California FORESTRY Note

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HARDWOOD UTILIZATION PROJECT

By

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Hardwood Utilization Project

I. Background

California hardwoods are a historically under-utilized forest resource. Often considered a weed species, hardwood trees are harvested primarily to reduce competition for the improved growth of conifers, and for the production of firewood, wood chips and biomass fuel. Hardwood harvests are conducted at a financial loss to accomplish this reduction in competition. To offset management losses and to gain the maximum potential benefits from California's hardwood resources, it is imperative to move into the commercial production of hardwood lumber.

Toward this end result, a working hardwood sawing and drying operation has been established at Parlin Fork Conservation Camp. This facility serves as a demonstration of successful hardwood processing as well as providing a continuous supply of kiln-dried lumber used to produce hardwood products for CDF facilities throughout California.

Parlin Fork is located in the Jackson Demonstration State Forest (JDSF) in Mendocino Ranger Unit on Highway 20, east of Fort Bragg.

II. Resources

Hardwood volume in the State of California is estimated at more than 12 billion cubic feet. California black oak (Quercus kelloggii), tanoak (Lithocarpus densiflora), and madrone (Arbutus menziesii) are the most abundant hardwood species. Annual growth rates vary from 2.4% for black oak, 3.5% for tanoak, and 3.1% for madrone. The hardwoods milled at Parlin Fork

Conservation Camp come from the Jackson Demonstration State Forest (JDSF). JDSF recently compiled data for their hardwood species component, based on timber inventories conducted in 1988 and 1996.

TABLE ONE

TOTAL ESTIMATED HARDWOODS ON JDSF:		**121 MBF**	**100%**
1	TANOAK	106 MBF	88%
2	MADRONE	8 MBF	6%
3	OTHER HARDWOODS*	6 MBF	6%

*The *OTHER HARDWOODS* category of the JDSF inventory primarily includes *EUCALYPTUS, RED ALDER, CALIFORNIA BAY LAUREL, CANYON LIVE OAK, WILLOW, BIG LEAF MAPLE, AND CHINKAPIN.*

III. Potential Benefits

In 1993, 860 furniture manufacturers in California used an estimated 108 million board feet of hardwood lumber. Only 500,000 board feet of hardwood lumber was produced from California hardwoods equaling ½ of 1% of the state's demand.[1]

Hardwood lumber and the products derived from it have a much greater value than the current hardwood uses. Development of hardwood sawmills and hardwood processing operations increase opportunities for value-added industries. As the lumber product value increases, stumpage prices will increase, creating greater incentives for the timberland owner to manage and utilize the hardwood resource.

[1] Shelly, John R. 1998. *An Examination of the Oak Woodland as a Potential for Higher-Value Wood Products.* Proceedings: *Symposium on Oak Woodlands,* March 19-22, 1996. USDA Forest Service Res. Paper PSW-GTR-160.

IV. Parlin Fork Procedures

Following is a summary of steps to a successful California hardwood lumber processing operation, from log procurement through stacking and drying procedures.

A. The Sawmill

Parlin Fork Camp's primary mill is a Corley #4-40 Sawmill with a 54" circle blade, manual single action set works, a carriage, with four head blocks, two off-set knees and a friction log turner. There is a separate mobile dimension sawmill unit to mill logs too large for the Corley.

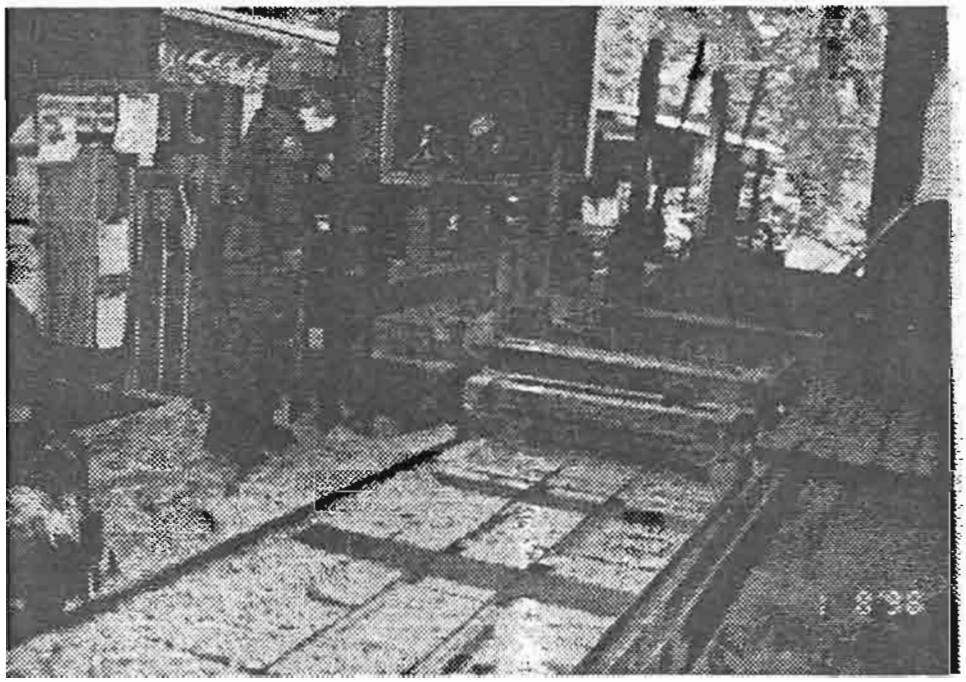

Figure 1 -Parlin Fork Sawmill

The University of California, at Berkeley, purchased the Corley equipment in 1955 for $2230.40 to test saw logs at the UCB Forest Products Lab. In June of 1989, Parlin Fork Camp acquired the sawmill to expand the existing camp products program.

B. Log Procurement

To develop an annual hardwood log inventory in a manner that demonstrates a feasible logging procedure, a contract clause is placed in a JDSF Sale Contract each year to generate 40MBF of hardwood saw logs. This is primarily a conifer sale, where hardwoods are harvested for silvicultural reasons to maintain the desired species balance.

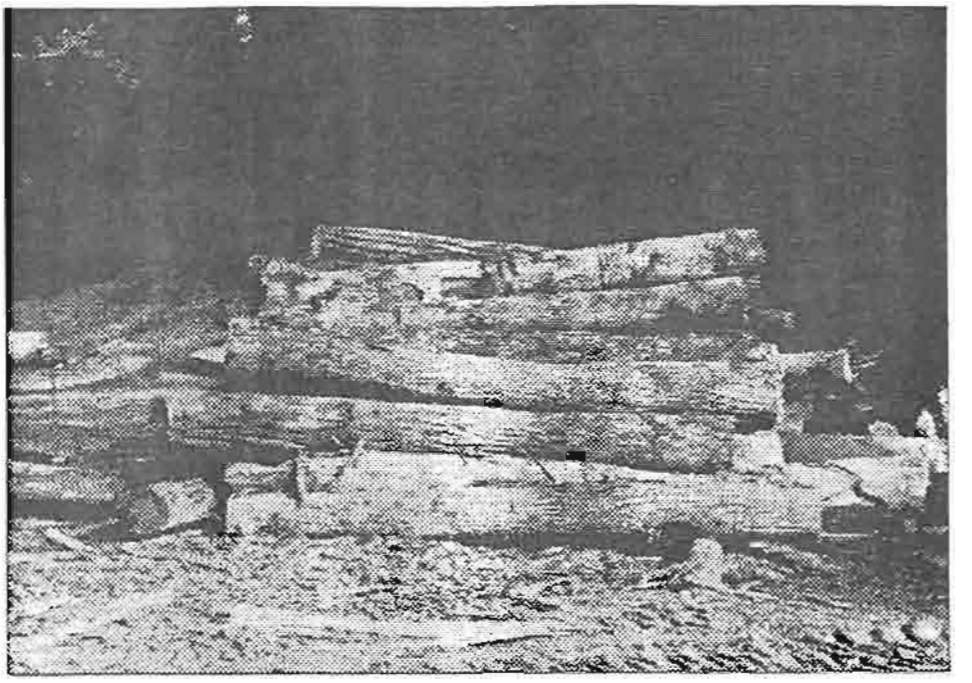

Figure 2 - Typical Hardwood Logs Received, Based on Parlin Fork *Log Specifications*

A landing sort is utilized to develop the desired saw logs from tanoak, chinkapin, and madrone. The log sort insures that only quality sawlogs enter the mill. Log sorts can be done either on the landing as we are doing or at a log receiving yard connected to a chipping operation. The projects log specifications take into consideration species, log size, log grade and the position of the log in the tree.

TABLE TWO

LOG SPECIFICATIONS

Species:	Tan Oak, Madrone, and Chinkapin
Log Description:	Length - 12' 3"
Minimum Diameter:	12" (Scaling End)
Sweep:	No more than 8 inches
Grading Factors:	In tanoak, butt logs only with at least 2 clear faces.
Uppers (2nd & 3rd) log:	OK in Madrone and Chinkapin if log has at least 2 clear faces.

The above grading factors produce a log that will generate lumber that meets the needs of the CDF cabinet shops. Madrone and chinkapin, being better self-pruning species, allows us to use more of the tree than the butt logs. Tanoak form and branching characteristics may improve in areas with better tanoak sites.

C. Log Storage

All hardwood logs are end-coated with either a wax emulsion or latex paint the same day they are received at the mill yard.[2] Every attempt is made to haul the logs in from the landing as soon as they are available.

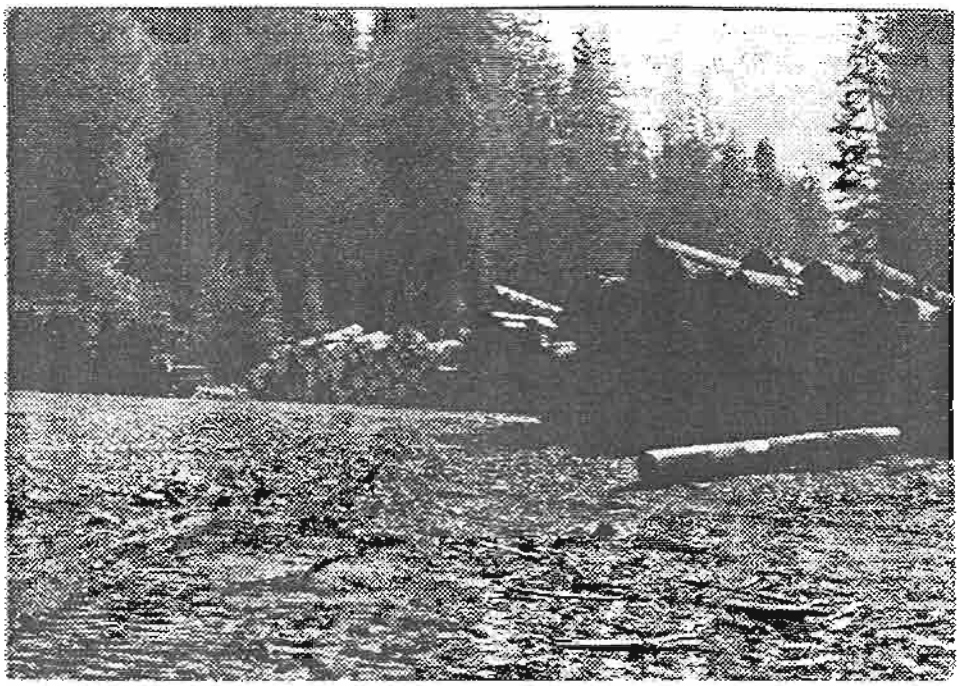

Figure 3 -End-Coated Hardwood Logs (In Background)

It is important to saw the logs as soon as possible and to place the stickered lumber into the drying sheds, greatly reducing the possibility of fungal staining and end checking in the logs. Fungal stains start to develop quickly in the winter months and end checking can occur within a few days especially during hot weather.

[2] Sources of end seal products: Associated Chemists. Tele: (503) 659-1708; Contechem Inc. Tele: (503) 283-3021; Convey Cleveland Tele(616) 458-0056; Willamette Valley Company . Tele: (800) 333-9826.

D. Sawing For Grade (Milling Procedure)

All logs are sawn to achieve the highest lumber grade recovery based on the *National Hardwood Lumber Association Grading Standards (NHLA)*. The sawyer, the edger operator, and the trim saw operator need a working knowledge of the NHLA Rules to meet this objective. The hardwood lumber grade is based on appearance and the amount of clear wood on the worst side of the board.[3] The grade is strongly influenced by the size and position of defects on the face of the board. Higher grades are given to boards with large areas of clear wood, the highest grade (FAS) requiring at least 83-1/3% of the surface area to be clear.

The sawyer first evaluates logs coming onto the carriage by looking for sweep and location of defects; primarily knots.[4] Generally, the worst log face is positioned towards the saw and then sawn lightly to establish a full length bearing surface. The log is then turned 90° and a 6½" face is sawn on larger logs (a 4½" face is sawn on logs less than 13" in diameter). Sawing is continued on that face until the grade drops below the grade which could be expected from another face. The log is then turned to a new face and sawing continues until the grade drops again. This process continues until all the log faces are sawn. To produce a finished 1-inch nominal thickness, boards are sawn to a $^{5}/_{4}$-inch target thickness. This extra thickness is necessary to account for the greater drying shrinkage that exists with western hardwoods, for sawing tolerances, and for expected drying defects.

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[3] Smith, Walton R. 1967. *Simplified Guidelines to Hardwood Lumber Grades.* USDA Forest Service, Southeastern Forest Experiment Station, Asheville, North Carolina.

[4] Malcolm, F.B., 1965. *A Simplified Procedure for Developing Grade Lumber from Hardwood Logs.* USDA Forest Service Research Note FPL-098, Madison, Wisconsin.

The Parlin Fork Hardwood Project will continue to experiment with drying techniques and schedules with a goal to reduce the green sawn target thickness.

Taper Sawing. The highest grade wood is on the outermost surface of the log. If the butt log has two opposing good faces (clear) which are not "taper sawn," there will be a significant volume loss of the high value boards.

For logs with sweep, the log is positioned with the crook vertical (up) on the carriage to saw deep enough to create a firm, bearing surface. The log is then turned 180° (crook down) and sawn until another firm bearing face exists. Finally the log is turned 90° and can be sawn as a straight log. If a log has a serious split, it may be necessary to consider sawing parallel to the split to obtain the best volume recovery.

Edging. Proper edging of lumber will improve the grade, but care must be taken to avoid volume loss. It is important to edge the lumber to get the highest grade, while also considering volume recovery. Things to consider are board width, knot position, and any other defects that can be removed to increase the board's grade. The edgerman must know the wane limitation of the various grades so that no more than necessary is edged off a board.

The hardwood end-product must be determined before deciding grade and dimension of the finished lumber. Parlin Fork produces lumber primarily for cabinets and furniture, which has different specifications than lumber produced for flooring.In processing hardwoods for lumber, the end-product must be determined and the milling must proceed accordingly. All the value and the resulting demand are in the appearance of the finished product. The log is merely the raw material.

E. Lumber Drying

Overview of Important Considerations

Exposure to conditions that uncontrollably accelerate the drying rate of hardwood lumber such as direct sunlight, high temperatures, low relative humidity, or wind must be avoided. When trim sawing is complete, it is imperative to end coat all lumber to reduce checking. Failure to protect green lumber from the hazards of accelerated drying will lead to failures later in the drying process. The general drying procedures for the hardwoods are based on East Coast climates, which consistently have different average temperatures and relative humidities, with different corresponding equilibrium moisture contents (EMC).

For example, the estimated average summer EMC for inland California drying conditions is 8.4% while the coastal regions of California are more similar to the average summer EMC of Ohio at 13.4%. The inland drying conditions are obviously more severe. Without careful summertime handling of green lumber, there exists a greater potential for drying losses.[5]

F. Stacking Units

Prompt stacking of lumber reduces potential attacks from insects and fungi. Lumber with like drying schedules and like thickness are stacked together in separate units. Top restraints will help reduce warping in the unit's top layers. The units base support must be a firm, flat, weight-bearing foundation. Units are 4' wide, 6-8' high and are always kept in a good symmetrical form. Stickers ¾" thick and 1 ½" wide are placed on 12" centers, assuring there is a sticker at each end of the unit in perfect vertical alignment over the base support. Parlin Fork uses stickers made from Douglas fir.

G. Air Drying

The air-drying sheds are partially closed with louvered siding that protects the unit of lumber from sun, rain and condensed fog while providing free air movement. This shed design seems to provide the required protection with the air drying condition at Parlin Fork Camp. Inland areas may require a design for a more restricted airflow.

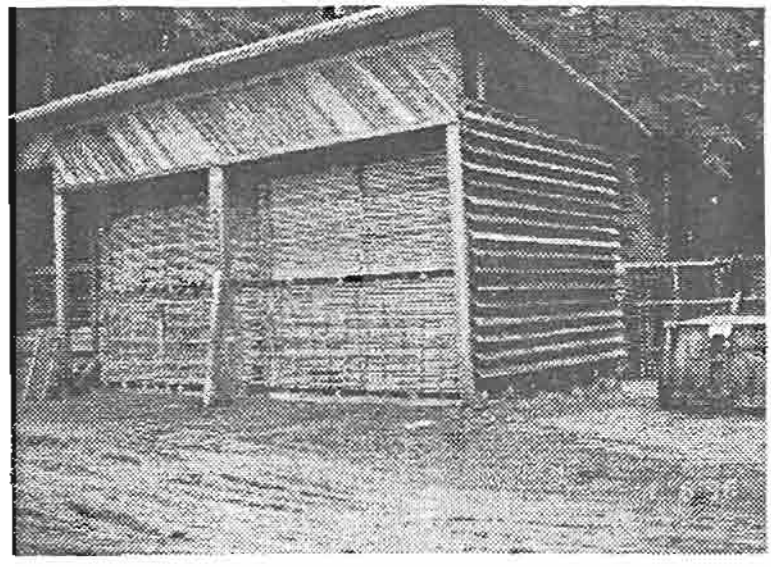

Figure 4 - Parlin Fork Air Dry Sheds

Lumber is immediately stacked and stickered as it comes out of the mill and is moved into the drying sheds as soon as a unit is completed. If there is any delay in moving units from the sheds, they are covered with a tarp while in the yard area to protect the wood from rapid moisture loss. Within 4-6 months the $^{5}/_{4}$-inch thick unit of lumber in the air-dry sheds will reach 18-20% moisture content and will go to the kiln. This moisture content is an average determined from moisture meter sampling over the years of operation.

G. Kiln Operation

Parlin Fork uses a Nyle Standard Dryers, Inc., L-200 dehumidification kiln (DH) with a 2000 B.F charge capacity. The basic temperature schedule is a combination of a mild white oak DH schedule found in the Dry *Kiln Operator's Manual*[6] and recommendations found in *Nyle's Operator's Manual*.[7] The Nyle schedule does not specify wet bulb temperatures or RH. The RH is controlled by the amount of time the DH compressor is turned on.

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[5] Storage of Lumber, Agr. Handbook No. 51 USDA, Table 3.

[6] United States Dept. of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin, Revised 1991. *Dry Kiln Operator's Manual Handbook* #188. 274 pp.

[7] Nyle Corp., Bangor, ME 1992. *Operator's Manual for Dry Kiln Systems. Models L33 and L200.*

H. Drying Schedules

1. USDA -FS White Oak Schedule

4/4 White Oak-T4-C2 Converted to Dehumidification Schedule with Maximum Temperature of 120° F

MC	Dry Bulb Schedules	Wet Bulb Schedules	RH	EMC
>40	110°	106°	87	17.5
40	110°	105°	84	16.2
35	110°	102°	75	13.3
30	120°	106°	62	10.0
25	120°	91°	35	5.6
20	120°	80°	17	3.3
15	120°	80°	17	3.3
(Equalize)	120°	84°	22	4.2
(Condition)	120°	108°	67	11.0

2. Nyle Temperature Schedule

Wood M.C.	Dry Bulb Temp.
Above 35%	90° F
25%-35%	100° F
Below 25%	120° F

3. Parlin Fork Schedule

*Summary of a Typical Parlin Fork Kiln Schedule for Air Dried Tanoak**

Time	Lumber Moisture Content (%) (A Four Sample Board Average)	Temp. °F	Control Setting (% of hour) (Run Time)
1. Start	23%	75°	20
2. 11 Days	17%	104°	To 40
3. 5 Days	14%	104°	To 80
4. 3 Days	10%	114°	To 100
5. 6 Days	7%	123°	On equalization cycle for 24 Hours

*This schedule would also apply to madrone and chinkapin.

J. Tests and Records

The kiln is inspected every working day. Moisture content and temperature records are updated every 2-3 days. Moisture content samples are taken from 4 sample boards using a Delmhorst Model RC 1-D Pin Type Meter. Occasional oven dry tests are run to validate the meter samples. The goal is to avoid drying the lumber faster than a 1% per day drop in moisture content, on average, as measured in the sample boards. The sample moisture content readings provide the information required to make decisions on kiln temperature adjustments. As the moisture content of the sample boards drops, the kiln temperature is increased in stages approximating the Nyle Schedule. When the sample boards have all reached the target of 6-8% moisture content, a random sample of 10-12 boards is then measured to verify the moisture content results of the smaller sample.

To equalize the moisture content of the boards and to condition them for stress relief, the kiln compressor is turned off and the load remains in the chamber for an additional 24 hours with the fans running. A more complete moisture content survey of the units is made when the kiln load is unstacked and packaged for shipment. Boards are measured with a Wagner L606 moisture meter, which scans the layers. Any wet boards are rejected. Wood characteristics and suggested kiln schedules for western hardwood trees can be found in the following source books:

a) *A Hardwood Lumber Drying Handbook*[8]
b) *Hardwoods of the Pacific Northwest*[9]
c) *Dry Kiln Operator's Manual*[7]

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[8] Shelley, Dr. John, UC Berkeley Forest Products Laboratory, 1997. *A Hardwood Lumber Drying Handbook.* Presented at the Hardwood Drying Workshop, Laytonville, CA, Feb. 26-28, 1997. 96 pp.

[9] Neiniec, Stanley S., Ahrens, Glenn R., Willits, Susan, and Hibbs, David E., March 1995. *Hardwoods of the Pacific Northwest.* Research Contribution #8, Oregon State University, College of Forestry. 115 pp.

V. Summary

Parlin Fork Conservation Camp makes kiln-dried hardwood lumber for use primarily in the cabinet shop at the Chamberlain Creek Conservation Camp. The hardwood is crafted into cabinets and office furniture, and offered for demonstration use in government facilities throughout the state. Parlin Fork is continuing to expand and improve the hardwood lumber operation as demand and interest increases.

The Parlin Fork hardwood project is a success! The operation follows some very simple guidelines: start with good quality logs, end-coat logs and lumber, be very protective of the lumber in early stages of drying, and saw boards to the target $^{5}/_{4}$-inch thickness.

Following is a checklist summarizing the steps that can maximize the potential for quality high-grade lumber:

1. **Maintain Log Quality**
   - √ Select logs with good lumber potential
   - √ Careful log treatment from the woods to mill.
2. **Saw for Best Grade Recovery**
3. **Treat Green Lumber**
   - √ Protect from rapid drying
4. **Follow appropriate Kiln Schedule**
5. **Store Dry Lumber Properly**
   - √ Protect from moisture gain

Remember, it is important to think value and add value while milling the hardwood lumber.