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Contents

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Tree Grade Versus Product Output From a Mature Sugar Maple Stand in Cape Breton, Nova Scotia

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ABSTRACT

This report describes a study relating tree grade to product output from 56 mature sugar maple (*Acer saccharum* Marsh.) trees in Cape Breton, Nova Scotia. Results showed that better tree grades are associated with increased occurrence and percent volume of high value products such as veneer and select lumber. These results support ongoing efforts to collect and use tree grade data for hardwood management planning purposes.

INTRODUCTION

In Nova Scotia as elsewhere, hardwood sawlog value is related to quality more than quantity. Prices paid for veneer logs may be 10 to 20 times that paid for low quality sawlogs (per mfbm). High quality sawlogs may be priced 5 to 10 times higher. Because of these differences in value, impacts on potential quality should be considered when choosing management treatments for tolerant hardwood stands.

One way to integrate quality considerations into hardwood management is through evaluation of standing tree grade. Tree grade information can be related to potential product output and/or value (Hanks 1976). This information can then aid in the assessment of various stand treatment options, as well as subsequent treatment impacts.

A hardwood tree grading system has been in use by the Nova Scotia Department of Natural Resources Inventory Section for several years. This grading system is derived from a USDA Forest Service system and is designed to evaluate standing hardwood trees for conversion into sawlogs for lumber (Calvert and Petro 1993). Basically, the system generates a tree grade based on the best 12 foot, 14 foot, or 16 foot section found in the first 16 foot butt log[1]. Both scale and face grade defects are considered, as well as tree size. Possible sawlog tree grades are G1, G2, and G3; with G1 being the best grade and G3 the worst.

In order to better relate the NSDNR tree grading system to products being produced from Nova Scotia hardwood stands, a study was initiated by the Forest Management Planning Section of NSDNR in co-operation with B.A. Fraser Lumber Ltd. of Margaree Valley, Cape Breton. The objectives of the study were:

1. To assess tree grade and measure product output from several mature sugar maple trees.

2. To determine trends between tree grade data and product output.

[1] Imperial units are the standard in hardwood sawlog grading and scaling and are used throughout this report.

METHODS

Site Description

The harvest site was located in the Claverhouse/West Lake Ainslie area of Cape Breton (Figure 1). Cover type was essentially 100% mature tolerant hardwood dominated by sugar maple (*Acer saccharum* Marsh.). Herbaceous ground cover was approximately 60%, dominated by fern species (mainly wood fern: *Dryopteris sp.*). Soils in the area are classed as Woodbourne and Diligence series, derived from gravelly clay loam till and clay loam till respectively (Cann *et al*. 1963). A sample soil pit contained surface horizons of sandy loam and sandy clay loam with 15-30% coarse fragments. The site was moderately exposed, and was well to moderately well drained.

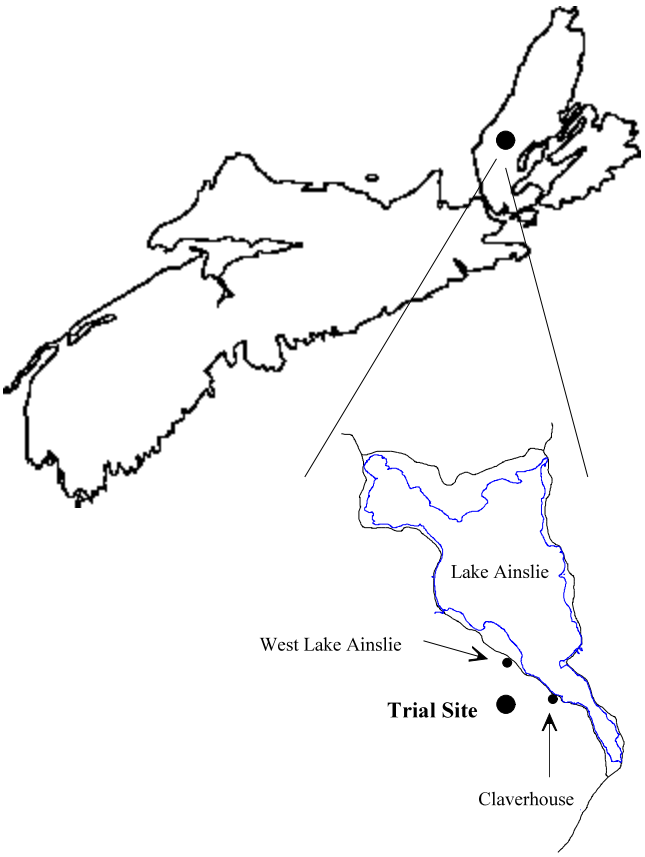

Figure 1. Location of harvest site for sugar maple tree grade/product yield study.

Field Methods

Fifty-six sugar maple trees were assessed for this study. Target trees were those with a minimum 13 inch inside bark diameter at 12 feet above stump height, and a maximum breast height diameter (dbh) of 20 inches. These specifications were used to minimize the effect of size on possible tree grade. In addition to tree quality data, estimated merchantable height and merchantable top diameter data were recorded for each tree. After assessment, numbers were painted sequentially on each tree for identification during harvesting.

Selected trees were harvested by B.A. Fraser Lumber Ltd. as part of a planned treatment for the area. Graded trees were not treated any differently than other harvested trees with respect to handling, except that tree numbers were transferred to bucked logs for later tracking.

Tree assessments were conducted in July, 2000. Harvesting and processing took place during August, 2000.

Grading Methods

All trees were graded according to methods described in Grading Standing Hardwood Trees in Nova Scotia (Calvert and Petro 1993). In addition to overall tree grade, face grade (FG) and scale grade (SG) classes were assigned to each tree based on specifications shown in Appendix 1. This was done to aid computer analysis and to allow more detailed assessment of possible relationships between tree grade components and product output.

Face grade is based on clear-cutting yield found on the second worst face of the tree's grading section. Scale grade is based on allowable scale (volume) deductions associated with various rot and seam defects, as well as sweep and crook. Final tree grade was based on the tree's face grade and scale grade, as well as the top diameter of the grading section.

Face grade defects and scale defects are listed in Appendix 1 along with examples of how grade classes were assigned.

Volume Data

All veneer logs were scaled at roadside using Bangor Log Rule. Sawlogs processed by B.A. Fraser were scaled at their mill yard (NB Log Rule) with board foot lumber outputs tallied after processing (see Appendix 2 for veneer, sawlog, and lumber class specifications). Volume data for some upper section sawlogs were not recorded after harvest because these logs were separated at roadside and sold elsewhere. To estimate these top log volumes, scaled log lengths for each tree were compared to estimated merchantable lengths to determine if there were log sections of 8.5 feet or more which were unaccounted for. If additional log sections were identified, volumes were estimated using NB Log Rule.

Analysis Methods

The frequencies of veneer log and No.1 sawlog occurrence were tabulated for each tree grade, face grade, and scale grade class to determine if any trends existed between high value product occurrence and grade class occurrence. Tabulated frequencies were then compared to expected frequencies, which were based on the overall percentages of each grade class found in the data set.

To compare sawlog volume data by tree grade, mean percent volumes (by sawlog class) were calculated for each tree grade class. Percentage volumes were used to reduce bias caused by differences in individual tree size. To examine trends between lumber quality and tree grade, mean percentage veneer and lumber class volumes were calculated for each tree grade class. For this analysis, product volume percentages were based on the estimated 16 foot butt log volume of each tree (NB Log Rule).

RESULTS AND DISCUSSION

Tree Grade and Yield Data

Occasional tracking problems during harvesting and processing resulted in missing log yield data for seven trees, and lumber yield data for nine trees. Data from these trees were not used in further analysis.

Of the 49 trees with log data, 13 were classed as G1, 19 as G2, and 17 as G3 (Table 1). Almost all trees were within target dbh class limits, but only 23 had inside diameters at 12 feet greater than or equal to 13 inches (the target diameter). This resulted in six trees of G1 quality being classed as G2 because of top diameter only. Overall, however, most G2 trees were downgraded because of face grade defects (not diameter limitations), while most G3 trees were downgraded because of scale defects (Table 1).

Only one tree analyzed was classed as Scale Grade 2. Since this count was so low, and since SG2 is really SG3 adjusted because of face grade and tree size (see Appendix 1), the SG2 tally was added to the SG3 total for all grade class comparisons.

Detailed quality data for all trees assessed can be found in Appendix 3. Overall volume data is contained in Appendix 4.

Log Product Frequencies

Log quality was correlated with tree grade in the 49 trees studied (Tables 2 and 3ab). Seven of 13 G1 trees (54%) contained veneer logs and 12 of 13 (92%) contained veneer and/or No.1 class sawlogs (Table 2). In contrast, no G3 trees contained veneer logs and only 2 of 17 (12%) contained No.1 sawlogs. Values for G2 trees were between those of G1 and G3 trees.

With respect to tree grade components, veneer frequency was strongly associated with face grade, with all 11 veneer trees having FG1 ratings (Table 3a). Scale grade was less associated with veneer frequency than was face grade.

Log and Lumber Volume Trends

Trends in log product frequencies carried through into log and lumber volume yields. Veneer volume averaged 27%, 9%, and 0% for G1 trees, G2 trees, and G3 trees respectively; and veneer + No.1 sawlog volumes averaged 47%, 30% and 5% (Figure 2). Looking at veneer and high quality lumber outputs, percentage yield essentially doubled with each increase in tree grade (Figure 3). Veneer + select lumber yields averaged 54%, 26%, and 13% of butt log volume for G1, G2, and G3 trees; and veneer + select and No.1 lumber yields averaged 67%, 48%, and 28%.

Table 1. Tree grade data for 49 mature sugar maple trees tracked for product outputs.

	Tree Grade 1	Tree Grade 2	Tree Grade 3	Total
Tree Counts	13	19	17	49
Mean DBH (inch) [1]	18.0	15.3	15.9	16.2
DBH Range (inch)	15.7 - 20.6	13.1 - 21.0	13.4 - 19.5	13.1 - 21.0
Mean DIB 12 (inch) [1]	14	12	12	12
DIB 12 Range (inch)	13 - 14	11 - 14	11 - 15	11 - 15
Mean Est. Merch. Ht. (ft)	35	32	32	33

	Face Grade 1	Face Grade 2	Face Grade 3	Total
Tree Counts	22	24	3	49

	Scale Grade 1	Scale Grade 2	Scale Grade 3	Total
Tree Counts	32	1	16	49

Reasons For Reduced Grade	Tree Grade 2	Tree Grade 3
Face Grade Defects Only	12	2
Scale Defects Only	1	13
Face Grade or Scale Defects [2]	0	1
Top Diameter Only	6	0
Scale Defects and Top Diameter [3]	0	1

1. Mean diameter breast height (dbh) and inside diameter at 12 feet (dib12) for Grade 1 trees were both significantly greater than for Grade 2 and Grade 3 trees (95% confidence: 1 way ANOVA and Tukey multiple comparison test).

2. Tree was both Face Grade 3 and Scale Grade 3.

3. Tree was Grade 3 due to a combination of scale defects and top diameter limitations.

Table 2. Product occurrence associated with tree grade (G1-G3), face grade (FG1-FG3), and scale grade (SG1-SG3) data for 49 mature sugar maple trees.

Tree Grade or Component	Veneer (all classes)		No. 1 Log		Veneer (all classes) and/or No. 1 Log	
	Count	%	Count	%	Count	%
G1	7/13	54	5/13	38	12/13	92
G2	4/19	21	7/19	37	11/19	58
G3	0/17	0	2/17	12	2/17	12
FG1	11/22	50	6/22	27	17/22	77
FG2	0/24	0	8/24	33	8/24	33
FG3	0/3	0	0/3	0	0/3	0
SG1	10/32	31	12/32	38	22/32	69
SG2-3	1/17	6	2/17	12	3/17	18

Table 3a. Veneer frequency data and associated grade class data for 49 mature sugar maple trees.

Product [1] Frequencies	Overall Tree Grade				Difference [2] Likelihood
	G1	G2	G3	Totals	
Veneer Only	7	4	0	11	
Expected	*2.9*	*4.3*	*3.8*	*11.0*	**99%**
All Other	6	15	17	38	
Expected	*10.1*	*14.7*	*13.2*	*38.0*	**75%**
Totals	13	19	17	49	

Product Frequencies	Face Grade Only [3]			Difference Likelihood
	FG1	FG2 and FG3	Totals	
Veneer Only	11	0	11	
Expected	*4.9*	*6.1*	*11.0*	**99%**
All Other	11	27	38	
Expected	*17.1*	*20.9*	*38.0*	**90%**
Totals	22	27	49	

Product Frequencies	Scale Grade Only			Difference Likelihood
	SG1	SG2 and SG3	Totals	
Veneer Only	10	1	11	
Expected	*7.2*	*3.8*	*11.0*	**75%**
All Other	22	16	38	
Expected	*24.8*	*13.2*	*38.0*	**50%**
Totals	32	17	49	

1. The number of trees which contained product type(s) and their associated grade classes. Expected frequencies are based on overall percentages of each grade class found and represent expected counts if no correlations exist between grade classes and product frequencies.

2. Percent likelihood that a significant difference exists between actual and expected frequencies (based on Chi Square goodness of fit tests).

3. Due to low FG3 counts, FG3 was combined with FG2 to meet statistical criteria.

Table 3b. Veneer plus No. 1 log frequency data and associated grade class data for 49 mature sugar maple trees.

Product [1] Frequencies	Overall Tree Grade				Difference [2] Likelihood
	G1	G2	G3	Totals	
Veneer+No.1 Log	12	11	2	25	
Expected	*6.6*	*9.7*	*8.7*	*25.0*	**99%**
All Other	1	8	15	24	
Expected	*6.4*	*9.3*	*8.3*	*24.0*	**99%**
Totals	13	19	17	49	

Product Frequencies	Face Grade Only [3]			Difference Likelihood
	FG1	FG2 and FG3	Totals	
Veneer+No.1 Log	17	8	25	
Expected	*11.2*	*13.8*	*25.0*	**95%**
All Other	5	19	24	
Expected	*10.8*	*13.2*	*24.0*	**95%**
Totals	22	27	49	

Product Frequencies	Scale Grade Only			Difference Likelihood
	SG1	SG2 and SG3	Totals	
Veneer+No.1 Log	22	3	25	
Expected	*16.3*	*8.7*	*25.0*	**95%**
All Other	10	14	24	
Expected	*15.7*	*8.3*	*24.0*	**95%**
Totals	32	17	49	

1. The number of trees which contained product type(s) and their associated grade classes. Expected frequencies are based on overall percentages of each grade class found and represent expected counts if no correlations exist between grade classes and product frequencies.

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3. Due to low FG3 counts, FG3 was combined with FG2 to meet statistical criteria.

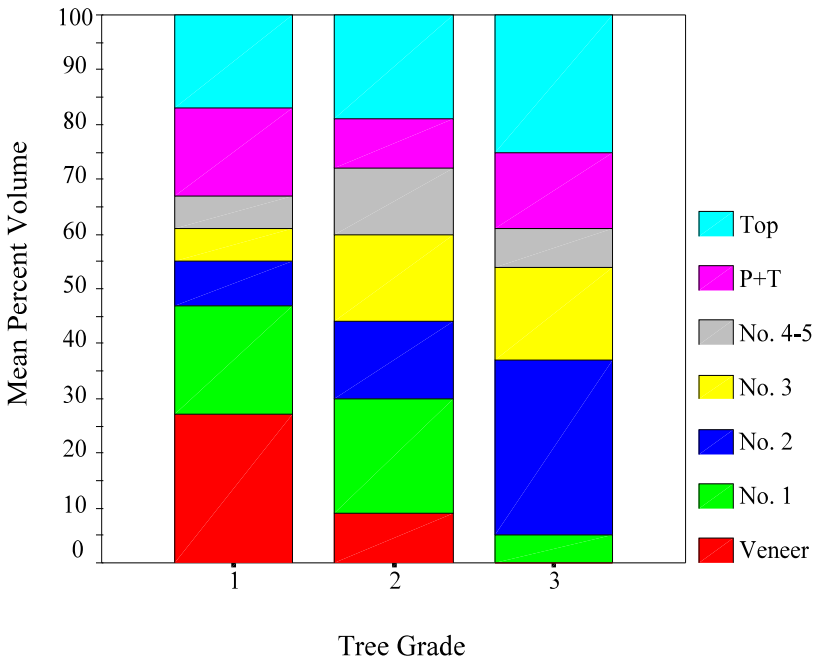

Figure 2. Mean percent veneer (all classes) and log class volumes by tree grade. See Appendix 2 for No. 1 to No. 5 sawlog class specifications. P+T = pallet and tie logs. Percentages are based on scaled log volumes and estimated merchantable top log volumes.

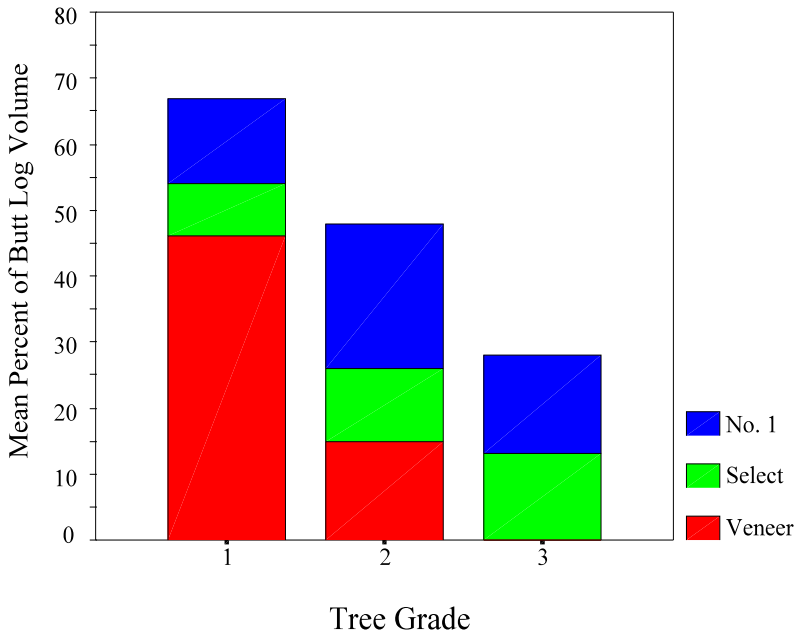

Figure 3. Mean percent veneer (all classes) and lumber class volumes with respect to calculated 16 foot butt log volumes (by tree grade). See Appendix 2 for select lumber and No. 1 lumber class specifications.

Discussion

The tree grading system used in this study is designed to evaluate standing hardwood trees for conversion into lumber. As such, tree grades are not necessarily related to specific log classes, especially when class specifications change over time or vary between buyers. However, it is not unreasonable to expect some correlation to exist between tree grade and high quality log products like veneer, since veneer logs would likely yield high percentages of quality lumber if milled.

All trees assessed had diameters which were within veneer product specifications (Appendix 2), but only Grade 1 and Grade 2 trees contained veneer logs (Table 2). This correlation was even stronger with respect to face grade (Tables 3a), where only FG1 trees contained veneer logs. This suggests face grade may be a good indicator of veneer potential when trees are less than G1 size.

Sawlog specifications used were those of B.A. Fraser Lumber Ltd. (Appendix 2). With a 14 inch diameter requirement for No.1 sawlogs, the larger average size of G1 trees (Table 1) likely contributed to the frequency of No.1 logs found in this grade class (Tables 2 and 3b). However, within similarly sized G2 and G3 trees, No.1 sawlog occurrence was mainly associated with G2 trees (Tables 2 and 3b), indicating an increase in product frequency with increasing tree grade.

With respect to lumber output comparisons, it was necessary to combine veneer volumes with lumber volumes to account for quality lumber removed with veneer logs. In these comparisons, it was again shown that the percentage of quality lumber (and veneer) increased with increasing tree grade, despite some differences in average tree size (Figure 3).

By its very nature, a tree grading system can only consider external defects and external signs of internal defects. There are, however, other defects which impact product yields that cannot be measured during standing tree assessment. The most important of these is heartwood percentage. For grading purposes, heartwood includes any discolored inner column of wood, whether it is "true" heartwood (the dead inner core of the tree) or "false" heartwood (discolored wood related to fungal activity) (Erickson and Reed 1992). False heartwood formation is a result of localized changes in wood chemistry as a tree tries to slow the spread of decay organisms which enter through old branch stubs and wounds (Lamson 2000). This means heartwood percentage will vary not only according to tree size and vigour, but also according to how soon branches were lost from the butt log portion of the tree. As a result, while the relationships between tree grades and product outputs shown in this study are likely valid throughout the province, the strength of these relationships may vary according to individual stand histories.

CONCLUSION

This study relating hardwood tree grade data and product output from a mature sugar maple stand in Cape Breton showed occurrence and percent volume of high value products to be strongly associated with increasing tree grade. These results support ongoing efforts to collect and use tree grade data for hardwood management purposes.

To examine the variation in sugar maple tree grade versus product output in the province, and to gather data on other high value hardwood species (ie. yellow birch, red oak, white ash), it is recommended that more tree grade/product studies be conducted. Results from these studies would increase the interpretive value of provincial inventory tree grade data and may lead to the formulation of quantitative relationships between hardwood tree grade classes and product yields for the province.

ACKNOWLEDGMENTS

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Appendix 1.

Tree Grade Specifications, Defect Types, and Grading Examples

Tree Grade Specifications [1]

Parameter	Specifications	Tree Grade					
		G1			G2		G3
Diameter	Minimum Top Diameter Inside Bark (inches)	13 (12 for ash)	16	20 +	11 (10 if FG1)	12 +	8
Clear Cuttings (2)	Minimum Length (feet)	7	5	3	3	3	2
	Maximum Number	2	2	2	2	3	Unlimited
	Min. Yield: Best 12 ft.	10 ft.			8 ft.		6 ft.
	Min. Yield: Best 14 ft.	11 ft. 8 in.			9 ft. 4in.		7 ft.
	Min. Yield: All 16 ft.	13 ft. 4 in.			10 ft. 8 in.		8 ft.
	Equivalent Face Grade	FG1			FG2		FG3
Scale Deductions	Allowable Deductions	10%			10 %		50%
	Equivalent Scale Grade	SG1			SG1		SG3
	Allowable Deductions				40% with max. 15% crook and sweep if G1 diameter and FG1		60% if G2 diameter and FG2 (or better)
	Equivalent Scale Grade				SG2		SG3

4. Face grade and scale grade were used in this study to refine data analysis. These terms are not used directly in the tree grading system described by Calvert and Petro.

5. Clear cuttings are defined by the number of grade defect stops found along the grading section face. The second worst face is chosen as the grading face.

Appendix 1. continued...

Face Grade and Scale Defects

Defect	Face Grade	Scale
Bark Distortion	X	
Bird Pecks (old)	X	
High Bump	X	
Medium Bump	X	
Low Bump	X	
Butt Bulge	X	X
Butt Scar	X	
Butt Scar with Rot	X	X
Burl	X	
Canker	X	
Canker with Rot	X	X
Conks	X	X
Corky Bark	X	
Epicormic Branches	X	
Flutes	X	
Forks	X	
Galls	X	
Holes	X	X
Knots	X	
Unsound Knots	X	X
Limbs	X	
Overgrowths	X	
Seams	X	X
Seams with Rot	X	X
Stem Bulge	X	X
Worm/Insect Holes	X	
Wounds	X	
Wounds/Scars with Rot	X	X
Sweep		X
Crook		X

Appendix 1. continued...

Grading Examples

1. A sugar maple tree which has less than 10% scale defects and a minimum of 10 continuous feet of clear bole on the second worst face of the 12 foot grading section would be classed as SG1 and FG1. If the top diameter of the grading section is 13 inches or more, the tree would be classed as G1. If the diameter is 10 to 12 inches, the tree would be classed as G2 (because of diameter).

2. A sugar maple tree which has less than 10% scale defects and a clear 5 foot and 3 foot bole section on the second worst face of the 12 foot grading section would be classed as SG1 and FG2. If the top diameter of the grading section was 11 inches or more, the tree would be classed as G2 because of face defects (regardless of whether it was G1 size or not).

3. A sugar maple tree which has 20% rot defects and a minimum of 10 continuous feet of clear bole on the second worst face of the 12 foot grading section would be classed as SG3 and FG1. If the top diameter of the grading section was 11 or 12 inches, the tree would be classed as G3 because of scale defects. If the top diameter was 13 inches or more, the scale grade would be changed to SG2 (because the tree was of G1 yield and size), and the tree would be classed as G2 because of scale defects.

Note: These examples all use a 12 foot grading section (within the 16 foot butt log) because this length is most commonly used in hardwood tree grading. However, a 14 foot or 16 foot section can be used if this results in a higher grade. Also, the best 12 foot section can start at 0, 1, 2, 3, or 4 feet above stump height; and the best 14 foot section can start at 0, 1, or 2 feet above stump height.

Appendix 2.

Log and Lumber Grade Specifications

Sugar Maple Veneer Specifications: [1]

Grade	Lengths	Minimum Diameter	Allowable Defects	Allowable Heart
Prime	9'5",10'5", 11'5"	14" +	0	1/3
Select	9'5",10'5", 11'5"	11", 12", 13"	0	1/3
Select	9'5",10'5", 11'5"	14" +	1	1/3
#1	9'5",10'5", 11'5"	11", 12", 13"	1	1/3
#1	9'5",10'5", 11'5"	14" +	0	1/2
#2	9'5",10'5", 11'5"	14" +	1	1/2
#3	9'5",10'5", 11'5"	11" +	2	1/3
#3	9'5",10'5", 11'5"	11", 12", 13"	0	1/2

4. Columbia Forest Products, Presque Isle Maine (January, 2001)

Sugar Maple Sawlog Specifications: [2]

Grade	Lengths	Minimum Diameter	Clear Faces	Allowable Heart
#1	8'6" +	14" +	4	1/2
#2	8'6" +	11" +	4	1/3
#3	8'6" +	11" +	3	1/3
#4	8'6" +	10" +	2	1/3
#5	8'6" +	8" & 9"	2	1/4

5. B.A. Fraser Lumber Ltd. Cape Breton, Nova Scotia (August, 2000)

Appendix 2. continued...

Hardwood Lumber Specifications (Partial List Only): [3]

Grade	Minimum Specifications				
	Lengths (feet)	**Width (inches)**	**Yield % Clear Cuttings**	**Size of Cuttings**	**Number of Cuttings**
Firsts & Seconds	8	6	83 1/3	4" x 5' 3" x 7'	1 to 4
Select	6	4	Better face is FAS; reverse side of cutting is 1 Common		
1 Com	4	3	66 2/3	4" x 2' 3" x 3'	1 to 5
2A & 2B Com	4	3	50	3" x 2'	1 to 7
3A Com	4	3	33 1/3	3" x 2'	No Limit
3B Com	4	3	25	1.5" wide 36 sq inch	No Limit Sound

6. National Hardwood Lumber Association (see NHLA 1998 for complete specifications).

Appendix 3.

Tree Grade Versus Product Output: Tree Grade Data

Tree #	Species	DBH (inch)	Est. DIB16 (inch)	Est. DIB12 (inch)	Est. Merch. Length (feet)	Est. Merch. DIB (inch)	Stump to 16 Foot Defect Assessment					
							Sweep (Y/N)	Crook (Y/N)	Rot (Y/N)	Spiral Seam (Y/N)	Straight Seam (Y/N)	Grade Defects Found
1	sM	14.8	11	12	19	11	N	N	N	N	N	6
2	sM	13.1	11	11	32	9	N	Y	Y	N	N	9
3	sM	14.1	10	11	32	8	N	Y	Y	N	N	2
4	sM	14.3	11	11	30	8	Y	N	Y	N	Y	7
5	sM	15.2	10	11	34	8	N	Y	N	N	N	5
6	sM	18.0	12	12	35	8	Y	N	Y	Y	N	4
7	sM	16.9	12	13	34	9	N	N	N	N	N	3
8	sM	19.0	13	14	36	8	Y	N	Y	N	N	1
9	sM	20.2	13	14	38	9	N	N	N	N	Y	7
10	sM	20.6	13	14	30	10	N	Y	Y	N	N	4
11	sM	14.5	11	11	34	8	N	Y	N	N	N	10
12	sM	18.4	13	14	38	8	N	Y	Y	N	N	4
13	sM	14.1	12	12	36	8	Y	N	N	N	N	8
14	sM	13.1	10	11	34	8	N	Y	N	N	N	5
15	sM	17.4	14	14	40	8	N	Y	N	N	N	3
16	sM	16.2	12	13	36	10	Y	N	Y	N	N	0
17	sM	18.2	12	13	32	9	N	Y	N	N	N	5
18	sM	21.0	13	14	40	8	N	N	Y	N	N	8
19	sM	13.8	11	11	30	8	Y	Y	Y	N	N	5
20	sM	18.6	14	14	30	9	N	Y	Y	N	N	3
21	sM	15.4	11	11	32	9	Y	N	N	N	N	2
22	sM	17.4	13	13	38	8	N	Y	N	N	N	4
23	sM	18.2	13	14	30	9	N	Y	N	N	N	4
24	sM	15.5	11	12	34	8	N	Y	N	N	N	4
25	sM	15.7	11	12	30	8	Y	N	N	N	N	4
26	sM	15.0	12	12	40	8	N	N	N	N	N	6
27	sM	14.2	11	11	24	8	N	Y	N	N	Y	3
28	sM	14.0	11	11	36	8	Y	Y	N	N	N	3
29	sM	15.0	11	11	36	8	N	Y	N	N	N	3
30	sM	16.5	12	13	38	8	Y	Y	N	N	N	9

Appendix 3. continued...

Tree #	Species	DBH (inch)	Est. DIB16 (inch)	Est. DIB12 (inch)	Est. Merch. Length (feet)	Est. Merch. DIB (inch)	Stump to 16 Foot Defect Assessment					
							Sweep (Y/N)	Crook (Y/N)	Rot (Y/N)	Spiral Seam (Y/N)	Straight Seam (Y/N)	Grade Defects Found
31	sM	14.7	11	12	34	9	N	Y	N	N	N	4
32	sM	17.8	12	14	32	8	N	N	Y	Y	N	8
33	yB	20.8	15	15	38	9	Y	N	N	N	N	2
34	sM	15.4	12	12	28	9	Y	N	N	Y	N	8
35	sM	17.4	12	13	32	8	N	N	N	N	N	8
36	rM	17.0	13	13	40	8	N	Y	N	N	N	4
37	yB	17.4	14	14	28	8	Y	N	N	N	N	2
38	rM	17.9	14	14	34	9	N	Y	Y	N	N	1
39	sM	14.6	10	12	28	8	N	Y	N	N	N	12
40	sM	16.9	11	12	32	8	N	Y	Y	N	Y	10
41	sM	17.8	13	13	32	8	N	Y	N	Y	Y	3
42	sM	13.9	11	11	28	8	N	Y	N	N	N	8
43	sM	13.4	11	11	32	8	N	Y	N	N	N	20
44	sM	15.7	12	13	30	8	N	Y	Y	N	N	3
45	sM	16.8	12	13	36	8	N	Y	N	Y	N	3
46	sM	15.0	12	12	38	8	N	N	N	N	N	6
47	sM	19.5	15	15	32	8	N	Y	Y	Y	N	5
48	sM	14.9	12	12	34	8	N	Y	N	N	N	15
49	sM	15.2	12	12	34	9	N	Y	N	N	Y	6
50	sM	13.9	11	11	32	8	Y	N	N	N	N	4
51	sM	14.9	11	12	32	9	N	Y	N	N	N	6
52	sM	17.4	14	14	28	8	Y	N	Y	N	N	3
53	sM	16.9	13	13	38	9	N	N	N	N	N	4
54	sM	17.6	12	13	36	8	N	Y	Y	N	N	1
55	sM	13.9	11	11	36	8	Y	N	Y	N	N	5
56	sM	16.3	12	13	34	9	Y	N	N	N	N	2
57	sM	15.2	9	13	26	8	N	Y	Y	N	N	7
58	sM	17.7	11	13	24	8	Y	Y	Y	N	N	7
59	sM	17.2	11	12	32	8	N	Y	N	N	N	6
60	sM	15.1	11	11	28	8	N	Y	Y	N	Y	4

Note: Two yellow birch and two red maple were also assessed along with 56 sugar maple. Data on these extra trees are included here for completeness.

Appendix 3. continued...

Tree #	Best Overall Grading Section	Grading Section Sweep % Deduct	Grading Section Crook % Deduct	Grading Section Rot+Seam % Deduct	Grading Section Scale Grade	Grading Section Face Grade		Overall Tree Grade	Reasons [1] If Not Grade 1
1	0-12 ft	0	0	0	1	1		**2**	**D**
2	2-14 ft	0	3	0	1	2		**2**	**F (D)**
3	0-12 ft	0	4	13	3	1		**3**	**S+D**
4	0-12 ft	7	0	2	1	2		**2**	**F (D)**
5	0-12 ft	0	0	0	1	2		**2**	**F (D)**
6	4-16 ft	4	0	17	3	2		**3**	**S**
7	0-12 ft	0	0	0	1	1		**1**	
8	0-12 ft	5	0	1	1	1		**1**	
9	0-12 ft	0	0	2	1	1		**1**	
10	4-16 ft	0	4	0	1	1		**1**	
11	0-16 ft	0	10	0	1	2		**2**	**F (D)**
12	4-16 ft	0	6	0	1	1		**1**	
13	0-12 ft	6	0	0	1	2		**2**	**F (D)**
14	0-12 ft	0	6	0	1	1		**2**	**D**
15	0-12 ft	0	0	0	1	1		**1**	
16	0-12 ft	0	0	0	1	1		**1**	
17	0-12 ft	0	5	0	1	1		**1**	
18	0-12 ft	0	0	0	1	2		**2**	**F**
19	0-12 ft	4	0	0	1	1		**2**	**D**
20	0-12 ft	0	0	0	1	1		**1**	
21	4-16 ft	9	0	0	1	1		**2**	**D**
22	0-12 ft	0	4	0	1	1		**1**	
23	0-12 ft	0	0	0	1	1		**1**	
24	0-12 ft	0	0	0	1	2		**2**	**F (D)**
25	0-12 ft	4	0	0	1	2		**2**	**F (D)**
26	0-12 ft	0	0	0	1	2		**2**	**F (D)**
27	0-12 ft	0	9	2	3	2		**3**	**S**
28	0-12 ft	0	0	0	1	1		**2**	**D**
29	4-16 ft	0	17	0	3	2		**3**	**S**
30	0-12 ft	9	10	0	3	2		**3**	**S**

7. F = Grading face defects, S = Scale defects, D = Top diameter limits.
Where two letters appear with a + sign, tree grade is due to both reasons acting in combination.
Where two letters appear without a + sign, tree grade is due to both reasons equally.
Where F(D) appears, top diameter is secondary to grading defects (ie. tree grade could not have been higher even if top diameter was G1 size).

Appendix 3. continued...

Tree #	Best Overall Grading Section	Grading Section Sweep % Deduct	Grading Section Crook % Deduct	Grading Section Rot+Seam % Deduct	Grading Section Scale Grade	Grading Section Face Grade		Overall Tree Grade	Reasons [1] If Not Grade 1
31	0-12 ft	0	6	0	1	1		**2**	**D**
32	4-16 ft	0	0	15	3	2		**3**	**S**
33	0-12 ft	7	0	0	1	1		**1**	
34	0-12 ft	3	0	2	1	2		**2**	**F (D)**
35	0-12 ft	0	0	0	1	2		**2**	**F**
36	3-15 ft	0	8	0	1	2		**2**	**F**
37	0-12 ft	6	0	0	1	1		**1**	
38	0-12 ft	0	10	0	1	1		**1**	
39	0-12 ft	0	21	0	3	2		**3**	**S**
40	0-12 ft	0	17	2	3	3		**3**	**SF**
41	4-16 ft	0	10	8	2	1		**2**	**S**
42	0-12 ft	0	6	0	1	2		**2**	**F (D)**
43	0-12 ft	0	6	0	1	3		**3**	**F**
44	0-12 ft	0	10	0	1	1		**1**	
45	0-12 ft	0	10	25	3	2		**3**	**S**
46	0-12 ft	0	0	0	1	2		**2**	**F (D)**
47	0-12 ft	0	10	35	3	3		**3**	**SF**
48	2-14 ft	0	6	0	1	2		**2**	**F (D)**
49	0-12 ft	0	10	2	3	2		**3**	**S**
50	0-12 ft	3	0	0	1	1		**2**	**D**
51	0-12 ft	0	0	0	1	1		**2**	**D**
52	0-12 ft	2	0	0	1	1		**1**	
53	0-12 ft	0	0	0	1	1		**1**	
54	0-12 ft	0	0	4	1	1		**1**	
55	0-12 ft	16	0	8	3	2		**3**	**S**
56	0-12 ft	20	0	0	3	1		**3**	**S**
57	0-12 ft	0	10	13	3	2		**3**	**S**
58	0-12 ft	15	0	0	3	2		**3**	**S**
59	1-13 ft	0	30	0	3	2		**3**	**S**
60	0-12 ft	0	8	27	3	2		**3**	**S**

1. F = Grading face defects, S = Scale defects, D = Top diameter limits.
Where two letters appear with a + sign, tree grade is due to both reasons acting in combination.
Where two letters appear without a + sign, tree grade is due to both reasons equally.
Where F(D) appears, top diameter is secondary to grading defects (ie. tree grade could not have been higher even if top diameter was G1 size).

Appendix 4A.

Tree Grade Versus Product Output: Veneer and Log Data

Tree #	Tree Grade	Scaled Veneer Volumes (Bangor Log Rule) and Log Volumes (NB Log Rule)									Est. Top Volume (fbm)
		Veneer All (fbm)	Log No.1 (fbm)	Log No.2 (fbm)	Log No.3 (fbm)	Log No.4 (fbm)	Log No.5 (fbm)	Rail/ Tie (fbm)	Pallet (fbm)	Log Total (fbm)	
1	**2**	**46**						24		**24**	**0**
2	**2**	**0**	60		50		24			**134**	**0**
3	**3**	**0**				32		32	10	**74**	**0**
4	**2**	**0**		50					32	**82**	**25**
5	**2**	**0**		56	42		40			**138**	**0**
6	**3**	**0**	70	48	48					**166**	**0**
8	**1**	**80**				40			18	**58**	**20**
9	**1**	**0**	93			46			48	**187**	**27**
10	**1**	**90**						63		**63**	**40**
11	**2**	**0**	60			35				**95**	**35**
12	**1**	**75**		80						**80**	**44**
14	**2**	**0**			40			32		**72**	**44**
15	**1**	**0**	93						24	**117**	**55**
16	**1**	**70**			50					**50**	**52**
17	**1**	**0**	82						48	**130**	**36**
18	**2**	**0**	82				30			**112**	**49**
19	**2**	**0**		55					32	**87**	**23**
20	**1**	**0**	85			49			24	**158**	**0**
21	**2**	**59**		55					21	**76**	**0**
22	**1**	**0**	93		36					**129**	**47**
23	**1**	**90**			42					**42**	**24**
24	**2**	**0**			116				40	**156**	**0**
25	**2**	**0**		66	48				18	**132**	**0**
26	**2**	**0**	60				48			**108**	**44**
27	**3**	**0**			40				18	**58**	**0**
28	**2**	**0**	60				35			**95**	**35**
29	**3**	**0**		60		32				**92**	**68**
30	**3**	**0**		56	40					**96**	**55**
32	**3**	**0**			42					**42**	**123**
34	**2**	**0**		60						**60**	**64**
35	**2**	**0**	138							**138**	**30**
39	**3**	**0**	54							**54**	**47**
40	**3**	**0**			110					**110**	**30**

Appendix 4A. continued...

Tree #	Tree Grade	Scaled Veneer Volumes (Bangor Log Rule) and Log Volumes (NB Log Rule)									Est. Top Volume (fbm)
		Veneer All (fbm)	Log No.1 (fbm)	Log No.2 (fbm)	Log No.3 (fbm)	Log No.4 (fbm)	Log No.5 (fbm)	Rail/ Tie (fbm)	Pallet (fbm)	Log Total (fbm)	
41	**2**	**65**			65					**65**	**30**
42	**2**	**0**	50						20	**70**	**20**
43	**3**	**0**		60					62	**122**	**0**
44	**1**	**0**						56	44	**100**	**0**
45	**3**	**0**		65	42					**107**	**30**
46	**2**	**0**			42	62				**104**	**25**
47	**3**	**0**		107				65		**172**	**30**
49	**3**	**0**		70			40			**110**	**35**
51	**2**	**65**					20			**20**	**36**
53	**1**	**98**		60					32	**92**	**0**
54	**1**	**89**		45						**45**	**38**
55	**3**	**0**		60		45				**105**	**38**
56	**3**	**0**		50	48				18	**116**	**0**
57	**3**	**0**							56	**56**	**44**
58	**3**	**0**		90						**90**	**30**
60	**3**	**0**		50				56		**106**	**20**

Note: Data is only shown for 49 sugar maple with complete log data. Trees 7, 13, 31, 48, 50, 52, and 59 are excluded.

Appendix 4B.

Tree Grade Versus Product Output: Veneer and Lumber Data

Tree #	Tree Grade	Scaled Veneer All (fbm)	Scaled Lumber Volume					
			Lumber Select (fbm)	Lumber NO. 1 (fbm)	Lumber NO. 2 (fbm)	Lumber NO. 3 (fbm)	Lumber Other (fbm)	Lumber Total (fbm)
1	**2**	**46**	0	10	8	9	16	**43**
2	**2**	**0**	25	30	5	12	64	**137**
3	**3**	**0**	8	9	16	14	46	**93**
4	**2**	**0**	0	8	26	0	75	**108**
5	**2**	**0**	9	30	9	37	30	**115**
6	**3**	**0**	27	29	12	10	92	**170**
8	**1**	**80**	4	2	7	5	18	**36**
9	**1**	**0**	0	10	74	38	69	**191**
10	**1**	**90**	9	23	15	5	24	**76**
11	**2**	**0**	0	18	29	3	47	**97**
12	**1**	**75**	26	13	5	1	20	**65**
14	**2**	**0**	4	6	21	4	51	**86**
15	**1**	**0**	15	8	8	34	62	**126**
16	**1**	**70**	0	17	11	1	30	**59**
17	**1**	**0**	0	18	18	40	55	**132**
18	**2**	**0**	0	0	15	36	68	**119**
19	**2**	**0**	3	15	29	37	0	**84**
20	**1**	**0**	21	41	18	33	92	**205**
21	**2**	**59**	12	13	4	10	37	**75**
23	**1**	**90**	0	17	6	12	27	**62**
24	**2**	**0**	28	16	22	16	75	**156**
25	**2**	**0**	32	24	4	11	37	**108**
26	**2**	**0**	0	54	21	24	13	**112**
27	**3**	**0**	10	9	0	0	72	**91**
28	**2**	**0**	0	28	8	33	31	**99**
29	**3**	**0**	11	11	20	24	27	**94**
30	**3**	**0**	10	18	15	17	36	**96**
32	**3**	**0**	0	11	11	5	28	**55**
35	**2**	**0**	19	35	17	23	44	**138**
39	**3**	**0**	10	14	21	0	6	**51**
40	**3**	**0**	13	20	16	21	47	**117**

Appendix 4B. continued...

Tree #	Tree Grade	Scaled Veneer All (fbm)	Scaled Lumber Volume					
			Lumber Select (fbm)	Lumber NO. 1 (fbm)	Lumber NO. 2 (fbm)	Lumber NO. 3 (fbm)	Lumber Other (fbm)	Lumber Total (fbm)
41	**2**	**65**	26	13	11	6	12	**68**
42	**2**	**0**	0	7	12	26	28	**73**
43	**3**	**0**	0	3	9	39	75	**125**
44	**1**	**0**	12	9	7	2	71	**101**
45	**3**	**0**	17	23	17	17	31	**104**
46	**2**	**0**	0	9	26	31	48	**114**
47	**3**	**0**	0	10	31	21	111	**174**
49	**3**	**0**	0	0	5	18	103	**126**
51	**2**	**65**	0	8	0	2	12	**22**
53	**1**	**98**	0	20	7	27	49	**103**
54	**1**	**89**	21	3	3	18	13	**58**
55	**3**	**0**	24	14	0	40	22	**101**
56	**3**	**0**	27	34	9	13	65	**148**
57	**3**	**0**	0	3	6	7	52	**67**
58	**3**	**0**	26	17	5	0	33	**81**
60	**3**	**0**	0	0	14	7	93	**114**

Note: Data is only shown for 47 sugar maple with complete lumber data. Trees 7, 13, 22, 31, 34, 48, 50, 52, and 59 are excluded.