

Ownership Patterns on Hardwood Lands¹

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Abstract: The pattern of land use and ownership—including sizes of ownerships, types of landowners, and their various management objectives—affects the level of benefits available from the California's hardwood resource. Geographic information system (GIS) databases of ownership and population characteristics were developed for two California counties using local assessors' data, Census data and existing vegetation maps. The utility of these spatial data sets is demonstrated in preliminary comparisons of hardwood land ownership patterns in Nevada and Shasta Counties. Refinement of these data capture techniques and the addition of other data layers will greatly increase the potential for more detailed analysis of ownership patterns.

California's oak woodlands and hardwood rangelands provide a variety of benefits including wildlife habitat, biological diversity, range forage, wood products, open space, and scenic beauty. The quality and availability of these benefits from hardwood lands is not determined by the mere extent of tree cover, but is also a function of human interaction with the hardwood landscape. Over 70 percent of California's hardwood forest land is privately owned (Bolsinger 1988) and, therefore, subject to a wide range of management objectives and practices. The particular juxtaposition, or spatial nature, of different sizes of ownerships, types of landowners, and land management objectives—as well as ecological conditions—dictates the nature of benefits available from the hardwood resource.

Demand for land for residential and commercial development has been a major force of change across California's hardwood landscape. Urban expansion and development of high density subdivisions have obvious and direct effects on the extent of hardwood land. Shifting patterns of ownership across rural lands, however, may have more extensive, albeit less visible, ramifications on hardwood resource-related benefits (Doak and Stewart 1986).

The process of changing ownerships, decreasing parcel sizes, and residential occupation, particularly dispersed, rather than high-density development, alters the character of hardwood lands by introducing multiple new owners and their often conflicting management activities. Wildlife habitat is compromised by land clearing, new roads, fences and roaming dogs. Soil stability is endangered by construction and land clearing. And, the introduction of new homes complicates rural fire

protection responsibilities and further burdens local infrastructure (Doak and Stewart 1986).

The management objectives of new landowners are often quite different from those of traditional owners of California's rural hardwood areas. New owners generally relocate from urban areas to enjoy a different lifestyle in a natural setting, and they are less likely than established residents to rely on natural resources as a source of income (Fortmann and Huntsinger 1985). Many are absentee owners with little interest in active land management. Often they are more educated and wealthier than their long-standing rural counterparts (Blakely 1984; Romm and others 1983; Fortmann and Huntsinger 1985). Conflict over land use is more likely to occur in areas of fragmented ownership and management, and near wealthy and highly educated landowners (Doak and others 1988). A clearer understanding of these spatial ownership patterns and their relationships to resource management and conflict is needed to help further the State's objectives of stabilizing hardwood resource values through research, landowner education and monitoring.

HARDWOOD COVER AND LAND USE

Remotely sensed imagery such as aerial photography or satellite imagery is well suited for describing the extent and structure of hardwood stands, as well as detecting changes in cover over time. Vegetative cover alone, however, is not a good indicator of land use. Shifts in land use are not always accompanied by perceptible changes in vegetative cover. For example, dispersed residential development, while a major change in land use, may have little effect on total hardwood canopy closure.

Although remotely sensed data can describe the hardwood resource in a physical sense, it alone cannot answer compelling questions about the use and management of hardwood lands. Who owns these lands? Are they resident or absentee owners? What are their management objectives? How large are management units and how much do they vary in size? How rapidly is land ownership changing? What is the potential for conflict over use and management of hardwood lands? The implications of different types of vegetative cover and changes in cover must be assessed within the context of relevant social, economic, political and physiographic factors that affect land use and management.

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SPATIAL DATA LAYERS OF OWNERSHIP AND POPULATION

Geographic information systems (GIS) provide a framework in which various sources of data can be combined to model spatial patterns of land use and ownership. With a GIS, computerized maps, or layers, are linked to databases describing various attributes of particular locations. Data sets can be combined and enhanced by developing attribute relationships both within and between individual data layers. Physiographic characteristics of hardwood areas can be combined with ownership, demographic, and infrastructure characteristics, to create powerful tools for analysis of land use.

County assessors' property records contain extensive information on the ownership and use of individual parcels such as parcel size, landowner name and address, assessed improvement values, and historic deed recordation dates. Although these data are developed for assessment and taxation purposes, they do provide opportunities for describing ownership characteristics and patterns. With some manipulation, assessors' data can be used to indicate landowner wealth, ownership unit size, parcel ownership transfer rates, landowner residency status, land use fragmentation and other characteristics (Doak and Stewart 1986). Census data provides additional information on population/household characteristics such as age, employment, education, income, tenure, and living conditions.

To test the utility of these sources of data in characterizing ownership patterns in hardwood woodlands, GIS³ databases describing ownership and population characteristics were developed for two California counties: Nevada and Shasta. Three GIS layers were developed for each county: (1) ownership, created from county assessors' property data; (2) population characteristics, based on Census data; and (3) vegetation type.

Assessors' mapbooks were selected as the primary analysis unit for the ownership layers. Although assessors' records contain detailed information on individual parcels, the cost of digitizing all parcels in a county is prohibitive.⁴ Fortunately, the structure of assessors' parcel identification numbers provide alternative, although somewhat arbitrary, units for spatial analysis. Assessors' parcel numbers generally describe three to four spatially nested units. The largest unit is the mapbook; mapbooks contain multiple pages; and pages, which are sometimes divided into blocks, contain groups of individual parcels.

Ownership layers were digitized from each county's assessors' mapbook index map. Using digital tapes of the 1988 secured property roll purchased from each county assessors' office, individual parcel records were manipulated to provide summary statistics of parcel and ownership characteristics at the mapbook level. These summary variables were then related as

attributes to each ownership layer. Mapbook attributes developed for the Nevada and Shasta County layers included variables describing: average parcel size; variation of parcel size; estimated average ownership size; assessed improvement value per acre; estimated number of houses per acre; number of owner-occupied houses per acre; and percent of area by parcel transfer rate.

An attempt was made to identify ownership units based on combinations of parcels. Assessors' data are parcel specific, and while parcels may conform to legal property divisions, they do not necessarily represent total ownership or management units. Many landowners own multiple parcels but manage them together as single units. Ownership units were defined in this study by summing parcels by owner name within each mapbook polygon. This method tends to underestimate actual ownership unit size since: (1) if the owner's name is misspelled, the two (or more) spellings are interpreted as separate ownerships; (2) a single ownership that crosses two mapbooks will be defined as two separate ownership units; and (3) some management units may actually be composed of multiple parcels owned under the names of different family members.

Census tracts were selected as the primary analysis unit for the population characteristics layer. A digital file of summary 1980 Census data was purchased from the California Department of Finance.⁵ These data were manipulated and condensed into variables which were used as attributes to a digitized Census tract layer. Attributes included population density by various age, education, personal income, and residency status classes; and household characteristic such as average home value, household income and tenure.

An existing CALVEG GIS layer was used as the vegetation layer.⁶ The CALVEG maps were created by the USDA Forest Service at a scale of 1:250,000 from manual interpretation of satellite imagery. Minimum polygon sizes vary between 400 and 800 acres. While a fairly generalized vegetation map, the hardwood species designations in CALVEG provide a general definition of hardwood extent sufficient for demonstrating general ownership patterns on hardwood lands. Other vegetation maps and data may provide more accurate and more detailed estimates of hardwood extent and structure (Tosta and Marose 1986).

PATTERNS OF OWNERSHIP

The three GIS layers were used to describe ownership patterns on hardwood lands in Shasta and Nevada County through a series of overlays. The vegetation layer was first used to develop separate layers of hardwood land in each county.

³The geographic information system used here was PC-ARC/INFO.

⁴Based on 1988 assessor's property rolls, there are 42,879 parcels in Nevada County and 76,681 parcels in Shasta County.

⁵U.S. Department of Commerce, Bureau of Census Summary Tape File Number 3 (STF-3).

⁶The California Department of Forestry and Fire Protection, Forest and Rangeland Resources Assessment Program provided county level ARC/INFO coverages of CALVEG.

Hardwood land was identified, using CALVEG attributes, as non-urban land dominated by blue oak (*Quercus douglasii*) in Shasta County and interior live oak (*Q. wislizenii*) in Nevada County. These county hardwood layers were then combined with the other layers and used as "cookie cutters" to create separate ownership, and population layers for hardwood lands in each county. Summary attributes within each new polygon⁷ of the ownership and population layers were then used to develop estimates of a variety of characteristics describing ownership patterns in each county's hardwood land. Some of these characteristics are presented in table 1.

Table 1— Patterns of Land Use and Ownership in Hardwood Lands in Nevada and Shasta County⁸

	NEVADA	SHASTA
Hardwood Area (acres) ⁹	128,986	278,231
Privately owned Area (acres)	117,874	247,599
Privately owned Area (pct)	91	89
Total Parcels	18,536	8,532
Average Parcel Size (acres)	7	33
Total Ownerships	14,066	4,764
Average Ownership Size (acres)	9	58
Assessed Improvement Value	\$771,720,38	\$ 235,106,709
Average Assessed Value per acre	\$5,983	\$845
Total Houses ¹⁰	10,797	3,257
Houses Per 1,000 Acres	84	12
Resident Landowners ¹¹	7,329	2,966
Percentage of Owner Occupied Units	68	91
Acres Transferred > 3 Times in 15 Yrs. ¹²⁼	13,613	NA
Percentage Transferred > 3 Times in 15 Yrs.	11	NA
Population (1980)	20,458	13,145
Population (#) New to County since 1975	10,376	4,486
Population (pct) New to County since 1975	51	34
Households (#, 1980) Heating with Wood	3,878	861
Households (pct, 1980) Heating with Wood	19	20

⁷The final Nevada hardwood ownership layer had 46 polygons, the Shasta hardwood ownership coverage—56 polygons, the Nevada hardwood Census coverage—14 polygons, and the Shasta hardwood Census coverage—18 polygons.

⁸For purposes of this analysis, hardwood lands were identified from the CAL VEG coverages as blue oak woodlands in Shasta County and live oak woodlands in Nevada County. This excluded some areas of riparian and montane hardwoods.

⁹These acreage figures are based on a simple definition of hardwood lands used for demonstration purposes. Other sources may provide more accurate acreages of oak woodland (Tosta and Marose, 1986).

¹⁰This estimate may be low. Since houses are not defined as such on the assessor's property rolls, an assessed improvement value of at least \$10,000 on any parcel was assumed to be a house.

¹¹Resident landowners were inferred from homeowner's exemptions on the assessor's property roll.

¹²The number of acres transferred more than three times in 15 years were estimated from deed recordation dates on the assessor's property roll. All such recordations were assumed to indicate a transfer of ownership.

The results provide some interesting contrasts between the ownership patterns of Shasta and Nevada County's hardwood lands. Nevada County is characterized by small parcel and ownerships sizes, high assessed improvement values per acre, and a large percentage of new residents. Shasta County has larger average parcel and ownership sizes, lower improvement values per acre, and a higher percentage of resident homeowners.

The relative degree of land use fragmentation was estimated using the coefficients of variation (CV) in average parcel and ownership size. Using CV as a proxy, the level of fragmentation increases considerably when the primary unit changes from parcels to ownerships. Ownership units may be a more useful variable for depicting fragmentation since they more closely resemble the way land is actually managed. Table 2, showing the percentages of hardwood land in Nevada County by CV of average parcel and ownership size, illustrates the relative difference between these units as measures of fragmentation.

POTENTIAL USES

The potential utility of the GIS data layers developed here far exceed simple overlays and data queries. These type of data have applications for a variety of research, landowner education and monitoring efforts related to California's hardwood resource.

GIS ownership and population attribute layers can be used to test hypotheses regarding relationships between ownership characteristics and: landowner goals; land use conflict; resource production; and environmental degradation. For example, GIS layers of vegetation, ownership and population characteristics could be used as a framework for implementing landowner surveys designed to test relationships between hardwood landowner and ownership characteristics (e.g., age, residency status, ownership size) and owner management objectives. Specific categories of landowners could be identified based on vegetation and ownership characteristics. Individual names and addresses could then be drawn from the basic assessors' data. Finally, survey results could be related back to the spatial framework for more detailed analysis.

These databases might be used in a similar fashion to target certain types of landowners with specific types of extension

Table 2—Fragmentation of Hardwood Land in Nevada County as Measured by the Coefficient of Variation (CV) in Parcel Size and Ownership Size

CV	Pct of total area	
	Parcels	Ownerships
1-2	28	1
2-3	57	32
3-4	15	40
4-5	0	9
> 5	0	18

programs. Small residential hardwood landowners, for instance, are likely to respond to a different array of programs than are owners of large management units.

With the addition of other data layers such as slope, zoning, soils, roads, fire hazard, or hydrography, spatial models can be developed to simulate or predict a multitude of natural and cultural processes. Wildlife habitat suitability models, for example, could be developed as functions of a canopy closure, distance to streams, elevation, density of major roads, average parcel size, and density of houses.

Predictive models could be developed to estimate the level and intensity of future residential development. These models might estimate the likelihood of parcelization and development based on current ownership (private vs. public), zoning (allowable parcel density and use), existing infrastructure (road networks), slope (related to construction suitability) and distance from community centers.

These types of models could also be used for land use planning and resource allocation. High densities of housing development, for example, are thought to have negative effects on wildlife species associated with oak woodlands, while low home densities covering a broader area may both complicate fire protection efforts and increase risk of habitat loss due to destructive fires. Use of GIS modeling can help local planners minimize development impacts on habitat and assist fire agencies in efficiently allocating resources to protect both new development and existing habitat.

GIS data layers of ownership and population characteristics have applications in hardwood monitoring efforts, both in directly assessing changes in land ownership, and in providing a context in which to assess changes in vegetative cover on hardwood lands. Changes in the hardwood canopy that occur in areas of large isolated ownerships, for example, are likely to have different resource implications than canopy changes that occur across areas of multiple small parcels.

The use of smaller analysis units may result in more refined ownership and population data layers in future data development projects. While assessors' mapbooks are useful units due to their relative homogeneity, rural mapbooks often cover very extensive areas. Future development of ownership layers may benefit by dividing these larger mapbooks along page lines or groups of pages. Smaller units, of course, will tend to increase develop-

ment costs. Census blocks are smaller spatial units than tracts and will be available in the 1990 Census TIGER line files.

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