Translating Log Volumes from BC Metric to US Scribner Scale

Neal Hart Jendro & Hart LLC

April 2018 Timber Measurement Society Meeting

In This Discussion:

- *Complexity of m3-to-MBF translations*
- *Results of BC Interior Dual-Scale Study*

Both Metric and Scribner are Volume Measures, BUT

While conversion between most volume measures involves a single precise factor

One Quart ⟷ 0.946353 Liter

There is NO Single Conversion Ratio for Logs

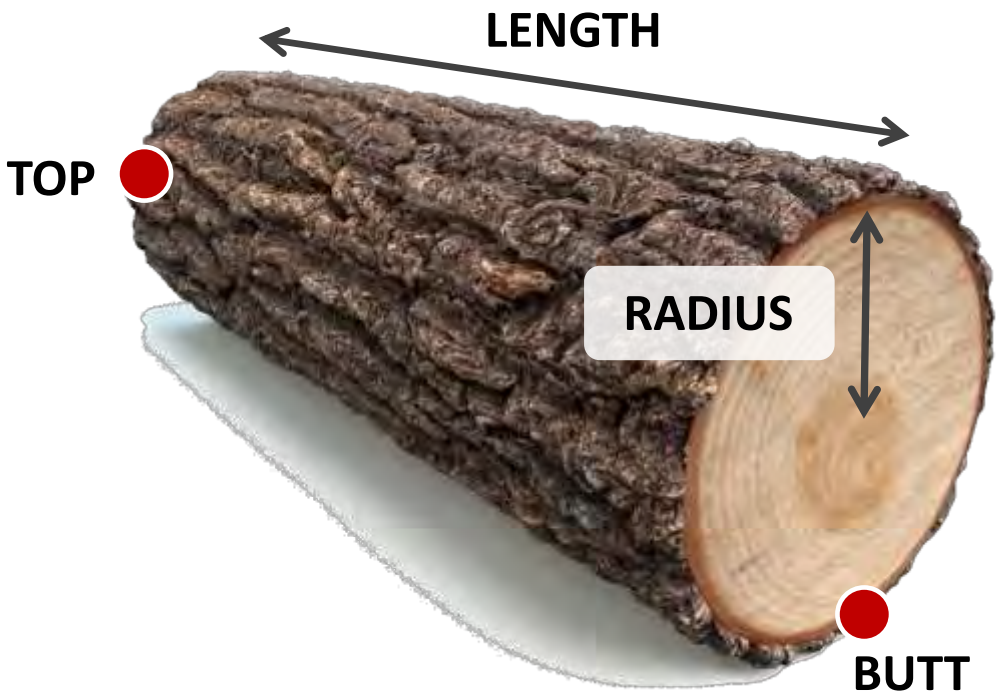
One BC Metric m3 ⟷ **? ? ? BF Scribner**

Sound  **Wood Fiber** **vs.** **Lumber**  **Only**

Logs vary in diameter, length, shape (taper, sweep, etc.) and defect –

So Metric-to-Scribner conversion ratios are specific to each log

BC METRIC SCALE



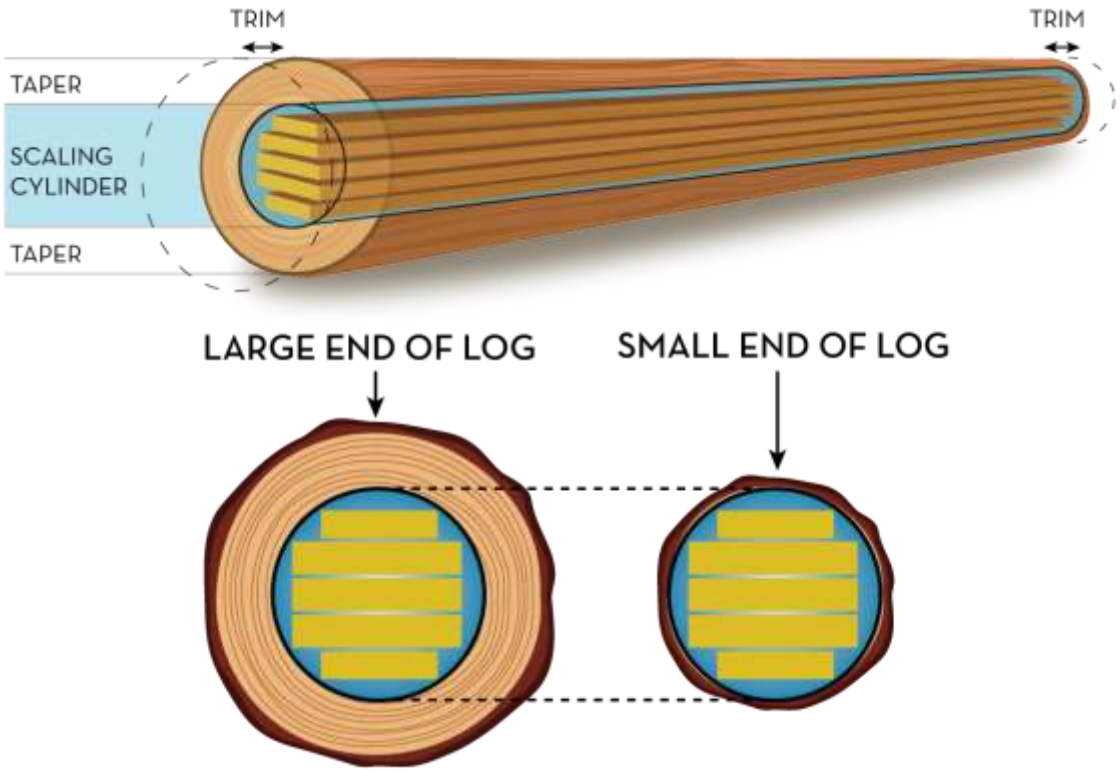
BC Metric scale measures the total cubic volume of sound wood fiber in a log, regardless of its potential use (lumber, veneer, chips, etc.)

Deductions are made for unsound wood defects only (rot, char and missing wood)

A uniform approach is applied for all logs regardless of diameter or length

BC Metric scale measures a log's total sound-wood fiber content

SCRIBNER DECIMAL C RULE



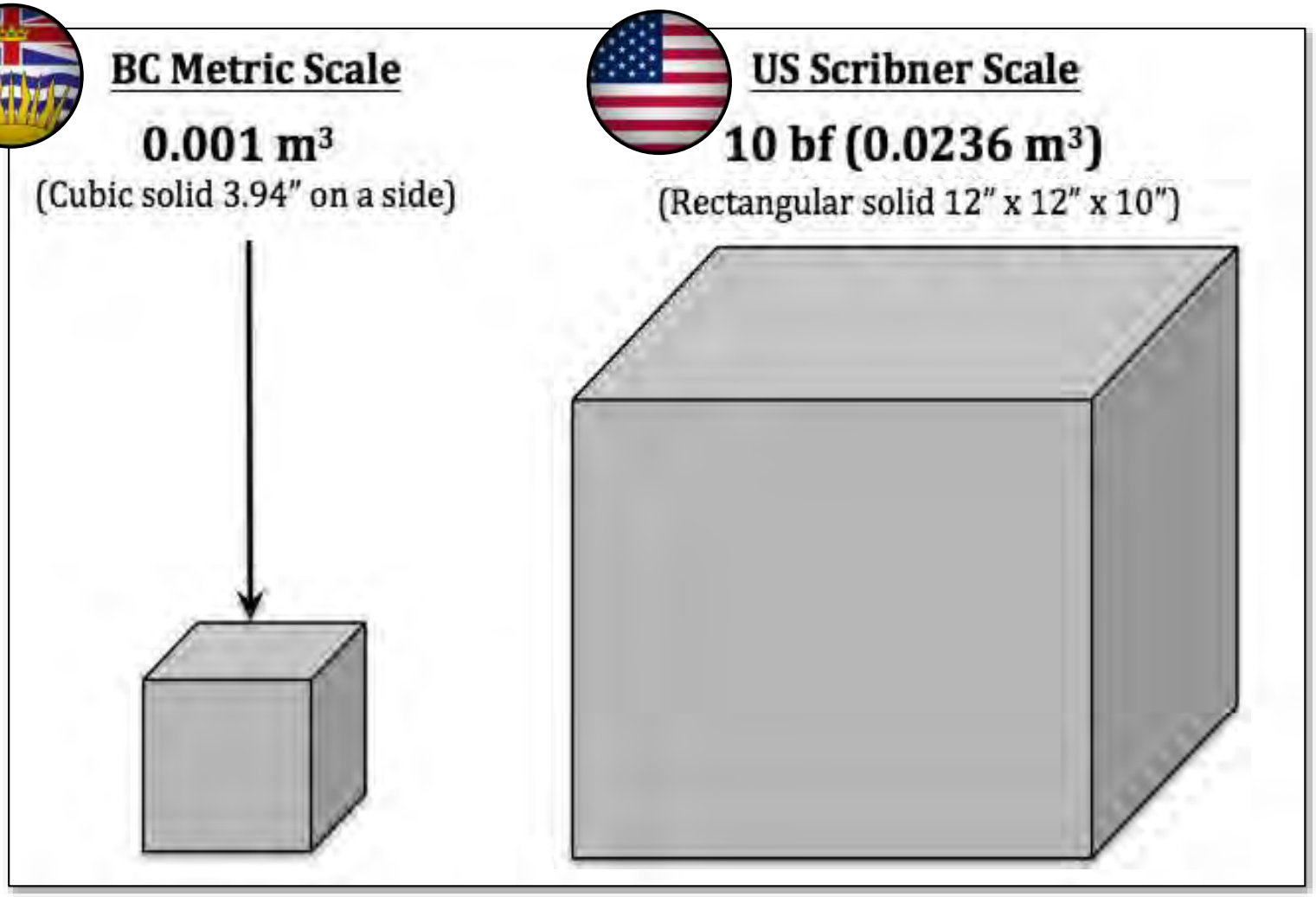
Scribner estimates only lumber volume within the log's scaling cylinder based on 19th century sawmill technology

Deductions are made for unsound-wood (rot, char, missing wood) and also for solid-wood defects (e.g., sweep, crook, check, splits, etc.)

The approach varies depending on diameter and length

Scribner's lumber volume varies in relation to total wood fiber content of logs

Basic Measurement Units



Basic measurement unit in Scribner is 24 times larger than the Metric scale unit

THE SCRIBNER DECIMAL C RULE

Top Diameter:	5"	6"	7"	8"	9"	10"	11"	12"
Length								
6'	10	10	10	10	10	20	20	30
7'	10	10	10	10	10	20	30	30
8'	10	10	10	10	20	30	30	40
9'	10	10	10	10	20	30	30	40
10'	10	10	10	20	20	30	40	
11'	10	10	20	20	20	30	40	
12'	10	10	20	20	30	40	40	
13'	10	20	20	20	30	40		
14'	10	20	20	20	30	40		
15'	20	20	20	20	30			
16'	20	20	30	30	40			
17'	20	20	30	30	40			
18'	20	20	30	30	40			
19'	20	20	30	40				
20'	20	20	30	40				
21'	20	30	30	40				
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24'	30	30	40	40				
25'	30	30	40					
26'	30	30	40					
27'	30	30	40					
28'	30	30						
29'	30	40						
30'	30	40						
31'	30	40						
32'	30							

For logs 5" to 8" in Diameter and 10' to 20' in length there are 44 unique combinations of diameter and length

For 25 out of the 44 (or 57%) Scribner records the same volume at 20 bf

Few of those 25 would be likely to have the same Metric scale cubic volume

Scribner is less sensitive to differences in log size at the small end of the diameter range

THE SCRIBNER DECIMAL C RULE

Top Diameter:	5"	6"	7"	8"
Length				
6'	10	10	10	10
7'	10	10	10	10
8'	10	10	10	10
9'	10	10	10	10
10'	10	10	10	20
11'	10	10	20	20
12'	10	10	20	20
13'	10	20	20	20
14'	10	20	20	20
15'	20	20	20	20
16'	20	20	30	30
17'	20	20	30	30
18'	20	20	30	30
19'	20	20	30	40
20'	20	20	30	40

In Scribner, 5" & 6" logs have the same volume for all but two scale lengths – 13' & 14'

In BC Metric, these logs measure 6, 7 or 8 rads, and each has a <u>different</u> volume

In Scribner, 7" & 8" logs have the same volume for all but three scale lengths – 10', 19' & 20'

In BC Metric, these logs measure 8, 9, 10 or 11 rads - each with different volume

Scribner is less sensitive to differences in log size at the small end of the diameter range

THE SCRIBNER DECIMAL C RULE

	Diameter	Factor	Diameter	Factor
	5	1.070	19	14.990
Logs 1’ – 15’	6	1.160*		
	7	1.400*		
	8	1.501*		
	9	2.084*		
	10	3.126*		
	11	3.749*		
Logs 16’ – 31’	6	1.249*		
	7	1.608*		
	8	1.854*		
	9	2.410*		
	10	3.542*		
	11	4.167*		
Logs 32’ – 40’	6	1.570*		
	7	1.800*		
	8	2.200*	34	50.000
	9	2.900*	35	54.688
	10	3.815*		
	11	4.49		
	12	4.90		
	13	6.04		
	14	7.14		
	15	8.88		
	16	10.00		
	17	11.52		
	18	13.290		92.501

* Special Note: Logs having diameters 6" through 11" have a separate diameter factor for lengths 1' through 15', 16' through 31', and 32' through 40'.

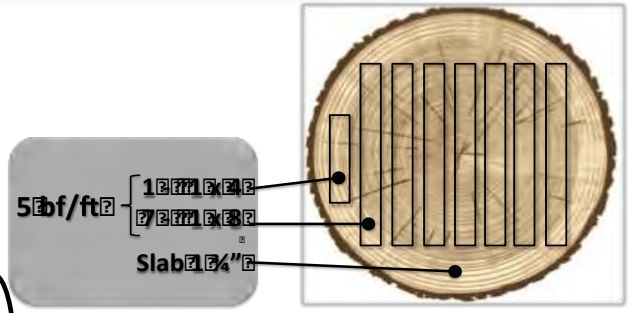
Dia.	1’ – 15’	16’ – 31’	32’ – 40’	% Diff.
6	1.160	1.249	1.570	35%
7	1.400	1.608	1.800	29%
8	1.501	1.854	2.200	47%
9	2.084	2.410	2.900	39%
10	3.126	3.542	3.815	22%
11	3.749	4.167	4.499	20%

*** Special Note: Logs having diameters 6” through 11” have a separate diameter factor for lengths 1’ through 15’, 16’ through 31’, and 32’ through 40’**

Scribner volume for 12-inch diameter logs

30 feet x 4.90 = 147

150 bf



12”

40 feet x 4.90 = 196

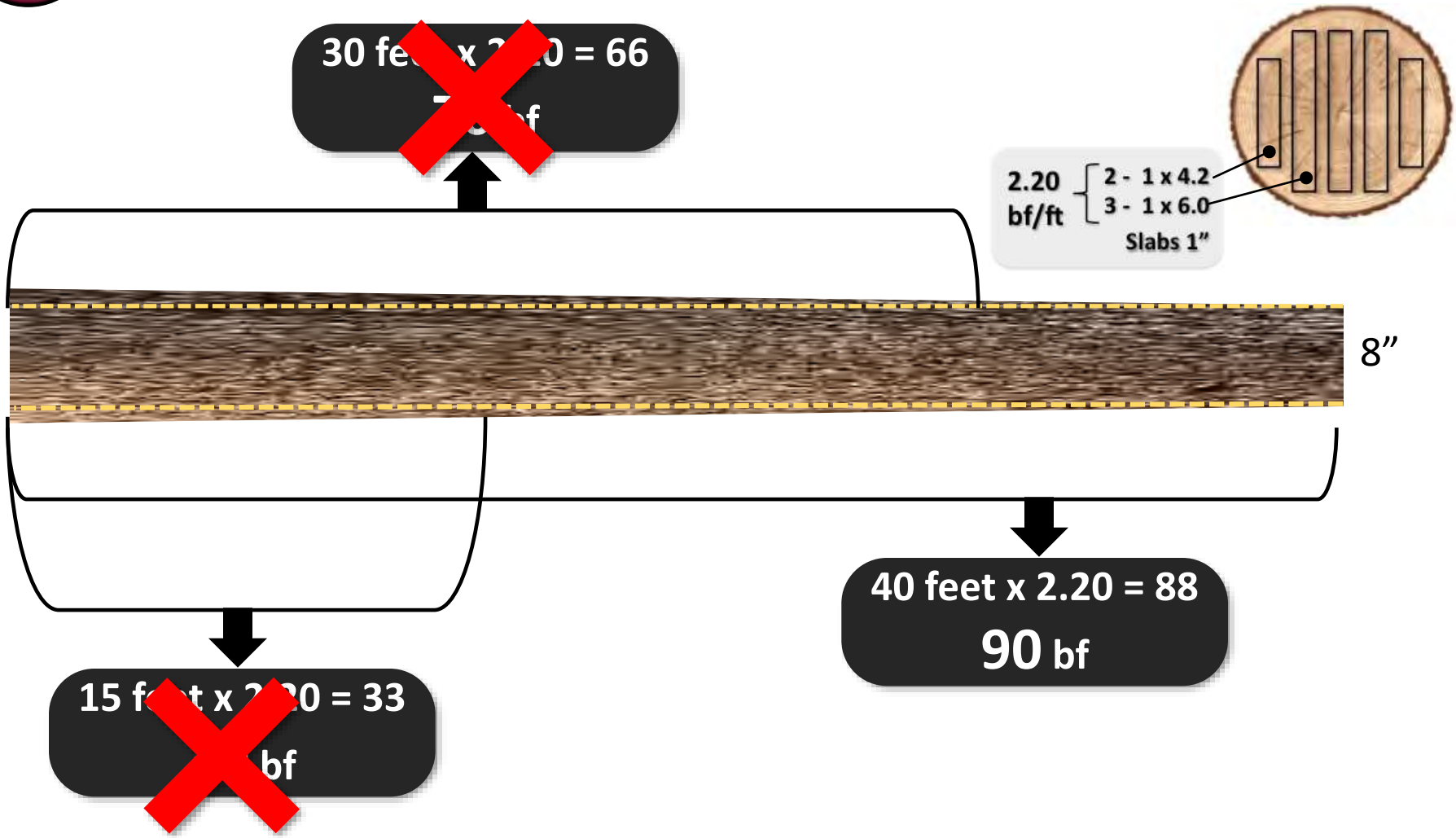
200 bf

15 feet x 4.90 = 74

70 bf

4.90 BF/FT recovery factor as applied to segments of a 40-foot scaling cylinder

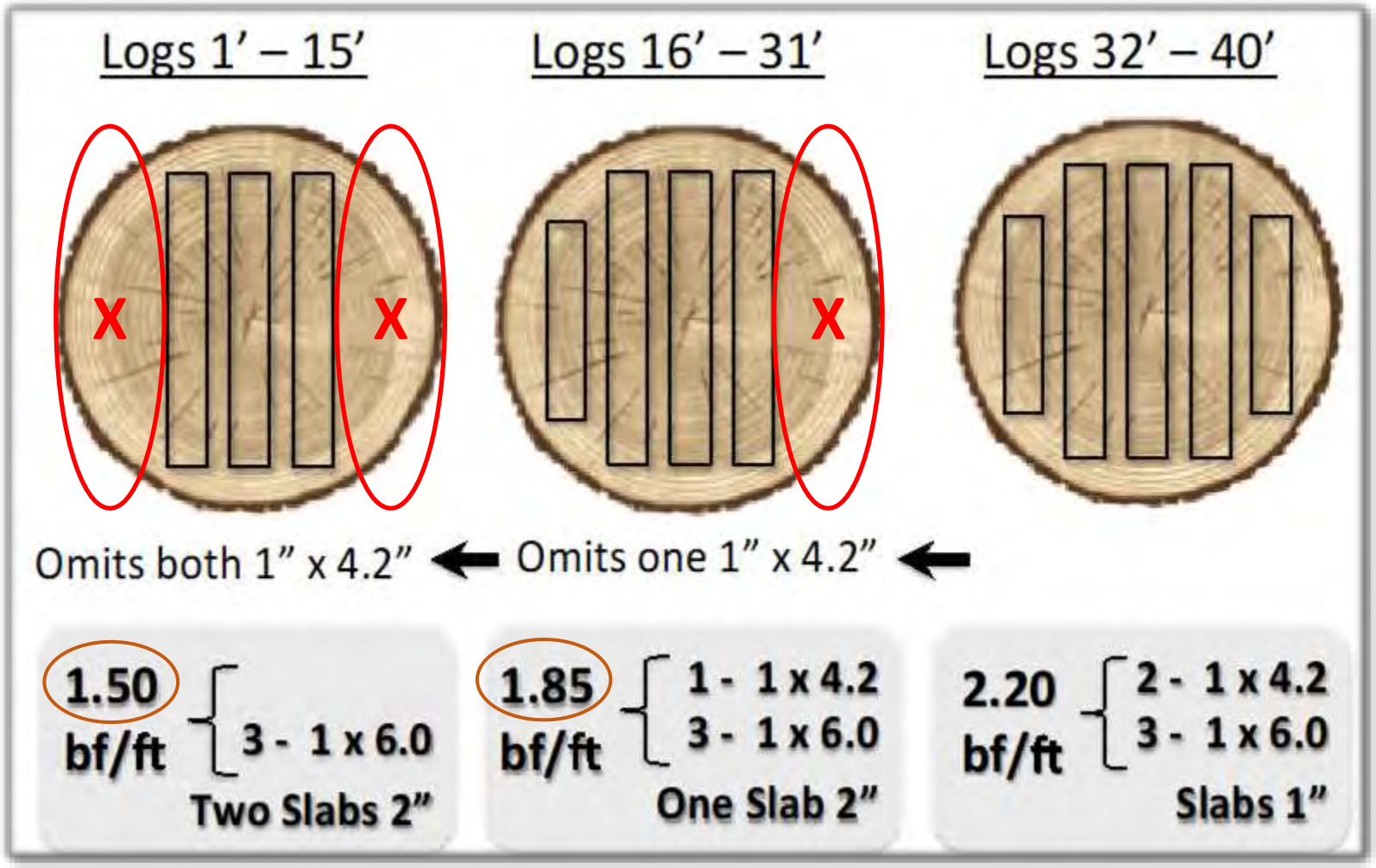
Scribner volume for 8-inch diameter logs



2.20 BF/FT recovery factor as applied to segments of a 40-foot scaling cylinder

SCRIBNER DECIMAL C RULE

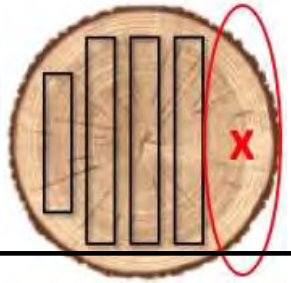
Scribner lumber recovery estimate for 8 inch logs

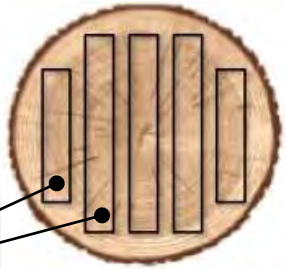


Scribner volume for 8-inch diameter logs

30 feet x 1.85 = 56

60 bf *instead of 70*





2.20 bf/ft
- 2 - 1 x 4.2
- 3 - 1 x 6.0

Slabs 1”

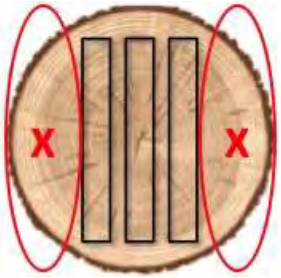
8”

40 feet x 2.20 = 88

90 bf

15 feet x 1.50 = 23

20 bf *instead of 30*



Variable recovery factors applied to logs <32’ yields lower volume for <u>most</u> scaling lengths

Scribner volume for 8-inch diameter logs

LENGTH (feet)	Using 2.20 bf/ft for all scale lengths	Scribner Table Values (bf)	DIFFERENCE
8-9	20	10	*-10 (-50%)*
10-11	20	20	-
12-15	30	20	*-10 (-33%)*
16-18	40	30	*-10 (-25%)*
19-20	40	40	-
21-24	50	40	*-10 (-20%)*
25-29	60	50	*-10 (-17%)*
30-31	70	60	*-10 (-14%)*
32-34	70	70	-
35-38	80	80	-
39-40	90	90	-

Variable recovery factors applied to logs <32' yields lower volume for <u>most</u> scaling lengths

A Dual-Scale Study Identifies Relationship of Volumes Measured Under Different Scaling Regimes

The *only* way to accurately translate between BC Metric and Scribner Scales is to dual-scale all, or a representative sample, of the log population.

Need for a Dual-Scale Study

Prior to 2016, only limited data existed on the relationship of Metric-to-Scribner scale for logs from live trees in the BC Interior,

and *no* publicly available data existed for logs cut from trees killed by mountain pine beetle and spruce beetle infestations.

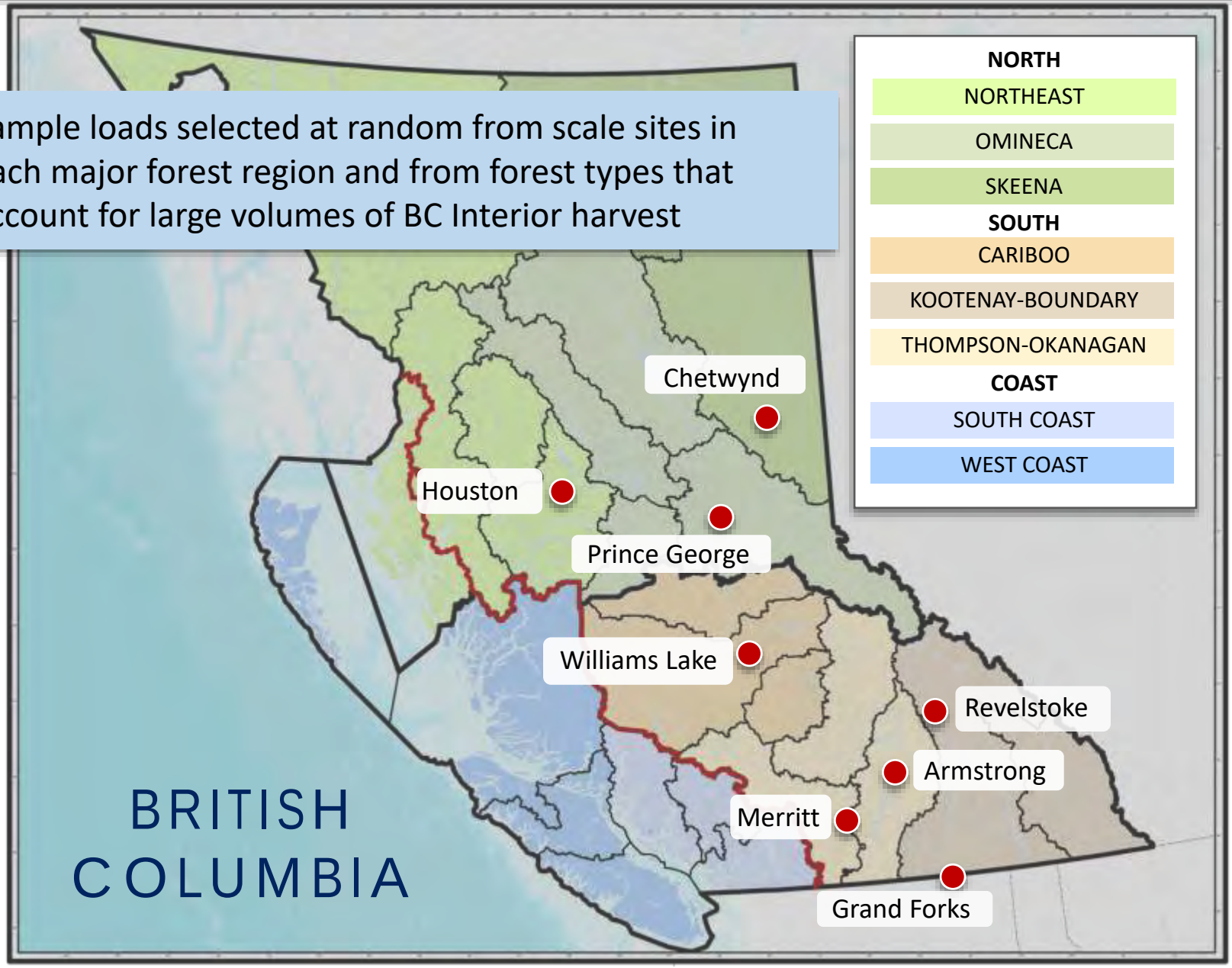
Dual-Scale Study of the Principal Conifer Species of Interior British Columbia Applying the BC Metric and Scribner Short Log Measurement Rules

2016

Jendro & Hart LLC
18160 Cottonwood Road #214
Sunriver, Oregon
97707

BC Interior Dual-Scale Study Sample Sites

Sample loads selected at random from scale sites in each major forest region and from forest types that account for large volumes of BC Interior harvest



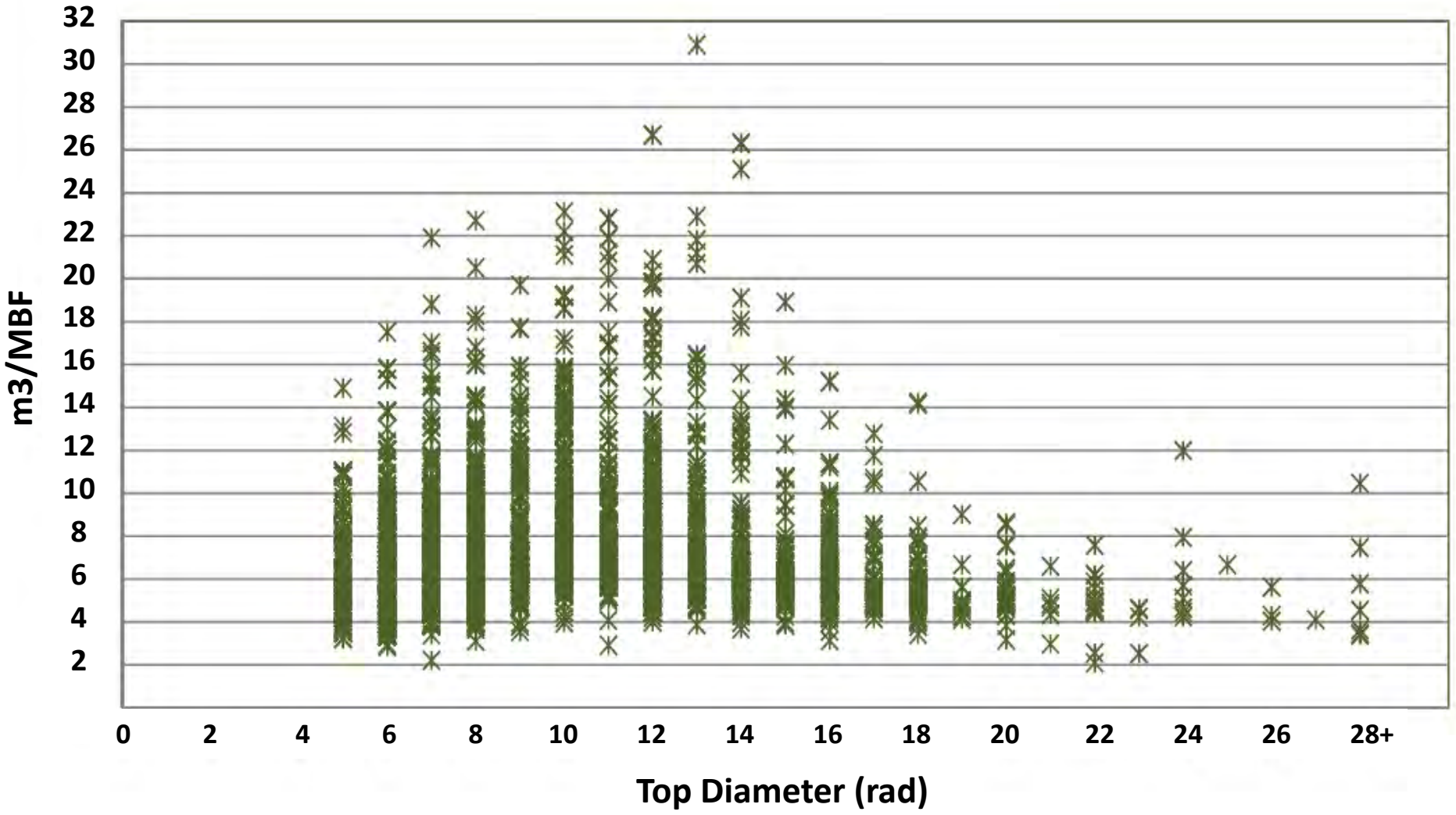
Trained Scalers From Both Sides of Border

From Left to Right

Kevin Wright – BC MFLNRO Interior Check Scaler
Judy Erlam – BC MFLNRO Provincial Scaling Officer and Project Field Supervisor
Tammy Evans – Interior Log Scaling Contractor Pattom Services Ltd. Nakusp BC
James Lane – Log Scaler Pacific Rim Scaling Bureau, USA
Audel Maldonado – Log Scaler Pacific Rim Scaling Bureau, USA

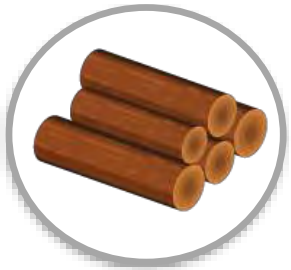
BC Interior Dual-Scale Study – A Detailed Approach

BC Interior Dual-Scale Study Metric-to-Scribner Conversion Ratios (7,237 logs/Segments)



Key Log Attributes That Affect m3/MBF Conversion Ratios

DIAMETER



LENGTH

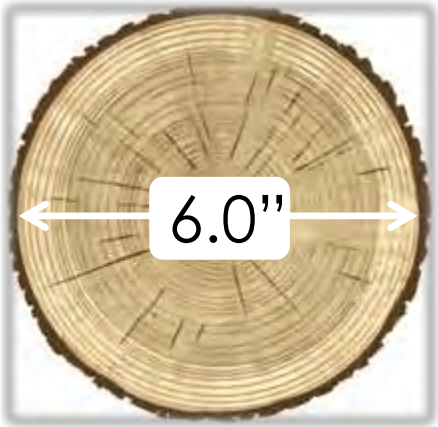
SHAPE

DEFECTS

Log Size – Diameter and Length

Logs 1 and 2 have the same taper (0.1 in/ft), but different diameters

LOG 1



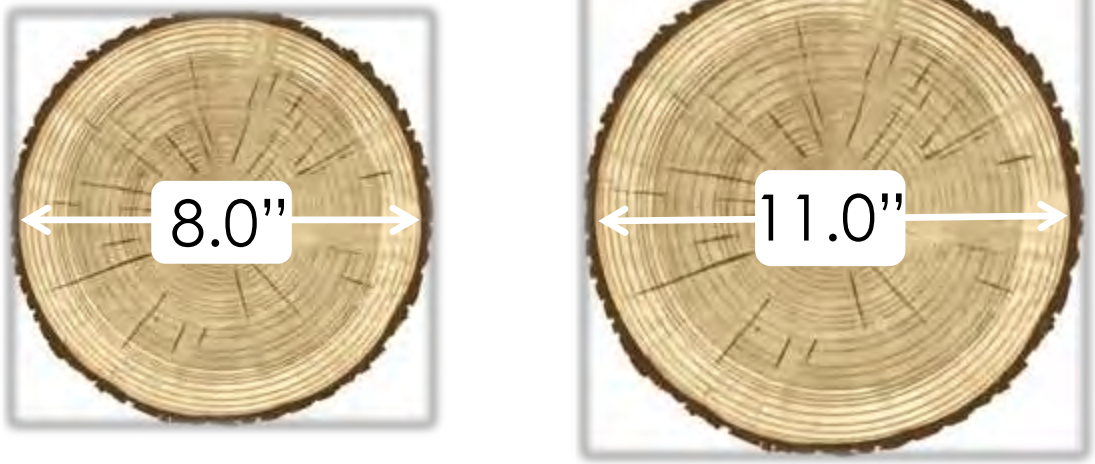
LOG 2

LENGTH	m3/MBF	m3/MBF	DIAMETER VARIANCE
16.33’	6.4	5.3	21%
18.33’	7.2	5.9	22%
20.33’	8.0	6.6	21%
LENGTH VARIANCE:	25%	24%	

>50%

Log Size – Diameter and Length

Logs 1 and 2 have the same taper (0.1 in/ft), but different diameters



LENGTH	m3/MBF	m3/MBF	DIAMETER VARIANCE
16.33’	6.4	5.1	25%
18.33’	7.2	5.0	44%
20.33’	6.6	5.9	12%
LENGTH VARIANCE:	12%	18%	

30%+

Log Shape – Taper

8 inch Logs with varying taper and length

TAPER (in/ft): LENGTH	0.05	0.10	0.15	TAPER VARIANCE
	m3/MBF			
16.33’	5.8	6.4	7.0	21%
18.33’	6.5	7.2	8.7	34%
20.33’	5.4	6.6	7.2	33%
LENGTH VARIANCE:	20%	12%	24%	

61%

BC Interior Dual-Scale Study – Results

Spruce logs cut from live trees (length 62 dm, or 20 ft)

	9	8	7	6	5	4
Scribner Diameter	**9”**	**9”**	**6”**	**8”**	**9”**	**8”**
Gross & Net Metric (dm^3)	390	282	180	238	331	262
Gross & Net Scribner (bf)	50	50	20	40	50	40
Conversion Ratio	7.8	5.6	9.0	6.0	6.6	6.6

BC Interior Dual-Scale Study – Results

Spruce logs cut from live trees (length 62 dm, or 20 ft)

All 9-inch dia. in Scribner

Metric Volumes Vary by 38%

	9	8	7	6	5
Scribner Diameter	9"	9"			9"
Gross & Net Metric (dm^3)	390	282			331
Gross & Net Scribner (bf)	50	50			50
Conversion Ratio	7.8	5.6			6.6

BC Interior Dual-Scale Study – Results

Spruce logs cut from live trees (length 62 dm, or 20 ft)

All 9-inch dia. in Scribner

Metric Volumes Vary by 38%

	9	8	7	6	5
Scribner Diameter	9"	9"			9"
Gross & Net Metric (dm^3)	390	282			331
Metric Diameter (rad)	12	11			12
Taper (rad/dm)	0.065	0.032			0.032

How can these be different?

Due to Differences in Metric Diameter & Taper

BC Interior Dual-Scale Study – Results

Spruce logs cut from live trees (length 62 dm, or 20 ft)

2 cm = 0.787 in.

	9	8	7	6	5
Scribner Diameter	9"	9"			9"
Gross & Net Metric (dm^3)	390	282			331
Metric Diameter (rad)	12	11			12
Taper (rad/dm)	0.065	0.032			0.032

Metric Volumes Vary by 38%

How can these be different?

Due to Differences in Metric Diameter & Taper

Log Size – Diameter Measurement Precision

BC METRIC SCALE

SCRIBNER DECIMAL C RULE

Metric Diameter Class					Scribner Diameter Class				
Metric Scale		Converted to Inches			Inches				
Rads	Cent.	Midpoint	*Low*	*High*	7	8	9	10	11
9	18	7.09	*6.77*	*7.40*	**झझझ**				
10	20	7.87	*7.48*	*8.27*	**9.1प**	**90.9प**			
11	22	8.66	*8.35*	*8.98*		**33.3प**	**67.7प**		
12	24	9.45	*9.06*	*9.84*			**63.6प**	**36.4प**	
13	26	10.24	*9.92*	*10.55*				**88.9प**	**11.1प**
14	28	11.02	*10.63*	*11.42*					**झझझ**

Different measurement precision affects Metric-to-Scribner conversion ratios

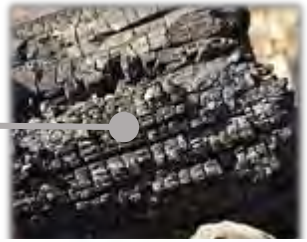
BC Interior Dual-Scale Study – Results

Spruce logs cut from live trees (length 37 dm, or 11 ft)

	10	9	8	7
Scribner Diameter	**12”**	**12”**	**9”**	**15”**
Gross & Net Metric (dm^3)	317	307	198	514
Gross & Net Scribner (bf)	50	50	20	100
Conversion Ratio	**6.3**	**6.1**	**9.9**	**5.1**

Log Quality – Defects

BC METRIC SCALE



SCRIBNER DECIMAL C RULE

All These… Plus:

- Sweep
- Crook / Hooked Butt
- Fork
- Spike Knot / Knot Clusters
- Twist
- Pitch Pockets / Massed Pitch
- Checks / Cracks / Break
- Ring Shake
- Bark Seam

And more…

Differences in treatment of defects affect Metric-to-Scribner conversion ratios

Log Quality – Defects in Beetle-Killed Timber

Lodgepole pine logs cut from beetle-killed trees show significantly higher conversion factors due to substantial and pervasive solid wood defects

Half the BC Interior harvest of lodgepole pine in 2015 was beetle-killed timber

BC Interior Dual-Scale Study – Results

Lodgepole pine logs from beetle-killed trees (length 50 dm, or 16 ft)

	39	38	37	36	35
Scribner Diameter	**10”**	**10”**	**11”**	**11”**	**11”**
Gross Metric (dm^3)	355	287	355	355	355
Gross Scribner (bf)	60	50	60	70	70
Gross Conversion Ratio	**5.9**	**5.7**	**5.9**	**5.1**	**5.1**

BC Interior Dual-Scale Study – Results

Lodgepole pine logs from beetle-killed trees (length 50 dm, or 16 ft)

	39	38	37	36	35
Scribner Diameter	**10”**	**10”**	**11”**	**11”**	**11”**
Net Metric (dm^3)	355	280	355	355	355
Net Scribner (bf)	20	30	30	60	30
Net Conversion Ratio	**17.8**	**9.3**	**11.8**	**5.9**	**11.8**

Log Quality – Defects

Beetle-killed lodgepole with spiraling check defect (length 50 dm, 16 ft)

Butt
16 rads

Checks

	Gross	Deduct	Net
Metric	355	0	355
Scribner	70	40	30
Ratio	5.1		11.8

Top
14 rads (11 in.)

Differences in treatment of defects affect Metric-to-Scribner conversion ratios

Log Quality – Defects

Beetle-killed lodgepole with spiraling check defect (length 50 dm, 16 ft)

Butt
11 rads

Checks

Top
9 rads (7 in.)

	Gross	Deduct	Net	Utility
Metric	159	0	159	-
Scribner	30	>67%	0	30
Ratio	5.3		-	5.3

A portion of BC Grades 2, 4 and 6 scale as Utility grade in Scribner

Defects: Impact of Mountain Pine Beetle

LODGEPOLE PINE LIVE

LODGEPOLE PINE DEAD

BC GRADE	SCRIBNER % DEFECT	SCRIBNER % UTILITY	SCRIBNER m3/MBF	SCRIBNER % DEFECT	SCRIBNER % UTILITY	SCRIBNER m3/MBF
2	12%	8%	6.2	28%	10%	8.4
4	11%	24%	6.7	34%	39%	9.5

Conversion ratio and utility proportion are higher for beetle-killed timber

Defects: Impact of Spruce Beetle

SPRUCE LIVE

SPRUCE DEAD

BC GRADE	SCRIBNER % DEFECT	SCRIBNER % UTILITY	SCRIBNER m3/MBF
2	5%	3%	6.5
4	12%	14%	6.3

SCRIBNER % DEFECT	SCRIBNER % UTILITY	SCRIBNER m3/MBF
22%	12%	7.9
26%	43%	8.1

Conversion ratio and utility proportion are higher for beetle-killed timber

Log Quality – Defects

Catface defect in lodgepole pine log (length 62 dm, 20 ft)

Catface

Butt
16 rads

	Gross	Deduct	Net
Metric	390	0	390
Scribner	70	10	60
Ratio	5.6		6.5

Top
12 rads (10 in.)

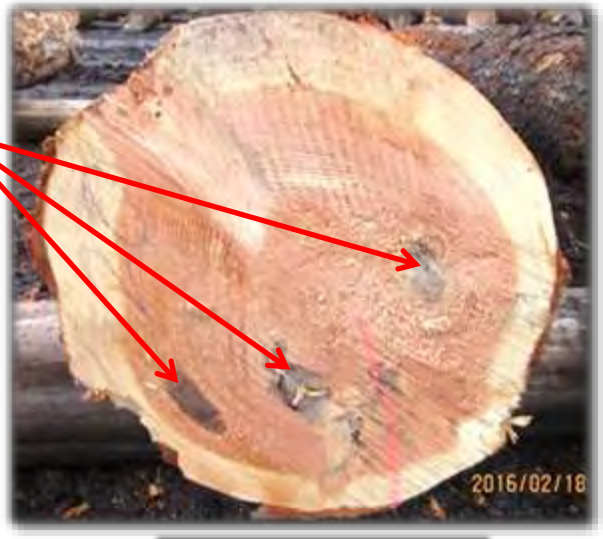
Differences in treatment of defects affect Metric-to-Scribner conversion ratios

Log Quality – Defects

Massed Pitch defect in Douglas-fir log (length 38 dm, 12 ft)

Butt
24 rads

Massed Pitch



Top
20 rads (16 in.)

	Gross	Deduct	Net
Metric	583	0	583
Scribner	120	30	90
Ratio	4.9		6.5

Differences in treatment of defects affect Metric-to-Scribner conversion ratios

Log Quality – Defects

Rot defect at top end of Balsam log (length 37 dm, 11 ft)

Butt
18 rads

Rot

Top
16 rads (12 in.)

	Gross	Deduct	Net
Metric	337	21 (6%)	316
Scribner	50	10 (20%)	40
Ratio	6.7		7.9

Differences in treatment of defects affect Metric-to-Scribner conversion ratios

Why Dual-Scale?

Green Hemlock

Log #	Length (ft) Gross	Length (ft) Net	Diameter (in) Gross	Diameter (in) Net	Scribner BF Gross	Scribner BF Net	m3/MBF
1	17	9	5	5	20	10	7.3
2	17	12	5	5	20	10	8.8

Log #	Length dm	Diameter Top (rad)	Taper (rad/dm)	Metric dm3
1	55	6	0.0182	73
2	56	6	0.0357	88

It's the only way to know the Metric-to-Scribner conversion ratio

Why Dual-Scale?

Six Green Spruce Logs (Grand Forks - Sample Load 729488)

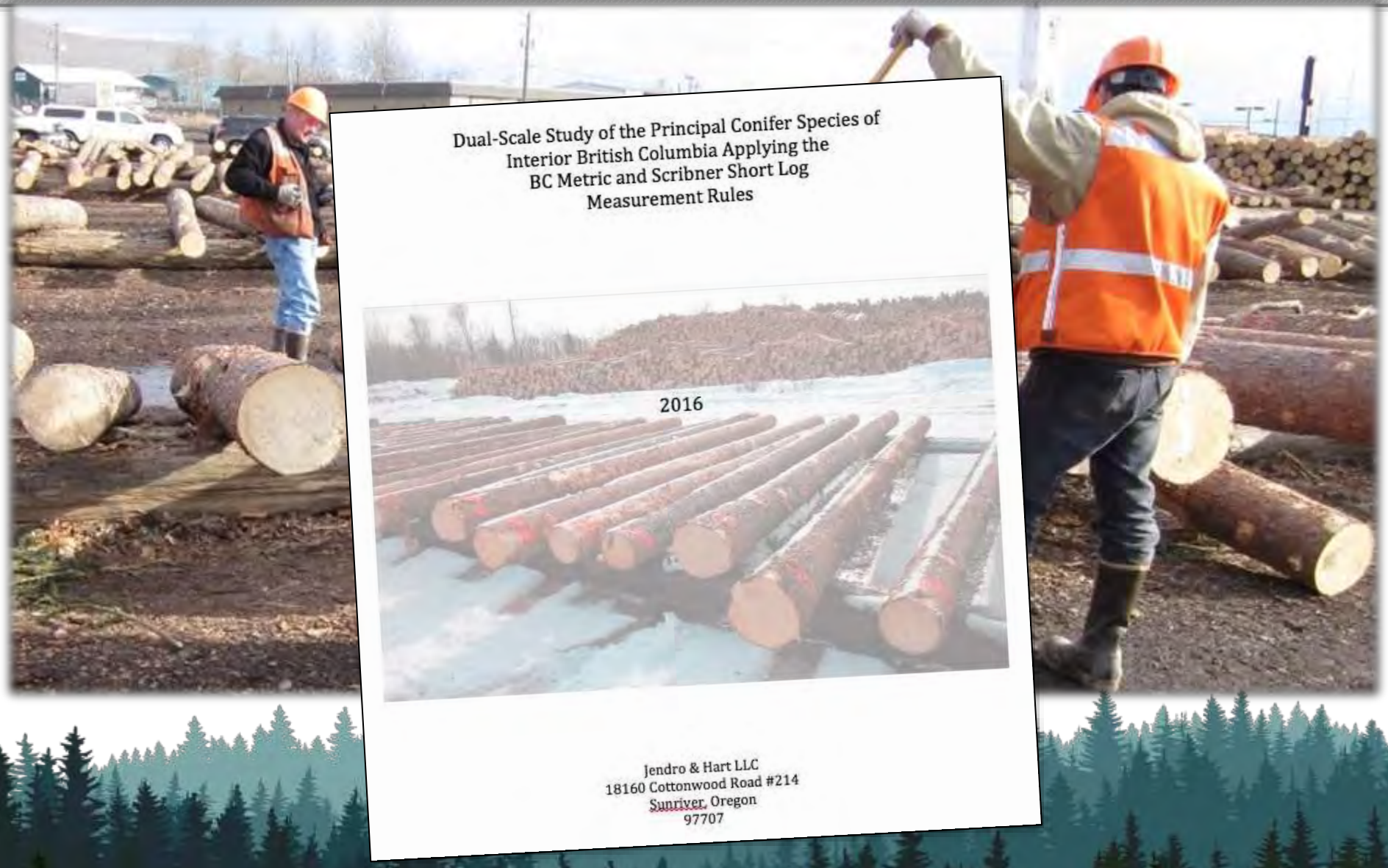
	Scribner Gross & Net			Conversion m3/MBF ?	Metric Gross & Net			
Log #	Length ft	Top Dia. in	BF		Length dm	Top Dia. rad	Butt Dia. rad	dm3
70	20	7	30	5.9	62	9	10	176
75	20	7	30	7.9	62	10	12	238
89	20	7	30	6.8	62	8	12	203
108	20	7	30	6.6	62	9	11	197
149	20	7	30	5.3	6[illegible]	8	10	160
174	20	7	30	8.1	[illegible]	9	13	243

Each has <u>different</u> combination of top & butt diameters

Giving each a <u>different</u> Metric scale volume

It's the only way to know the Metric-to-Scribner conversion ratio

BC Interior Dual-Scale Study



Questions

or

Comments

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