

Chaparral Studies at Sequoia Provide Management Insights

By David J. Parsons

While better known for its stately giant sequoia groves and spectacular high elevation scenery, Sequoia National Park is home to the most expansive, undisturbed area of chaparral in the National Park System. Located immediately downslope from the sequoia mixed conifer forest, over 20,000 acres of chaparral are protected in the low elevation foothills of the park. Characterized by hard leaved, deep rooted, evergreen shrubs, mature, often uniform aged chaparral now covers extensive areas within the park. This highly flammable, fire adapted vegetation type presents a challenge to park managers: that is, how to restore fire to its natural role without risking damage to life, property, and the sequoia groves immediately upslope. Such decisions require considerable knowledge of past and contemporary vegetation patterns, ignition sources, fire behavior and fire effects.

Over the past decade a major research program has been directed at better understanding the ecology of the foothill zone of Sequoia NP. Since fire plays such an integral role in the foothill ecosystems, which include annual grasslands, oak savannas and hardwoods in addition to chaparral, much of this effort has been directed towards understanding the natural role of fire in the area. This includes studies of fire adaptations as well as the effects of fire and fire suppression on such ecosystem properties as plant succession, productivity and nutrient cycling. The research has been carried out as a cooperative effort between the park's research staff and Dr. Philip Rundel at UCLA (previously at UC Irvine). These studies, which for the most part have been recently completed, provide a wealth of knowledge of value to park managers and interpreters.

The dominant plant community in the foothill zone of Sequoia NP is known as chamise chaparral. Overwhelmingly dominated by a single species, the needle leaved evergreen chamise, the community does especially well on dry slopes with thin, rocky soils. Chamise is noted for its high flammability and its capacity to resprout following fire. Other locally important species include manzanitas, ceanothus and mountain mahogany. Manzanita species, which are restricted primarily to rocky ridgetops in the foothills, become relatively more common at higher elevations. Several species of Ceanothus, most of which are nitrogen fixers, are locally abundant for several decades following fire but usually die out after 40 to 50 years. Mountain mahogany is found primarily on the moister north facing slopes. Several other short lived shrub species can be found following fire or disturbance. The hot dry summers characteristic of mediterranean climate areas limit shrub growth to late winter and spring. During summer months severe water stress reduces physiological activity to low levels. Maximum growth occurs in the spring when temperatures are warm and moisture is available. Soils in the chaparral zone are characterized by sandy loams with low levels of total nitrogen and phosphorus.

While most of the foothill zone of Sequoia has not burned in at least 60 years (as far back as reliable fire history records go), and probably 80 to 100 years, it is known that chaparral is a highly fire adapted vegetation type. For example, the ability to resprout following fire, while most likely an ancestral trait not evolved under a fire regime, allows many species to

quickly reestablish following burning. Other species, including many fire successional herbs are obligate seeders adapted to prolific germination following heat or exposure to charate (charcoal leachate from burned wood). The abundant growth of ephemeral herbs the first few years following fire (we found they constituted 64 percent of the total biomass one year following fire in chamise chaparral) plays an important role in sequestering nutrients so they will not be lost to erosion and leaching. Our studies of the successional dynamics of chamise chaparral following fire have documented an increasing fuel loading, surface to volume ratio, and ether extractive content, all of which increase flammability, in the decades following fire. This fits well with the general belief that chaparral is best adapted to fire at intervals between about 20 and 50 years.

Much of the Sequoia research has focused on evaluating the effect of seasonality of burning on stand recovery. Experimental burns carried out in the spring and early fall have documented a higher root crown survival and thus stand regrowth rate following more natural fall fires. On the other hand, it appears as if more intense fires cause higher mortality of chamise regardless of the time of year. Additional studies of population structure and post fire demography have documented many of the subtle effects of burning under different conditions. The development of regression equations to predict the above ground biomass of individual shrubs based on basal stem diameter and density provides a basis for determining pre-burn fuel loading as well as monitoring post-burn succession.

The management implications of the Sequoia fire research program include the ability to better predict both the short and long term effects of alternative burning strategies. Since the ultimate management goal is to restore natural fire regimes, and natural ignitions are known to have occurred primarily in the late summer and fall it follows that management burns should be conducted during those periods. On the other hand, before natural ignitions can be allowed to burn or prescribed fires can be set during the high fire danger period, it will be necessary to first assure that such ignitions will not threaten structures, safety or other resources. This requires a thorough understanding of fire behavior, the protection of boundaries and the breaking up of large areas of uniform aged brush to reestablish what is thought to be a more natural mosaic of age classes. The Parks Division of Resource Management is now in the process of developing a fire management plan to restore more natural fire regimes in the chaparral and other foothill communities. In addition to eventually allowing most lightning strikes to burn, such a plan must ultimately incorporate knowledge of lightning ignition patterns and fire spread and behavior models. This will provide at least part of the data base necessary to replace those fires that are either suppressed for safety or political reasons or would have burned into the park if not suppressed by other agencies. Unfortunately, much of the necessary data on fire history and behavior required to fully implement such a program is still lacking. In the meantime, management decisions will have to be made on the basis of the best available information.

Other benefits that have been derived at least in part from the Sequoia chaparral research program include a better understanding of the plant communities and flora of the area and the development of monitoring guidelines to assist managers in evaluating the effects of management burns. Additional spinoffs have come from the National Acid Precipitation Assessment Program study that is ongoing in Sequoia. That program has funded meteorological measurements, soil survey and chemistry work, hydrology measurements, and the establishment of permanent vegetation plots in the chaparral zone. Other research currently under way in the area includes studies of dry and wet deposition chemistry and nitrogen mineralization. This focus on multi-disciplinary, long term research promises a continued emphasis on better understanding natural ecosystem processes and thus more refined management and improved interpretive programs.

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