

A QUALITY INDEX FOR NORTHERN RED OAK LOGS FROM GREEN RED OAK LUMBER YIELDS

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The Quality Index

- **Concept of QI initially developed through research at Purdue**
- **Use of the QI to evaluate lumber obtainable from hardwood logs and trees developed as part of the US Forest Service's Hardwood Improvement Program**
 - **Started shortly after WWII to early 1980s**
 - **Evaluated timber stands and mills across Appalachian range**

Slide: Dr. Randall Heiligmann



The Quality Index

- **A single number that expresses the relative value of a log**
 - **Determined by the volume and value of the different grades of 4/4 lumber obtainable from the log**
 - **Assumes the log is sawn entirely into 4/4 lumber**
 - **While not entirely accurate in today's marketplace, it can provide a base case or benchmark**
- **QI tables were based on**
 - **Air-dry lumber grade yields from factory grade hardwood logs**
 - **USFS grades F1, F2, F3**
 - **Data required: Lumber grade yield by log grade, log scaling diameter, and species**
 - **Prices obtained for 4/4 hardwood lumber by grade**
 - **Set to 4/4 #1C price as a base--- Price Relative**

The Quality Index

$$QI^* = (\% \text{ FAS} * PR_{\text{FAS}}) + (\% \text{ \#1C} * PR_{\text{\#1C}}) + (\% \text{ \#2C} * PR_{\text{\#2C}}) + (\% \text{ \#3C} * PR_{\text{\#3C}})$$

% FAS is the volume of lumber that would grade FAS relative to total volume of lumber that could be sawn from the log, etc. for each grade

PR_{FAS} is the ratio of FAS lumber price relative the price of #1C lumber

- Prices gathered over 5 yr period to account for production cycle
- $PR_{\text{\#1C}}$ always equal to 1.00

***Here, F1F combined with FAS; Selects combined with #1C; #2 & #3 A,B combined to #2C and #3C (per USFS and NHLA)**

Developing QI from Green Red Oak Lumber

- Used USFS model to estimate green Red Oak Lumber grade yields
- Data required
 - Scaling Diameter
 - Log Length
 - % Defect
- Used random number generator in Excel to simulate 1,000 sawlogs across ranges of each
 - Ensured values of all variables met minimum grading requirements for each log grade
- Modeling green lumber yields isolated the drying process from the analysis



An Example: % Yield for #1 Northern Red Oak Logs

Scaling Diameter, in.	FAS	1C	2C	3C
13	35.6%	31.0%	22.3%	11.1%
14	37.2%	31.3%	20.9%	10.6%
15	39.5%	30.9%	19.7%	9.9%
16	41.8%	30.6%	18.3%	9.3%
17	44.9%	29.6%	17.1%	8.3%
18	45.6%	30.4%	15.7%	8.3%
19	46.7%	30.7%	14.6%	8.0%
20	47.4%	31.0%	13.7%	7.9%
21	50.6%	29.9%	12.6%	7.0%
22	50.4%	30.9%	11.5%	7.2%
23	50.3%	31.8%	10.6%	7.4%
24	52.7%	31.0%	9.7%	6.6%
AVERAGE	47.2%	30.8%	14.0%	8.0%

% Yield Distribution Calculated for #2 and #3 Logs As Well

Summary: % Yield for Northern Red Oak Logs

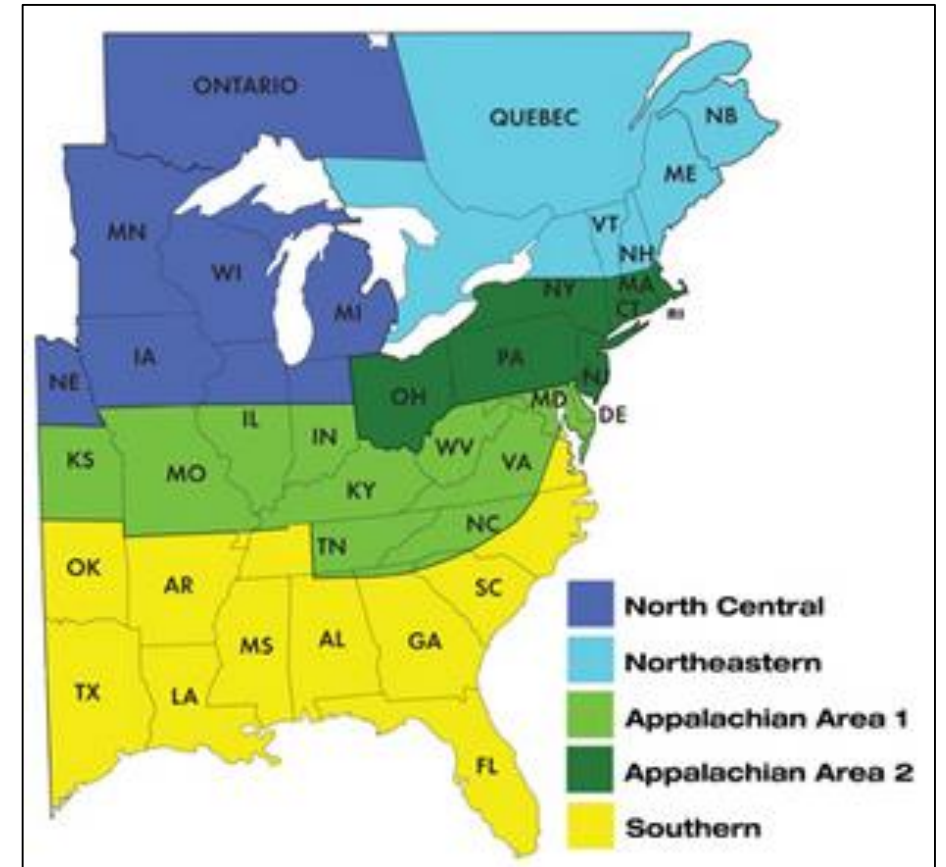
(Averaged Across Diameters)

Log Grade	FAS	1C	2C	3C
Grade 1	47.2%	30.8%	14.0%	8.0%
Grade 2	21.6%	39.8%	22.2%	16.4%
Grade 3	4.4%	21.6%	33.4%	40.6%

5 Year Price Relatives for Green Red Oak Lumber, 8/2010 to 7/2015

Appalachian Region (Area 1)

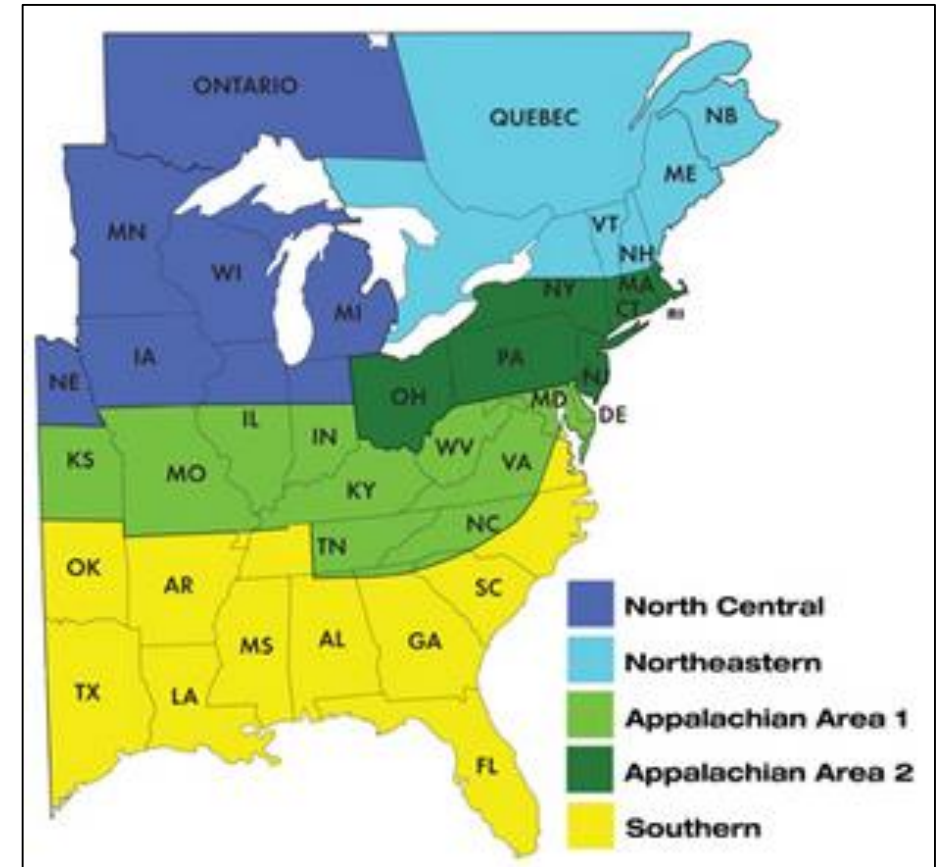
- FAS, 5yr Avg.: \$1,021, PR= 1.50
- #1C, 5yr Avg.: \$681, PR= 1.00
- #2C, 5yr Avg.: \$570, PR= 0.84
- #3C, 5yr Avg.: \$498, PR= 0.73



5 Year Price Relatives for Green Red Oak Lumber, 8/2010 to 7/2015

Southern Region

- FAS, 5yr Avg.: \$953, PR= 1.50
- #1C, 5yr Avg.: \$635, PR= 1.00
- #2C, 5yr Avg.: \$543, PR= 0.86
- #3C, 5yr Avg.: \$473, PR= 0.74



Calculate QI, 16" #1 Northern Red Oak Log as Example

Appalachian Region

$$QI = (\% \text{ FAS} * PR_{\text{FAS}}) + (\% \text{ \#1C} * PR_{\text{\#1C}}) + (\% \text{ \#2C} * PR_{\text{\#2C}}) + (\% \text{ \#3C} * PR_{\text{\#3C}})$$

$$QI = (0.42 * 1.50) + (0.31 * 1.00) + (0.18 * 0.84) + (0.09 * 0.73)$$

$$QI = 1.15$$

Calculate QI, 16" #1 Northern Red Oak Log as Example

Southern Region

$$QI = (\% \text{ FAS} * PR_{\text{FAS}}) + (\% \text{ \#1C} * PR_{\text{\#1C}}) + (\% \text{ \#2C} * PR_{\text{\#2C}}) + (\% \text{ \#3C} * PR_{\text{\#3C}})$$

$$QI = (0.42 * 1.50) + (0.31 * 1.00) + (0.18 * 0.86) + (0.09 * 0.74)$$

$$QI = 1.16$$

Northern Red Oak Quality Index, Appalachian Region

Scaling Diameter	GRADE 1	GRADE 2	GRADE 3
8	(----	(----	0.79
9	(----	(----	0.80
10	(----	(----	0.82
11	(----	0.91	0.83
12	(----	0.94	0.85
13	1.11	0.95	0.86
14	1.12	0.97	0.87
15	1.14	0.99	0.89
16	1.15	1.00	0.90
17	1.17	1.01	(----
18	1.18	1.03	(----
19	1.19	1.03	(----
20	1.19	1.05	(----
21	1.21	1.06	(----
22	1.21	1.07	(----
23	1.21	1.07	(----
24	1.23	(----	(----
AVERAGE	1.19	1.03	0.86

Northern Red Oak Quality Index, Southern Region

Scaling Diameter	GRADE 1	GRADE 2	GRADE 3
8	(----	(----	0.80
9	(----	(----	0.81
10	(----	(----	0.83
11	(----	0.92	0.84
12	(----	0.95	0.86
13	1.12	0.96	0.87
14	1.13	0.98	0.88
15	1.14	1.00	0.90
16	1.16	1.01	0.91
17	1.18	1.02	(----
18	1.18	1.04	(----
19	1.19	1.04	(----
20	1.20	1.05	(----
21	1.22	1.06	(----
22	1.22	1.07	(----
23	1.22	1.08	(----
24	1.23	(----	(----
AVERAGE	1.18	1.02	0.86

**So How Can We Use
the Quality Index?**

So How Can We Use the Quality Index?

It's Easy!

Apply the current price you are receiving for #1C lumber to the QI

This will yield a predicted Lumber Product Value

This example shows the QI table for the Appalachian region and the region's average price for #1C lumber in July, 2015 (per prices reported in Hardwood Review)

Scaling Diameter	GRADE 1	GRADE 2	GRADE 3	LUMBER PRICE
8	(----	(----	0.79	\$535
9	(----	(----	0.80	\$535
10	(----	(----	0.82	\$535
11	(----	0.91	0.83	\$535
12	(----	0.94	0.85	\$535
13	1.11	0.95	0.86	\$535
14	1.12	0.97	0.87	\$535
15	1.14	0.99	0.89	\$535
16	1.15	1.00	0.90	\$535
17	1.17	1.01	(----	\$535
18	1.18	1.03	(----	\$535
19	1.19	1.03	(----	\$535
20	1.19	1.05	(----	\$535
21	1.21	1.06	(----	\$535
22	1.21	1.07	(----	\$535
23	1.21	1.07	(----	\$535
24	1.23	(----	(----	\$535
AVERAGE	1.19	1.03	0.86	\$535

Red Oak Lumber Product Values

Appalachian Region as an Example

Scaling Diameter	GRADE 1	GRADE 2	GRADE 3
8	(----	(----	\$421
9	(----	(----	\$429
10	(----	(----	\$436
11	(----	\$489	\$445
12	(----	\$504	\$453
13	\$595	\$509	\$460
14	\$601	\$521	\$467
15	\$609	\$530	\$474
16	\$617	\$536	\$479
17	\$628	\$542	(----
18	\$631	\$552	(----
19	\$635	\$553	(----
20	\$638	\$561	(----
21	\$649	\$566	(----
22	\$649	\$571	(----
23	\$649	\$574	(----
24	\$658	(----	(----
AVERGAGE	\$638	\$550	\$459

Product Values are per MBF of lumber (#3C & Better) obtained from a log with Dia=X and Grade=Y

The predicted value of one MBF of lumber obtained from Grade 1 Red Oak logs with SD=16" is \$617

Or, the average predicted value of one MBF of lumber all dias. of Grade 1 Northern Red Oak logs is \$638

Note, as the current #1C lumber price changes, the Lumber Product value will change

Be sure to use the most current price to obtain the most up to date information!

Another Way of Using the QI

Quality Index is useful for estimating value of lumber in a single log

Once grade is determined...

- Apply the QI for given Diameter
 - To current price of #1C lumber
 - And to the lumber yield



Lumber Product Value, Log Scale

Suppose an Appalachian Northern Red Oak log

- 16" SD
- 12' excluding trim
- 5% defect
- Grade 1
- 135 bdft*
- QI= 1.15

*From Yaussy and Brisbin model

130 bdft. Int'l ¼"; 108 bdft. Doyle



Calculate Lumber Product Value for this Log

$$\text{LPV} = (\text{Log Volume} / 1,000) * (\text{QI}) * (\text{Current Price 4/4 \#1C})$$

Or

$$\text{LPV} = (\text{Log Volume}) * (\text{QI}) * (\text{Current Price 4/4 \#1C} / 1,000)$$

Either is fine

Northern Red Oak Log Lumber Product Values

**LPV= (Log Volume / 1,000) * (QI)
* (Price 4/4 #1C)**

LPV = (135/1,000) * 1.15 * \$535

Suppose a Northern Red Oak log

- **16" SD**
- **12' excluding trim**
- **5% defect**
- **Grade 1**
- **135 bdft**
- **QI= 1.15**
- **#1C Price= \$535/MBF (July, 2015)**

Northern Red Oak Log Lumber Product Values

Appalachian Red Oak Log

16" DIA, 12' Log	BF, Int.	QI	Price #1C	Lumber Product Value
Grade 1	135	1.15	\$535	\$83

The value of the lumber (#3C & Better) obtained from this log is predicted to be \$83.

Note: this is the value of the lumber in the log, not the value of the log!

Northern Red Oak Log Lumber Product Values

Appalachian Red Oak Log

16" DIA, 12' Log	BF, Int.	QI	Price #1C	Lumber Product Value
Grade 1	135	1.15	\$535	\$83
Grade 2	135	1.00	\$535	\$72
Grade 3	135	0.90	\$535	\$65

The value of the lumber (#3C & Better) obtained from a Grade 1 log is predicted to be \$83.

The value of the lumber (#3C & Better) obtained from a Grade 2 log is predicted to be \$72.

The value of the lumber (#3C & Better) obtained from a Grade 3 log is predicted to be \$65.

Note: this is the value of the lumber in the log, not the value of the log!

The Quality Index

- **Practical and easy to use**
- **For Lumber Product Value per MBF**
 - **Apply the QI to the current price of 4/4 #1C lumber**
- **For Lumber Product Value of a Log**
 - **Apply Yaussy & Brisbin model to get lumber volume**
 - **Or use proprietary information**
 - **Or obtain scale volume from log rule specific to area (*must apply over/underrun)**
 - **Doyle, Scribner, International ¼", etc.**

The Quality Index

- **Practical and easy to use**
- **All of the data needed to make business-specific QI's are often contained in the mill/buyer's records**
 - **Log scale and quality data**
 - **Lumber grade yield for each log grade**
 - **Lumber prices obtained**
- **Based on final product value, and allowing for individual costs and profit, can determine price to pay for log**

The Quality Index

- **Lumber price relatives are 5 yr avgs, indexed to #1C**
 - **As grades' prices change, so will Price Relatives, and so will QI**
 - **As prices change between grades, so will Price Relatives, and so will QI**
- **Assumes all lumber is 4/4**
 - **Rarely the case, but still provides a base case for further comparisons**
 - **QI adjustments were researched by USFS some years ago**
 - **For #1 and #2 logs, the QI predicted product value within $\pm 10\%$, and scaling diameter was not a factor**
 - **Plan is to update so the lumber product values for logs accommodate a range of products**

The Quality Index

- **Plan periodic updates**
 - **Further research needed to determine how often revisions are needed**
 - **At the least, annual or biannual**
 - **Preliminary research suggested monthly update not required**
- **Plan to develop QIs for other species**
 - **Work has begun on White Oak QI**

Questions or Comments About the QI

Slide: Dr. Randall Heiligmann

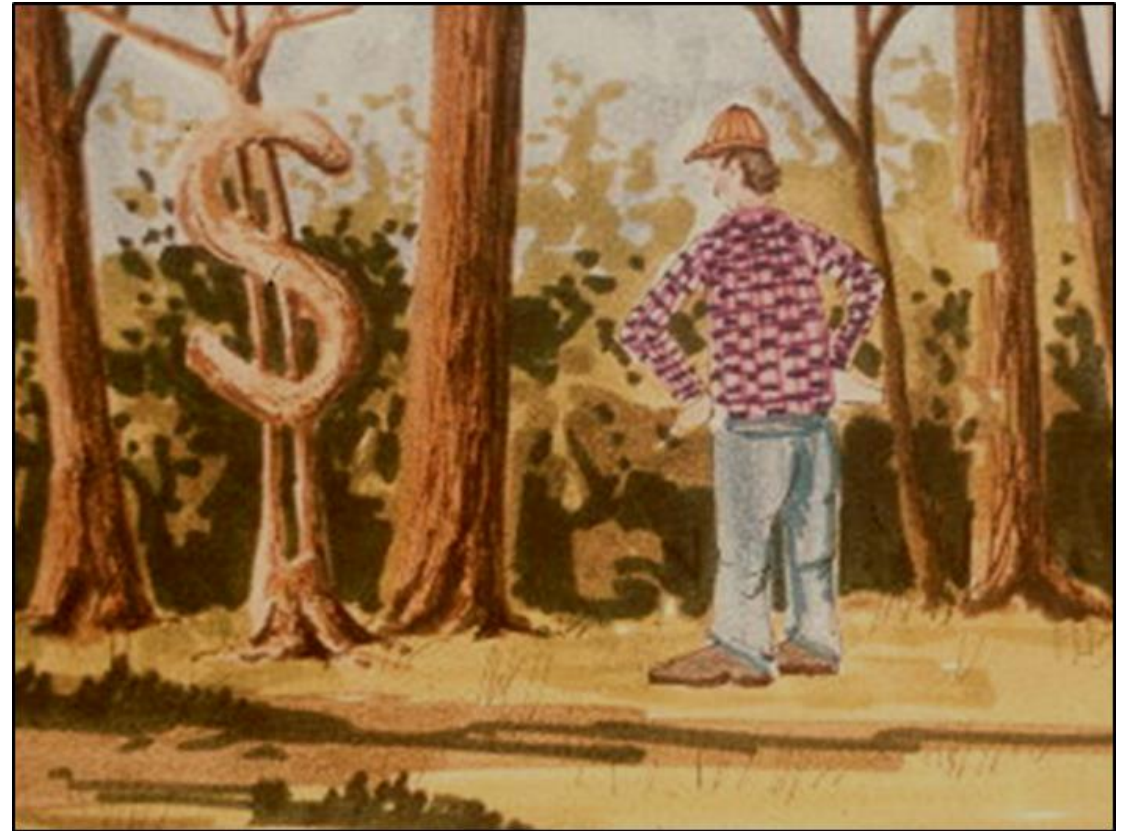
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