LUMBER AND CLEAR CUTTING RECOVERY FROM MESQUITE (*PROSOPIS* SPP.) LOGS

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by

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Abstract

The volume of wood (expressed in board feet) recoverable from mesquite logs depends not only on the size of the bole (stem) but also on the defects in each log. Larger logs tend to yield more large clear cuttings but less total cutting volume per unit of log volume. The Forest Products Laboratory of the Texas Forest Service has developed a set of tables for calculating board foot volume and clear cutting volume yield of wood from mesquite logs.

Keywords: Mesquite, *Prosopis* spp., wood utilization, specialty wood products, log scales.

Lumber and Clear Cutting Recovery From Mesquite (*Prosopis* spp.) Logs

Introduction

The utilization of the mesquite tree for solid wood products is accelerating. Many small-scale industries have developed throughout the mesquite range of Texas, New Mexico, Arizona, and California. A number of large-volume national industries are interested in mesquite as a raw material for new lines of products. It appears that increases in the use of mesquite for solid wood products can be anticipated.

The mesquite tree grows basically in two forms; a multi-stem, large, hardy shrub and a single stem tree attaining heights of 15 to 20 feet and diameters to 24.0+ inches. Most of the trees are quite crooked, and a large majority have ring shake and splits internally.

Mesquite wood ranks with the finest of woods in appearance. With its reddish-golden brown sheen, most woodworkers praise it as equal to walnut and cherry. Mesquite wood is very dimensionally stable and extremely hard. Many of its other physical and mechanical properties attract wood buyers and users.

As the industry's use of mesquite wood increases, there will be need for means of estimating expected board foot volume recovery from various sizes of logs. Also, it will be necessary to know the expected square footage of clear cuttings meeting minimum usable dimensions.

Objectives

The objective of this research was to develop a simple means by which lumber volume and clear cutting footage could be estimated from various sizes of logs. Due to the extremely poor form and characteristic of the tree (ring shake, splits, crook and other defects), a very accurate estimate may not be possible. An attempt was made, however, to develop the best possible means while still keeping simplicity in mind.

The study also determined the effect of log size on total available clear cutting and on the volume of larger clear cuttings.

Photo 1. Mesquite logs being unloaded for milling

Procedure

In July 1983, 105 mesquite logs were harvested near Cuero, Texas. Log diameters ranged from 4.0 inches to 14.0 inches at the small end, and lengths ranged from 2.5 to 6.5 feet. Log quality, as far as mesquite logs go, was average. Longer logs with extensive crook were bucked to a minimum length of 2.5 feet to eliminate most of the crook. Each section was treated as a separate log (see photo 1).

The logs were transported to the Texas Forest Products Laboratory at Lufkin, Texas for milling and further analysis.

The logs were sawn in a consistent fashion using the following procedure. Sawing technique consisted of sawing on a Brett bolter mill to obtain a flat 3-4 inch wide surface, turning the log 90 degrees, cutting another 3-4 inch wide surface, and then turning another 90 degrees and completing the sawing. All boards were marked as to log origin.

Each board was edged slightly, leaving much wane. Each was then scaled to obtain board foot volume. The minimum acceptable board dimensions were 2.0 inches wide and 1.5 feet long.

Clear cutting square footage was determined by marking off cuttings on the boards *worst* side with crayon (see photo 2). Basically, the technique used was to obtain the largest size of clear cuttings possible from each board. Cutting width was given slight priority over length (see Table 1). The minimum cutting size was 2.0 inches wide and 6.0 inches long. Some sacrifice on total volume was probably made trying to obtain large cuttings, but, was minimal due to the small minimum clear cutting size.

Cuttings 2 inches and 4 inches wide or greater and at least 2.0 feet long were determined and totaled by log.

Photo 2. Typical procedure for determination of clear cutting

Results and Discussion

One of the first goals of this study was to arrive at a means of estimating board foot volume for mesquite logs. Figure 1 gives predicted board foot volume recovery as a function of log small-end diameter and log length. It should be kept in mind that in edging the boards, the board's edges were "straightened up" (leaving significant wane) with no objective of getting perfectly square edges throughout the board length. This would tend to produce more board volume than if "conventional" edging techniques were used.

Table 1. Priorities in Selection of Clear Cutting

Priority	Cutting Dimension	
	Length (feet)	Width (inches)
1-a	4.0	4.0
1-b	3.0	4.0
1-c	2.0	4.0
2-a	4.0	3.0
2-b	2.0	3.0
2-c	1.0	3.0
3-a	4.0	2.0
3-b	2.0	2.0
3-c	1.0	2.0
4	0.5	2.0

Figure 2 gives the total clear cutting volume in square feet by log small diameter and length, with minimum clear cutting dimensions of 2 inches wide and 6.0 inches long. Values taken from this table could be used by manufacturers that have the facilities and product line which would enable them to use the small cutting sizes. In selecting clear cuttings, the larger widths and lengths were given priority over small sizes.

Figures 3 and 4 give the clear cutting square footage recovery that met larger minimum dimensions; Figure 3 being 2 inches wide and 2.0 feet long and Figure 4 being 4.0 inches wide and 2.0 feet long. Figures from these tables should be useful to those manufacturers who require the larger clear cuttings for products such as furniture and

Figure 1. Board Foot Volume Recovery for Mesquite Logs

Small diameter in inches	Log length in feet									
	2	2½	3	3½	4	4½	5	5½	6	6½
	(Board feet)									
4	—	—	—	.46	1.56	2.66	3.76	4.86	5.96	7.06
5	—	.27	1.37	2.47	3.57	4.67	5.77	6.87	7.97	9.06
6	1.17	2.27	3.37	4.47	5.57	6.67	7.77	8.87	9.97	11.07
7	3.18	4.28	5.38	6.48	7.58	8.68	9.78	10.88	11.98	13.08
8	5.19	6.29	7.39	8.49	9.59	10.69	11.79	12.89	13.99	15.09
9	7.20	8.30	9.40	10.49	11.59	12.69	13.79	14.89	15.99	17.09
10	9.20	10.30	11.40	12.50	13.60	14.70	15.80	16.90	18.00	19.10
11	11.21	12.31	13.41	14.51	15.61	16.71	17.81	18.91	20.01	21.11
12	13.22	14.32	15.42	16.52	17.62	18.72	19.82	20.92	22.02	23.11
13	15.22	16.32	17.42	18.52	19.62	20.72	21.82	22.92	24.02	25.12
14	17.23	18.33	19.43	20.53	21.63	22.73	23.83	24.93	26.03	27.13
15	19.24	20.34	21.44	22.54	23.64	24.74	25.84	26.94	28.04	29.14
16	21.25	22.35	23.45	24.55	25.64	26.74	27.84	28.94	30.04	31.14

Board foot volume = 2.0072 (small diameter in inches) + 0.1833 (length in inches) − 15.2677

R^2 = 0.71

Figure 2. Total Clear Cutting Surface Measure for Mesquite Logs (Minimum Cutting Dimensions 2 Inches Wide; 6 Inches Long)

		Log length in feet									
		2	2½	3	3½	4	4½	5	5½	6	6½
		(Square feet)									
	4	—	—	—	.33	.88	1.42	1.97	2.52	3.06	3.61
	5	—	.49	1.03	1.58	2.12	2.67	3.22	3.76	4.31	4.85
	6	1.19	1.73	2.28	2.82	3.37	3.91	4.46	5.01	5.55	6.10
	7	2.43	2.98	3.52	4.07	4.61	5.16	5.70	6.25	6.80	7.34
Small	8	3.68	4.22	4.77	5.31	5.86	6.40	6.95	7.49	8.04	8.59
diameter	9	4.92	5.47	6.01	6.56	7.10	7.65	8.19	8.74	9.29	9.83
in	10	6.16	6.71	7.26	7.80	8.35	8.89	9.44	9.98	10.53	11.08
inches	11	7.41	7.95	8.50	9.05	9.59	10.14	10.68	11.23	11.77	12.32
	12	8.65	9.20	9.75	10.29	10.84	11.38	11.93	12.47	13.02	13.57
	13	9.90	10.44	10.99	11.54	12.08	12.63	13.17	13.72	14.26	14.81
	14	11.14	11.69	12.23	12.78	13.33	13.87	14.42	14.96	15.51	16.05
	15	12.39	12.93	13.48	14.03	14.57	15.12	15.66	16.21	16.75	17.30
	16	13.63	14.18	14.72	15.27	15.82	16.36	16.91	17.45	18.00	18.54

Cutting measure in square feet = 1.2447 (small diameter in inches) +0.0909 (length in inches) − 8.4654
R^2 = 0.53

Figure 3. Clear Cutting Yield (≥2 Feet Long and ≥2 Inches Wide) for Mesquite Logs

		Log length in feet									
		2	2½	3	3½	4	4½	5	5½	6	6½
		(Square feet)									
	4	—	—	—	—	—	—	—	—	—	.13
	5	—	—	—	—	—	.05	.20	.35	.50	.65
	6	—	—	.11	.26	.41	.56	.71	.87	1.02	1.17
	7	.33	.48	.63	.78	.93	1.08	1.23	1.38	1.54	1.69
Small	8	.85	1.00	1.15	1.30	1.45	1.60	1.75	1.90	2.05	2.20
diameter	9	1.37	1.52	1.67	1.82	1.97	2.12	2.27	2.42	2.57	2.72
in	10	1.88	2.04	2.19	2.34	2.49	2.64	2.79	2.94	3.09	3.24
inches	11	2.40	2.55	2.70	2.86	3.01	3.16	3.31	3.46	3.61	3.76
	12	2.92	3.07	3.22	3.37	3.52	3.68	3.83	3.98	4.13	4.28
	13	3.44	3.59	3.74	3.89	4.04	4.19	4.34	4.50	4.65	4.80
	14	3.96	4.11	4.26	4.41	4.56	4.71	4.86	5.01	5.17	5.32
	15	4.48	4.63	4.78	4.93	5.08	5.23	5.38	5.53	5.68	5.83
	16	5.00	5.15	5.30	5.45	5.60	5.75	5.90	6.05	6.20	6.35

Cutting yield = 0.5186 (small diameter in inches) +0.0251 (length in inches) − 3.9044
R^2 = 0.45

picture frames, etc.

Figure 3 clearly illustrates the very low recovery of large cuttings in small logs. Obviously, as you reduce log size, it might take just one small defect to make it impossible to produce a larger clear cutting. In the larger logs, large clear cuttings can be "fitted" around the defects; even if there are many.

Log size and defects are extremely critical when producing 4.0 inches wide, 2.0 feet long clear cutting. It would not take much of a defect to make it impossible for small to medium logs to yield larger cuttings.

In comparing Figures 3 and 4 to Figure 2, it can be readily seen that most of the clear cutting volume in mesquite is in the smaller sizes (take note that the volume in Figure 3 includes those in Figure 4). Regardless of log size, approximately two-thirds of all clear cuttings are consistently less than 2 inches wide and/or 2.0 feet long.

Clear Cutting Recovery Relative to Log Cubic Volume

Large logs should be best for producing the desired cutting sizes. With mesquite, however, the large logs often have more defects which negates the benefit of size in yielding clear cuttings. It was expected that a diameter of 8 or 9 inches may give the best value for the dollar.

Figure 5 (line A) gives the total clear cutting recovery per unit of log volume as a function of log size (cubic volume). The curve illustrates a very slight decrease in unit clear cutting recovery as the logs get larger. Although the larger logs appeared to have more defects, cutting recovery per unit volume was relatively constant probably because the

Figure 4. Clear Cutting Yield (≥2 Feet Long and ≥4 Inches Wide) for Mesquite Logs

		Log length in feet									
		2	2½	3	3½	4	4½	5	5½	6	6½
		(Square feet)									
Small diameter in inches	4	—	—	—	—	—	—	—	—	—	—
	5	—	—	—	—	—	—	—	—	—	—
	6	—	—	—	—	—	.02	.11	.19	.28	.37
	7	—	.03	.11	.20	.29	.37	.46	.54	.63	.72
	8	.29	.38	.46	.55	.64	.72	.81	.90	.98	1.07
	9	.65	.73	.82	.90	.99	1.07	1.16	1.25	1.33	1.42
	10	.99	1.08	1.17	1.25	1.34	1.42	1.51	1.60	1.68	1.77
	11	1.35	1.43	1.52	1.60	1.69	1.78	1.86	1.95	2.03	2.12
	12	1.70	1.78	1.87	1.95	2.04	2.13	2.21	2.30	2.38	2.47
	13	2.05	2.13	2.22	2.31	2.39	2.48	2.56	2.65	2.74	2.82
	14	2.40	2.48	2.57	2.66	2.74	2.83	2.91	3.00	3.09	3.17
	15	2.75	2.84	2.92	3.01	3.09	3.18	3.27	3.35	3.44	3.52
	16	3.10	3.19	3.27	3.36	3.44	3.53	3.62	3.70	3.79	3.87

Cutting yield = 0.3509 (small diameter in inches) + 0.01434 (length in inches) − 2.8583

R^2 = 0.38

Figure 5. Total Clear Cutting Recovery and Clear Cutting with Minimum Dimensions of 2.0 Inches Wide and 2.0 Feet Long Per Unit of Log Cubic Feet at Various Log Volumes of Mesquite (*Prosopis* spp.)

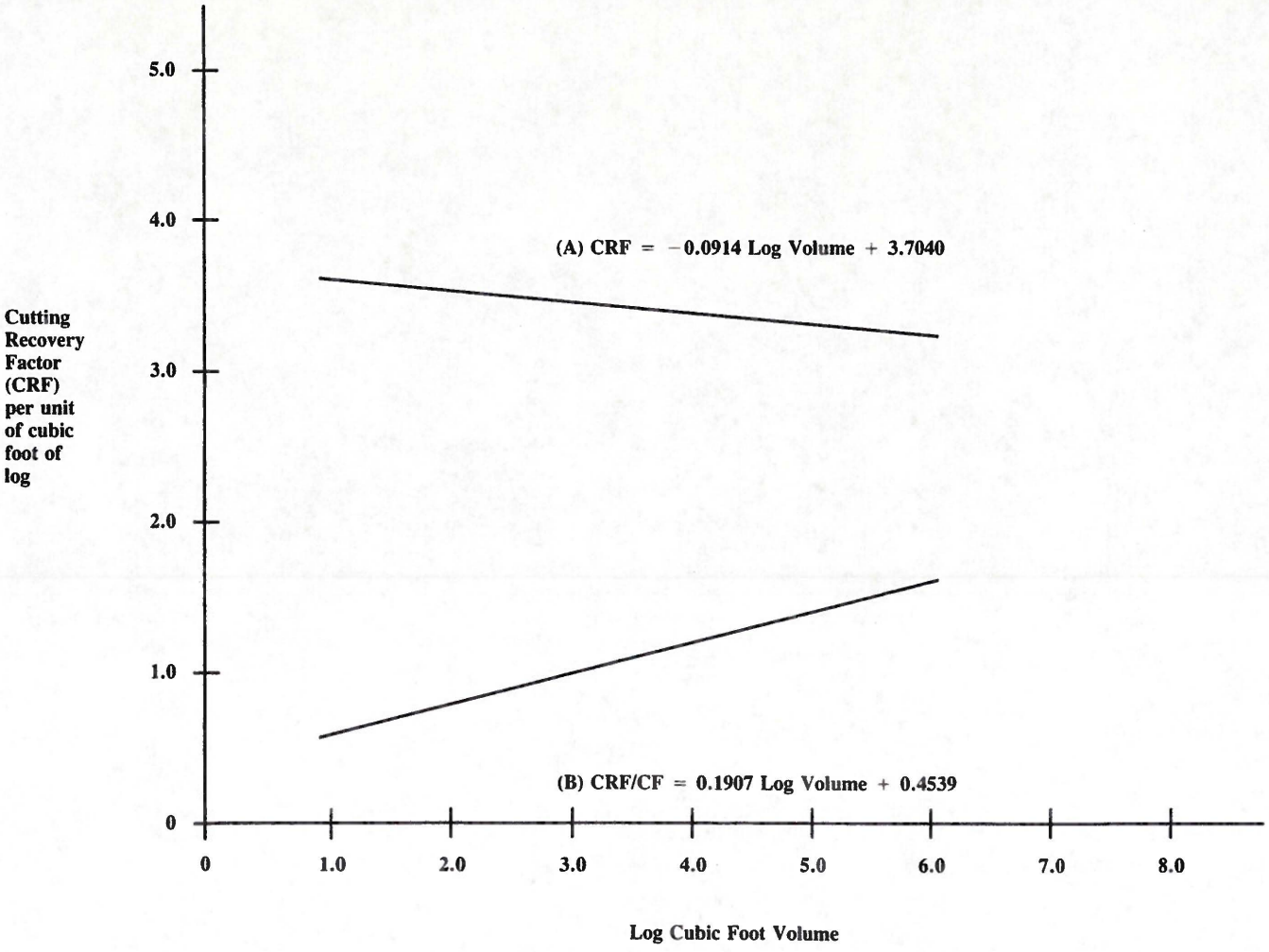
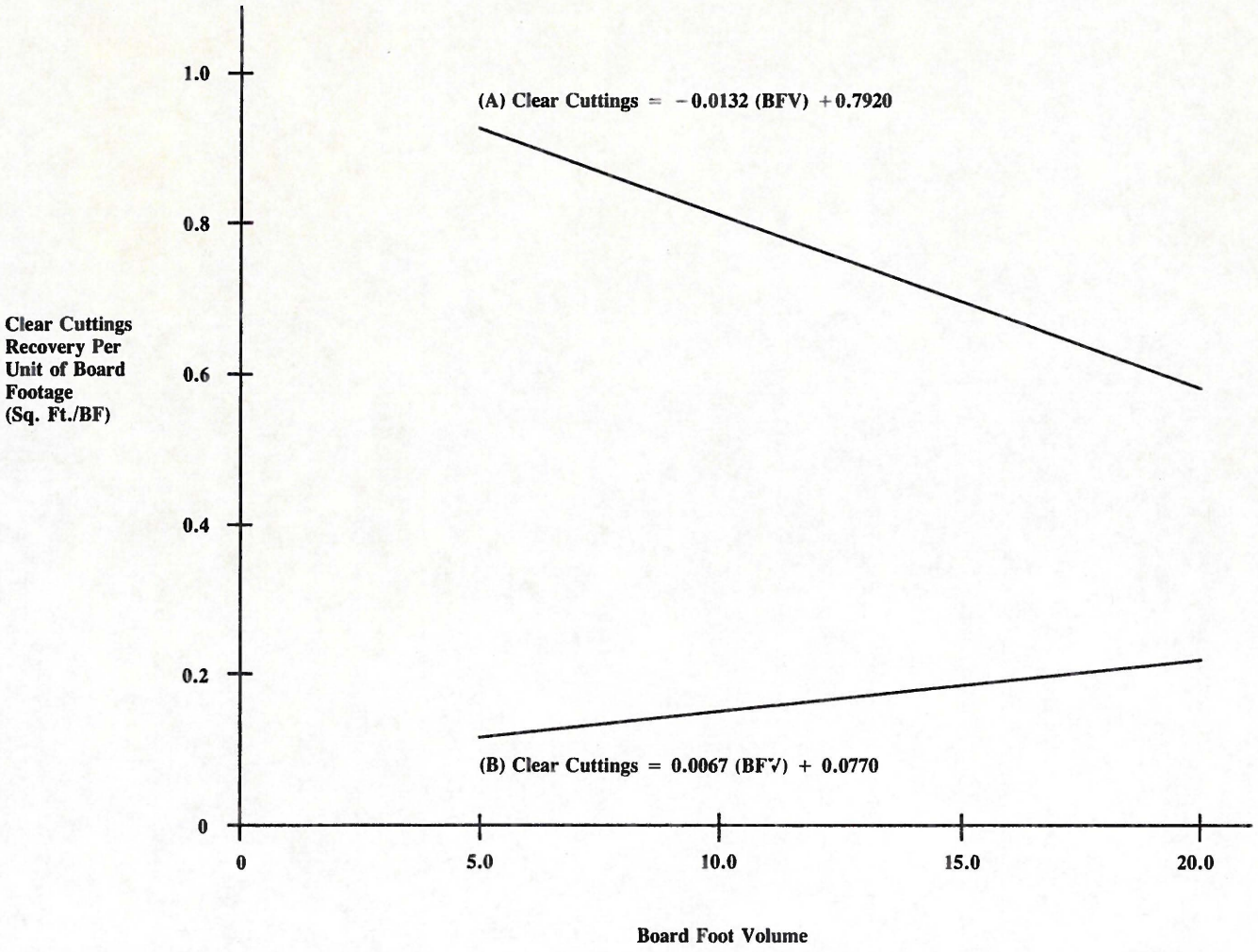


Figure 6. Total Clear Cutting Recovery and Clear Cutting Recovery With Minimum Dimensions of 2.0 Inches Wide and 2.0 Feet Long Per Board Foot Scale at Various Board Foot Volumes for Mesquite (*Prosopis* spp.)



small minimum clear cutting could be "fitted" in between the defects.

Figure 5 (line B) gives the unit recovery of 2.0 inches wide and 2.0 inches long clear cutting relative to log size. In contrast to the total clear cutting recovery trend towards smaller logs (as in Figure 5, line A) yielding more clear cutting volume, larger logs yielded significantly larger volumes of the larger clear cutting. Although the larger logs seemed to have more defects, size was more significant than defects when considering large clear cutting yield.

Clear Cutting Recovery Relative to Board Foot Volume Scale

Using the predicted board foot volumes as given in Figure 1, it would be of interest to see whether or not logs of various board foot volumes yielded the same clear cutting volume recovery per board foot of scale (or in fact per $). It may be valuable to know whether larger or smaller logs yielded "better buys" when buying on a board foot basis. Figure 6 (line A) gives the clear cutting value recovery as a function of board foot volume. If all logs were of equal value (in terms of $/board foot) the line should be horizontal. As can be seen in Figure 6 (line A) the trend is similar to that in Figure 5 (line A) for log cubic volume. If the maximum clear cutting volume is wanted, disregarding cutting size, the smaller logs are the better buy. Also, as it was for the log cubic volume analysis, when the larger clear cuttings are the target (2 inches wide, 2 feet long; minimum dimensions), the larger logs will yield up to 200+ percent more than smaller logs per unit of board foot volume. This can be seen in Figure 6 (line B).

Conclusions

A board foot volume table is presented in Table 1 which

can be used in log procurement transactions.

When considering total clear cutting recovery (minimum size of 2.0 inches wide and 6.0 inches long), the yield for mesquite is quite low—approximately 60-65 percent of each board's surface area.

When considering clear cuttings wider than 2.0 inches and longer than 2.0 feet, the yield is very low—18-20 percent of each board's surface area.

When considering clear cuttings wider than 4.0 inches and longer than 2.0 feet, the yield is extremely low—9-11 percent of each board.

When considering the total clear cutting yields and footage of cutting over 2 inches wide and 2 feet long as a function of log cubic volume and log board foot volume scale, there are varying conclusions depending on target cutting sizes.

If the maximum total clear cutting volume is desired (with no preference for larger sizes), it appears that the smaller logs tend to be better buys, ie., they yield more value for the dollar.

If footage of the larger cutting sizes is desired, it appears that the larger logs are significantly the better buy.