# THE EFFECTS OF BRUSH BURNING ON DEER

W. M. Longhurst and
G. E. Connolly
University of California, Hopland Field Station
Hopland, California

Abstract: Approximately 1,400 acres of spot burns (1 to 100 acres each) were created on a 3,000-acre chaparral area adjacent to the University of California, Hopland Field Station in southeastern Mendocino County and southwestern Lake County from 1963 through 1968 in order to observe the response of the résident deer (*Odocoileus hemionus columbianus*) population to brush burning. Observation of the deer population responses were continued through 1969. The vegetation on the study area consisted mainly of chamise (*Adenostoma fasciculatum*), live oak (*Quercus wislizenii*), scrub oak (*Q. dumosa*), buckbrush (*Ceanothus cuneatus*), manzanita (*Arctostaphylos* spp.), and knobcone pine (*Pinus attenuata*). The health and productivity of the deer population on the study area were compared with those observed in deer on the lower part of the Hopland Field Station where the cover was primarily oak woodland with a grass understory and where burned brush was not available, by means of herd composition counts taken each April, July, and October. Body weights, rumen fill, blood urea nitrogen levels, and pregnancy rates were also determined in samples of deer collected from these two areas as well as from an unburned chaparral area approximately 2 miles east of the burn area. The plant species composition of rumen contents was also determined.

Throughout the course of this study, the general health of deer on the burned chaparral area appeared better than that in the unburned chaparral but poorer than that observed on the Hopland Field Station. Year-to-year variations within each of the three areas studied was found to be as great as overall differences among habitat types. Although this burning program did not markedly improve the health and productivity of the deer population in the study area, such burning increases hunter access to deer in chaparral areas. This increased accessibility of deer for hunters may be equal in value to the forage improvement resulting from burning programs. An analysis of brush treatment costs, however, indicates that such management is economically questionable under current hunting regulations under which only adult males constituting 10 to 15% of the deer population are legal game.

It is suggested that a major goal of chaparral management programs should be to increase the availability of grasses and forbs to deer for as much of the year as possible.

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## INTRODUCTION

Controlled burning is a popular deer management practice in the chaparral lands of California. Several workers (Biswell et al. 1952; Taber and Dasmann 1958; Anonymous 1961) have cited the desirability of this practice, and it is widely favored by sportsmen and many landowners as well. In a hunter survey conducted in Mendocino County in 1965, 89% of the 436 respondents desired controlled burning to improve feed conditions for deer although only 56% favored changes in hunting regulations if necessary to permit the harvest of increased deer production on burned areas (Connolly 1966).

In view of this broad support for brush burning, it is surprising that little quantative information on the effects of burning on deer populations is available. While Taber and Dasmann (1958) showed higher deer densities in burned than unburned chaparral, their data were based on study areas of limited size. Comparable data for large areas, to the best of our knowledge, have not been developed. While the study of Taber and Dasmann (op. cit.) included follow-up treatment to increase the growth of grasses and forbs in burned areas, some sportsmen in this area favor burning alone when funds for follow-up treatment are not available. Currently available data, however, appear inadequate to predict deer population changes resulting from either of these management strategies. Cost-analysis data for various management inputs are likewise limited, even though basic public policy logically requires a favorable cost: benefit ratio when public funds are utilized for management purposes.

This report describes an attempt, at the applied management level, to measure the response of a resident black-tailed deer population in Mendocino County to a program of prescribed burning. The objectives were:

1. To manipulate chaparral vegetation through prescribed burning to provide and maintain an excess of new growth browse for the deer population.
2. To measure the effects of this management practice on the deer population.
3. To evaluate the economic aspects of this program.

This study was conducted on public domain lands under a special use permit kindly granted by the Bureau of Land Management. We also wish to thank the California State Division of Forestry for advice on burning techniques and for the required burning permits; the California Department of Fish and Game, Wildlife Investigations Laboratory for analyzing the plant species composition of deer rumen samples; and W. C. Weir, Department of Animal Science, University of California, Davis for blood urea nitrogen analyses.

## PROCEDURES

Study area: Burning operations were conducted on a 3,160-acre portion of the Cow Mountain Recreation Area adjacent to the Hopland Field Station maintained by the University of California. The study area lies along the Lake-Mendocino

County line between the Clear Lake and Russian River drainages. The covers consists almost entirely of chaparral ranging in elevation between 2400 and 3500 feet and characterized by chamise and buckbrush on southern exposures, live oak on north slopes, and small groves of knobcone pine on ridgetops. Manzanita (primarily Arctostaphylos glandulosa and A. canescens) is also abundant. The responses of these and other dominant shrubs to burning are summarized in Table 1.

Portions of the study area were burned in the 1950's by the California Department of Fish and Game, so that some of the brush was low when this study was initiated in 1963. A network of ridgetop trails established as firebreaks by the Fish and Game Department and subsequently used as jeep trails by deer hunters provided the principal means of vehicular access, although a seasonal 2-wheel drive road between Talmage and Lakeport served as the north boundary of the study area.

Burning operations: The dominant chaparral shrubs are well adapted to burning; most send up shoots from their root crowns which contain reserves of stored nutrients (Jones and Laude 1960; Laude et. al. 1961).while others accumulate reserves of seeds which depend upon fire to break their dormancy. These new shoots are more nutritious than the new growth on unburned plants (Sampson 1944), and are also accessible to deer while most of the new growth on mature shrubs is above the animals' reach. Chaparral burning therefore is expected to improve the quality as well as the availability of deer feed. This improvement should logically increase the health, productivity, and survival of deer in the burned area. Our burning activities were therefore intended to provide deer throughout the study area with a continuously available supply of recently burned brush.

Following an initial period of fire break improvement, burning was conducted on the study area as summarized in Table 2. Burned areas were kept under 50 acres in size as far as possible. No burning was done in 1967 as the regrowth in earlier burns appeared to be exceeding the rate of utilization by deer. After 1968 burning was terminated although surveillance of the deer population was continued through 1969.

The usual burning procedure involved crushing brush with a D-7 tractor on the periphery of the desired burn. This brush was allowed to dry for several weeks. A flame thrower or drip torch was then used to ignite the dry brush at the bottom of the slope. The fire ordinarily burned to the ridgetop and then went out. While burning was attempted at all times of the year, it was found that north slopes could be successfully burned only during high risk conditions. South facing chamise slopes, on the other hand, could be burned during dry periods at any time of the year.

Deer evaluations: In order to observe the effects of this brush burning on deer, the health and productivity of the deer population on the study area were compared with those of deer at lower elevations on the Hopland Field Station where no burned brush was available. This area consists of mature oak woodland

(*Quercus douglasii*, *Q. lobata*, *Q. kelloggii*, *Q. wislizenii*, and others) with an understory of annual grasses and forbs. Limited observations were also made in a chaparral area two miles east of the study area which had not been burned since the late 1940's. Because extensive studies with marked deer on the Hopland Field Station indicated that these animals have home ranges one-half to three-quarters of a mile in diameter, it was considered unlikely that deer in either of the comparison areas were significantly influenced by burning on the study area.

The parameters compared among these deer populations included fawn survival rates as measured in herd composition counts made three times each year; body weights of antlerless deer collected at various times of the year and bucks taken by hunters during the regular deer season; rumen fill in relation to body weight; productivity as determined by fetal counts; and blood urea nitrogen (BUN) levels. Forage items in rumen contents were also determined. Each of these parameters provides a somewhat different indication of the nutritional status of the deer population. Pregnancy rates, for example, reflect the condition of the doe for a period of several weeks before breeding, while BUN levels reflect the quality of forage eaten by the animals shortly (24 hours or less) before the sample is collected, according to unpublished studies conducted with sheep at the Hopland Field Station. Rumen fill shows the general quality of forage eaten for several days prior to sampling. Body weights are a function of forage quality and quantity throughout the life of the animal. Rumen fill should be relatively high in poor forage areas since poor forage is low in digestibility and therefore has a relatively long retention time in the rumen. On poor ranges the deer must also eat larger amounts of forage to obtain minimum nutrient requirements compared to deer in better habitats. While all of these parameters were measured on deer in the burned chaparral and oak woodland, it was found impractical to conduct herd composition counts in the unburned chaparral where much of the brush was so high that the deer could not be adequately observed. Deer collections in this area were likewise difficult. Our comparative data for burned and unburned chaparral are therefore not as complete as those for the burned chaparral and oak woodland areas.

When these comparative data were compiled, it was assumed that the healthiest deer population should exhibit the highest fawn survival rate, pregnancy rate, body weights, and BUN levels and the lowest rumen fill. Differences between areas were evaluated by standard analysis of variance or "t" test procedures wherever these methods were applicable.

## RESULTS

A total of 1,390 acres, or about 40% of the study area, were burned from 1963 through 1968 at an average labor and equipment cost of $8.00 per acre (Table 2). The first year was devoted largely to firebreak preparations, which accounts for the relatively high per-acre cost shown for 1963-1964. Costs for 1968, on a per acre basis, were higher than those in 1965 and 1966 because of the relatively small acreage burned. The 1968 burns also involved a greater amount of preparatory tractor work in an attempt to achieve the cleanest possible burns.

While these costs include travel time between Hopland Field Station headquarters and the study area (approximately one hour each way), they do not include costs of personnel transport vehicles, incendiary equipment and supplies, planning, deer observations, or administration. The actual cost of this project, therefore, exceeded $10 per acre burned.

Deer herd composition counts made on the Hopland Field Station (oak woodland) and the burned chaparral area are summarized in Table 3. Throughout the study, the observed fawn:doe ratios tended to be higher on the Hopland Field Station. A similar, although less clear-cut, pattern was exhibited by the buck: doe ratios. It was noted that the difference between average fawn:doe ratios on the two areas increased with the age of the fawns (approximately 2, 5, and 11 months in July, October, and April, respectively). This progression suggests that fawn losses at all seasons of the year are greater in chaparral than in oak woodland. The fawn:doe rations in both areas exhibited considerable variation from year to year.

Body weight comparisons of deer taken in oak woodland (Hopland Field Station) and burned and unburned chaparral are summarized in Table 4. Fawns were weighed to the nearest 0.1 pounds and older deer to the nearest pound. No statistically significant differences in body weights were found except in the spring of 1967 when does from the unburned chaparral were significantly lighter than those from oak woodland. Efforts to collect fawns from the unburned chaparral in the spring of 1967 were abandoned after several trips to the area were made without sighting a single fawn. The fawn:doe ratio in the unburned chaparral in April, 1967 is therefore believed to have been even lower than the 28:100 recorded in the burned chaparral (Table 3). It is noteworthy that body weights did not differ significantly the next year (Feb.-Apr., 1968) when observed fawn:doe ratios were much higher.

The buck weight and age data presented in the second part of Table 4 was compiled from records of the Hopland Field Station public deer hunting program. Most of the hunters using the study area came through Talmage or Lakeport and no records of hunting effort or success were obtained from these people. Persons hunting on the Hopland Field Station, however, could hunt on the study area merely by crossing the station boundary fence. These hunters took 40 bucks on the burned chaparral area from 1963 through 1969 in addition to 104 bucks on the lower part of the field station (Table 4). Differences in buck weights were associated with different age structures in the two samples. None of the average weights shown in Table 4 for bucks of comparable ages differed significantly. The age compositions of the two samples differ markedly, however, with 50% of the oak woodland bucks consisting of yearlings and 2-year olds. It is noteworthy that no legal yearlings were taken in the chaparral study area. Yearling bucks rarely develop forked antlers at Hopland except under unusually good forage conditions.

The rumen fill comparisons (Table 5) include four samples in which the mean values for oak woodland deer were significantly lower than those in deer from the burned chaparral, and only one in which the mean values for burned and unburned chaparral differed significantly.

Productivity data obtained from fetal examinations (Table 6) appeared to vary more among years than among vegetative types. The averages shown in this table are based upon the total does and fetuses examined in each area. While these pregnancy data cannot be tested by normal analysis of variance or "t" test procedures, it is doubtful that the observed differences would be regarded as significant considering the small samples involved.

No significant differences in BUN levels (Table 7) were noted between the burned and unburned chaparral areas. Oak woodland deer, however, sometimes exhibited higher BUN levels than those from the burned chaparral.

The food habits of oak woodland and chaparral deer in late winter and late summer are contrasted in Tables 8 and 9, respectively. At both seasons of the year, the diet of oak woodland deer appeared to include higher percentages of grasses and forbs than that of chaparral deer.

## DISCUSSION

Summarizing all of the comparative data collected in this study, it is evident that the oak woodland deer were healthier than those in the burned chaparral, which in turn were somewhat healthier than deer in the unburned chaparral. These differences among areas, however, were probably no greater than overall year-to-year variations. Comparing the data collected in 1968 with those of the previous year, for example, fawn:doe ratios (Table 3), productivity (Table 6), and BUN levels (Table 7) all appeared higher in 1968. These observations suggest that normal yearly variations in weather and feed conditions may produce deer population responses as large as those attributable to burning.

While this study did not attempt to measure changes in deer density associated with burning, a significant increase in deer numbers should have been preceded by at least a temporary increase in the rate of fawn survival on the study area. No such increase was noted. This observation, together with our general impressions obtained in the course of field work, lead us to suggest that the pattern of fluctuations in deer numbers did not differ markedly between the study and control areas.

Although the direct effects of burning on deer appeared minor in this study, field observations made during hunting seasons indicated an increase in hunting pressure in the study area after burning operations commenced. It was not possible to measure this increase since most of the hunters did not enter the burned area through our check station. The only hunting pressure data available for the Cow Mountain Recreation Area are checking station figures collected by the Fish and Game Department on other access routes during opening weekend. These data are not adequate to determine whether hunting was done on the study area or elsewhere in the 50,000-acre Cow Mountain Area. Personal contacts made with hunters in the field, however, indicated that recent burns are preferred hunting spots. It is obvious that deer would be easier to see, and therefore more vulnerable to hunting, in a new burn than in tall, dense brush. We therefore suggest that the increased vulnerability of deer to hunting may be as valuable a benefit of burning as any improvement in forage conditions.

In view of the differences in plant composition between the oak woodland and chaparral vegetative types, it is of interest to compare the food habits of deer inhabiting these types (Tables 8 and 9). Many food items in addition to those shown in the tables were present in minute quantities.

The diet of deer inhabiting the oak woodland consists almost entirely of grasses and forbs during late winter and early spring. In the chaparral, however, these items are of limited abundance. During the spring of 1968 unusually heavy flowering was noted on the manzanitas, which accounts for the prevalence of this item in the rumen contents of chaparral deer. Feeding trials with captive deer at Hopland have indicated manzanita flowers to be highly preferred, and deer exhibit a remarkable ability to select these flowers while avoiding the leaves and twigs of the plants. The summer diets of oak woodland and chaparral deer likewise exhibit major differences, in the (availability and) use of acorns and in the intake of grasses and forbs. It will also be noted that 6% of the diet of oak woodland deer consists of Ramalina and other lichens.

It is obvious that one of the basic problems involved is the relative quality of the diets available to deer in oak woodland with a grass understory, unburned brush, and burned brush. Our estimate of the relationships between these three situations is as follows:

Unburned brush: If deer are forced to remain yearlong in a stand of mature, unburned brush they face both qualitative and quantative restriction of their diet. Much of the brush is above their reach. Growth of brush in this state is not vigorous and relatively little new growth, which is highest in protein, is available even in spring. The variety of browse plants is often less because after long exposure to browsing some of the more palatable species may have been reduced in density through selective use. Others such as Ceanothus foliosus are short-lived and drop out after a few years. However, it is risky to generalize on species composition of a stand of brush because of the great variability associated with site conditions. During the dormant period, from about August through mid-April in this area, protein levels are low and browse from such a situation is mainly valuable as a source of energy from the cellulose content. Young deer with high protein requirements associated with growth are especially vulnerable.

Recent studies at Hopland have shown that many species of plants contain substances which inhibit the growth of rumen microbes (Longhurst et al. 1968). Probably the substances which are of importance in this regard in chaparral species fall mainly in the group of chemicals known as phenolic compounds. Tannins in oaks and manzanita are good examples. The hypothesis has been put forth that the quality of a plant as forage depends on the "balance" present between available nutrients such as portein, carbohydrates, and cellulose and any inhibitory substances.

For these reasons we believe that mature, unburned brush is not an especially favorable deer habitat and the carrying capacity in terms of numbers is low. Because of the dense cover, however, the deer which exist in this kind of situation are relatively invulnerable to hunting, and such a population would be expected to have a low recruitment rate and to possess a preponderance of old animals.

Burned brush: From the standpoint of deer the diet available in a burned area is definitely better than that in unburned brush, but not as good as in oak woodland. When possible, deer seasonally shift their diet from browse to green grass and forbs in the fall, winter, and spring and to acorns in the late summer, fall and winter to take advantage of the better nutrient supplies in these items. Green grass and forbs provide a good source of protein, but because of their high water content are low in fiber and therefore deficient in energy. During the wet months energy can be supplied either by the cellulose found in browse or by acorns which are high in starch.

At any rate, burned brush intermixed with grass and forbs provides better deer forage than unburned brush or burned brush without grass and forbs, Burning brush, however, does not favor acorn production and this is a serious deficiency. If patches of unburned brush are left for escape cover, deer make better use of burned areas and acorn production is somewhat improved.

Oak woodland: An ideal situation for deer in this area seems to be a mixture of cover types with an interspersion of unburned chaparral for escape cover, burned chaparral for nutritious browse, grassland for winter protein, and mature oaks for both browse and acorn production. A significant amount of browse and lichen falls from mature oaks as a result of normal breakage and wind action. Oak woodland alone does not provide all of these attributes, but it appears to be better than burned or unburned chaparral as shown by the biological data gathered from deer collected in the three cover types. Probably the most serious dietary deficiency deer encounter in oak woodland is energy intake during the winter months when the bulk of their forage is obtained from the grass understory. This situation is accentuated if there is a poor acorn crop or if insufficient browse falls from the mature trees which are largely out of reach of the deer.

The net nutritional values of these cover types for deer basically depend upon their relative production of available digestible nutrients. Taken individually none is ideal but collectively they support one of the densest deer populations found anywhere in North America.

In view of the foregoing comments, we suggest that chaparral management should include an effort to increase the availability of grass and herbaceous forage for as much of the year as possible. Such management would require follow-up treatment after initial burning, such as seeding and reburning or spraying to reduce the density of brush. This would greatly increase the total cost, which must be examined in relation to the benefits expected to result from such treatments.

Under our present system of bucks only hunting, the maximum deer harvest that can practically be achieved is about 7% of the total population (Longhurst et al 1952; 60). To increase the hunter kill by one buck on a given area, therefore, the stocking rate must be increased by 14 animals. Biswell et al (1952) reported that deer numbers in heavy brush and managed brush ranged between 10 to 30 and 40 to 110 deer per square mile respectively. Using the averages of these figures, an increase from 20 deer per square mile before management to 75 per square mile after management can be predicted, resulting in a potentially increased kill of 3 to 4 bucks per year per square mile. This increase requires optimum shrubland management, in which 70% of the brush (450 acres per square mile) should be treated (Biswell et al 1952).

The effective life of this treatment will depend on a multitude of factors, but periodic re-treatment will obviously be necessary to sustain maximum populations. If the effective life is 10 years per treatment it would seem reasonable to propose that 45 acres per square mile be treated each year in a sustained management program. It is doubtful that this management could be achieved for less than $20 per acre. At this rate, however, such a program would cost $900 per square mile per year, or $225 to $300 per buck produced through improved carrying capacity. It is difficult to justify such expenditures, especially when an increased deer harvest of the same magnitude could be achieved simply by adopting either sex hunting regulations.

If this chaparral management was accompanied by changes in hunting regulations to permit either sex hunting, the potential harvest could approach 25% of the deer population per year, rather than the maximum 7% under the present bucks only system. Using the figures cited previously, the deer take could potentially increase from 5 to 19 (25% of 20 and 75 deer per mile respectively in unmanaged and managed brush). The increased harvest due to management (14 per square mile per year) would then cost about $64 per deer, assuming management costs of $900 per square mile per year as in the previous example. Given these approximate costs, it would seem logical to achieve maximum use of existing deer populations before attempting management to increase deer numbers.

It should be pointed out that these figures are based upon very optimistic estimates of brush management costs and deer population responses, and that costs as well as responses will vary with the species composition of the vegetation, soil types, precipitation, temperature, and other environmental factors. Migratory deer herds may also introduce other complications which were not apparent in this study of resident populations.

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Table 1. Dominant shrubs on the chaparral study area.

| Common name | Scientific name | Response to Burning: Sprouting | Response to Burning: Seed germination |
|---|---|---|---|
| Chamise | Adenostema fasciculatum | X | |
| Interior live oak | Quercus wislizenii | X | |
| Scrub oak | Quercus dumosa | X | |
| Leather oak | Quercus durata | X | |
| Eastwood manzanita | Arctostaphylos glandulosa | X | |
| Hoary manzanita | Arctostaphylos canescens | X | |
| Stanford manzanita | Arctostaphylos stanfordiana | X | |
| Buckbrush | Ceanothus cuneatus | | X |
| Sweet birch | Ceanothus integerrimus | | X |
| Wavy-leaf ceanothus | Ceanothus foliosus | | X |
| Chaparral pea | Pickeringia montana | X | |
| Knobcone pine | Pinus attenuata | | X 1/ |

1/ Seeds retained in cones until burned.

Table 2. Summary of brush burning activities on Cow Mountain study area, 1963-1968.

| YEARS | MAN HOURS | Equipment hours (D-7) | Acres burned 1/ | Labor and equipment 2/ cost per acre burned |
|---|---|---|---|---|
| 1963-1964 | 642 | 115 | 220 | $ 19.50 |
| 1965 | 758 | 48 | 816 | 4.60 |
| 1966 | 420 | 21 | 264 | 7.60 |
| 1967 | 0 | 0 | 0 | 0 |
| 1968 | 144 | 30 | 90 3/ | 11.40 |
| TOTALS | 1964 | 214 | 1390 | |
| AVERAGE | | | | $ 8.00 |

1/ Estimated by planimeter from burned areas outlined on aerail photographs.

2/ Based on $4 per man hour and $15 per tractor hour.

3/ Visual estimate.

Table 3. Deer herd composition counts on Hopland Field Station and adjacent burned chaparral area, 1964-1969.

| | | HOPLAND FIELD STATION | | | BURNED CHAPARRAL1/ | | |
|---|---|---|---|---|---|---|---|
| MONTH | YEAR | Deer classified | Fawns/ 100 does | Bucks/ 100 does | Deer classified | Fawns/ 100 does | Bucks/ 100 does |
| APRIL | 1965 | 116 | 78 | 22 | 149 | 67 | 22 |
| | 1966 | 76 | 48 | 33 | 178 | 48 | 20 |
| | 1967 | 111 | 44 | 38 | 164 | 28 | 24 |
| | 1968 | 96 | 84 | 29 | 157 | 55 | 29 |
| | 1969 | 114 | 98 | 40 | 141 | 87 | 21 |
| Average | | 103 | 70 | 32 | 158 | 57 | 23 |
| JULY | 1964 | 83 | 46 | 13 | 258 | 56 | 28 |
| | 1965 | 62 | 80 | 27 | 199 | 65 | 15 |
| | 1966 | 80 | 87 | 18 | 180 | 54 | 24 |
| | 1967 | 107 | 75 | 26 | 147 | 68 | 39 |
| | 1968 | 86 | 91 | 54 | 166 | 99 | 32 |
| | 1969 | 102 | 95 | 60 | 149 | 76 | 31 |
| Average | | 87 | 79 | 33 | 183 | 70 | 28 |
| OCTOBER | 1964 | 39 | 52 | 33 | 268 | 57 | 41 |
| | 1965 | 155 | 81 | 28 | 131 | 74 | 37 |
| | 1966 | 149 | 75 | 35 | 163 | 62 | 21 |
| | 1967 | 118 | 80 | 56 | 139 | 72 | 36 |
| | 1968 | 87 | 92 | 50 | 199 | 84 | 51 |
| | 1969 | 120 | 87 | 35 | 233 | 56 | 35 |
| Average | | 111 | 78 | 40 | 189 | 68 | 37 |

1/ Includes upper portion of Hopland Field Station, where deer had access to recent burns.

Table 4. Body weight comparisons among deer from Hopland Field Station and chaparral study areas, 1963-69.

A. DOES AND FAWNS (Live weights)

| | | | HOPLAND F. S. | | BURNED CHAPARRAL | | UNBURNED CHAPARRAL | |
|---|---|---|---|---|---|---|---|---|
| YEAR | SEASON | AGE CLASS | No. of deer | Average weight | No. of deer | Average weight | No. of deer | Average weight |
| 1966 | Mar-Apr | Fawns | 7 | 41.0a[1/] | 5 | 34.7a | -- | -- |
| | Sept | Fawns | 5 | 28.8a | 5 | 28.6a | -- | -- |
| 1967 | Mar-Apr | Fawns | 5 | 40.1a | 5 | 42.7a | -- | -- |
| | Mar-Apr | Does[2/] | 5 | 86 a | 5 | 81 ab | 5 | 77b |
| | Sept | Fawns | 5 | 34.8a | 5 | 36.8a | -- | -- |
| 1968 | Feb-Apr | Does[2/] | 8 | 81 a | 9 | 84 a | 5 | 85a |
| | Aug-Sept | Mixed[3/] | 5 | 61 a | 5 | 63 a | -- | -- |

B. LEGAL BUCKS TAKEN BY HUNTERS (Field dressed weights)

| | OAK WOODLAND | | | BURNED CHAPARRAL | | |
|---|---|---|---|---|---|---|
| AGE CLASS (Yrs) | Bucks taken (No) | (%) | Mean weight (lbs) | Bucks taken (No) | (%) | Mean weight (lbs) |
| 1 | 6 | 6 | 63 | 0 | 0 | -- |
| 2 | 46 | 44 | 71 | 9 | 22 | 68 |
| 3 | 29 | 28 | 82 | 14 | 35 | 83 |
| 4 | 16 | 15 | 87 | 7 | 18 | 87 |
| 5 | 4 | 4 | 91 | 4 | 10 | 85 |
| 6 and older | 3 | 3 | 90 | 6 | 15 | 97 |
| TOTALS | 104 | 100% | -- | 40 | 100% | -- |
| AVERAGES | -- | -- | 78 | -- | -- | 82 |

1/ Within each row, means followed by the same letter do not differ significantly (5% level). Weight in pounds.

2/ Adults (2 years and older).

3/ Each sample included 2 old does, 1 yearling buck, 1 yearling doe, and 1 fawn.

Table 5. Rumen fill comparisons among deer from Hopland Field Station and chaparral study areas, 1967-69.

| YEAR | SEASON | AGE CLASS | HOPLAND FIELD STATION No. of deer | HOPLAND FIELD STATION Average rumen fill 1/ | BURNED CHAPARRAL No. of deer | BURNED CHAPARRAL Average rumen fill 1/ | UNBURNED CHAPARRAL No. of deer | UNBURNED CHAPARRAL Average rumen fill 1/ |
|---|---|---|---|---|---|---|---|---|
| 1967 | Mar-Apr | Fawns | 5 | 7.9%a 2/ | 5 | 9.5%a | -- | -- |
| | Mar-Apr | Does 3/ | 5 | 5.7%a | 5 | 7.7%a | 5 | 11.3%b |
| | Sept | Fawns | 5 | 11.0%a | 5 | 13.0%a | -- | -- |
| 1968 | Feb-Apr | Does 3/ | 10 | 7.1%a | 10 | 9.2%b | 5 | 8.1%ab |
| | Aug-Sept | Mixed | 5 | 10.0%a | 5 | 15.5%b | -- | -- |
| | Nov-Dec | Mixed | 6 | 6.4%a | 6 | 8.7%b | -- | -- |
| 1969 | Feb-Apr | Mixed | 5 | 5.6%a | 5 | 8.5%b | 6 | 10.0%b |
| | May | Mixed | 5 | 10.1%a | 6 | 10.5%a | 3 | 11.7%a |

1/ Weight of rumen contents as percentage of live weight.
2/ Within each row, means followed by the same letter do not differ significantly (5% level).
3/ Yearlings and older.

Table 6. Productivity comparisons among does (2 years and older) from Hopland Field Station and chaparral study areas, 1967-69.

| YEAR | HOPLAND F. S. No. of does | HOPLAND F. S. Fetuses per doe | BURNED CHAPARRAL No. of does | BURNED CHAPARRAL Fetuses per doe | UNBURNED CHAPARRAL No. of does | UNBURNED CHAPARRAL Fetuses per doe |
|---|---|---|---|---|---|---|
| 1967 | 6 | 1.3 | 5 | 1.4 | 5 | 1.0 |
| 1968 | 9 | 1.6 | 9 | 1.6 | 5 | 1.6 |
| 1969 | 2 | 2.0 | 13 | 1.8 | 5 | 1.6 |
| TOTALS | 17 | --- | 27 | --- | 15 | --- |
| AVERAGES | -- | 1.5 | -- | 1.7 | -- | 1.4 |

Table 7. Blood urea nitrogen (BUN) levels in deer from Hopland Field Station and chaparral study areas, 1967-69.

| YEAR | SEASON | AGE CLASS | HOPLAND F. S. No. of deer | HOPLAND F. S. Average B.U.N.1/ | BURNED CHAPARRAL No. of deer | BURNED CHAPARRAL Average B.U.N.1/ | UNBURNED CHAPARRAL No. of deer | UNBURNED CHAPARRAL Average B.U.N.1/ |
|---|---|---|---|---|---|---|---|---|
| 1967 | Mar-Apr | Fawns | 5 | 19.9a2/ | 5 | 9.9b | -- | -- |
| | Feb-Apr | Does | 5 | 19.2a | 5 | 14.5ab | 5 | 11.1b |
| | Sept | Fawns | 5 | 10.1a | 5 | 8.6a | -- | -- |
| 1968 | Feb-Apr | Does | 10 | 25.5a | 10 | 15.3b | 5 | 15.7b |
| | Aug-Sept | Mixed | 5 | 7.8a | 5 | 8.8a | -- | -- |
| | Nov-Dec | Mixed | 6 | 7.4a | 6 | 11.0a | -- | -- |
| 1969 | Feb-Apr | Mixed | 5 | 12.4a | 5 | 6.9b | 6 | 9.2ab |
| | May | Mixed | 5 | 8.2a | 6 | 11.8a | 3 | 15.2a |

1/ Mg. urea nitrogen per 100 ml. of serum.
2/ Within each row, means followed by the same letter do not differ significantly (5% level).

Table 8. Principal food items eaten by deer in oak woodland and burned and unburned chaparral in late February, March, and April, 1963-1969, as determined by ruminal analyses.

| | | | OAK WOODLAND | CHAPARRAL Burned | CHAPARRAL Unburned |
|---|---|---|---|---|---|
| Number of deer sampled | | | 16 | 14 | 11 |
| FOOD ITEMS | | | Percent in rumen contents (by volume) | | |
| Common name | Scientific name | Plant parts eaten | | | |
| Oak | *Quercus* spp.[1/] | Acorns | 12% | tr[2/] | -- |
| Oak | *Quercus* spp.[1/] | Leaves | 7 | 13% | 4% |
| Poison oak | *Rhus diversiloba* | Leaves | -- | -- | 9 |
| Manzanita | *Arctostaphylos* ssp. | Leaves; mostly flowers | 1 | 14 | 29 |
| Chamise | *Adenostoma fasciculatum* | Leaves; stems | -- | 46 | 41 |
| Buckbrush | *Ceanothus cuneatus* | Leaves; stems | -- | 10 | 14 |
| Buckeye | *Aesculus californicus* | Leaves | 3 | -- | -- |
| Toyon | *Photinia arbutifolia* | Leaves | 2 | -- | -- |
| Bay | *Umbellularia californica* | Leaves | tr | -- | -- |
| Wavy-leaf ceanothus | *Ceanothus foliosus* | Leaves | -- | -- | 1 |
| Sweet birch | *Ceanothus integerrimus* | Leaves; twigs | -- | 1 | -- |
| Lichen | *Ramalina* & others | All | 6 | -- | -- |
| Grass | Gramineae | Leaves; stems | 46 | 13 | 2 |
| Vetch | *Lathyrus* or *Vicia* | Leaves; stems | 5 | tr | -- |
| Filaree | *Erodium* spp. | Leaves | 5 | -- | -- |
| Buttercup | *Ranunculus* sp. | Leaves; stems | 1 | -- | -- |
| Forbs | Misc. forbs | Leaves; stems | 12 | 3 | -- |
| TOTALS | | | 100% | 100% | 100% |
| Summary by forage classes: | | | | | |
| Browse | | | 31% | 84% | 98% |
| Grass | | | 46 | 13 | 2 |
| Forbs | | | 23 | 3 | 0 |
| TOTALS | | | 100% | 100% | 100% |

1/ Mainly *Q. douglasii* and *Q. kelloggii* in oak woodland and *Q. dumosa* and shrub form *Q. wislizenii* in chaparral.

2/ Trace items present in amounts less than 0.5%.

Table 9. Principal food items eaten by deer in oak woodland and burned chaparral in late August and September, 1963-1969, as determined by ruminal analyses.

| FOOD ITEMS: Common name | Scientific name | Plant parts eaten | OAK WOODLAND | BURNED CHAPARRAL |
|---|---|---|---|---|
| Number of deer sampled | | | 30 | 11 |
| | | | Percent in rumen contents (by volume) | |
| Oak | *Quercus* spp.[1/] | Acorns | 45% | 9% |
| Oak | *Quercus* spp. | Leaves | 28 | 69 |
| Coffeeberry | *Rhamnus californicus* | Leaves | 1 | -- |
| Poison oak | *Rhus diversiloba* | Leaves | tr[2/] | 9 |
| Chamise | *Adenostoma fasciculatum* | Leaves; stems | -- | 6 |
| Buckbrush | *Ceanothus cuneatus* | Leaves | -- | 2 |
| Buckeye | *Aesculus californicus* | Leaves; fruits | 3 | -- |
| Toyon | *Photinia arbutifolia* | Leaves | tr | 1 |
| Mistletoe | *Phoradendron villosum* | Leaves; twigs | 1 | -- |
| Lichen | *Ramalina* & others | All | 6 | -- |
| Grass | Gramineae | Leaves; stems | 7 | 1 |
| Bur clover | *Medicago hispida* | Pods; seeds | 3 | -- |
| Trefoil | *Lotus americanus* | Leaves | 2 | -- |
| Forbs | Misc. forbs | Leaves | 4 | 2 |
| Other trace items | | | tr | 1 |
| TOTALS | | | 100% | 100% |
| Summary by forage classes: | | | | |
| Browse | | | 84% | 97% |
| Grass | | | 7 | 1 |
| Forbs | | | 9 | 2 |
| TOTALS | | | 100% | 100% |

1/ Principally *Q. douglasii*, *Q. lobata*, *Q. kelloggii*, and *Q. wislizenii* in oak woodland and *Q. dumosa* and shrub form *Q. wislizenii* in chaparral.

2/ Trace items present in amouns less than 0.5%.