EFFECTS OF FIRE ON DEER IN CHAPARRAL

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INTRODUCTION

To understand the effects of fire on deer in chaparral, a brief review of their reproduction, seasonal history, and habitat requirements is in order. Also understanding the effects of fire on chaparral vegetation is important to understanding why deer respond positively to fire induced vegetative succession. Finally, the effects of un-managed, managed, and wildfire treated chaparral on deer will be discussed.

CHAPARRAL DEER

Chaparral deer populations in California include three sub-species, the Columbian black-tailed deer *(Odocoileus hemionus hemionus)*, the California mule deer *(Odocoileus hemionus californicus)*, and the southern mule deer *(Odocoileus hemionus fuliginatus)*. The combined ranges of these three sub-species of mule deer corresponds somewhat with Sampson (1944) and Jensen's (1947) classification of chaparral and chaparral associations in California (Figures 1 and 2).

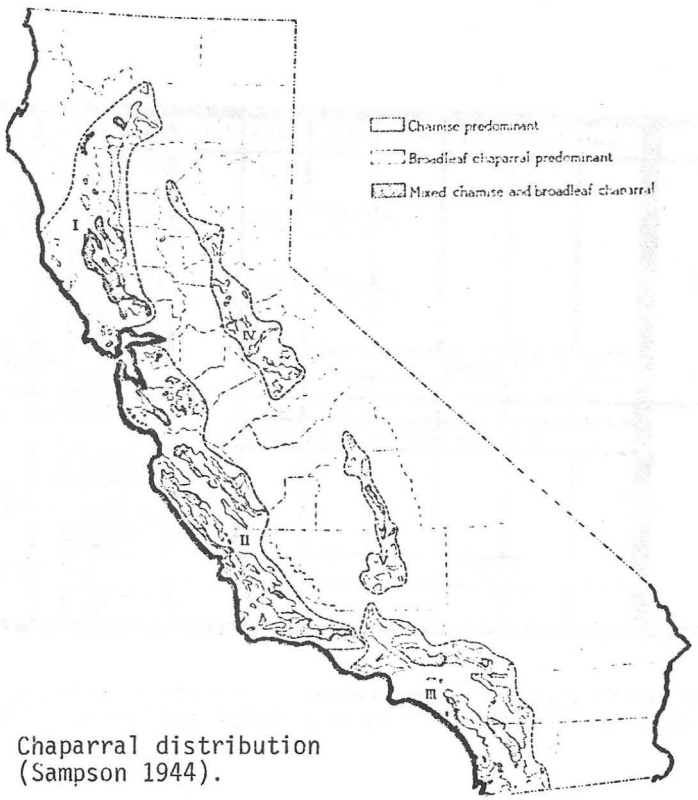

Figure 1. Chaparral distribution (Sampson 1944).

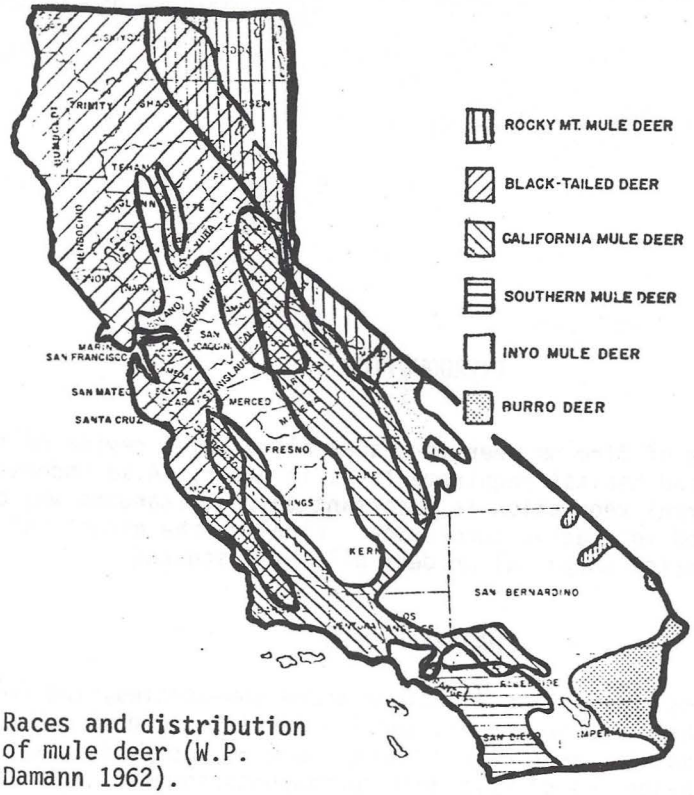

Figure 2. Races and distribution of mule deer (W.P. Damann 1962).

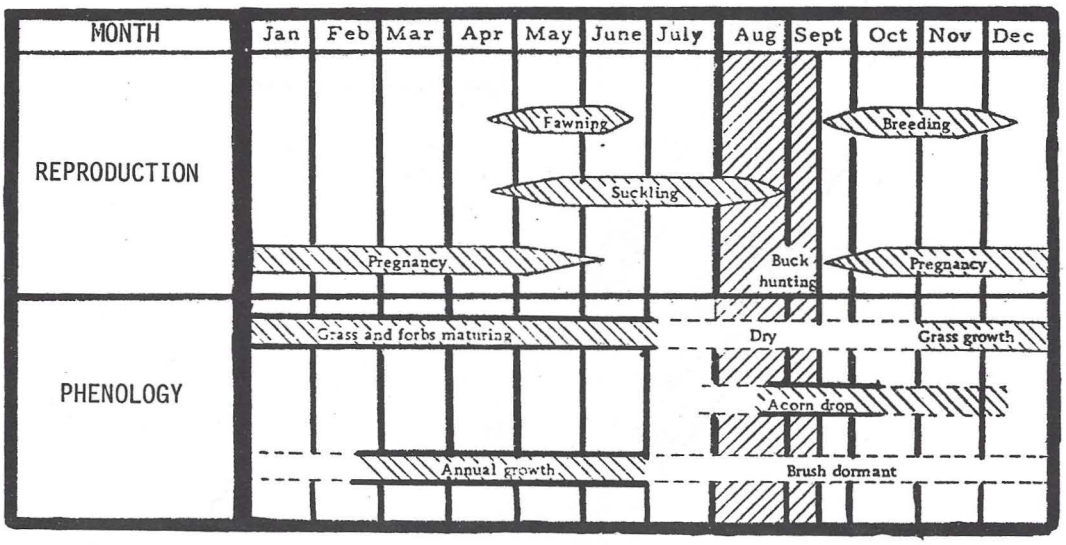

Figure 3. The annual cycle of deer reproduction and vegetative phenology in Mendocino County (modified from Taber and Dasmann 1958).

Reproduction

Chaparral deer seldom breed before they are 16 to 18 months old (Taber 1958; Bischoff 1958). Breeding activity generally begins in September and is completed in December. Southern herds begin breeding earlier than northern herds (Cronemiller 1950). Yearling females tend to breed 3 - 4 weeks later than the adult and single embryos are most prevalent (Taber 1958; Bischoff 1958). Adult does in good physical condition normally bear twin fawns each spring. On poor ranges or poor forage growth years chaparral, does do not breed as yearlings and they do not produce as many fawns a year when they do start breeding. This is due to a difference in the number of young conceived at the time of breeding rather than a loss during pregnancy (Taber 1958). Fawns are usually dropped in April, May and June (earlier in the sourthern chaparral ranges and later in the northern ranges) following a gestation period of about 204 days. Figure 3 depicts the annual reproductive cycle in relation to vegetative phenology.

SEASONAL HISTORY

Spring (April, May, June)

The fawning period generally peaks in May on northern chaparral ranges and for about 4 - 5 weeks in the spring heavy does fight off their young of previous years and retire to thick cover to bear their fawns. These adult does, two years old or more, are also antagonistic towards each other at this season and this results in their spreading apart rather evenly over the country wherever suitable fawning cover is found (Dasmann 1956). Taber and Dasmann (1958) found that when all of the fawning habitat is occupied there were about 36 fawning does to the square mile. These observations indicate the average fawning territory is about 18 acres in chaparral. This territorial behavior forces young pregnant does, just approaching their second birthday, to look for a fawning site out of the area of heavy deer concentration. Dasmann (1956) found on one Lake County range of high deer density there was an emigration of one-third of these young does every year because of the inhospitable behavior of the older does.

Fawn suckling begins shortly following birth and continues for about 60 to 75 days (Dixon 1934), provided the newborn fawn is healthy enough to stand and its dam has sufficient milk.

Autopsies of pregnant does from different chaparral ranges of the state show that from conception to birth practically all fawns survive in a healthy condition until birth. Many of them, however, die shortly after they are born. This loss of very young fawns is difficult to study but it is probably related to the inadequate nourishment of the does during and after pregnancy (Taber 1958).

Studies of pregnant does and herd composition counts from the North Kings ranges (Fresno County) show that a 60 - 80% fawn mortality occurs on this migratory herd's summer range and it is hypothesized this loss is due to the general curtailment of vegetative disturbance on middle elevation migration corridors and summer fawnings habitats that has led to a decline in the nutritional quality of forage on these key ranges. The consequence has been a reduction in fawn survival related principally to poor nutrition, but abetted by the concurrent losses of brush and other cover used by fawns for protection from weather and predation (Salwasser 1978).

Food

Spring is a period of abundant and nutritious forage (Figure 3). Shrubs make their annual growth beginning in March and April and the tender twigs and leaves of many are high quality deer feed. In addition to browse there is a supply of succulent herbaceous plants of high quality, especially on the burned or open shrublands. Even pregnant does, putting so much of their energy into the growing fawns, gain in condition.

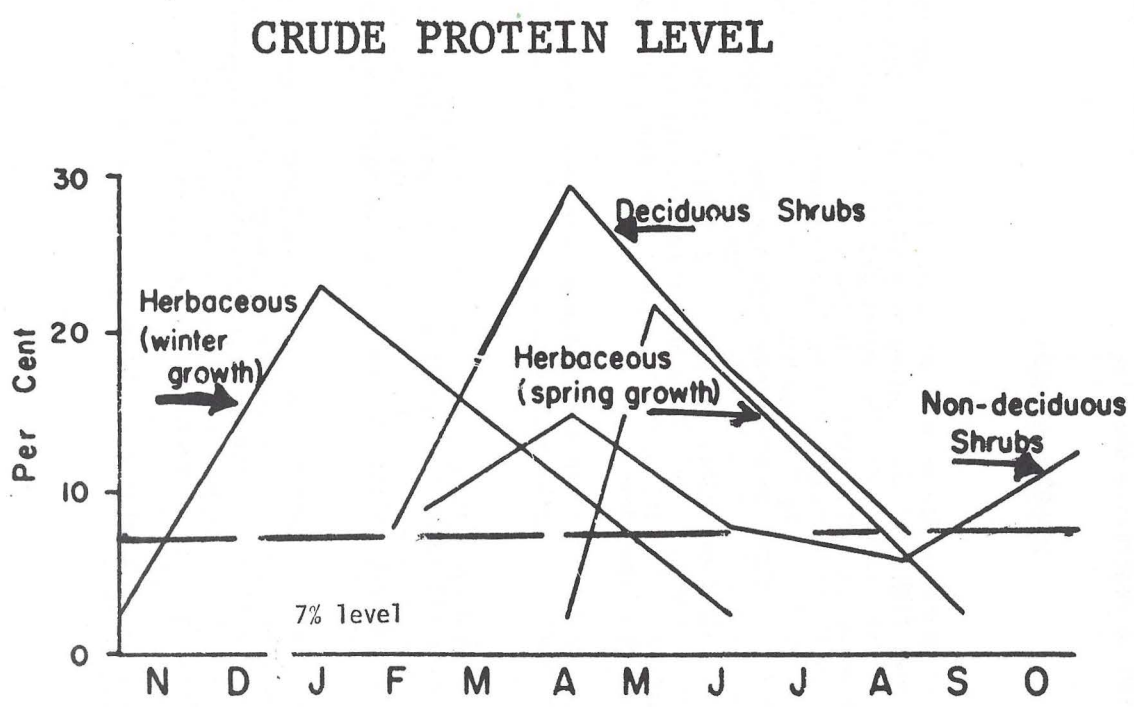

Figure 4. Seasonal level of crude protein in woody and herbaceous plants (modified from Taber and Dasmann 1958).

At this time of the year, right after fawn drop, the herd reaches its highest population level. While some fawns do not survive at this season, mortality is generally low, except in areas where cover or forage is not adequate. Does heavy with fawns are easy prey for predators as are fawns where cover is inadequate (Taber 1958).

Summer (late June, July, August and September)

Distribution and Behavior

During the spring and early summer deer in the chaparral shift from south to north facing slopes to remain in harmony with the optimum temperatures (55 to 65 F, Taber 1958) and to feed on the later maturing plants to be found there. At night when the temperature falls they often move onto the south slopes to feed and bed. At this season cover is essential for escape from the heat and the distribution of north slope cover patches that provide shade and allow understory air circulation determines the distribution of deer on their home ranges. If small patches of cover are available near food sources the deer will use these. The larger 40 acre or more escape cover areas are used and needed to escape from predators or human harassment.

Food and Water

The daily requirement of water for a hundred-pound deer appears to be about 2.5 quarts (Nichol 1938). During the winter and spring when the food is succulent, this amount is taken in automatically with the food, but as summer comes on, the moisture content of the food drops and the deer must have free water to drink (Taber 1958). Water could be a siginificant factor in chaparral fawn survival during dry years, with the early dessication of herbage during June, July and August while fawns are nursing. Does nursing fawns require a high quality diet with an adequate supply of moisture to sustain their milk production.

The quality of deer food is generally highest when plant growth is the fastest. This fast growth period occurs primarily in the period of fast growth and high protein content of forage that deer condition reaches its annual peak. There is an abrupt drop in forage value in late June and early July (Figure 4). Thus in July and early August a decline in chaparral deer condition begins. Protein quality of the chaparral forage continues to drop throughout August and September. Even in a good growth year the protein content of most deer foods including chamise, which is the staple of chaparral deer, falls off to a level of about 3 to 5%, too low to sustain deer in good condition (Dasmann 1955). Evidence at hand indicates that a 7% crude protein level in adequate amounts of palatable browse should maintain deer in situations other than those subjecting them to prolonged cold or stress (Bissell 1955).

In some years or on some chaparral ranges, the diet of the deer is supplemented by an acorn mast crop beginning usually in September. Acorns are an excellent source of fats and carbohydrates and a good supply generally leads to good survival of fawns and adults through the sometimes critical late summer and fall months. Chaparral deer decline in condition through July, August and September of any year (Taber 1958); however, on years when acorns are plentiful, high fawn production and survival have been recorded (Inlay pers. communication).

Mast Crop

On years of low acorn production and poor forage growth, deer mortality in chaparral is high in August and September and in the winter when the combined stresses of poor condition and weather can result in additional losses.

Acorns are also a significant factor in improving deer herd production as well as deer survival. Since the acorn drop is coincidental with the breeding period, years of good acorn production have been observed to improve breeding conditions of bucks and does, resulting in improved and increased fetal rates. Thus acorns in the diet of deer in any one year can result in improved herd survival and production and survival of the next year's fawn crop.

While there is a general drop in forage quality during the summer, some forage species sustain a higher protein level. Such species as California laurel, mountain mahogany, chokecherry and deer brush, maintain a protein level of 7 to 10% or more at this season (Bissell 1955; Taber 1958). These plants are usually very limited or unavailable in mature chaparral.

Riparian vegetation or irrigated plant growth associated with seeps, springs, streams or ponds often provides key foraging sites in chaparral during the hot summer months. These riparian forage sites generally represent the core of the chaparral deer populations. They represent the optimum foraging sites over the longest period of time and are generally the focal point of deer propagation units. These riparian niches provide a source of high quality succulent forage for nursing does, thus assuring a plentiful milk supply for fawns who continue nursing to some extent until late August on many chaparral ranges. It is these sites that year after year provide the colonizers that immigrate or restock surrounding marginal habits whose populations suffer high summer and winter mortality on hot, dry or cold years.

Another source of succulent forage is generally found on agricultural lands or in the yards and gardens where human land use has invaded the chaparral landscape. These urban sources of high quality forage are responsible for sustaining high deer carrying capacity on otherwise forage deficient chaparral lands by supplementing the deer forage needs through the dry summer months of July, August, September and October.

Fall and Winter (October through March)

Breeding activity begins in mid-September with swelling of the necks of prime bucks. Actual mating follows 4 - 6 weeks later and reaches a peak in October and November on most chaparral deer ranges (Figure 3). After a decline in rutting and breeding activity, bucks return to their home ranges, if they have been away, and spend much time foraging and in heavy cover in an effort to renew their condition. The does and young deer resume their feeding and bedding routine.

During the rut and up to late November, chaparral deer concentrate in the stream bottoms, ridge tops and north slopes, searching for acorns, streamside plants and new herbaceous growth. Herbaceous growth as a result of fall rain often begins in October and this new forage supply usually becomes available first on north slopes where it receives protection from the early fall sun, heat and wind (Figure 5). North slopes are used until they become too cold, which usually occurs in late November. As the south slopes become more habitable and the young herbaceous forage grows, use increases on these slopes.

As the days grow shorter and colder and the damp cold air settles into the canyon and stream bottoms, deer congregate on south and east slopes and in selected warm pockets and sheltered ridges. The long weight loss which began in July continues into winter and usually ends in January or February, when the grass and browse diet quantity and quality are renewed (Figure 5). Many of those deer in poor condition that made it through the summer and fall die in late winter prior to this improvement in the forage supply. By March many of the forbs such as filaree, popcorn flower and brodea are eagerly sought after and eaten. In the heavy brush where the herbaceous plants are largely shaded out, the deer are forced to maintain a diet largely comprised of browse (Figure 5).

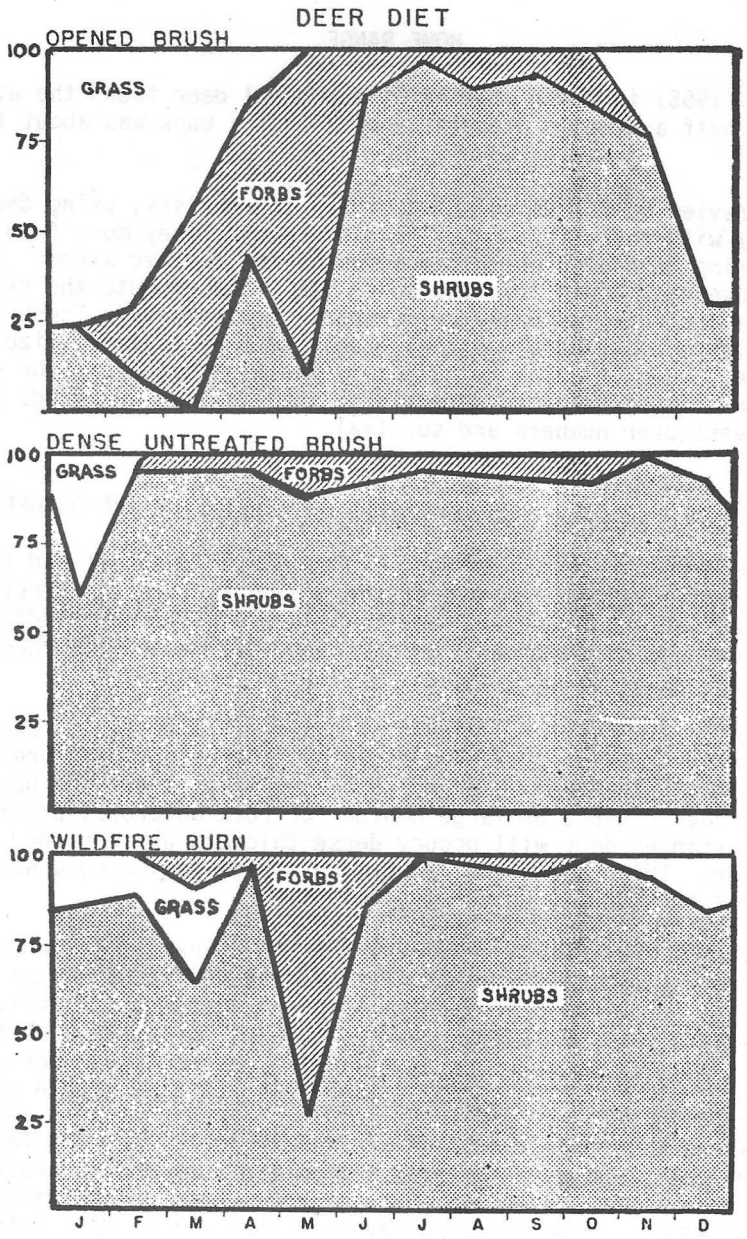

Figure 5. Comparative diets of deer on opened brushland, on dense untreated brush, and on wildfire burn. Grasses and forbs constitute a favorite winter and spring food item where available, but shrubs are the primary source of food in summer. (Adopted from Taber and Dasmann 1958).

As winter merges with spring, the sap rises in the shrubs and from March to May this annual growth attracts the deer to feed on the tender and nutritious shoots. As the browse species new growth becomes available, deer that were daily using lush herbage have been observed to leave it to browse in the brush field until the succulent new leaves and twigs begin to harden when they again seek out green herbage if available (Figure 5).

HOME RANGE

Taber and Dasmann (1958) in their studies of chaparral deer found the average home range of a doe was only half a mile in diameter and that of a buck was about three-quarters of a mile.

In the preceding review we discussed how deer are oportunists, using the various slopes to stay in harmony with their forage and bedding needs. They move from south facing slopes in late spring to cooler north exposures as the weather warms. In the late fall and winter deer move back again into the sun. They move up onto the ridges or down into the canyon bottoms according to daily or seasonal requirements. These daily and seasonal requirements are very important since they predicate the location, size and shape of each adult's home range. When it comes to purposely managing chaparral for deer, knowing their habitat requirement is necessary to determining the location and kinds of treatments necessary to increase deer numbers and survival.

WILDFIRE EFFECTS IN CHAPARRAL ON VEGETATION AND ON DEER

Most wildfires temporarily denude the land exposing both the soil and the wildlife to the elements. Seventy-five percent or more of the ground is bare the first year after a wildfire burn. Generally but few deer are trapped and killed by wildfires. They usually escape into the surrounding brushlands or back into the recently burned area. As a result direct losses of deer in fires are rare.

Since cover is a vital habitat requirement of chaparral deer for forage, escape, bedding, loafing and thermal protection, its removal, with some exceptions, precludes use by deer. In some wildfires deer have been observed to occupy areas where the physical character of the land, such as deep canyons or large boulder or rock outcrops, provide the required cover. In some instances deer will occupy dense thickets where burned brush stubs or trees provide cover. This shortage of cover and forage following a wildfire forces most deer to utilize the surrounding unburned edges.

The shortage of forage and cover following a fire in chaparral is generally of very short duration (Figure 6). Plumb (1961) found that many shrubs had sprouted 10 days after the 1960 wildfire on the San Dimas Experimental Forest. Regrowth of species referred to as sprouters usually occurs within a few days and some of these new succulent shoots provide excellent forage. Most of this forage is not utilized the first year except around the margins of the burn. Deer prefer to do most of their feeding within about 300 feet of cover (Ashcraft 1970; McCaffrey 1969). During the second post-burn year vegetative growth meets and exceeds the cover needs of deer and the pre-burn deer population returns to the recently burned ranges along with immigrants from the surrounding unburned chaparral whose home ranges overlapped the burn or whose ranges were close enough for the animal to detect the new improved forage. Gibbens (1963) reported that belled deer detected manipulated chaparral for distances of three-quarters of a mile and some individuals relocated their home ranges to take advantage of the new improved forage supply.

The improved forage benefits as a result of fire last for only a short time as indicated in Figures 6 and 7. Sampson (1944) depicted the increase and decline in forbs and grasses before and after bunring (Figure 6), indicating herbaceous forage benefits for deer can be expected to last about 7 years. The crude protein content of browse increases dramatically the first growing season following burning and decreases back to its preburn value within just three years. Taber (1958) graphically portrayed this rise and fall in chamise during its annual growth cycle over 3 years (Figure 7).

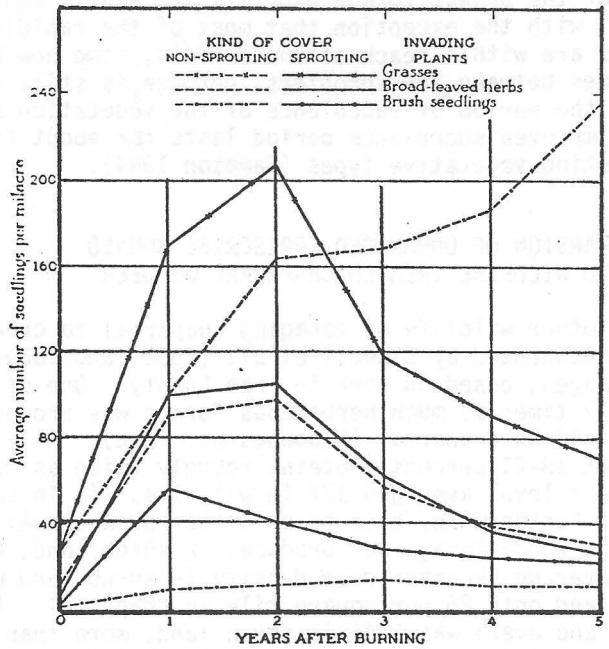

Figure 6. Average number of herbaceous plants and brush seedlings per milacre on sprouting an on non-sprouting covers, before and after burning (From Sampson 1944).

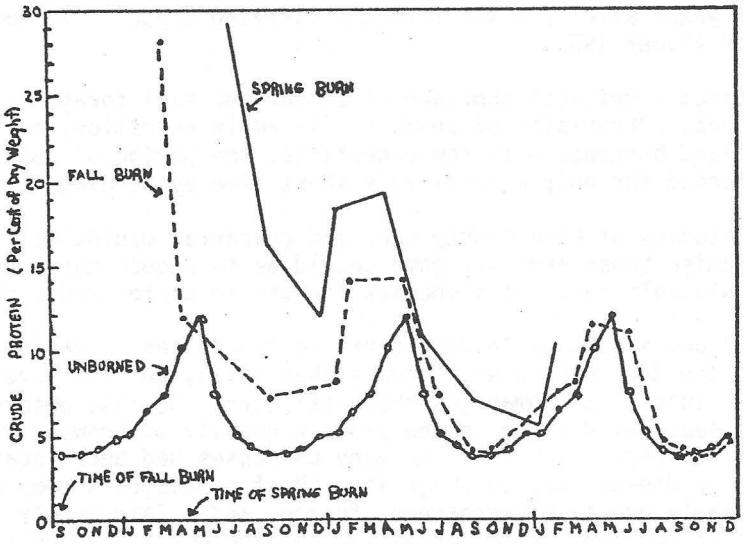

Figure 7. The effects of burning on the protein content of chamise goes through an annual cycle correlated with its schedule of annual growth. (Adapted from Taber 1958).

In capitulation, most of the forage benefits resulting from a wildfire are restricted to the 300 ft. strip around the margins or near cover the first year. Thereafter the original occupants move back to their original home ranges occupying most of the burn. Thus most of the highly nutritious forage produced the first year goes unutilized except near cover. After the first year the original population together with new immigrants and the new fawn crop begins to utilize the now over-abundant forage supply. By the third year the nutritional value of the browses has declined to nearly its pre-burn level. After the third growing year the browse forage benefits are nearly equal to the pre-burn conditions or old chaparral with the exception that most of the rapidly growing succulent shoots of the browse plants are within reach of the animals, some new browse species are beginning to fill interspaces between the sprouters, herbage is still an important component of the stand and the period of succulence of the vegetation as a whole is still slightly prolonged. This improved succulence period lasts for about five years in both the sprouting and non-sprouting vegetative types (Sampson 1944).

COMPARSION OF UNMANAGED, PRESCRIBE BURNED AND WILDFIRE TREATED CHAPARRAL ON DEER

The advantages to deer and other wildlife of managing chaparral to create "opened brush" or "shrub land" have been documented by Biswell et al. (1952) and Taber (1956). Taber has summarized these advantages, based on work in Lake County. One of the most striking comparisons is that about 17 times as much herbaceous forage was produced in shrub land (86 pounds per acre) as in climax chaparral (5 pounds per acre). As a result, winter deer diet on shrub land was about 18-21 percent protein, roughly twice as much as in chaparral. On a year-long basis, protein level averaged 17% in wildfire, 14% in shrub land and only 9% in chaparral (Table 1). Furthermore, because of better browse availability, 506 pounds per acre of available woody forage was produced in shrub land, against only 181 pounds in chaparral. The average December deer density in shrub land was 60 per square mile, 56 in wildfire burn, and only 25 per square mile in chaparral. Fawn production average (per doe two years and over) was 1.45 in shrub land, more than twice the 0.7 rate in chaparral and 1.15 in new wildifre burn (Table 2). Taber (1956) surmises that a diet low in protein and phosphorus is responsible for the low ovulation and reproductive rates of deer living in untreated chaparral.

Wildfire burns in chaparral during their early successional development can thus significantly increase deer populations; however, as the herbaceous component of the vegetative cover disappears and the browses mature, the forage quality and quantity decline. For two or three years wildfires are productive for deer, thereafter their productivity declines until 4 or 5 years after the wildfire the carrying capacity is about equal to the preburn population (Taber 1951).

Sampson (1944) recognized a critical shortage of summer and fall forage in burned and unburned chaparral types. "Provision of animals with ample nutritious forage is seldom accomplished by brushland burning; with few exceptions, the period of nutritious forage of these areas is extended for only a relatively short time by burning."

Biswell (1961), from studies of Lake County deer and chaparral manipulation, concluded that management of chamise brushlands for game should be to reduce the brush cover in spots and introduce palatable herbaceous species for use in winter and early spring.

Dasmann, R.F. (____) found a decline in deer carrying capacities in managed chaparral or shrub land similar to the declines in wildfires (Taber 1951), but the leveling off point is considerably higher than on an unmanaged chaparral burn. He also observed that coincidental with the seasonal decline in the protein quality of browses during hot dry summer weather, mortality began. By fall, so many carcasses had been located that it was obvious that a major die-off was in progress. "Most carcasses showed obvious signs of malnutrition. An early growth of herbaceous forage, and a fair supply of acorns became available to the deer in October. With increased food the mortality declined. Only two deer were found dead in October-November, compared with 20 in August-September."

TABLE 1. Monthly level of crude protein in the diet of deer on three range types (Expressed in percent of dry weight)

RANGE	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	AVER.
Chaparral	12.3	9.4	9.3	12.3	13.9	12.1	8.4	8.0	7.0	5.9	5.1	6.1	9.2
Shrubland	18.3	21.1	18.1	17.5	14.1	12.1	11.3	9.2	10.0	10.0	12.8	17.9	14.4
Wildfire	19.6	19.6	19.6	20.1	26.4	17.8	15.0	14.1	10.1	11.1	12.5	14.6	16.7

TABLE 2. Fawn production by 100 adult does on each of three range types.

	AGE AT FAWN DROP	PROPORTION IN 100 ADULT DOES	MEAN NUMBER OF CORPORA LUTEA PER DOE	FERTILIZATION RATE	FAWN PRODUCTION
Chaparral	2 years	19	*0.5	0.94	9
	Older	81	0.82	0.94	62
	PRODUCTION PER 100 ADULT - 71 FAWNS				
Shrubland	2 years	27	1.0	0.94	25
	Older	73	1.75	0.94	120
	PRODUCTION PER 100 ADULT DOES - 145 FAWNS				
Wildfire burn (second spring following burning)	2 years	25	0.66	0.94	16
	Older	75	1.40	0.94	99
	PRODUCTION PER 100 ADULT DOES - 115 FAWNS				

*Assumed

Deer carrying capacities in untreated chaparral are largely governed by weather and its effects on forage quality and quantity. Good "deer years" are represented by weather conditions that promote good herbaceous production and/or an acorn mast crop. Those conditions that extend the forage succulence period through the critical summer and fall months and alleviate entry of animals in poor condition into the cold dormant winter months when browse forage quality is low. When these conditions occur, deer populations and survival increase.

SUMMARY

In summation, wildfires are infrequently responsible for losses of deer. Immediately after a wildfire and for about one vegetative growth year, deer use and populations in large burns are generally very limited due to the displacement of animals and removal of cover. Concurrent with the growth of cover and in response to increased vegetative diversity, particularly the herbaceous species that improve the opportunity for selection of a more nutritious diet, the displaced deer population returns and fawn production and survival increase. In wildfire this increase in herbaceous diversity is short lived and within 5 - 7 years most of the post-burn herbaceous invaders have disappeared. As this herbaceous vegetative element declines the deer carrying capacity in terms of fawn production and survival also declines. As a result the deer population gradually returns to its pre-burn level.

In managed chaparral, deer populations can be maintained at a much higher level than occurs for a short time following a wildfire. This is achieved through a combination of periodic burning (2 - 3 years) of small parcels (2 - 5 acres) to maintain succulent and nutritious browse and invading forbs, and inclusion of permanent grassy openings. This is an over-simplification of chaparral management for deer, but the primary objective is to improve the nutritional plane and succulent forage period over a longer period of time, particularly during the late summer and fall months when forage conditions in chaparral are generally poor.

LITERATURE CITED

Bischoff, Arthur I. Productivity in some California deer herds. Cal. Fish and Game Vol. 44, No. 3 July 1958.

Bissell, Harold D. and Helen Strong. 1955. The crude protein variations in the browse diet of California deer. Cal. Fish and Game, Vol. 41, N9. 2, pp 145-155.

Biswell, H.H. 1961. Manipulating of chamise brush for deer range improvement. Cal. Fish and Game Vol. 47. No. 2, pp 125-144.

Dasmann, R.F. (___). Fluctuations in a deer population in California chaparral. Humboldt State College, Federal Aid Proj. PRW-31-R. Mimeo 10 pp.

Dasmann, R.F. and Richard D. Taber. 1956. Behavior of Columbian blacktailed deer with reference to population ecology. Journal of Mammology Vol. 37, No. 2, May 1956, pp 143-164.

Dasmann, W.P. 1962. Big game of California. Cal. Dept. of Fish and Game, publication booklet. 55 pp.

Dixon, Joseph S. 1934. A study of the life history and food habits of mule deer in California. Cal. Fish and Game, Vol. 20, Nos. 3 and 4.

LITERATURE CITED
(Continued)

Jensen, Herbert A. 1947. A system for classifying vegetation in California. Cal. Fish and Game Vol. 33, No. 4, Oct. 1947.

Nichof A.A. 1938. Experimental feeding of deer. Univ. Ariz. Agric. Exper. Sta., Tech. Bull. No. 75, pp 1-39.

Plumb, T.R. 1961. Sprouting of chaparral by December after a wildfire in July. U.S. Forest Service Pacific SW forest and Exper. Sta. Tech. paper 57:1-12.

Sampson, Arthur W. 1944. Plant succession on burned chaparral lands in Northern California. Univ. of Cal. College of Agri. Exp. Sta. Bull. 685 pp 1-139.

Taber, Richard D. 1953. Studies of black-tailed deer reproduction on three chaparral cover types. Cal. Fish and Game Vol. 39, No. 2, pp 177-186.

_____. 1958. The black-tailed deer of the chapparral. Dept. of Fish and Game Bull. 8 pp 1-163.