way that might lead to the acceptance of prohibitively large defects in any subsequent use of the database. For example, large knots, holes, bark pockets, and similar defects were never divided into subdefects measuring ½ inch or less in average diameter. Defects that were less than ½ inch in average diameter were never subdivided. Checks, splits, and similar defects were never divided into subdefects 6 inches or less in length. In practice, any subdefects other than wane and crook were still very large.

To speed data collection, and because they are permitted in any number on the sound face of clear face cuttings, clusters of defects ⅛ inch or less in average diameter and of the same type were usually mapped as a single defect. Defects larger than ⅛ inch in average diameter were mapped individually.

Mechanical defects due to particular machining and handling techniques characterize the limitations of the personnel and equipment used to process the raw material into lumber, not the nature of the material itself. For this reason, mechanical defects were not treated as defects and were not included in the defect database. The format for the database is described in Appendix B.

Preliminary Analysis of the Crook Defect Data

Because the amount of crook in a board is important when making decisions concerning secondary processing of lumber, a preliminary analysis of crook data was performed. During the process of defect mapping, boards were positioned against a fence in such a way that the edge with the most concave crook was in contact with the fence at two points (usually the ends of the boards). The fence served as the Y-axis (Y=0), and crook was measured between the edge of the board and the fence. Crook defects were recorded only for the better face of each board and are assumed to be the same throughout the thickness of the board. Actual crook measurements were rounded up to the nearest ¼ inch. When the upper edge of the board deviated from a straight line, crook defects were mapped to the upper edge of the board rectangle.

Figure 3 shows the number of boards in each size class of crook when measured along the bottom edge of the boards. The majority of the boards, 70 percent, had ¼ inch or less crook, 21 percent had ½ inch of crook, and the remaining 9 percent of the boards had crook between ¾ and 2 inches. Those boards for which zero crook was recorded had to meet a particular set of conditions. Actual crook, if any, had to be less than ⅛ inch and the NHLA width of the board had to be equal to the rectangle width.

Summary

The yellow-poplar lumber defect database contains complete board and defect descriptions for 627 boards in grades FAS, FAS1F, No. 1 Common, and No. 2 Common. The database can be used as a whole or subsamples, which represent a user's own particular distribution of board types, can be drawn from it. The data were collected for use with computer programs that simulate rough-mill operations. The goal was to be able to estimate yields for specific products and to examine the feasibility of utilizing lower grade material for those products.

All data for the 627 boards are stored in two separate DOS text files (DOS 3.3) on a single 3.5-inch floppy disk. One file with the name YPDB.BTR contains the defect information for just the better faces of the boards. The second file is the combined faces database, named YPDB.CMB, and contains the defect information for both the better face and worse face of each board.

Database floppy disks are available on request from either of the following locations:

USDA Forest Service
Rt. 2 Box 562-B
Princeton, WV 24740-9628
(304) 425-8106

Appalachian Hardwood Center
Division of Forestry
West Virginia University
P.O. Box 6125
Morgantown, WV 26506-6125
(304) 293-7550

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National Hardwood Lumber Association. 1990. **Rules for the measurement and inspection of hardwood and cypress.** Memphis, TN: National Hardwood Lumber Association. 108 p.

Appendix A: Defect Definitions

Bark pocket A bark-filled blemish on the face of a board.

Cross break A separation of the wood across the grain that extends to the long edge of the board. (Splits extend to the end of a board.)

Check A lengthwise separation of the wood that usually extends across the annual growth rings and commonly results from stresses set up in wood during seasoning. For the purposes of this study, the defect could not extend to the end of the board.

Crook Deviation edgewise from a straight line from end to end of a piece of lumber, measured at the point of the greatest distance from the straight line. For the purposes of this study, crook is a void along either edge of a board between the board outline and the rectangle on the 0.25 X 0.25-inch grid system which completely surrounds the board.

Discoloration, dark A black discoloration of undetermined cause. Also often referred to as mineral stain.

Discoloration, light An olive to greenish-black, brown, or purple discoloration of undetermined cause. Also often referred to as mineral stain.

Hole National Hardwood Lumber Association grading rules assign different names to distinguish between holes of different sizes (that is, pin worm holes, spot worm holes, shot worm hole, grub holes). For this study, all holes were assigned the same defect-type code, HO, and the defect size code was used to distinguish between different sizes.

Knot, loose A knot that is not held tightly in place by growth or position, one that cannot be relied on to remain in place. This is an unsound defect, even if the knot itself is solid across the face.

Knot, tight A knot that is fixed by growth or position so as to retain its place. For the purposes of this study, this also refers to a sound knot, one that is solid across the face and of the same hardness as the surrounding wood.

Knot, unsound A knot that is tight but is not solid across the face either due to the presence of seasoning checks, decay, or a soft pith.

Pith The small, soft core that occurs in the center of a log or branch.

Rot Refers to any area of advance or incipient decay in the wood as evidenced by color and softness when compared to the surrounding wood.

Shake A separation along the grain, the greater part of which occurs between the annual growth rings.

Stain, heavy Black discoloration of the wood due to sapstain or surface fungi.

Stain, light Grey, blue, or pink discoloration of the wood due to sapstain or surface fungi.

Split, end A lengthwise separation of the wood, due to the tearing apart of wood cells. For the purposes of this study, the defect had to extend to the end of the board in order to be classified as a split, otherwise it was called a cross break.

Wane Bark or any absence of wood on the edge or corner of the board.

Appendix B: Database Format

For each board, the first three lines of code are the board header data which describe the board itself:

```
bbAAAbBBbCCCbDDD
bEEEbFFbGGGbHHbII.IIIbJ
bKKbLbMMM.MMbNNN.NNbO
```

where:

- b = 1 blank space.
- AAA = 3-digit board number.
- BB = 2-character board grade as mapped (FA, 1F, 1C, 2A, or 2B).
- CCC = Number of defects on the entire board.
- DDD = Number of defects on the better face.
- EEE = Lowest X coordinate of board (0).
- FF = Lowest Y coordinate of board (0).
- GGG = Greatest X coordinate of board (board length).
- HH = Greatest Y coordinate of board (rectangle width).
- II.III = Precise board width measured at $1/3$ of the board length from narrower end in inches (NHLA width).
- J = 1-character board supplier identification code (C, R, or V).
- KK = NHLA surface measure of board in square feet.
- L = Number of cuttings plotted during NHLA grading.
- MMM.MM = Percentage of surface measure contained within NHLA cuttings that was computed using Equation 1.
- NNN.NN = Cutting units contained within NHLA cuttings.
- O = 1-character subgrade designation, where: "−" refers to boards with NHLA yields (NNN.NN) in the lowest third of the standard limits for the board's grade, "0" refers to boards with NHLA yields in the middle third, and "+" refers to boards with NHLA yields above the middle third of the normal range for that board's NHLA grade (Table 3).

For each defect, one line of code describes the defect using the following format:

```
bPPPbQQbRRRbSSbTTbUbV
```

where:

- b = 1 blank space.
- PPP = Lowest X coordinate of defect rectangle.
- QQ = Lowest Y coordinate of defect rectangle.
- RRR = Greatest X coordinate of defect rectangle.
- SS = Greatest Y coordinate of defect rectangle.
- TT = 2-character defect-type code (Table 4).
- U = 1-character defect-size code (average diameter) for defects $1/32$ to $16/32$ inch. The numbers 1 through 9 correspond to $1/32$ through $9/32$. The letters A through G correspond to $10/32$ through $16/32$.
- V = Face of defect location (1 = better, 2 = worse).

A sample of the combined-faces database for board 151 and the 7 defects on it (2 on the better face, 5 on the worse face), and board 152 and the 11 defects on it (7 on the better face, 4 on the worse face) follows:

```
 151 1C    7  2
   0  0 319 16  3.750 R
   2 1  82.08   19.70  +
   0  0 319 16 SL     1
   0  0 319  1 CR     1
   0  0 319 16 SL     2
   0  0  32  3 WA     2
  32  0  71  2 WA     2
  71  0  85  1 WA     2
 291  7 296  9 BP     2
 152 1F   11  7
   0  0 386 28  6.750 R
   4 1 101.96   48.94  +
   0  0 386  1 CR     1
   0 27 193 28 CR     1
 347 27 355 28 WA     1
 355 26 360 28 WA     1
 360 25 369 28 WA     1
 369 24 386 28 WA     1
 340  0 386  1 WA     1
   0  0 386 28 SL     2
   0  4   3  6 KU     2
 129  9 132 11 BP C   2
 117  9 149 12 DD     2
```

Osborn, Lawrence E.; Gatchell, Charles J.; Hassler, Curt C. 1992. **West Virginia yellow-poplar lumber defect database.** Res. Pap. NE-660. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 10 p.

Describes the data collection methods and the format of the new West Virginia yellow-poplar lumber defect database that was developed for use with computer simulation programs. The database contains descriptions of 627 boards, totaling approximately 3,800 board feet, collected in West Virginia in grades FAS, FAS1F, No. 1 Common, No. 2A Common, and No. 2B Common. The database includes a complete description of each board and each defect on the boards in a format that is readily acceptable for use with different simulation programs.

Keywords: Lumber, wood defects, *Liriodendron tulipifera*

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