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Plant Succession on Prescribed Burn Sites in Chamise Chaparral

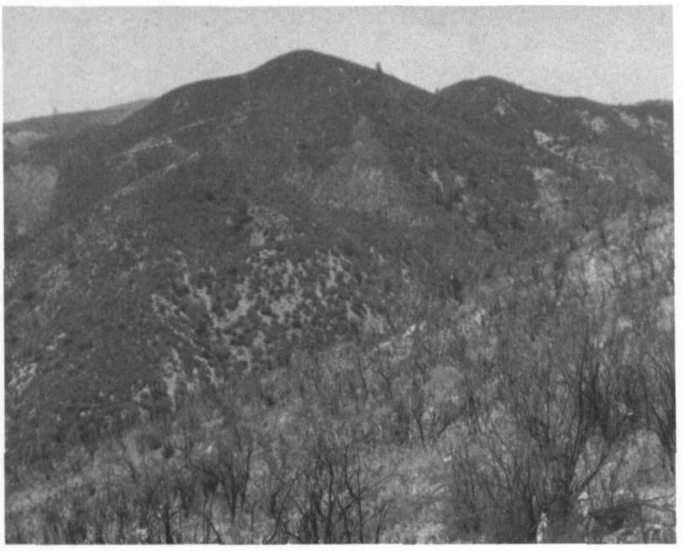
Melanie Florence

California chaparral species evolved under a regime of natural (lightning) fire occurring during the hot, dry summer months. As a result, chaparral vegetation is dependent upon fire occurring optimally every 30 to 60 years to rejuvenate itself (Biswell 1979). With wildfire suppression during the twentieth century, this natural fire cycle has been interrupted in many chaparral areas. Large acreages of chaparral now exist with a continuous cover of decadent brush containing large amounts of dead material. A wildfire in one of these areas could burn with high intensity over thousands of acres causing severe environmental damage and site degradation. Prescribed burning is a method which can be used to break up continuous brushfields and reduce unnaturally high accumulations of fuel, to improve wildlife habitat and to improve rangelands.

Prescribed burning is one of the most cost effective and ecologically acceptable solutions to managing California chaparral (Biswell 1980, Koenigs 1980). Its use is becoming more widespread each year with burns during the cool months of the year. Since chaparral species have naturally burned during the hot, dry months, many people have expressed apprehensions about cool-season prescribed burning and its effect on native species.

The response of herbaceous species after cool season fires was studied on several prescribed burn sites at Pinnacles National Monument in the central California coast range. Three chamise chaparral sites on south-facing slopes were burned using a driptorch in 1981 during the winter (February 19, 1981), early spring (April 28, 1981) and late spring (June 2, 1981). The sites were studied for two consecutive spring seasons to compare species composition and successional trends. Also, data obtained from a nearby July, 1978, wildfire site adjacent to the Monument on Bureau of

Location of Pinnacles National Monument.



Typical prescribed burn sites at Pinnacles National Monument. Close-up of a burn site in the foreground and patches of burned areas on the hills. Photograph by Brian Mattos

Land Management land were compared with the prescribed burn site data.

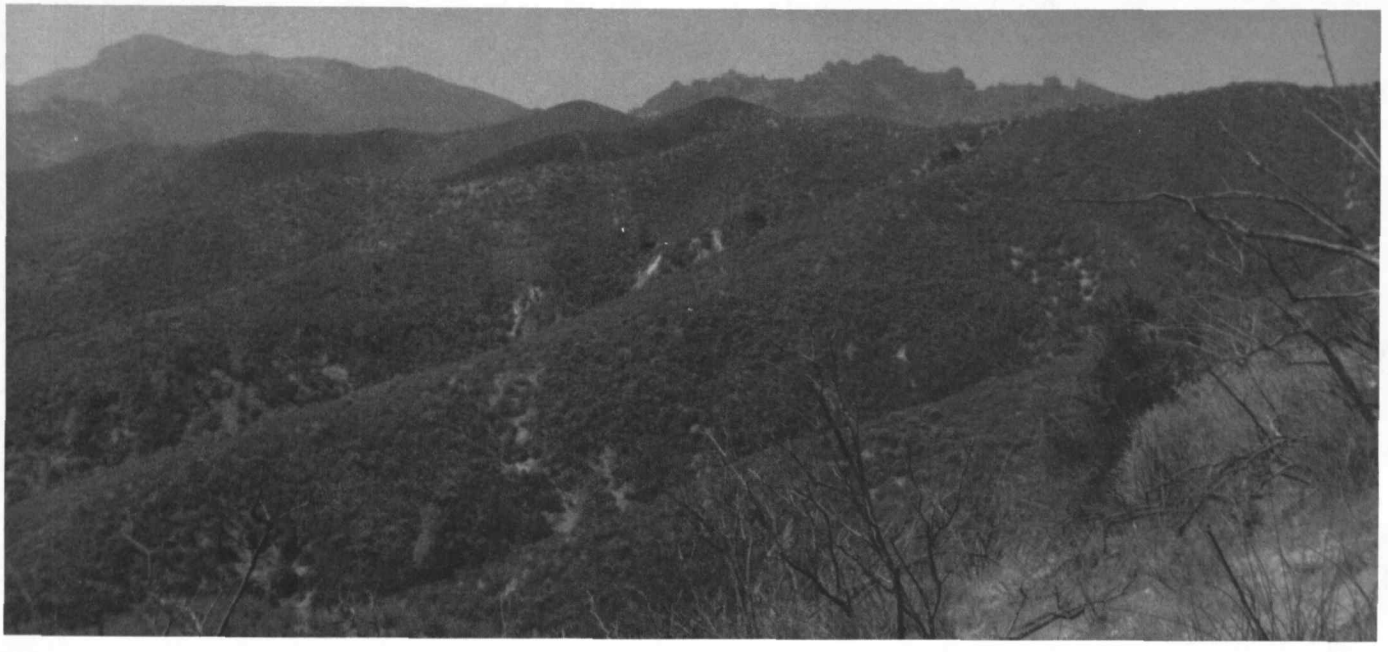
Chaparral succession after a warm-season wildfire follows an established progression. During the first few post-fire years, native annual and perennial plants are abundant on the burn site. Many of these plants are specialized fire-followers. These species have refractory seeds, seeds which need scarification in the form of heat or charate (chemicals released from fire-charred shrubs) to germinate, and therefore are only found on burn sites in the early post-fire years (Keeley and Keeley 1981). These long-lived seeds are deposited on the soil after the plants mature and stay dormant until the next fire. Also, some species have root burls, lignotubers or underground stems which sprout after fire destroys the apical parts of the plant (Sweeney 1956).

Generalized fire-followers are also found on burn sites during the early post-fire years. These species grow on disturbed areas and on openings in mature chaparral so they are not restricted solely to early post-fire year burn sites. They are often non-native weedy species with non-refractory seeds (Keeley et al. 1981). Generalized species have broad ecological tolerances which allow for extended survival under changing conditions (Hutchison 1975). The presence and abundance of the annual species is related to the amount and distribution of rainfall in a growing season.

A first post-fire year burn site is typically occupied predominantly by fire-following forbs; grasses are less important (Sweeney 1956). Specialized fire-following forbs decrease in abundance with succeeding years because of the absence of fire as a dormancy breaking influence and/or the inability of these species to compete with grasses and generalized fire-followers (Hutchison 1975). Fire-following shrubs and subshrubs gradually become larger, eventually crowding and shading out the herbaceous plants. Subshrubs such as deerweed and black sage reach maximum development the third or fourth year after fire. Dominant shrubs such as chamise and buck brush comprise an increasing cover percentage in succeeding years while generalized annuals and subshrubs are restricted to smaller and smaller openings (Keeley et al. 1981). After ten years or so, a dense shrub cover with little understory has again developed. Dense growth of the shrubs (many with flammable compounds in the foliage), accumulation of fuels, and summer drought eventually result in another fire.

Herbaceous species presence and dominance the first post-fire year is determined by many factors: (1) topography of the site including elevation, aspect, soils and microsite availability (Hutchison 1975); (2) seeds present on the site, their germination requirements and heat tolerances; (3) fire intensity; and (4) the precipitation and temperature regime after the fire (Ammirati 1967). In this study, fire intensity appears to be the overriding factor controlling diversity and dominance in herbaceous plant communities.

The vegetation found on the wildfire study sites and two of



Very mature, dense chaparral in Pinnacles National Monument. Photograph by Brian Mathos

Pinnacles, NM—US Department of the Interior, National Park Service Photo by Richard Frear

the prescribed burn study sites (the spring burn sites) closely approximated the warm-season herbaceous plant successional trends described above. Dense chaparral and hot, dry weather resulted in a high intensity burn on the wildfire site. The spring burns both had weather, fuel conditions, and fire behavior resulting in moderate intensity burns. In contrast, the winter burn had conditions resulting in a low intensity burn. The wildfire and spring burns were hot enough to heat-stimulate the seeds of specialized fire-followers and form charate. The fires killed most non-refractory grass seeds and some generalized forbs. Species diversity was highest on the moderate intensity burn sites and these sites were floristically more similar to each other than to the low intensity burn site.

The low intensity burn allowed more non-refractory seeds to survive the fire resulting in a high proportion of grasses the first post-fire year. The temperature was not hot enough to kill most heat sensitive seeds but it was hot enough in spots to form charate and heat-stimulate the seeds of some specialized fire species.

Because of the high grass cover the first post-fire year, the low intensity burn site was dominated by grasses the second post-fire year. All other study sites had the expected, but much smaller, increase in grass cover the second post-fire year. Increased competition from annual grasses may reduce the dominance and eventually the occurrence of specialized fire-followers if low intensity fires occur frequently or over large areas.

The above conclusions can be applied to management of chamise chaparral. Most chaparral areas should be managed to promote species diversity and regeneration of native vegetation in coordination with management goals. Since intensity of fire affects species response, burns can be timed to maximize the desired response.

A prescribed burn in progress. Photograph by Scott Florence.

To perpetuate specialized fire annuals and perennials, the burn should be performed under conditions which will produce a moderate to high intensity burn so that most nonrefractory annual seeds will be destroyed. In contrast, if a good grass crop is preferred, a low intensity burn should be performed. This pasturage would be temporary unless the shrubs were killed.

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California Annual Grassland and Oak Savannah

James W. Bartolome

The grasslands and savannahs of California cover approximately 15 million acres or 15 percent of the State, but provide 80 percent of the range forage for sheep and beef cattle (California Department of Forestry 1987). With a growing population, rangelands are foci for suburban development, water, wildlife habitat, and recreation. Annual forbs and grasses introduced from other regions with winter rains and summer drought (Heady 1977) dominate the vegetation of the herbaceous layer. The woody overstory, where present on suitable sites, is most often an open canopy of oak, a genus *(Quercus)* shared with savannahs of the Mediterranean Basin (Griffin 1977).

The original California grassland, a mix of perennial bunchgrasses and annuals, formed the resource, enabling settlement by Europeans. Cattle and sheep, introduced from Baja California upon the founding of Mission San Diego in 1769, and later resupplied from Tubac in Arizona, numbered in the millions by the early 1800's (Burcham 1957). The few thousand non-native people in California depended upon these livestock as the mainstay of the economy for eighty years. The only major exports were hides and tallow shipped from points along the coast. Not until gold was discovered and populations of hungry miners formed a local market, did meat production become important in livestock ranching. The forage base of native bunchgrasses, not adapted to this kind of heavy use, was rapidly destroyed. Later expansion of cultivation in the 1860's and 1870's further contributed to the demise of the native grasses. As with other fertile rangelands of the U.S., the best sites in the Central Valley were those put to the plow.

New plants, survivors of thousands of years of livestock use in a climate similar to California's, arrived from the Mediterranean region with the earliest settlers. Verified by the presence of their seeds in adobe bricks used to construct the missions, successive waves of plant immigrants moved into California (Burcham 1957). Some weedy species from Europe arrived in the 1700's, but most of the annual grasses, the wild oats (*Avena* spp.), filarees (*Erodium* spp.), bromes (*Bromus* spp.), and fescues (*Vulpia* spp.), which produce most of the forage annually, arrived in the middle 1800's. Soft chess *(Bromus mollis),* now the most widespread annual, was a late comer and only became abundant in the 1890's (Heady et al. in press). By the mid 1800's the take over from native perennials was complete and no areas free of exotic annuals are left. Although grazing started the process of change by damaging or destroying the native grasses, the new immigrant plant species made the change permanent and irreversible, even under complete protection.

The present annual grasslands and oak savannahs (Fig. 1) intergrade across a wide geographic range and could be separated into numerous subtypes. The most commonly described divisions are the Coastal Prairie, Valley Grassland, and Oak woodlands (Barbour and Major 1977). The Coastal Prairie extends from the Monterey Bay in Central California northward to the Oregon Border near the immediate coast and along the San Francisco Bay. The cooler coastal climate, with annual rainfall from about 20 inches to over 80 inches annually, should place less summer drought stress on perennial grasses than the hot inland Central Valley. Indeed, native and exotic perennial grasses are common along the coast, even under livestock use. The dominant grasses are California oat grass *(Danthonia californica),* Pacific hairgrass *(Deschampsia holciformis),* and Pacific reedgrass *(Calamagrostis nutkaensis)* (Heady et al. 1977). Average forage production exceeds 3,000 lbs/acre/year. Little has been published about management of grazing or burning in Coastal prairie and much of the type is in Parks or other reserves.

The Valley Grassland forms a ring around the Central Valley, extending into the Mountains of Southern California

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