Tanoak Utilization: Coordination of Tanoak Recovery and Yield Studies and Knowledge Transfer

Progress Report No. 4

by

John R. Shelly, Ph.D.
CE Advisor - Biomass and Forest Products

July 26, 2000

UNIVERSITY OF CALIFORNIA
FOREST PRODUCTS LABORATORY

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TABLE OF CONTENTS

Introduction

This is the fourth project report of the University of California Forest Products Laboratory (UCFPL) Tanoak yield and recovery study. Progress Report #1 (Shelly 1998) summarized the project objectives, scope and the procedures for study tree selection and harvesting.[1] Project Report 2 describes the field activities, harvesting, milling, grading, and drying procedures at the Mendocino Hardwood Development Association (MHDA) and Institute for Sustainable Forestry (ISF) project sites.[2] Progress Report #3 reported the preliminary results of the the green lumber production and grading as well as the partial data from the early kiln drying runs.[3] This report covers the period from November 1, 1999 to March 30 2000, during which time the following project milestones where addressed.

Table 1. Project Milestones From November 1999 to April 2000

Task	Initiated	Completed
Analysis of Selected Specimens at UCFPL	May 1, 1999	In Progress
Kiln drying of ISF lumber:		
Kiln Runs 1 - 4	April 14, 1999	November 11, 1999
Kiln Run 5	January 10, 2000	January 24, 2000
Kiln Run 6	February 6, 2000	February 29, 2000
ISF Dry Lumber Grading		
Kiln Runs 1 - 3	May 20, 1999	August 20, 1999
Kiln Run 4		February 10, 2000
Kiln Run 5		February 12, 2000
Kiln Run 6		March 20, 2000
Field and Mill Site Data Collection	October 1, 1998	March 17, 2000
Project Report at two Public Hardwood Meetings		April 12, 2000 April 19, 2000
Data Analysis and Reporting	May 1, 1999	In Progress

[1] Shelly, John R. 1998. Tanoak Utilization: Coordination of Tanoak Recovery and Yield Studies and Knowledge Transfer. Progress Report #1. August 1998. University of California Forest Products Laboratory, Richmond, CA.

[2] Shelly, John R. 1999. Tanoak Utilization: Coordination of Tanoak Recovery and Yield Studies and Knowledge Transfer. Progress Report #2. April 1999. University of California Forest Products Laboratory, Richmond, CA.

[3] Shelly, John R. 1999. Tanoak Utilization: Coordination of Tanoak Recovery and Yield Studies and Knowledge Transfer. Progress Report #3. December 1999. University of California Forest Products Laboratory, Richmond, CA.

Preliminary Results

As of this report date all of the study lumber has been milled, dried and surfaced. Except for the final two kiln runs of the ISF lumber, all data has been entered into computer databases and the analysis of the data has started.

Data summaries of the green lumber yield were presented in Progress Report 3. Additional information, including the dry lumber yield and information on discoloration that developed during drying is presented in Appendix of this report. This information was presented in the two hardwood training workshops presented on April 12 and April 19, 2000.

Future Work

The final stages of the data analysis are in progress. In addition to the green and dry lumber yields reported in the progress reports to date, the dry lumber will also be analyzed for dying defects. Selected specimens of dry lumber from each group was shipped to the UC Forest Products Laboratory for analysis of the final lumber thickness, moisture content, and magnitude of drying defects. The dry lumber grade yield will be analyzed by log grade and also drying method to determine the best method. This analysis will also indicate if different dying methods are needed for the different types of lumber represented by the ISF and MHDA sites. In addition, the time and cost data for all stages of production are being collected and will be analyzed to estimate production costs. The analysis is expected to be completed by June 2000.

All results and conclusions will be reported in the final project report as well as presented at the annual meeting of the Forest Products Society on June 20, 2000.

Appendix – Summary of Tanoak Yield and Recovery as Presented in the Hardwood Training Workshops

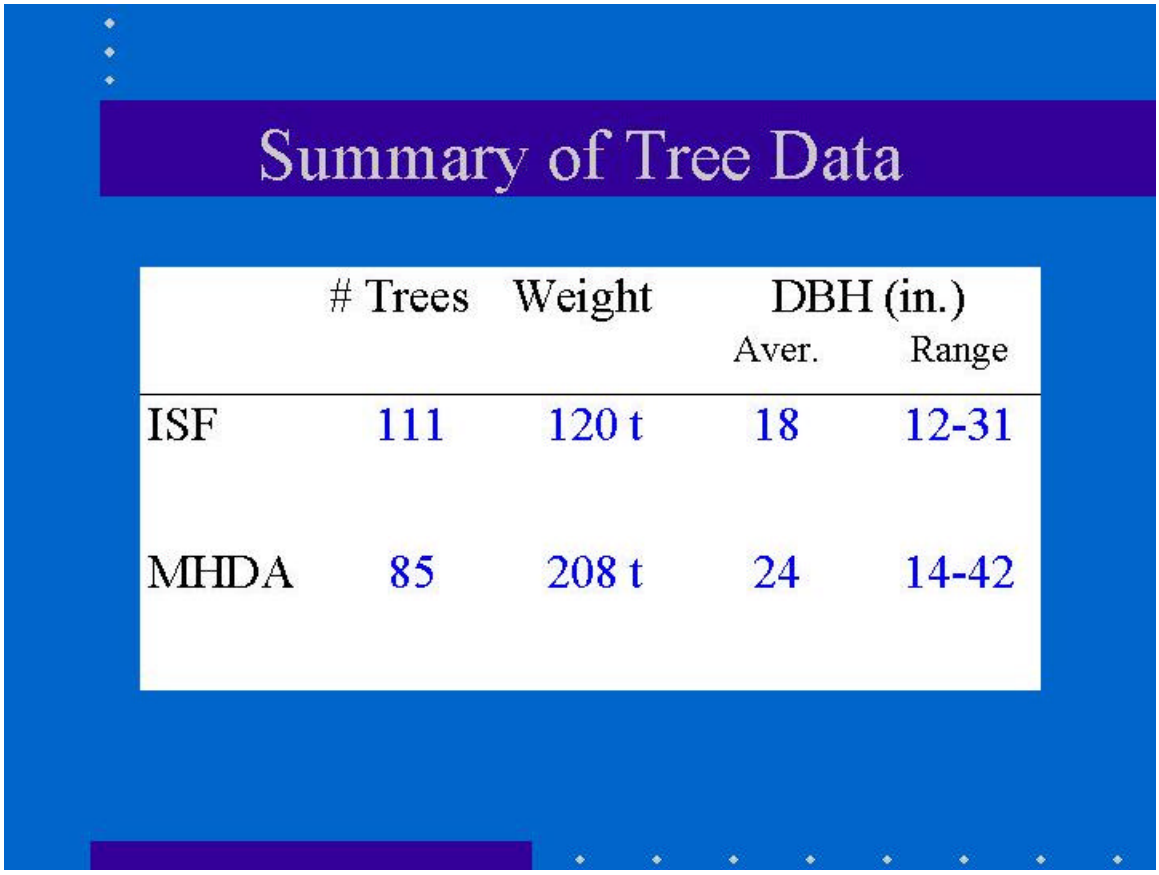

Figure 1. Summary of Tree Data

Trees were selected from two sites. The ISF site was in southern Humbolt county and the MHDA site was in the vicinity of Branscomb, CA. The trees at the ISF site were generally smaller, younger trees with an average diameter (DBH) of 18 inches compared to 24 inches at the MHDA site. The reported weight is for the material hauled to the mill site.

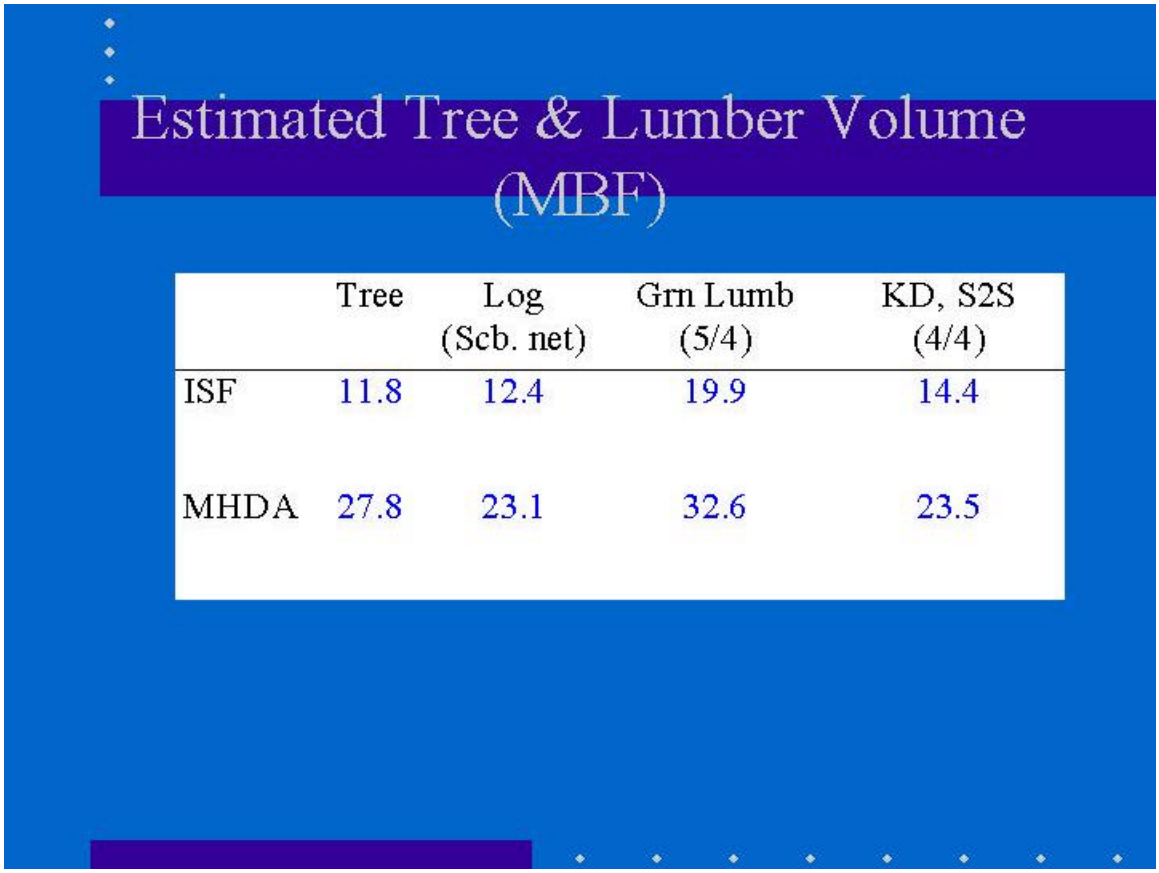

Figure 2. Estimated Tree and Lumber Volume (MBF)

The volume tally of green lumber was greater than the estimated volume based on the tree and log data. This overrun was 60 percent for the ISF material and 41 percent for the MHDA material, measured on a 5/4-inch thick basis. After kiln drying and surfacing the lumber the overrun dropped to 16 percent for ISF and 2 percent for MHDA. This drop is explained by the loss in thickness due to shrinkage during drying and the material removed during planing. The more dramatic reduction in dry volume for the MHDA lumber is due to the excessive cell collapse that occurred during drying in the MHDA lumber. Cell collapse was much less of a problem in the ISF material.

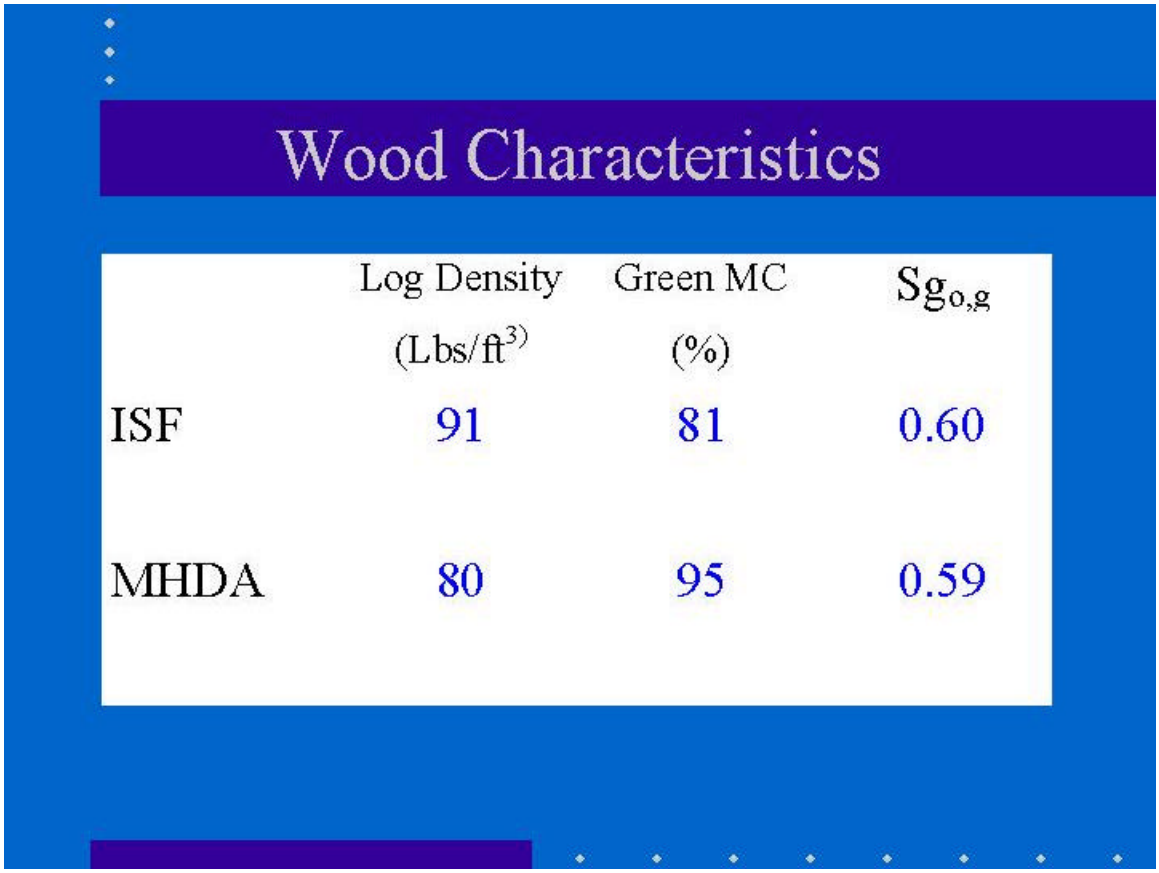

Figure 3. Wood Characteristics

The study logs ranged from 80 to 91 lbs/ft3, based on the net weight of the delivered logs and the scaled log volume. The MHDA logs averaged a green moisture content of 95 percent compared to only 81 percent for the ISF logs. The higher MC for the MHDA logs is consistent with the observation that the logs contained a higher proportion of mineral streak. This mineral streak is know to be a zone of high moisture content that usually develops cell collapse during drying.

The average wood density (measured as specific gravity on an oven dry mass and green volume basis) from the two sites was very similar, 0.59 for the MHDA material and 0.60 for ISF.

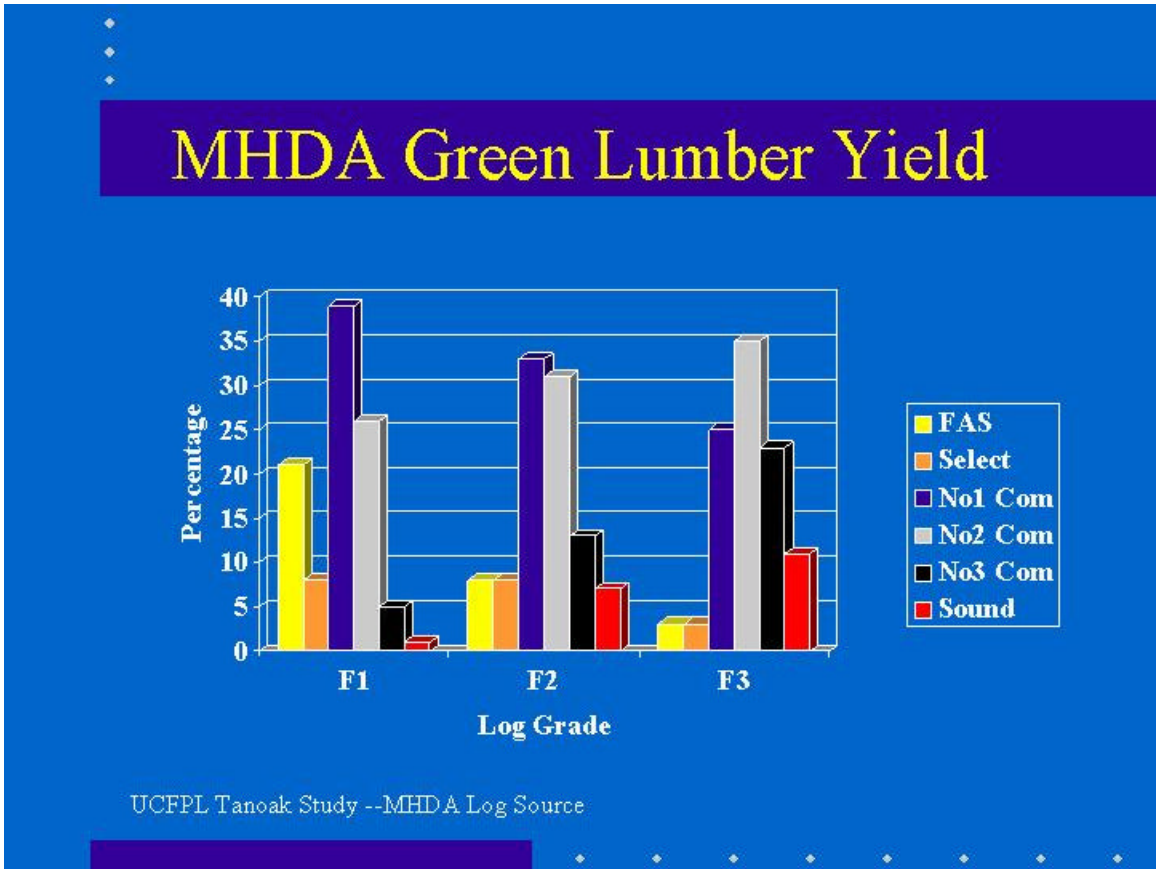

Figure 4. MHDA Green Lumber Yield

The yield of NHLA green lumber grades from the tanoak harvested at the MHDA site are consistent with the expectations for each log grade from other hardwood species. The 68% yield of upper grades (FAS, Select, and NO1 common) for F1 was comparable to the dry lumber yield of 65% for eastern white oak. The upper grade yield for F2 was 49% and 31% for F3 compare favorably with the respective 40% and 21% expected for eastern white oak.

The dry lumber yield for the tanoak log grades does not compare as well with the dry lumber grades of other hardwood species indicating that drying defects are a major challenge in processing tanoak lumber. This relationship is explored further in Figures 6 and 7.

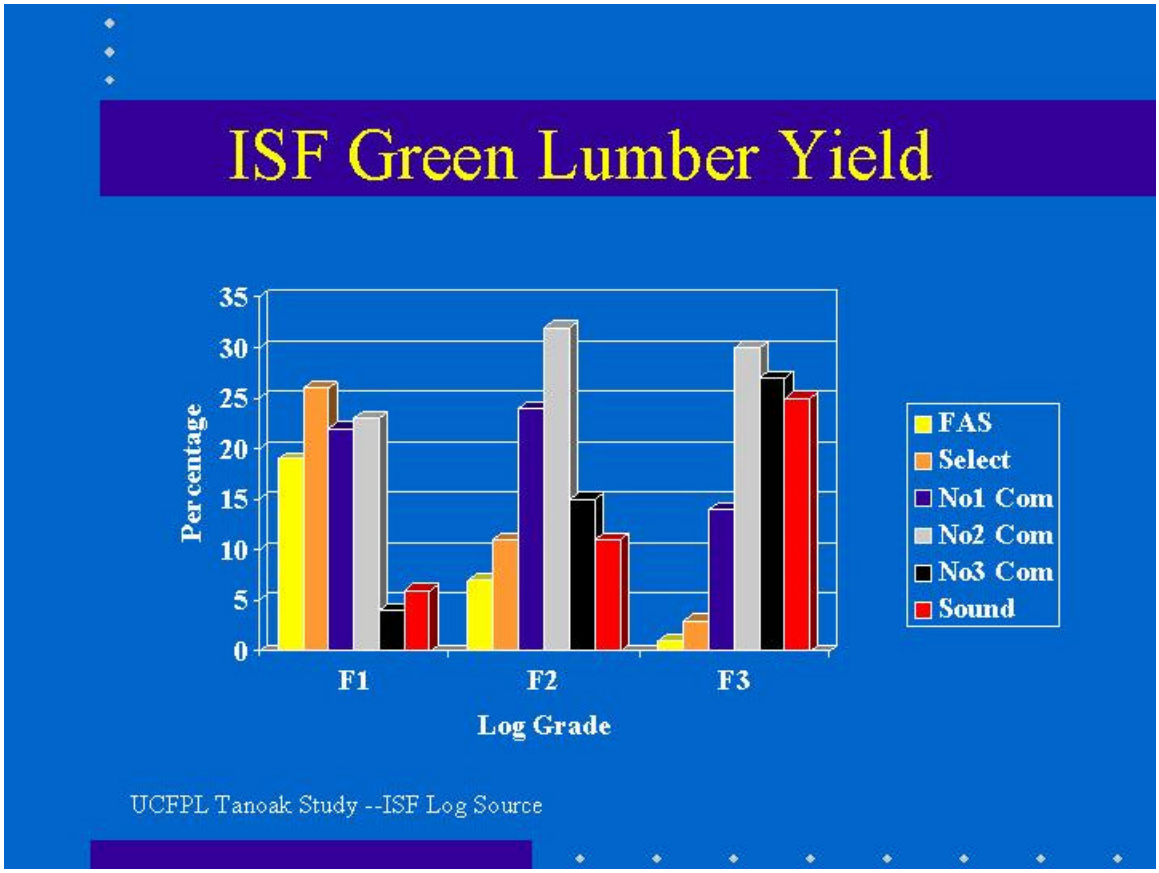

Figure 5. ISF Green Lumber Yield

Similar to the results for the MHDA lumber the yield of upper grade green lumber for the ISF lumber was 67% for F1 logs and 42% for F2. The upper grade yield for the F3 logs was lower than expected at 18%, compared to the MHDA F3 yield of 31%. This reflects the smaller tree size sampled at the ISF site. The F3 log grade is expected to have a higher proportion of the smaller logs; F1 and F2 would have more of the larger logs.

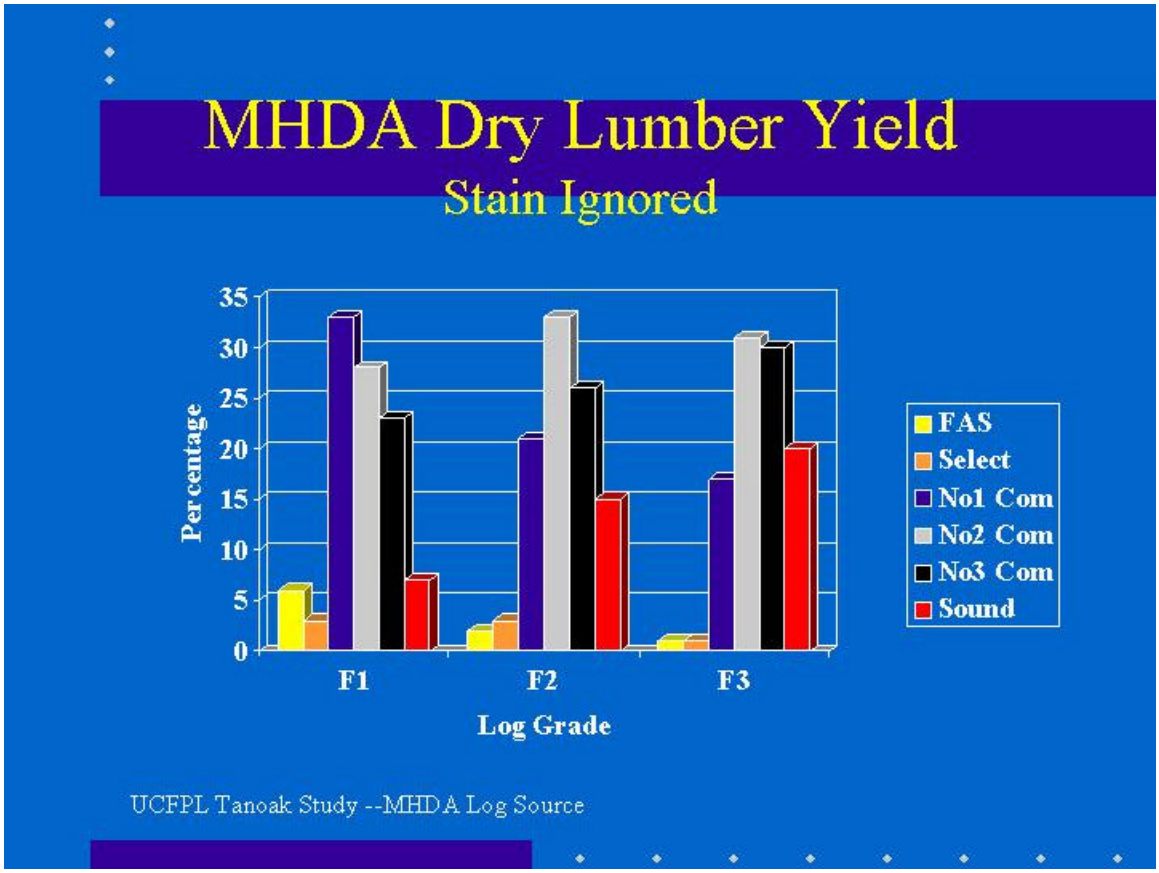

Figure 6. MHDA Dry Lumber Yield

For the two top log grades, the yield of NHLA dry lumber grades of the tanoak harvested at the MHDA site are lower than expectations compared to other hardwood species. The 42% yield of upper grades (FAS, Select, and No1 common) for F1 was about 1/3 less than the expected 65% dry lumber yield of upper grades for eastern white oak. The upper grade yield for F2 of 26% for the tanoak is also about 1/3 less than that of white oak. The dry lumber yield of 19% for F3 tanoak logs is similar to the 21% expected for white oak.

The lower than expected yield of upper grade lumber from the F1 and F2 log grades for dried lumber is not apparent when the lumber is graded green, suggesting that the MHDA lumber suffered from serious drying defects. This hypothesis is consistent with observations of excessive shrinkage and collapse found in the kiln dried MHDA lumber.

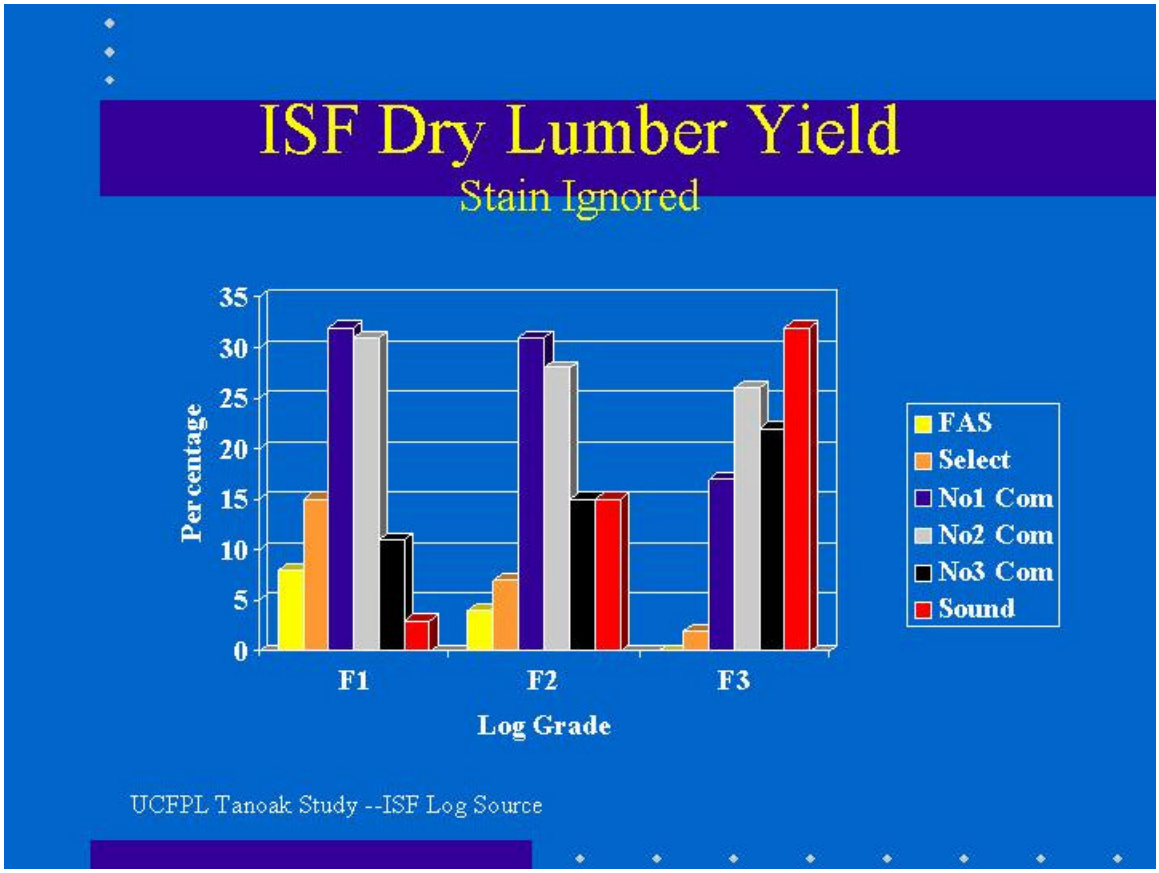

Figure 7. ISF Dry Lumber Yield

The yield of upper grade, dry lumber for the ISF material was closer to expectation that the MHDA material. The 55% yield of upper grades (FAS, Select, and No1 common) for F1 was only about 1/6 less than the expected 65% dry lumber yield of upper grades for eastern white oak. The upper grade yield for F2 of 42% and the 19% for F3 is very similar to the 40% and 21% expected for white oak for the respective log grades.

Since the yield of upper grade lumber from the all log grades is similar to the expectations for similar eastern hardwood species it is suggested that the ISF lumber did not suffer from the same serious drying defects that plagued the MHDA material. This hypothesis is consistent with field observations that the ISF material had fewer drying defects than noted in the MHDA trials.

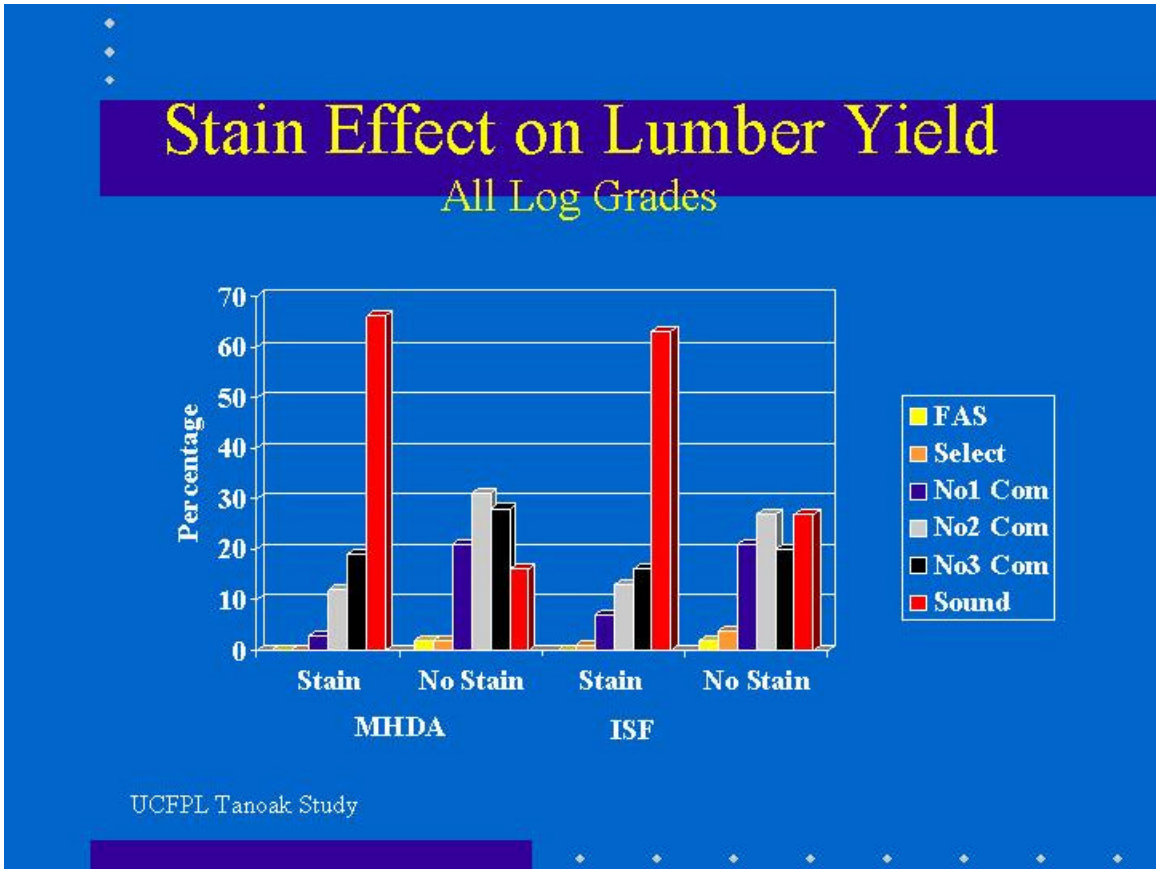

Figure 8. Stain Effect on Lumber Yield

After the lumber was kiln dried and surfaced it was noted by the lumber grader that the wood varied greatly in color due to enzymatic/chemical staining. If these areas of discoloration were classified as stain, a grading defect, then the upper grade yield (FAS, Select, No1 Common) dropped dramatically. The yield of upper grade tanoak lumber from all log grades dropped from about 25% to 3% for the MHDA lumber and from 35% to 8% for the ISF lumber.

Clarification is needed to assess if the discoloration noted should be considered a grading defect.

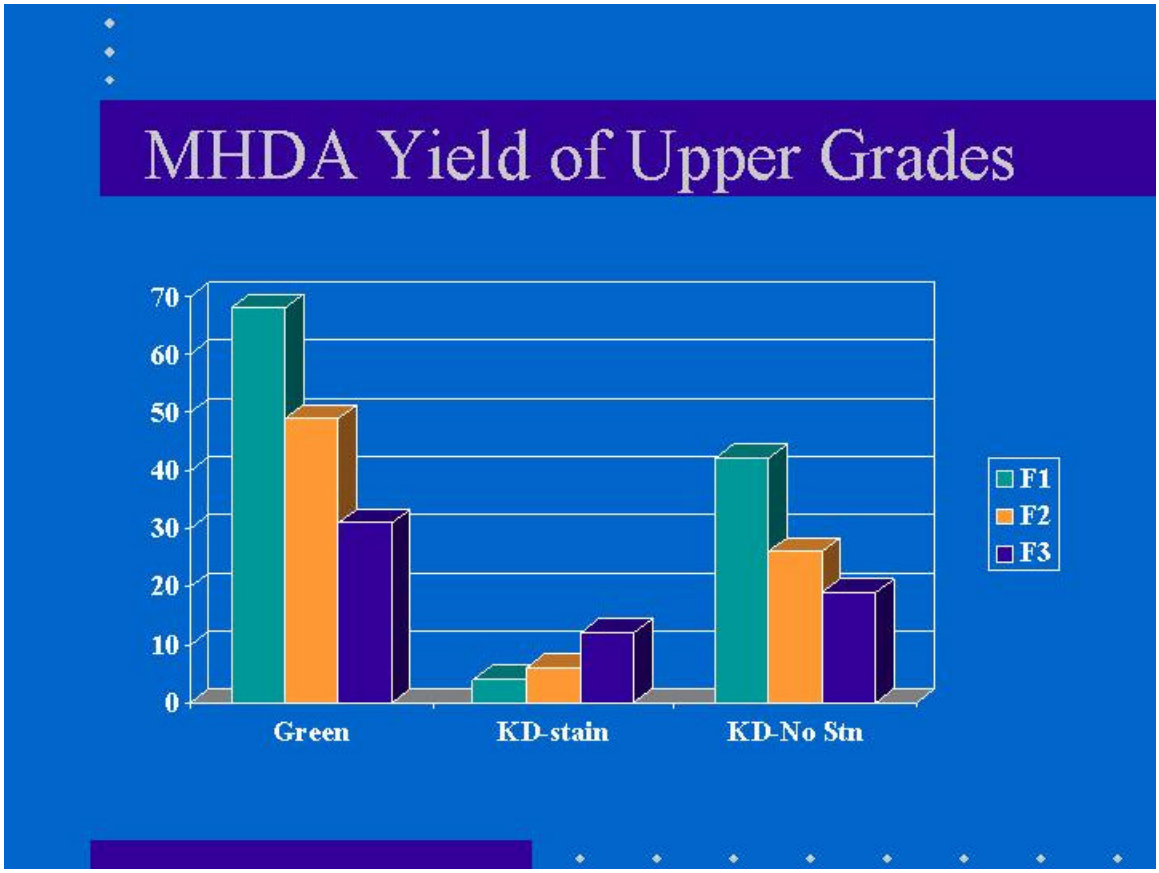

Figure 9. MHDA Yield of Upper Grades

The grading effect of drying defects and stain as a defect is clearly illustrated in the Figures 9 and 10. The 1/3 drop in upper grades in the MHDA lumber from green to kiln-dried, without considering stain as a defect (KD-No Stn), shown in Figure 9, is due to the high incidence of collapse and warp found in the MHDA lumber. When stain is considered a defect (KD-stain) the grade yield drops to unacceptable levels, with the greatest effect found in the higher log grades.

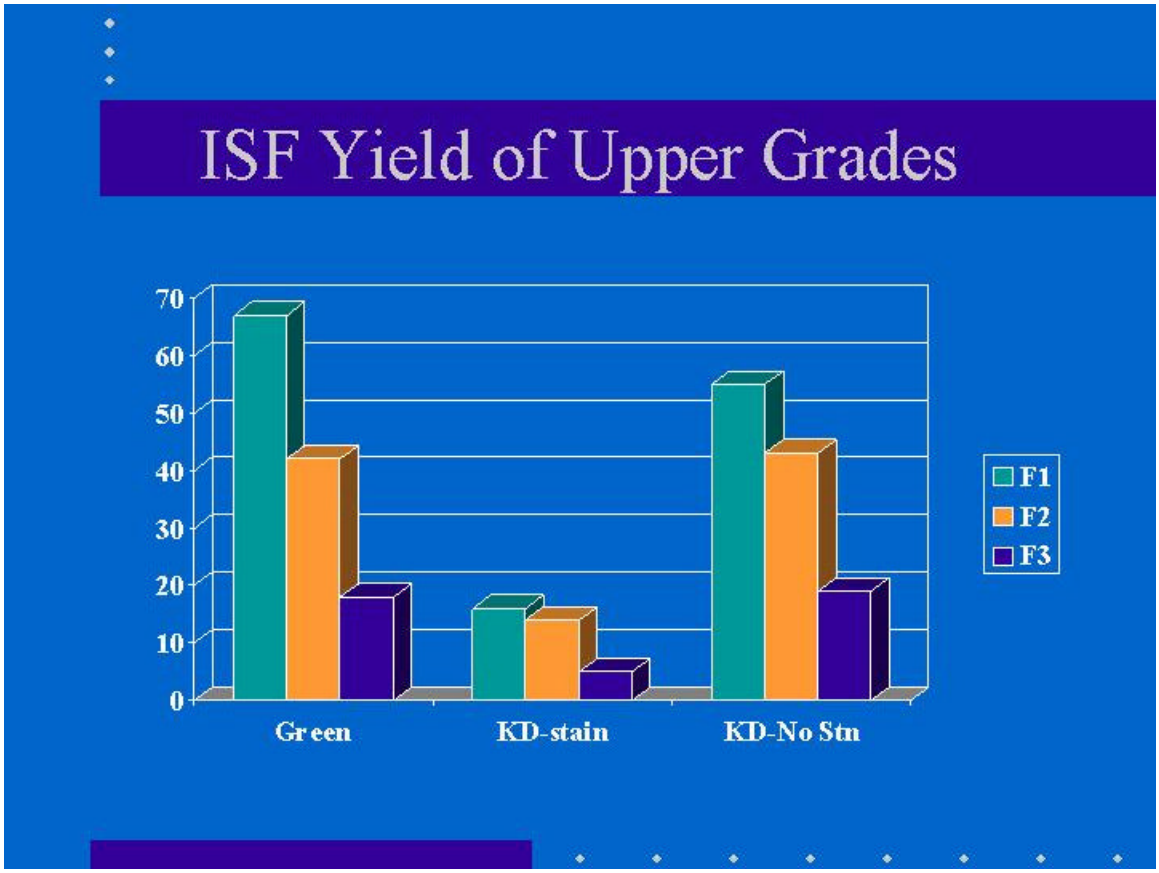

Figure 10. ISF Yield of Upper Grades

Comparing Figure 10 with Figure 9, it is clear that both the drying defect and the stain discoloration were less in the ISF material than in the MHDA material. The yield of upper grades in the ISF lumber dropped about 10% due to drying defects from green to kiln-dried, without considering stain as a defect (KD-No Stn). This drop in grade is normal when lumber is dried. When stain is considered a defect (KD-stain) the grade yield drops to unacceptable levels, but it is less of a drop than was observed in the MHDA material.

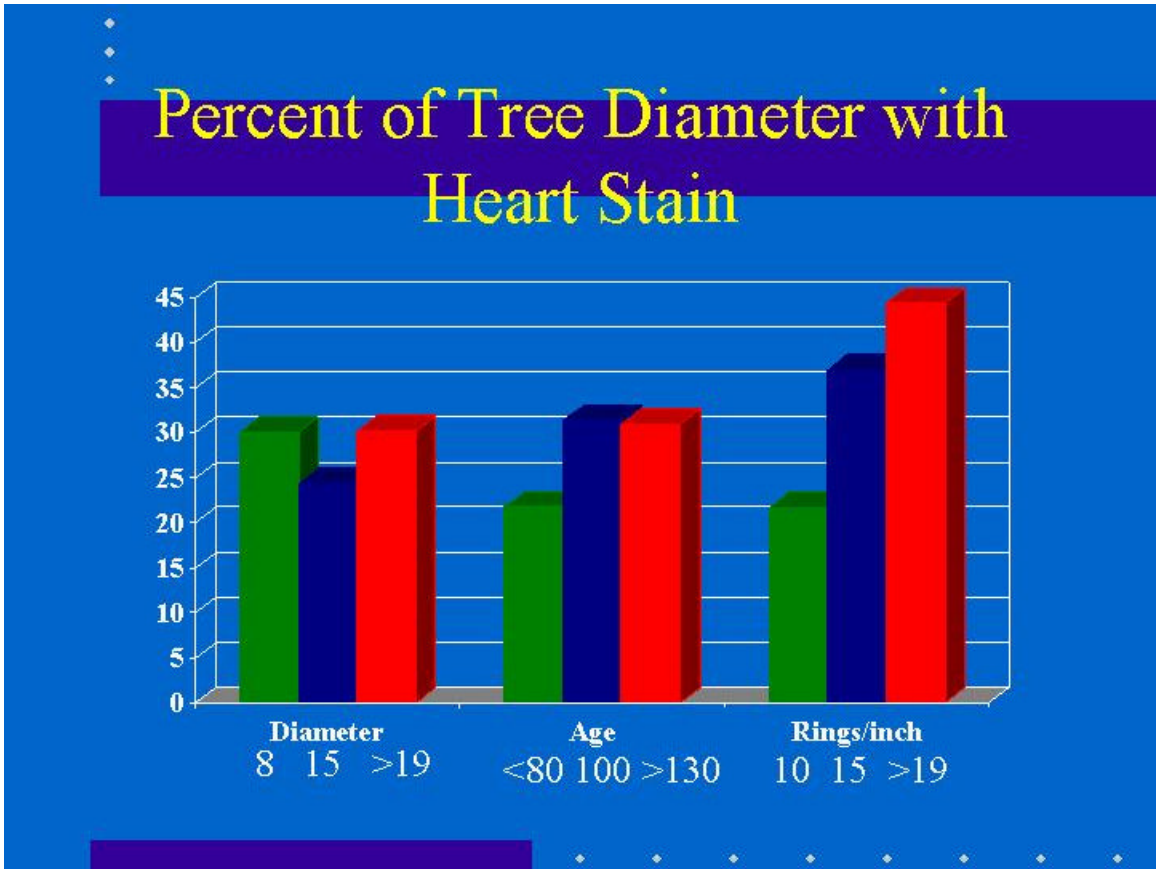

Figure 11. Percent of Tree Diameter with Heart Stain

An observation was noted during the field trials that the lumber from the MHDA site appeared to have a higher incidence of "mineral streak/heart stain" than the ISF material. It was also evident that severe drying defects were almost always present in the zones of this "heat stain". A study conducted at the University of California Forest Products Lab in 1965 found a higher incidence of heart stain in older trees with slow growth rates*. In the above figure, the percentage of the surface area log ends with heart stain was grouped by log diameter (large end), tree age, and growth rate (rings/inch). There was no apparent trend between heart stain and diameter, but trees less than 80 years old had less heart stain than trees over 100 years old. When growth rates were compared the trend was strong, with faster growing trees exhibiting the least amount of heart stain (20%) and the slowest growing trees having the most (43%). The field observations in the current project are consistent with these observations. Further study is needed to understand the mechanism of heart stain formation and its effect on drying defects.

*Prestemon, DR 1966. The variation of heart stain and wood density in tanoak *(Lithocarpus densiflorus Hook. & Arn. Rehd.).* PhD Dissertation. University of California, Berkeley.