This neighborhood in South Lake Tahoe was developed in even-aged Jeffrey pine. *Photo by Peggy L. Fiedler*

Urban forest structure: A key to urban forest planning

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Urban development in California has occurred within savanna, woodland, and forest types. Many cities in the San Francisco and Los Angeles areas were built in oak savannas and woodlands; suburban developments continue to occur similarly. Towns and recreation home developments in the Sierra Nevada and in other mountainous regions have been established in coniferous forests. All of these urban areas enjoy street and yard trees which were naturally established originally in a wildland.

Pre-development savanna, woodland, or forest stands affect the character of the urban forest after development, and knowledge of their structure can suggest tree renewal practices as pre-development trees mature and die. Urban forestry research in the University of California Department of Forestry (Berkeley) has focused on evaluating structure to understand the transition from wildland to urban forest.

Contrasting urban forests

Two cities in California, Menlo Park and South Lake Tahoe, serve to contrast differences in structure and consequent influences on urban forest development. Menlo Park was developed in an area characterized by a mosaic of oak savanna and oak woodland types; coast live oak, valley oak, and blue oak dominate. South Lake Tahoe was developed in Jeffrey and Lodgepole pine.

Neighborhoods in Menlo Park and South Lake Tahoe were sampled for tree species composition, cover, density and age distribution. Undeveloped areas adjacent to or within each city were also sampled as indicators of pre-development conditions. Only areas in Menlo Park originally in oak savanna and areas in South Lake Tahoe originally in even-aged Jeffrey pine are compared here.

Tree density before development in Menlo Park averaged two trees per acre in oak savanna. An average of one relict oak per acre has survived urbanization. Average total tree density has increased to 14 trees per acre. Tree cover in the pre-development savanna averaged 14 percent. The same areas show an average tree cover of 25 percent today. Species richness before development was one species per acre and is now 12 species per acre as a result of tree planting by developers and home owners.

In South Lake Tahoe density of Jeffrey pine in the neighborhoods built in even-aged stands dropped from an average of 308 trees per acre to 133 trees per acre after development. Total tree density now averages 151 trees per acre because of tree planting. Tree cover in the undeveloped Jeffrey pine stands near to the sample plots averages 57 percent while in the urbanized forest areas cover has dropped to 19 percent. Species richness has changed from one species per acre to three species per acre.

The age structures of the dominant species in each urban forest sampled are different. Coast live oaks of all age classes occurred in the pre-development savanna at Menlo Park and this age structure persists in the urban forest. Relict trees range in age from 45 to 375 years old. Jeffrey pine trees formed an even-aged forest in many areas of South Lake Tahoe, and this age structure remains, with nearly all relict trees 70 to 94 years old.

These results suggest two patterns of urban forest development in areas where trees occur before urbanization. The Menlo Park pattern is probably characteristic of development in savanna and low density woodland types. Trees were planted to increase tree cover following construction. Tree mortality eliminated about one-half of pre-development savanna. (In this case, mortality resulted when lawn irrigation induced tree-root disease.) Species richness in the Menlo Park urban forest can be attributed, in part, to the open character of the savanna. Few shaded areas occur where establishment of shade-intolerant species would be limited. Species richness at Menlo Park is also related to mild winters which permit use of a large number of species.

South Lake Tahoe's pattern is no doubt characteristic of urban forest development in closed canopy woodland and forest. Here trees are cut to provide building sites, driveways, and sidewalks. In addition, trees may be cut to allow for more direct sunlight. Cutting and other urbanization-induced tree mortality eliminate about one-half of the original tree density. Furthermore, bark beetles have caused major tree mortality subsequent to development. Limited tree planting for ornamental purposes generally follows home construction in South Lake Tahoe. Species richness is low because of limited sunlight reaching the ground beneath the existing forest canopy. Low winter temperatures also limit the number of species that can be planted.

The age structure of the Menlo Park pre-development savanna provides for a continuity of tree cover during the transition from wildland savanna to an urban forest that no longer supports relict trees. Those relict trees that survive urban development generally live to maturity and die or are removed individually. The extended period of tree mortality does not leave major portions of the urban area without tree cover. A management practice similar to selection methods used in timber management can be used to perpetuate tree cover and the urban forest's all-age nature. This practice is applied in Menlo Park today.

The even-age structure of some South Lake Tahoe urban forests provides for less continuity of tree cover during the transition period. Age- or size-related mortality can quickly eliminate major portions of the urban forest cover. The heavy forest cover that existed at the time of urban development has not encouraged significant natural establishment or tree planting. As a result, continuity of tree cover over time is less sure. Cities with even-aged urban forests should develop planting programs to increase the number of age classes. This will help assure continuous tree cover during the transition from wildland to urban forest.

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