Botanical Trends in Northern California Oak Woodland

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Northern California oak woodland represents an extensive rangeland community enriched with a diverse array of oaks grasses, forbs, and shrubs. It covers nearly 4.5 million acres of typically rolling terrain and is bounded by valley grassland, chaparall, and montane forest. The community occurs on a variety of soils throughout the Coast Ranges and Sierra Nevada Foothills, dominating the landscape between 500 and 2,500 feet in elevation. Seasonal variation in forage biomass is typical of Mediterranean, annual-type systems with growth primarily being limited to October through mid-May.

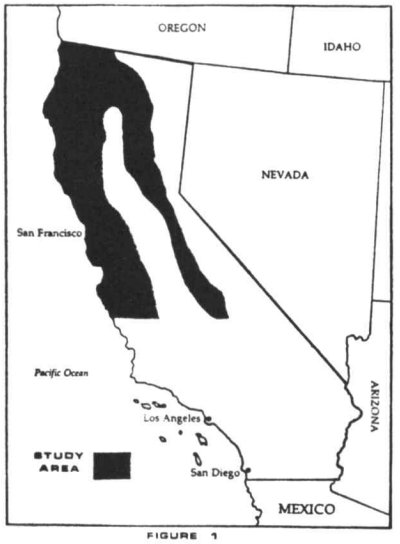

FIGURE 1

Over the past two centuries human activity has markedly affected this community, spurring many shifts in its physiognomy and composition. This article will focus on these shifts, describing general historical trends and causes.

Northern California oak woodland is defined as all oak-dominated communities north of Tulare County (Fig. 1). This designation was chosen to restrict this review to two oak-woodland types; the foothill woodland and the northern oak woodland (Griffin 1977). The foothill woodland is found throughout the Sierra foothills and central Coast Ranges, and about the periphery of the Central Valley. Dominant oak species include blue oak and valley oak. The northern oak woodland occurs from roughly Mendocino County northward. It differs from foothill woodland in that Oregon white oak predominates.


An open oak community near Red Bluff, California.

Each of these oak-woodland types can be generically subdivided into three components: the oak community, the interspersed herbaceous community, and the understory shrub community. The species composition of each is given in Table 1.

Oak Community

This is a diverse and dynamic community. Oak species vary in age and distribution and occur in hybrid, spindly, robust, and scrubby forms. This diversity was shaped by 1) exotic and endemic browsers, 2) woodcutting, 3) vegetation-type conversion, 4) fire manipulation, and 5) urban sprawl.

Browsing

Cattle and sheep have had a major impact on the oak community. Rossi (1980) notes that the Spanish coastal missions, including Santa Clara and San Jose, had acquired approximately four million sheep by 1880 and nearly 1 million cattle by 1890. This undoubtedly created a heavy demand for oak browse. This demand has remained high, especially on coast live oak, blue oak, black oak, and valley oak.

In addition to cattle and sheep, hogs and rodents have been important browsers of oaks and oak mast. Feral hogs have a strong appetite for acorns. Rodents, such as ground squirrels and pocket gophers use both acorns and seedlings heavily. This may be due to recent population increases induced by the removal of rodent predators and the introduction of new and abundant

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Table 1. Representative species of Northern California oak woodland flora.

Oak and Associated Silva

Black oak *(Quercus kelloggii)* (N)*
Blue oak *(Quercus douglasii)* (N)
California buckeye *(Aesculus californica)* (N)
Canyon live oak *(Quercus chrysolepis)* (N)
Coast live oak *(Quercus agrifolia)* (N)
Digger pine *(Pinus sabiniana)* (N)
Leather oak *(Quercus durata)* (N)
Interior live oak *(Quercus wislizenii)* (N)
Oregon white oak *(Quercus garryana)* (N)
Valley oak *(Quercus lobata)* (N)

Interspersed Herbaceous Community

Grasses

Annual blue grass *(Poa annua)* (I)
Annual fescues (*Vulpia* spp.) (N) & (I)
Annual ryegrass *(Lolium multiflorum)* (I)
Hare barley *(Hordeum leporinum)* (I)
Little quakinggrass *(Briza minor)* (I)
Mediterranean barley *(Hordeum geniculatum)* (I)
Medusahead *(Taeniatherum asperum)* (I)
Nitgrass *(Gastridium ventricosum)* (I)
Pine bluegrass *(Poa scabrella)* (N)
Purple stipa *(Stipa pulchra)* (N)
Red brome *(Bromus rubens)* (I)
Ripgut brome *(Bromus diandrus)* (I)
Silver hairgrass *(Aira caryophyllea)* (I)
Slender oat *(Avena barbata)* (I)
Soft chess *(Bromus mollis)* (I)
Spanish brome *(Bromus madritensis)* (I)
Velvet grass *(Holcus lanatus)*(I)
Wild oat *(Avena fatua)* (I)

Other

Bur clover *(Medicago polymorpha)* (I)
Fiddleneck (*Amsinckia* spp.) (N)
Filaree (*Erodium* spp.) (I)
Geranium (*Geranium* spp.) (N) & (I)
Italian thistle *(Carduus pycnocephalus & tenuiflorus)* (I)
Lupines (*Lupinus* spp.) (N) & (I)
Mustard (*Brassica* spp.) (I)
Popcorn flower *(Plagiobothrys nothofulvus)* (N)
Star thistle (*Centaurea* spp.) (I)
Tarweed (*Hemizonia, Holocarpha, & Madia* spp.) (N)
Trefoils (*Lotus* spp.) (N) & (I)
Turkey mullein *(Eremocarpus setigerus)* (N)

Understory Shrub

Buck brush *(Ceanothus cuneatus)* (N)
California coffeeberry *(Rhamnus californica)* (N)
Chamise *(Adenostoma fasciculatum)* (N)
Manzanita *(Arctostaphylos* spp.) (N)
Poison oak *(Toxicodendron diversilobum)* (N)
Scrub oak *(Quercus dumosa)* (N)
Toyon *(Heteromeles arbutifolia)* (N)
Western redbud *(Cercis occidentalis)* (N)

*Key: N - native
I - introduced

References - Albin-Smith and Raguse, 1984; Munz and Keck, 1959; Sampson and Jesperson, 1981; USDA handbook, 1984; White, 1966a.

food items, especially prolific seed-producing species such as oats and filaree.

Woodcutting

Rossi (1980) discusses the history of oak harvesting. He credits the Spanish missionaries as the first Europeans to harvest the wood, using it primarily as a source of fuel. Later, gold and quicksilver mines required oak for shaft supports. By 1900, oaks were being used for commercial charcoal production or, as in the Santa Clara valley, removed for orchards.

Menke and Fry (1980) note that oak-fuelwood production rose steadily from 1947 to 1953, declined, began to climb again in 1959, and then increased further in 1973. This latest up-swing is the product of a changing market. Recent declines in the profitability of livestock production have increased the value of firewood to hardwood rangeland managers. The fuelwood market for oak has thus encouraged marked removal.

White (1966b) has examined the effects of woodcutting on stand age structure. In central California he found old harvest sites to be comprised of stands averaging 70 to 90 years of age, while areas that have gone uncut contained individuals which had survived for nearly 400 years. White also observed that woodcutting had reduced the occurrence of blue oak at his study site.

Vegetation-type Conversion

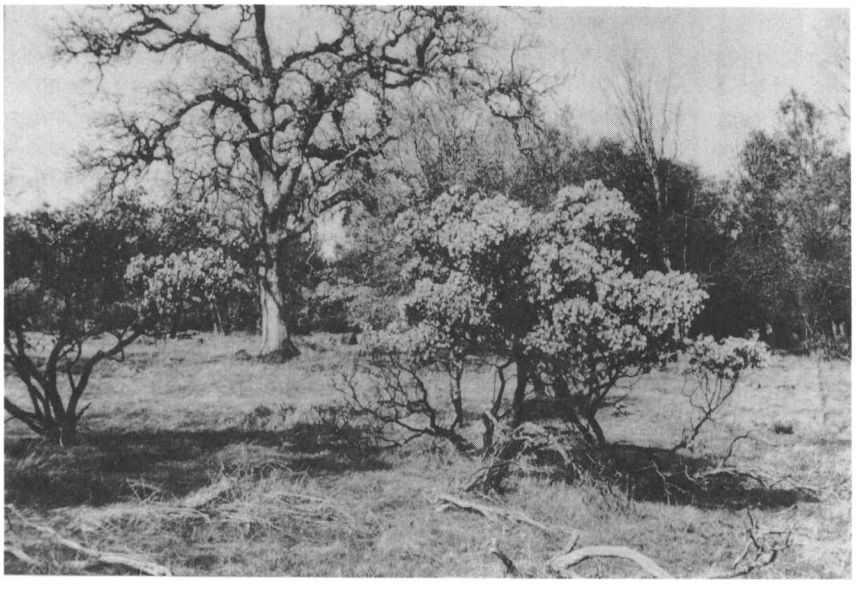
In addition to woodcutting, oaks have also been removed through vegetation-type conversion. Typically this technique has involved the use of herbicides followed by clearing via controlled burning or a process of mechanical removal, piling, and then burning. Vegetation-type conversion has been employed to reduce fire hazards and improve forage and watershed production. Over time such "range modification" has greatly reduced the distribution of oaks in northern California, especially in the Sierra foothills (Rossi 1980). Mayer et al. (1986) cite such activities as being a major cause of the decline in this community.

Fire

Man has also modified this community through the manipulation of fire, a practice extending well back into California's prehistory. Aboriginal burns were widespread (Margolin 1978) and may have maintained the oak community as a fire-climax. With the demise of these primitive cultures, this community was upset. In the northern Coast Ranges, this has produced denser stands of oaks and has favored invasion by Douglas-fir, a fire-sensitive species. This suggests that periodic burns are necessary to maintain open oaks stands.

Fire has also been implicated as a contributor to enhanced oak regeneration. Weeds may reduce seedling success in unburned areas, as they compete with oak seedlings for light and moisture. Periodic wildfires could thus reduce herbaceous biomass and favor improved oak reproduction.

Spring growth of an interspersed herbaceous community.



An unburned area showing characteristic brush encroachment.

Urban Sprawl

Perhaps no factor has had a more noticeable effect on shaping the oak community than urban development. When Vancouver visited the bayshore plain of the San Francisco Peninsula in 1798, he was impressed by the vast, open park of valley oaks that spread away from the bay toward the base of the distant hills (Griffin 1973). Later this area was cleared and planted with orchards. These orchards did not persist, however. Beginning with the close of the 19th century urban areas started spreading rapidly, eventually filling the entire Santa Clara Valley.

Many areas have similarly undergone this change from wilderness to farm, orchard, or ranch lands and then to urban sprawl. Most development has been residential and commercial, although road and free way construction has also contributed significantly. Currently expansion is greatest in the foothills, especially from Nevada and Yuba counties southward to Fresno County. The species that have been impacted most heavily are blue oak, coast live oak, and valley oak.

Interspersed Herbaceous Communities

This community is composed of those grass and forb species that occur in both open areas between oaks and as an understory component. Historical trends in community composition are the product of 1) a massive alien invasion, 2) cumulative effects of short-term grazing impacts, 3) vegetation-type conversion, 4) fire management, and 5) range seeding programs.

Alien Invasion

Theories differ on which native species have been displaced by aliens. It is generally thought that the original community was dominated by perennial bunchgrasses (Crampton 1974). However, Biswell (1956) postulates that in the Sierra Foothills introduced species may have primarily displaced native *annuals*. In addition, Savelle (1977) observed that areas left undisturbed do not return to perennial dominance. Savelle's observation is not compelling, however, as it may reflect the outcome of wildlife suppression. Therefore, most agree that the pre-invasion community consisted of perennial grasses such as purple stipa, pine bluegrass, blue wildrye, California brome, California melic, prairie junegrass, and California oatgrass (Crampton 1974); plentiful perennial forbs such as Brodiaea (Biswell 1956); and a principal contribution from various native legumes (Table 1).

These natives were displaced by alien annuals from Europe, Asia, Africa, South America, and elsewhere. Burcham (1970) lists several factors which contributed to the aliens' success. In comparison to native perennials, aliens have greater climatic adaptability, more rapid germination in the presence of sufficient moisture, more rapid growth to maturity, more prolific seed production, greater seed viability, and broader effectiveness in competing for scarce resources. In addition, alien species were often better adapted to domestic grazing and thrived in the many sites disturbed by cultivation.

Burcham (1970) describes the dispersion of alien species as consisting of four "waves of invasion." These are summarized as follows according to predomi-

vegetation. Reed and Sugihara (1987) attribute this to aboriginal burns.

Biswell (1954, 1956) reports that oak woodland has become increasingly crowded with native brush species, especially where woodland meets coniferous timber. He feels this increase is partly due to the effects of fires. A single burn tends to increase brush production, possibly by cracking the seed coats of many woody species and/or through reduction of herbaceous litter. Biswell also indicates that close grazing has favored brush abundance. High-intensity removal of herbaceous species releases soil moisture for use by unpalatable brush seedlings.

These studies also indicate that in some areas brush may periodically decline. If one burn follows closely behind another, emerging brush seedlings are often killed. Also, heavy browsing by livestock and deer can effectively suppress brush regrowth. In ungrazed areas, grass species may rob brush seedlings of sufficient light and moisture and thereby reducing seedling survival. Finally, management may actively seek to remove brush through controlled burns, bulldozing, use of herbicides, or some combination of these (Murphy and Leonard 1974).

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