

## **California Hardwoods— Utilization Opportunities and Challenges**

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There is a sizable hardwood component to California's forests. Despite this, the native hardwoods never played an important role in the products produced from the forest. Today the major uses of hardwoods in California are for fuel chips, pulp chips, and firewood, all products that return little value to the landowner. Traditionally, hardwoods have also been a source of food (nuts and acorns), wildlife habitat, timber for local farm and home use, and firewood...but of little commercial value for value-added products. As we move into the 21st century, an increasing understanding of the science of ecology and societal pressures are causing a reevaluation of our natural resources with an emphasis on sustainable production and improving rural economies. In certain situations hardwoods may be a viable resource for local needs, specialty products, or perhaps even supply a larger commodity market. The high-density hardwoods such as tanoak, madrone, California black oak, and the white oaks may have the economic potential. Local products made by artisans, woodworkers and hobbyists prove that high value products can be made from many of these native hardwood species. The high cost of production will likely be a major limiting factor.

### **Opportunities**

**Resource**— Hardwoods represent an underutilized resource. Hardwood species in California are about 10 percent of the inventory of standing timber, more than 5 billion cubic feet of growing stock volume. Sixty percent of the hardwood inventory is located in the timberland forests and the remaining 40% is found in the rangelands and valley regions. About one-third of the timberland hardwood growing stock is sawlog quality. Reliable harvesting volumes of native hardwood sawlogs are not available, but there is no doubt that sustainable harvesting levels could be increased dramatically.

**Demand**— California is one of the nation's major consumer markets for hardwood flooring, furniture, cabinets, and other wood products. Manufacturing these products near the markets can offer distinct economic advantages in low transportation costs. These two factors have created a furniture-manufacturing sector in California that uses more than one million board feet of hardwood lumber per year. However, less than 5% of the total comes from the western U.S. species, and nearly all of that is red alder. Most (about 80%) is shipped from the eastern half of the US and about 10% is imported from tropical regions. Clearly, there is an opportunity for western hardwood lumber if consistent quality can be offered at a competitive price. California furniture manufacturers have a high demand for wood components and sub-assemblies -- intermediate products that are well suited to the native hardwood resource.

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**Economic Development**— The growth of an industry to produce wood products from an underutilized resource has the potential to create many jobs in rural communities with a timber resource base. These jobs may offset some of the employment losses resulting from reductions in softwood harvesting and the closing of sawmills.

**Marketing**— California hardwoods present unique marketing opportunities, especially in niche markets. There is often a distinct advantage to products that are locally grown and produced. In many cases, the sustainable harvest of California hardwoods will qualify for ecological certification by third party monitors. This certification has the potential to increase the value of a product to customers that place a premium on environmentally sound manufacturing. Even without an additional economic value, it may give a marketing edge over a product that is not certified.

**Raw Material Properties**— Many of California's hardwood species compare favorably with the benchmark species of the furniture industry. With the exception of the lower density hardwoods such as poplar, cottonwood, buckeye, and willow, most of the California hardwoods will perform very well in conventional hardwood products. The high-density, California hardwoods (specific density > 0.50) have very good machining and finishing properties, and some of the finer textured woods such as madrone and red alder are exceptional. Many of the high-density hardwoods also have unique and interesting grain patterns that add to the appearance value of the wood. All of the moderate to high-density hardwoods also have very good strength properties. A few such as tanoak, madrone, Oregon white oak, valley oak, and eucalyptus exhibit very high hardness values making them an exceptional choice for hardwood flooring. A summary of properties for some California hardwoods are listed in Tables 1 and 2, along with the comparable values for northern red oak, a benchmark species.

### **Challenges**

**Manufacturing**— There are also numerous challenges to manufacturing products from California hardwoods. In some cases, the high density and unique wood properties that may create marketing opportunities often create difficult manufacturing situations. For example, California hardwoods have a reputation for being hard to dry. Extra care during drying is required with the dense woods that have a tangential shrinkage (tangent to the growth rings) greater than 10% and a warp index greater than 2.0 (Table 1). These woods are expected to have a high frequency of drying defects if they are dried improperly. Tanoak, madrone, and the white oak species are three species with a high tendency to warp and collapse during drying. However, good results can be obtained by drying slow with good control of the drying conditions. A kiln capable of reaching a temperature of 150 F (the temperature required to sterilize insect-infested wood) that has a method to reintroduce moisture at the end of drying to relieve stresses can successfully dry any of these hardwoods to the desired final moisture content of 8%.

**Marketing**— Manufacturers and consumers are largely unaware of California hardwoods. The California Hardwood Initiative, a statewide effort supported by the California Trade and Commerce Agency, California Department of Forestry and Fire Protection, USDA Forest Service and the University of California, has successfully raised the level of

awareness but more needs to be done. The commodity lumber markets demand large volumes of lumber, readily available at a competitive price and manufactured to existing industry standards. In contrast, the niche market is more flexible because a specific product or customer is targeted and the product is tailored to the customer's needs. Availability and quality concerns make it difficult for a new product to enter the commodity market; however, based on the properties and characteristics of the California hardwoods successful niche markets are very possible.

### **State of the Industry**

A recent survey of hardwood sawmill manufacturers in California revealed 34 sawmills and 60 secondary manufacturers that are currently working with or interested in working with native California hardwoods. The sawmills are exclusively mini-mills, often with portable equipment, with annual productions less than 500 thousand board feet (MBF). Many of these mills produce less than 50 MBF per year. The estimated total production of all the mills in 1999 was only about 4 million board feet. At the time this survey was completed there were two large production softwood sawmills considering limited tanoak productions. These two mills have the potential to dramatically increase the availability of California hardwoods.

Based on the physical and mechanical properties, any of the common hardwood consumer goods could be manufactured from California hardwoods. Some woods are better suited for particular products than other woods and factors such as resource availability, cost of production, and quality of the end product will determine the long-term viability of a California hardwood business venture. These hardwoods present some manufacturing challenges, but the technology exists to address these challenges. With an understanding of some of the fundamental wood properties and basic manufacturing principles, many of these hardwoods can be manufactured into high value products.

For More Information:

Shelly, J. R., D. M. Lubin, and A. Johl. 1999 California Hardwood Industry Profile: Final Report. University of California Forest Products Laboratory Technical Report 35.01.454.

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**Table 1.** Physical properties of various underutilized tree species found in California

<b>Species</b>	<b>Common Name</b>	<b>Native CA, USA Domestic or Exotic Species</b>	<b>Specific Gravity</b>	<b>Density at 12% MC (lbs./ft3)</b>	<b>Hardness at 12% MC (lbs.)</b>	<b>Tangential Shrinkage (%)</b>	<b>Warp Index</b>
<i>Acacia longifolia</i> <sup>18</sup>	Acacia (golden wattle)	exotic	0.59	41	(1750)	(>10)	(>2)
<i>Alnus rubra</i>	Red alder	native	0.39	27	620 <sup>3</sup>	7.3 <sup>3</sup>	1.7
<i>Arbutus menziesii</i>	Madrone	native	0.61	42	1530 <sup>3</sup>	13.7 <sup>3</sup>	2.4
<i>Castanopsis chrysophylla</i>	Chinkapin	native	0.44	31	780 <sup>3</sup>	7.4 <sup>3</sup>	1.6
<i>Ceratonia siliqua</i>	Carob tree, Locust tree	exotic	na	na	na	na	na
<i>Chamaecyparis lawsoniana</i> <sup>1</sup>	Port-Orford cedar	native	0.39	27	630	6.9	1.5
<i>Cinnamomum camphora</i> <sup>18</sup>	Camphor tree	exotic	0.40	28	na	na	na
<i>Cupressus macrocarpa</i>	Monterey cypress	native	0.45	32	na	na	na
<i>Eucalyptus globulus</i> <sup>19</sup>	Blue gum	exotic	0.63	44	1650	15.3	2.0
<i>Fraxinus velutina</i> 'Modesto'	Modesto ash	native	(0.54)	(38)	na	na	na
<i>Jacaranda mimosifolia</i>	Jacaranda	exotic	(0.31)	(22)	(350)	(8.2) <sup>10</sup>	(1.4)
<i>Juglans hindsii</i>	California black walnut	native	na	na	na	na	na
<i>Liquidambar styraciflua</i>	American sweet gum	native	0.52	36	na	10.2 <sup>1</sup>	1.9
<i>Lithocarpus denisflorus</i>	Tanoak	native	0.59	41	1450 <sup>3</sup>	12 <sup>3</sup>	1.9
<i>Magnolia grandiflora</i>	Southern magnolia	domestic	0.46	32	1020 <sup>2</sup>	6.6 <sup>1</sup>	1.2
<i>Pinus radiata</i>	Monterey pine	native	0.42	29	na	na	na
<i>Pistacia chinensis</i>	Chinese pistache	exotic	1.00	61	na	na	na
<i>Platanus sp.</i>	Sycamore	domestic	0.46	32	610	8.4	1.7
<i>Platanus acerifolia</i>	London plane	exotic	0.42	29		7.8 <sup>9</sup>	

<i>Species</i>	Common Name	Native CA, USA Domestic or Exotic Species	Specific Gravity	Density at 12% MC (lbs./ft3)	Hardness at 12% MC (lbs.)	Tangential Shrinkage (%)	Warp Index
<i>Populus trichocarpa</i>	Cottonwood (black)	domestic	0.33	23	390 <sup>3</sup>	8.6 <sup>3</sup>	2.4
<i>Pseudotsuga menziesii</i>	Douglas-fir	native	0.48	33	710 <sup>2</sup>	7.6 <sup>1</sup>	1.6
<i>Quercus garryana</i>	Oregon white oak	native	0.66	46	1780 <sup>3</sup>	9 <sup>3</sup>	2.1
<i>Quercus ilex</i>	Holly oak	exotic	na	na	na	na	na
<i>Quercus kelloggii</i>	California black oak	native	0.50	35	1080 <sup>3</sup>	7.8 <sup>3</sup>	2.1
<i>Quercus lobata</i>	California white oak	native	0.60	42	1570 <sup>3</sup>	9.8 <sup>3</sup>	2.4
<i>Sequoia sempervirens</i>	Redwood	native	0.35	24	na	4.9 <sup>1</sup>	2.2
<i>Ulmus parvifolia chinensis</i>	Chinese elm	exotic	na	(30 to 40)	na	na	na
<i>Umbellularia californica</i>	California bay laurel	native	0.54	38	1460 <sup>3</sup>	8.1 <sup>3</sup>	2.9 <sup>3</sup>
<i>Zelkova serrata</i>	Japanese zelkova, Makino	exotic	0.54	38	na	na	na

Note: Superscript numbers refer to source information listed on reference page; numbers in parenthesis were estimated from similar species or general genus information; na means information is not available; specific gravity values were converted from values reported in citations to a common standard of oven-dry, green volume basis; density values were converted to a common 12% MC basis.

#### Table References

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**Table 2.** Woodworking properties of various underutilized species found in areas of California

<b>Species</b>	<b>Common Name</b>	<b>Machinability</b>	<b>Texture</b>	<b>Color</b>	<b>Workability Comments</b>
<i>Acacia longifolia</i> <sup>18</sup>	Acacia (golden wattle)	na	coarse <sup>9</sup>	brown or chocolate color <sup>14</sup>	hard, heavy & tough; similar to hickory <sup>9</sup> ; relatively easy to work, finishes with a high polish & luster <sup>12</sup>
<i>Alnus rubra</i>	Red alder	5	fine <sup>3</sup>	uniform, light brown <sup>3</sup>	easy to work, accepts finishes exceptionally well <sup>6</sup>
<i>Arbutus menziesii</i>	Madrone	10	fine <sup>3</sup>	variable, reddish <sup>3</sup>	easily <sup>5</sup> machined
<i>Castanopsis chrysophylla</i>	Chinkapin	6	medium <sup>3</sup>	uniform, light brown <sup>3</sup>	fair to good machining, glueing & fastening; excellent finish-holding capacity <sup>2</sup>
<i>Ceratonia siliqua</i>	Carob tree, Locust tree	na	na	sapwood is white, heartwood red <sup>16</sup>	wood is hard, tree can be difficult to grow <sup>16</sup>
<i>Chamaecyparis lawsoniana</i> <sup>1</sup>	Port-Orford cedar	na	fine	light yellow to pale brown	highly resistant to decay, dimensionally stable
<i>Cinnamomum camphora</i> <sup>18</sup>	Camphor tree	na	fine <sup>12</sup>	light yellow-brown, light pinkish or reddish brown, usually with darker streaks <sup>12</sup>	works easily with a smooth, lustrous finish <sup>12</sup>
<i>Cupressus macrocarpa</i>	Monterey cypress	(5)	fine, even <sup>2</sup>	yellow-brown to pinkish brown <sup>2</sup>	straight grain; works without difficulty, but knots can be troublesome. High resistance to insect & fungal attack <sup>17</sup>
<i>Eucalyptus globulus</i> <sup>19</sup>	Blue gum	(6)	medium, even <sup>2</sup>	dark or yellowish brown <sup>2</sup>	difficult to work with hand tools, works easily with power <sup>2</sup>
<i>Fraxinus velutina</i> 'Modesto'	Modesto ash	(6)	na	na	na

Species	Common Name	Machina bility	Texture	Color	Workability Comments
<i>Jacaranda mimosifolia</i>	Jacaranda	(3)	medium 0, 1	white to yellowish white <sup>10</sup> ; plain, ordinary - not related to rosewood species <sup>9</sup>	easily sawn & planed <sup>10</sup>
<i>Juglans hindsii</i>	California black walnut	(6)	medium <sup>3</sup>	uniform, dark brown <sup>3</sup>	prized for gun stocks, decay resistant
<i>Liquidambar styraciflua</i>	American sweet gum	5	medium, can vary with site <sup>2</sup>	grayish pink to deep red <sup>2</sup>	softer, straighter grained trees work easily; refractory trees are difficult <sup>2</sup>
<i>Lithocarpus denisflorus</i>	Tanoak	8	medium <sup>3</sup>	variable, golden brown <sup>3</sup>	wood is tough & hard, machines easily & finishes well <sup>8</sup>
<i>Magnolia grandiflora</i>	Southern magnolia	6	even <sup>2</sup>	yellow, greenish yellow or greenish brown <sup>2</sup>	not difficult to work with either hand or power tools; suitable for steamed bent components <sup>2</sup>
<i>Pinus radiata</i>	Monterey pine	na	soft & brittle <sup>2</sup>	reddish brown to brownish pink <sup>2</sup>	soft, brittle, knotty, light in weight & lacking in strength; pulpwood potential <sup>2</sup>
<i>Pistacia chinensis</i>	Chinese pistache	na	very fine	variable and unusual -- olive brown with narrow, dark brown concentric bands <sup>15</sup>	grain is crossed; very hard, strong & tough; seasons well, very durable; used for carving <sup>15</sup>
<i>Platanus sp.</i>	Sycamore	1	fine texture	light reddish brown	interlocked grain can make some machining difficult <sup>13</sup>
<i>Platanus acerifolia</i>	London plane	(1)	fine & uniform <sup>13</sup>	yellowish white or brownish <sup>13</sup>	hard, tough & rather difficult to work, but can be finished to a good, clean surface <sup>13</sup>
<i>Populus trichocarpa</i>	Cottonwood (black)	(1)	coarse <sup>3</sup>	uniform, gray brown <sup>3</sup>	nail & screw-holding ability is low, otherwise relatively easy to work & finish <sup>2</sup>
<i>Pseudotsuga menziesii</i>	Douglas-fir	na	straight-grained <sup>2</sup>	pale yellow, light brown <sup>2</sup>	easier to work with power than without; doesn't hold paint well <sup>2</sup>



<b>Species</b>	<b>Common Name</b>	<b>Machina bility</b>	<b>Texture</b>	<b>Color</b>	<b>Workability Comments</b>
<i>Quercus garryana</i>	Oregon white oak	8	fine <sup>3</sup>	uniform, cream <sup>3</sup>	good machining characteristics, except for shaping; nice bonding properties <sup>2</sup>
<i>Quercus ilex</i>	Holly oak	na	na	na	na
<i>Quercus kelloggii</i>	California black oak	7	medium <sup>3</sup>	uniform, medium brown <sup>3</sup>	hardness & finishing properties suitable for flooring <sup>7</sup>
<i>Quercus lobata</i>	California white oak	na	uneven <sup>2</sup>	moderate, dark brown <sup>2</sup>	can be brittle & difficult to work <sup>2</sup>
<i>Sequoia sempervirens</i>	Redwood	na	uniform, coarse <sup>2</sup>	light red, reddish brown <sup>2</sup>	all around high marks for workability <sup>2</sup>
<i>Ulmus parvifolia chinensis</i>	Chinese elm	na	coarse & uneven <sup>13</sup>	dull reddish brown <sup>13</sup>	interlocked grain can make some machining difficult <sup>13</sup>
<i>Umbellaria californica</i>	California bay laurel	6	medium <sup>3</sup>	uniform, cream <sup>3</sup>	good workability & luster <sup>4</sup>
<i>Zelkova serrata</i>	Japanese zelkova	na	coarse <sup>12</sup>	uniformly cream or light reddish brown with golden luster <sup>12</sup>	straight grain, easy to work and takes a high lustrous finish <sup>12</sup> . Hard, tough & resilient - very strong for its weight; durable <sup>17</sup>
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