Summer and Fall Diets of Blacktailed Jackrabbits on Semidesert Rangeland

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The black-tailed jackrabbit (*Lepus californicus*) is one of the most widespread herbivores on western rangelands. It occurs from Canada to northern Mexico and from the west coast to the Central Plains of the U.S. (Hansen and Flinders, 1969). Apparently they favor an open or semi-open habitat because they depend on speed and distance to escape predators (Ingles, 1947; Leopold, 1959).

Since black-tailed jackrabbits are so widely distributed, they must be able to utilize a wide array of food sources. Thus food-habit studies conducted in one area may not apply to another. In previous studies, jackrabbits and cattle exhibited considerable dietary overlap (Hansen and Flinders, 1969; Sparks, 1968; and Uresk, 1978). Griffing and Davis (1976) reported on gross examination of stomach contents and feeding behavior of black-tailed jackrabbits in southeastern New Mexico, but not on detailed food habits. However, information on food habits of the black-tailed jackrabbit in New Mexico is lacking but is needed for proper management of these herbivores.

The objective of this study was to compare botanical composition of black-tailed jackrabbit diets from different vegetational types, using microhistological analysis of fecal pellets.

LITERATURE REVIEW

Forage selectivity by black-tailed jackrabbits seemed to be governed by species, quantity, condition, and phenological stages of the plants that were present (Bear and Hansen, 1966; Hansen and Flinders, 1969; and Flinders and Hansen, 1972). Grasses were important food during early spring and summer, while forbs were important during the summer and shrubs in winter (Hayden, 1966; Sparks, 1968).

In Utah a study by Currie and Goodwin (1966) showed that grasses were preferred throughout late spring and summer and shrubs throughout late fall and winter. Principal shrub species consumed were whitesage (*Eurotia lanata*), shadescale (*Atriplex confertifolia*), saltsage (*A. nuttallii*), and big sagebrush (*Artemisia tridentata*).

Black-tailed jackrabbits on Colorado's sandhill rangelands ate flowers of plains larkspur (*Delphinium virescens*), leaves and flowers of spiderwort (*Tradescantia occidentalis*), leaves and seed stalks of blue grama (*Bouteloua gracilis*), and sandreed grass (*Calamovilfa longifolia*) in summer. During winter they utilized prickly pear cactus (*Opuntia phaeacantha*), yucca (*Yucca glauca*), and fringed sagebrush (*Artemisia frigida*) (Sanderson, 1959).

In Lassen County, California, jackrabbits lived almost entirely on sagebrush (Orr, 1940).

Utilization by black-tailed jackrabbits of four-winged saltbush (*Atriplex canescens*) and hopsage (*Grayia spinosa*) was heavy in northeastern California (McKeever and Hubbard, 1960).

Studies in Kansas have shown that buffalo grass (*Buchloe dactyloides*), pigweed (*Amaranthus palmeri*), blue grama, winter wheat (*Triticum* spp.), buffalo burr (*Solanum rostratum*), soapweed (*Yucca* spp.), and Russian thistle (*Salsola kali*) were utilized by black-tailed jackrabbits in winter. Russian thistle appeared to be an emergency food. In summer, plants such as western wheatgrass (*Agropyron smithii*), buffalo grass, sand dropseed (*Sporobolus cryptandrus*), blue grama, and sedges (*Carex* spp.) were preferred foods (Reigel, 1942; Brown, 1947). Stems and fruits were eaten from early fall throughout winter.

Vorhies and Taylor (1933) indicated that the availability of food materials has much to do with feeding habits of jackrabbits. Large amounts of both lambsquarters (*Chenopodium album*) and prickly pear were consumed only when readily available. Sparks (1968), however, found black-tailed jackrabbits on sandhill rangelands of Colorado utilized plant foods in proportions widely different from their relative availability. Uresk (1978) reported significant similarity in black-tailed jackrabbit diets between two plant communities although the communities, sagebrush (*Artemisia* spp.) and bitterbrush (*Purshia tri-*

dentata), were different in frequency and cover values of individual species. The conclusion was that black-tailed jackrabbits were actively seeking preferred foods.

As with most small mammals, the selection of food by jackrabbits is strongly influenced by the environment and the necessity of maintaining water balance. Hayden (1966) found that when succulent grasses and forbs were available, they were preferred by jackrabbits, while the woody, less palatable plants with low water content such as perennial shrubs were eaten when the more succulent spring annuals were no longer available or existed only as dry remains. Great quantities of cactus were reported in diets of jackrabbits during the dry periods of summer (Reigel, 1942; Brown, 1947). Stems of *Larrea tridentata* (3-8 mm in diameter) were eaten by jackrabbits in the summer months, when losses of body water were highest. Small stems and leaves, probably because of their large amounts of phenolic compounds, were discarded.

Seasonal preferences for certain plants could be influenced by the amount of energy they contain (Sparks, 1968). Although no energy determinations were made, rabbits may have been harvesting high energy foods when they consumed the seeds of six weeks fescue (*Vulpia octoflora*) and sand dropseed and the fruits of ground-cherry (*Physalis* sp.) and prickly pear (Sparks, 1968). In Kansas, sand dropseed was a staple food of black-tailed jackrabbits. In fact, seeds of sand dropseed made up 93% of all the seeds found in jackrabbit pellets (Brown, 1947).

One major objective of diet investigations of jackrabbits has been to measure the quantity of vegetation consumed. Arnold (1942) reported that in 24 hours an adult black-tail consumed an average of 127 g of native dry-forage and 122 g of native air-dry green-forage. Respectively, these represented 6.5 and 6.7% of its body weight Haskell and Reynolds (1947), working with the same species, calculated an average daily consumption by adults of 122 g of air-dry native forage. Contrasting these results with sheep and cow diets showed an equivalent of 30 and 148 black-tailed jackrabbits, respectively. The average daily consumption by an adult black-tail was estimated at 149 g of dry feed (Vorhies and Taylor, 1933). Currie and Goodwin (1966) found a minimum competition equivalent of 8.0 black-tails per sheep on Utah's salt desert ranges. In winter under more intensive dietary overlap, a maximum competition equivalent of 5.8 jackrabbits per sheep was reported. They were actually consuming or wasting 260 g of forage per animal per day. Assuming that each species ate the same foods, Johnson (1979) reported an equivalence of 31 black-tailed jackrabbits for each range ewe and 392 for each range cow in south-central Idaho.

DESCRIPTION OF AREA

General Area

The study was conducted on the New Mexico State University College Ranch, located about 40 km north of Las Cruces, Dona Ana County, New Mexico. The ranch lies in the southern portion of the Jornada del Muerto, between the San Andres Mountains and the Rio Grande. The elevation of the ranch varies from about 1,219 m along the river to 1,768 m at the highest point in the Dona Ana Mountains.

The climate is semiarid with a yearly mean temperature of about 16 °C. Extremes of -22.5 °C to 41 °C are sometimes reached (Norris, 1950). Average annual precipitation is 22 cm, of which about 56 percent falls during the growing season of July, August and September (table 1). In most years July is the month of highest rainfall, followed by August then September (table 1). The average wind velocity is 3.2 km per hour with the highest velocities in April and May. Evaporation from a free-water surface is 233 cm annually (Weather Records, Jornada Exp. Range SEA-AR-USDA).

Most of the soils of the ranch are underlain by a caliche layer at depths varying from a few centimeters to a meter or more (Wood, 1969). In general the soil is relatively well-preserved and stable; however, in some parts wind erosion has

Table 1. Monthly precipitation averages (cm) from several rain gauges on the College Ranch in 1978 and 1979 and the long-term average at the ARS-USDA Jornada Experimental Range located 12 km NE of the study area

Month	1978	1979	Long-term average
January	0.09	3.57	1.17
February	4.24	0.60	1.09
March	0.46	0	0.78
April	0	0.62	0.48
May	2.27	2.05	0.48
June	3.63	1.15	1.07
July	0.59	4.41	4.50
August	5.28	5.30	4.34
September	4.84	2.54	3.28
October	4.24	0	2.18
November	9.67	0	0.91
December	2.18	3.08	1.42
Total	37.49	23.32	21.70

exposed, to varying degrees, subsurface soil. The sandy texture of the soil, combined with good infiltration characteristics, low wilting percentage, and good storage capacity, offers partial compensation for the limitations imposed by low rainfall (Valentine, 1970).

Vegetation of Study Area

The study area produced six primary vegetation types that were identified by dominant species as: dropseed grassland, black grama grassland, mesquite dunes, open mesquite, creosote-mesquite-snakeweed, and creosote-mesquite-grass.

The dropseed grassland had mesa dropseed; as a dominant species, mixed with some heavy stands of annual forbs such as faint crown, purple roll-leaf, and deers tongue (table 2). A few individual yucca and mesquite shrubs also occurred sparsely in this cover type.

The black grama grassland had black grama (*Bouteloua eriopoda*) as the dominant species (table 2), several forbs, and a few scattered individual mesquite and yucca shrubs. Associated perennial grasses included threeawn (*Aristida wrightii*), mesa dropseed (*Sporobolus flexuosus*, sand dropseed, and fluffgrass (*Erioneuron pulchellum*). Most important forbs were faint crown (*Aphanostephus ramosissimus*), deer's tongue (*Cryptantha crassisepala*), purple roll-leaf (*Nama hispidum*), gordon bladderpod (*Lesquerella gordonii*), and several annuals.

The open mesquite type had mesquite, mesa dropseed, and broom snakeweed (*Xanthocephalum sarothrae*) as dominants. The most important forb

Table 2. Percentage of aerial cover and composition, as a percent of total vegetation, on six vegetational types

	Dropseed		Black Grama		Open Mesquite		Creosote-Mesquite-Graas		Mesquite Dunes		Creosote-Mesquite-Snakeweed	
Species	Cover	Comp.	Cover	Comp.	Cover	Comp.	Cover	Comp.	Cover	Comp.	Cover	Comp.
Grass												
Dropseed Species	19.9	47.9	9.6	18.3	15.5	42.5	12.5	37.5	5.5	16.3	2.4	10.5
Black Grama	0	0	16.5	31.6	0	0	0	0	0	0	0	0
Threeawn Species	1.2	2.9	0.8	1.5	0.9	2.6	0	0	0	0	0	0
Fluff Grass	0.9	2.3	0.3	0.5	0.4	1.1	0.3	0.8	0.8	2.4	0.1	0.6
Total	22.0	51.3	27.2	51.9	16.8	46.2	12.8	38.3	6.3	18.7	2.5	11.1
Forbs												
Faint Crown	12.4	29.9	15.7	30.0	2.1	5.9	0	0	0	0	0	0
Broom Snakeweed	1.9	4.5	3.5	6.6	8.5	23.4	2.8	8.4	8.3	24.6	4.3	18.7
Purple roll-leaf	2.3	5.5	0.9	1.8	0.4	1.1	0.7	2.0	2.5	7.5	1.7	7.6
Leatherweed Croton	0.5	1.3	0.1	0.3	0	0	0	0	1.5	4.4	0	0
Woolly paperflower	0.4	1.0	0.1	0.3	0	0	0.3	0.8	0	0	0	0
Deers tongue	0.8	1.9	1.1	2.0	0	0	0	0	0	0	0	0
Russian thistle	0.1	0.3	0.8	1.5	0	0	0	0	0	0	0	0
Wislizenus spectaclepod	0	0	0	0	1.3	3.6	1.3	4.0	1.6	4.8	1.1	4.7
Gordon bladderpod	0.4	1.0	0.7	1.3	0	0	0	0	0	0	0	0
Whitestem stickleaf	0	0	0	0	0.9	2.6	0.3	0.8	0	0	0	0
Sunflower	0	0	0	0	0	0	0.4	1.2	0	0	0	0
Hymenopappus	0	0	0	0	0.5	1.5	0	0	0	0	0	0
Indian rushpea	0	0	0	0	0	0	0	0	0.9	2.8	0	0
Two leaf senna	0	0	0	0	0	0	0	0	0.5	1.6	0	0
Ipomopsis	0	0	0	0	0	0	0	0	0.3	0.8	0	0
Other Forbs	0.3	0.6	1.1	2.0	0.4	1.1	0.4	1.2	0	0	0	0
Total	19.1	46.0	24.0	45.8	14.1	39.2	6.2	18.4	16.2	48.1	7.8	33.9
Shrubs												
Mesquite	0.3	0.6	1.2	2.3	4.4	12.1	9.5	28.3	9.7	28.9	4.8	21.6
Creosote bush	0	0	0	0	0	0	3.6	10.8	0	0	6.8	29.8
Yucca	0.1	0.3	0	0	0.3	0.7	0.3	0.8	0.7	1.9	0.7	2.9
Mormon tea	0	0	0	0	0.7	1.8	1.2	3.6	0	0	0	0
Fourwing saltbush	0	0	0	0	0	0	0	0	0.7	1.9	0	0
Other Shrubs	0	0	0	0	0	0	0	0	0.1	0.4	0.1	0.9
Total	0.4	0.9	1.2	2.3	5.4	14.6	14.6	43.5	11.2	33.1	12.5	54.9

species were faint crown, spectaclepod, (*Dithyrea wislizeni*), whitestem stickleaf (*Mentzelia albicaulis*), hymenopappus (*Hymenopappus robustus*), and purple roll-leaf.

Mesquite dunes vegetation cover type was referred to by Campbell (1929) as a moving dune complex where mesquite was the dominant species. Forbs were fairly abundant, but grasses were scarce except in the immediate proximity of the road sides, where they tended to occur in heavy stands. The principal associated species were broom snakeweed, purple roll-leaf, spectaclepod, leatherweed croton (*Croton corymbulosus*), dropseeds, *yucca* sp., fourwing saltbush, and twin leaf (*Cassia bauhinoides*).

Creosote-mesquite-snakeweed vegetation cover type had creosote and mesquite, as dominant species, associated with a heavy stand of broom snakeweed. Common forbs included purple roll-leaf, spectacle pod, and woolly paperflower (*Psilostrophe tagetinae*). Woolly paperflower, dropseed species, and fluffgrass were scattered in the open areas.

Creosote-mesquite-grass vegetation cover type consisted of creosotebush, mesquite, and mesa dropseed as dominant species; no other important grass species occurred on the area. Common forbs included purple roll-leaf, whitestem stickleaf, sunflower, desert baileya (*Baileya multiradiata*), woolly paperflower, and twin leaf.

METHODS AND PROCEDURES

Study Design

Three sampling sites were selected in each of the six vegetation cover types. The sampling sites, widely dispersed within a vegetation type, were about 0.4 ha each.

The aerial plant cover and botanical composition of the cover types were determined in June 1979 by the line-point transect method (Pieper, 1973). Five transects (each 16.7 m) per site were randomly sampled. A pin that was lowered vertically at 30 cm intervals and the first plant it intercepted was recorded. Plants in layers below the first intercept were not recorded. Fifty readings were made per transect.

Sampling

Herbage availability was determined by clipping eight 5 m x 1 m quadrats at each site, for a total of 24 on each vegetation type. The samples were separated by species and dried at 65 °C for 72 hours before being weighed. Browse availability was determined by procedures similar to the dimension analyses described by Ludwig *et al.* (1975).

Fecal collecting started in early June and ended in late October 1979. A sample of 10 to 15 "fresh" pellets was collected once a week on each sampling site, by collecting one or two pellets from many defecation piles. During September and October the collections were made every other week. The collections were completed in four to six hours during the mornings. "Fresh" pellets were distinguished from pellets which were several days old by their smooth, glossy appearance and mucous coating, since mucous easily weathers away. A sample for each vegetational type was composited from each collection of pellets.

Pellets were stored in envelopes and air dried then ground in a Wiley mill through a 1.0 mm screen. Grinding produced fragments of similar size and randomness, for thorough mixing and adequate subsampling (Todd and Hansen, 1973). Ground materials were stored in plastic containers in a dry place.

A microhistological technique, similar to that described by Sparks and Malechek (1968) and Hansen *et al.* (1971), was used to identify plant species in diet samples. For each sample, five slides were analyzed and considered as replications in the statistical analysis. Twenty fields were read on each slide.

Analysis

Split plot analysis of variance (Steel and Torrie, 1960) was used on selected dietary components to compare differences between replicates, periods, vegetation types, and interactions. Only those species or groups which were present in most of the diet samples were included in the analysis.

Where analysis of variance indicated significant differences for a species or plant group, means were compared by Tukey's test (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

Herbage Availability

Forbs were especially abundant in the spring and early summer of 1979 (appendix table 1). They comprised 68% of the available herbage in the black grama type, 78% in the dropseed type, and over 90% in two of the shrubby types.

Forbs responded to the above-average precipitation received during the fall of 1978 and the spring of 1979. From August 1978 through May 1979 precipitation averaged over 33 cm at several rain gauges located throughout the study area,

compared with the long-term average of nearly 16 cm (table 1). Faint crown contributed about 30% of the standing herbage on June 7 on the black grama type and nearly 53% on the dropseed type (appendix table 1). Broom snakeweed also contributed substantially to the standing crop of forbs in the black grama, open mesquite, creosote-mesquite-grass, creosote-mesquite-broom snakeweed, and the mesquite dunes types.

Black grama was an important contributor to standing herbage only on the black grama type (appendix table 1). Dropseed species were important contributors to standing herbage for several vegetational types.

Diets

The number of plant species found in black-tailed jackrabbit feces varied from 20 in the mesquite dunes type to 35 in the open mesquite type (appendix tables 2 to 7). However, in most cases only a few species contributed the bulk of the diet.

Among the grasses, dropseed species were the most consistent representives for all vegetational types (figures 1 and 2). The general trend was for a decline in dropseed species content of the diet as the season progressed, especially from August through September. While the general pattern of change in dietary content of dropseed was similar across vegetational types, there were some inconsistencies which likely accounted for the period X vegetational type interaction in the analysis of variance (table 3). The content of dropseed species was highest in jackrabbit pellets collected from the creosote-mesquite-grass type and lowest in pellets collected from the black gramma type (table 4). These differences were probably related to the availability of dropseed, which was lowest in the black grama type (in late August-early September) and highest in the creosote-mesquite-grass type (appendix table 1). In addition, forbs other than snakeweed comprised only 13.8% of the standing herbage in June on the creosote-mesquite-grass type.

Black grama was important in black-tailed jackrabbit diets only in the black grama type (figure 3, table 4 and appendix tables 2 to 7). It reached a peak in late July when it comprised over 70% of the diet (figure 3, appendix table 6).

Fluffgrass did not appear in any of the pellets until the collections made on September 14. The trend was similar for the four vegetational types on which fluffgrass made a major contribution: an increase from August 23 to September 14, a leveling off until September 28, and then a decline until October (figure 4). However, the period X vegetational type interaction was significant ($P < 0.01$) (table 3). probably because of the increase in fluffgrass content in September on the mesquite dunes type (figure 4). Apparently fluffgrass was palatable only when growing and relatively succulent.

The content of paperflower varied considerably during the study (figure 5). but was more important in the diets on the two grassland types (table 4). Paperflower also occurred in pellets collected from the creosote-mesquite-broom snakeweed type during the summer and early fall (figure 5, appendix table 2). On August 11, it comprised nearly 46% of the diet of black-tailed jackrabbits on this type, although it was not found in the herbage availability quadrats (appendix table 1).

Whitestem stickleaf was an important component of the diet during the early summer on the shrublands (figure 6). The seasonal patterns were similar, although the vegetational type x period interaction was significant ($P < 0.01$) (table 3). Peaks occurred on July 28 for all vegetational types (figure 6). Availability was apparently a factor in selection of whitestem stickleaf, since it was only found growing in those types where it occurred in the pellet samples (appendix table 1). However, it was highly selected in July, when it comprised as much as 80% of the diet (appendix table 5) but contributed less than 4% of the standing herbage crop (appendix table 1).

Faint crown contributed substantially to the standing crop of herbage on the grassland types (appendix table 1) but was more important in the diets of the rabbits grazing the shrublands (table 4, figure 7). The seasonal pattern was somewhat irregular, with a significant ($P < 0.01$) period X vegetational type interaction (table 3).

Dalea species was an important component of diets on the grassland types (figure 8), although this taxon did not contribute greatly to standing crop of herbage (appendix table 1). Averaged over the sampling period, dalea species comprised 22% of the diet on the dropseed type and 38% on the black grama type (table 4). Dalea species was low in diets on the black grama type in June, July, and August but increased to a peak of 65% in October (figure 8, appendix table 6). The dalea content of the rabbit diets from the dropseed type was more erratic, contributing to the significant ($P < 0.01$) period X vegetational type interaction (table 3).

Leatherwood croton contributed 7.2% of the standing herbage on the dropseed type and nearly 11% on the mesquite dunes, but it never contributed much more than 5% of the diet for any date except on the mesquite dunes vegetational type (appendix tables 1-7).

Fig. 1. Dietary content of dropseed species for blacktailed jackrabbits in three vegetational types

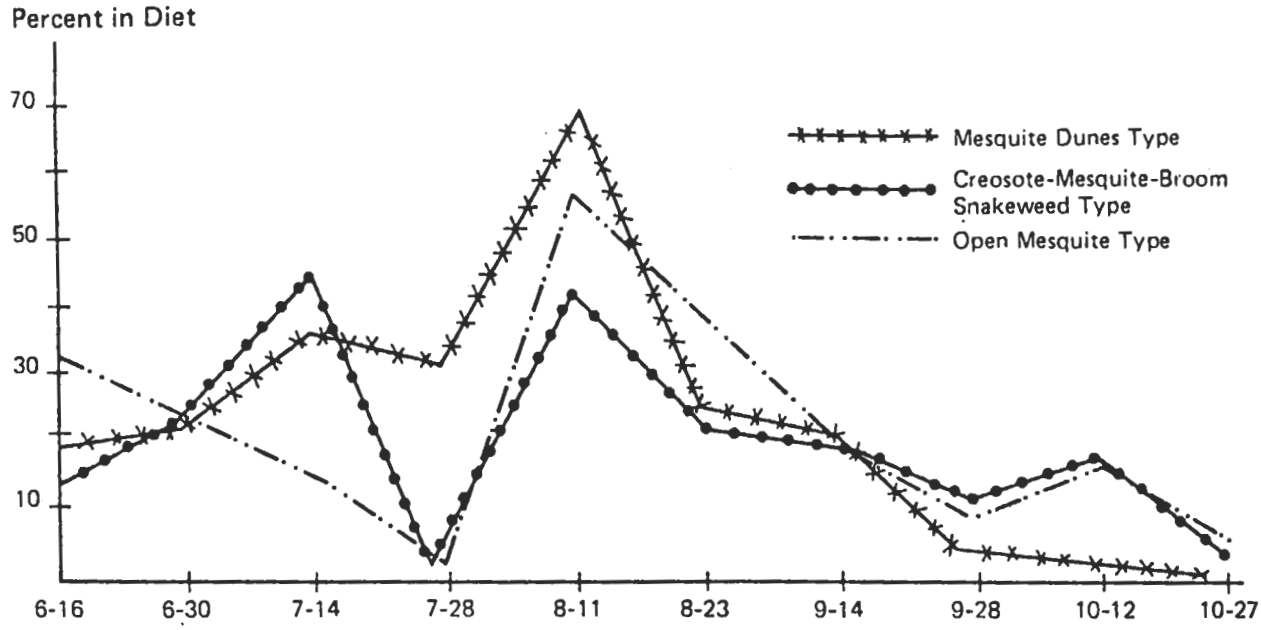


Fig. 2. Dietary content of dropseed species for blacktailed jackrabbits in three vegetational types

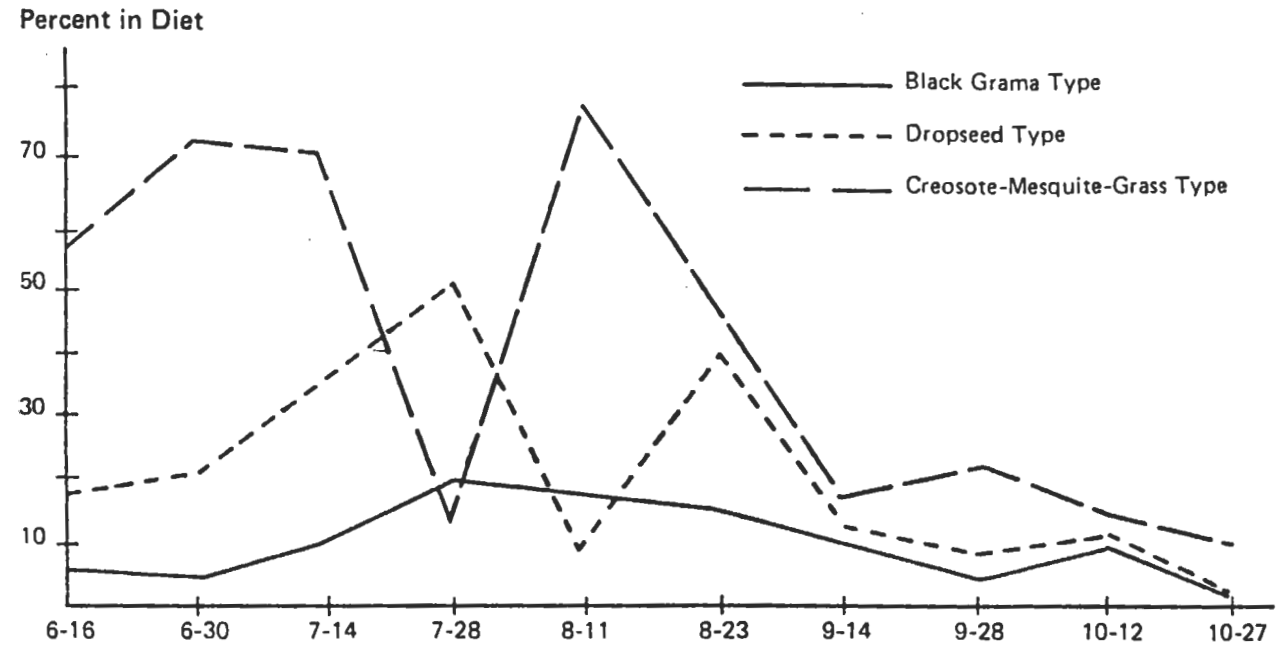


Table 3. Summary of the analysis of variance for selected botanical components of black-tailed jackrabbit diets

	Mean Squares													
	Degree of Freedom	Creosote-bush	Mesquite	Dropseeds	Fluffgrass	Black grama	Woolly paperflower	Dalea	Whitestem stickleaf	Faint crown	Leatherweed croton	Total grasses	Total forbs	Total shrubs
Corrected total	299	35.5	281.4	515.9	284.9	103.1	435.9	481.5	324.8	87.0	16.8	662.4	831.7	360.8
Replicates	4	5.5	5.7	289.8	34.1	9.2	61.9	88.3	28.6	12.9	13.8	122.2	113.9	10.1
Periods	9	163.8*	2484.4*	5060.4*	4889.5*	496.1*	2951.8*	1069.6*	4436.7*	294.1*	98.9	3468.8*	654.6*	2662.1*
Error (a)	36	6.0	41.6	180.1	33.9	10.6	64.3	87.9	40.2	22.3	5.7	229.5	201.0	54.7
Veg. Types	5	620.5*	5785.8*	4764.4*	1976.9*	1133.0*	7810.8*	3139.7*	1663.2*	1650.8*	102.8*	7884.4*	24203.7*	9212.6*
Per x Veg-types	45	111.9*	461.3*	985.3*	500.4*	363.5*	969.2*	1007.2*	745.9*	189.9*	52.2*	1898.6*	1830.3*	509.3*
Error (b)	200	6.7	52.8	164.5	37.1	19.6	92.7	99.0	68.7	28.6	5.0	166.2	158.6	64.6

* $P < .01$

Table 4. Means and standard errors for dietary composition percentages of major dietary species and plant groups on the different vegetation types

	Black Grama Type	Dropseed Type	Creosote-Mesquite Grass Type	Creosote-Mesquite Snakeweed Type	Open Mesquite Type	Mesquite Dunes Type
Dropseed	10.1 ± 3.8	21.0 ± 3.1	40.4 ± 4.3	21.6 ± 2.6	22.9 ± 2.3	25.1 ± 2.9
Fluffgrass	1.0 ± 0.3	1.2 ± 0.4	15.6 ± 3.0	11.9 ± 2.7	9.5 ± 2.1	13.4 ± 3.1
Black Grama	11.9 ± 3.1	1.9 ± 0.9	.008 ± 0.01	.2 ± 0.01	.02 ± 0.01	.1 ± 0.1
Grasses	23.9 ± 3.8	24.9 ± 3.1	57.7 ± 3.3	37.7 ± 3.3	37.5 ± 3.0	43.0 ± 3.1
Paperflower	33.3 ± 4.7	18.9 ± 2.6	3.6 ± 1.2	8.9 ± 2.5	1.0 ± 0.3	2.9 ± 0.7
Dalea Spp.	22.3 ± 4.0	38.0 ± 3.9	.3 ± 2.0	.1 ± 0.1	.3 ± 0.1	.4 ± 0.2
Whitestem stickleaf	3.1 ± 1.2	.2 ± 0.1	9.2 ± 3.1	4.3 ± 1.7	16.6 ± 4.3	6.4 ± 1.9
Faint crown	4.3 ± 0.8	6.6 ± 1.1	.5 ± 0.2	.2 ± 0.2	15.2 ± 1.7	9.8 ± 1.5
Croton	1.6 ± 0.4	.9 ± .02	1.3 ± 0.4	1.5 ± 0.6	2.0 ± 0.4	4.9 ± 1
Forbs	72.2 ± 3.8	72.8 ± 3.1	23.1 ± 2.9	25.3 ± 2.3	51.8 ± 2.9	39.5 ± 2.4
Mesquite	2.9 ± 0.6	1.4 ± 0.2	18.1 ± 2.3	30.2 ± 3.4	9.5 ± 1.1	15.8 ± 2.0
Creosotebush	.1 ± 0.1	.1 ± 0.1	.9 ± 0.2	8.9 ± 1.8	.02 ± 0.01	.4 ± 0.3
Shrubs	3.9 ± 0.7	2.3 ± 0.4	19.2 ± 2.2	39.5 ± 3.7	10.7 ± 1.3	17.4 ± 2.0

Fig. 3. Dietary content of black grama for the black grama vegetational type

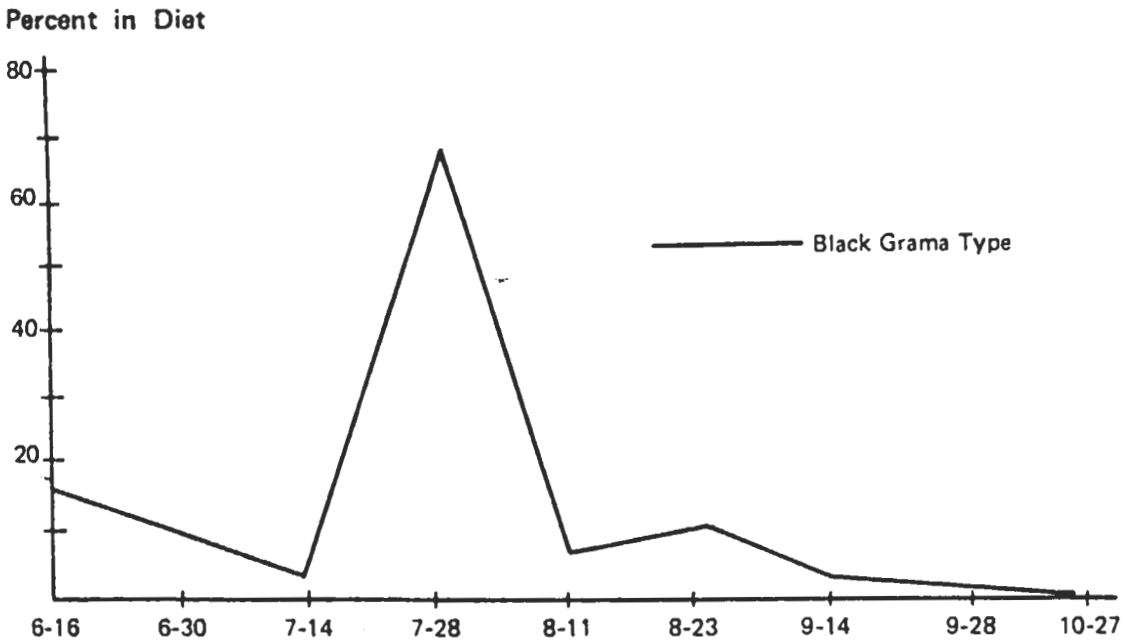


Fig. 4. Dietary content of fluffgrass for blacktailed jackrabbits on several vegetational types

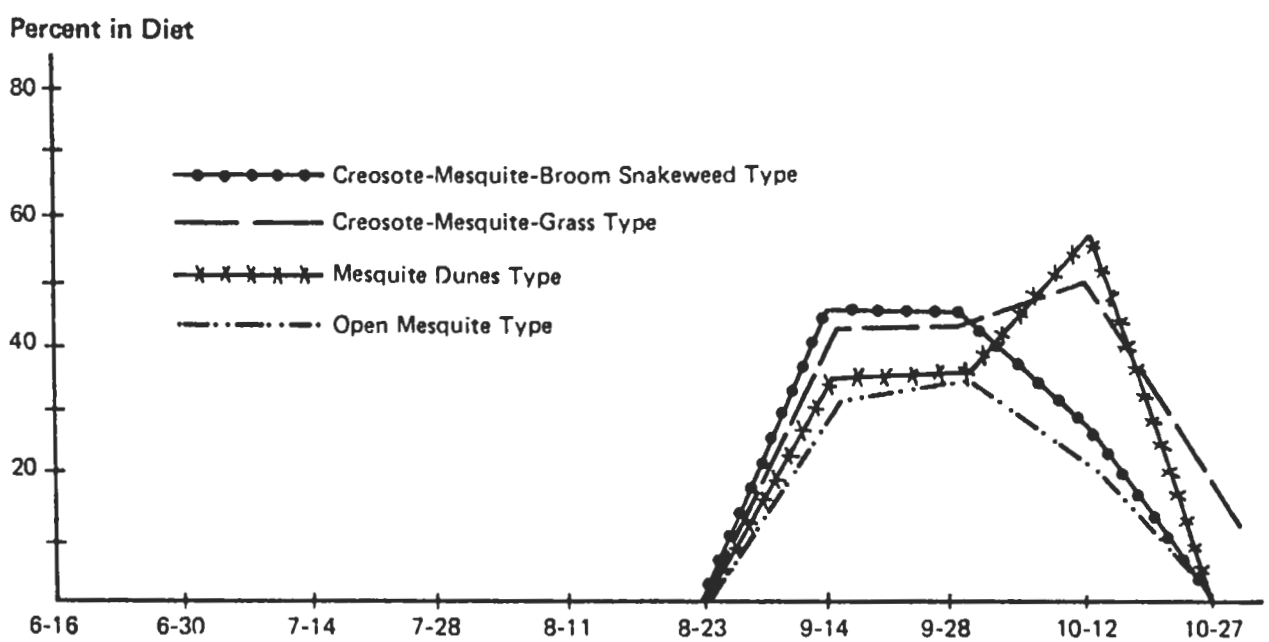


Fig. 5. Dietary content of paperflower for blacktailed jackrabbits on three vegetational types

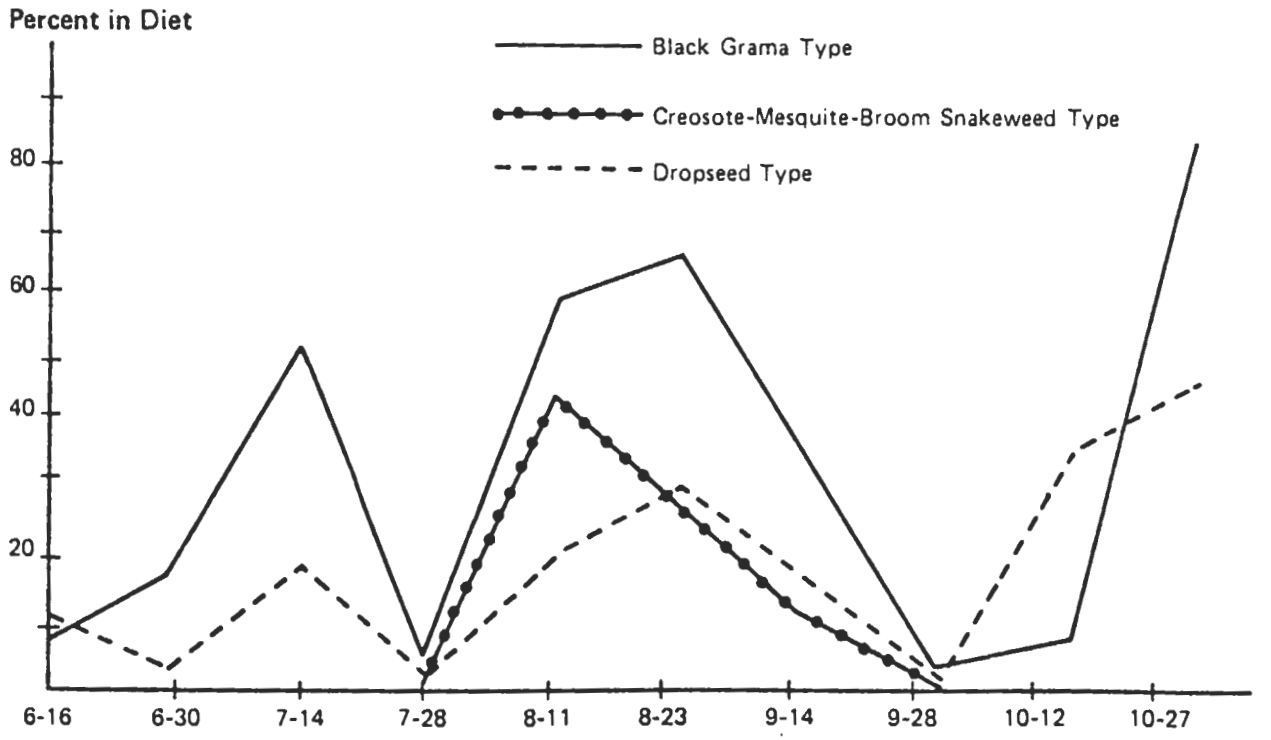


Fig. 6. Dietary content of Whitestem stickleaf for blacktailed jackrabbits on several vegetational types

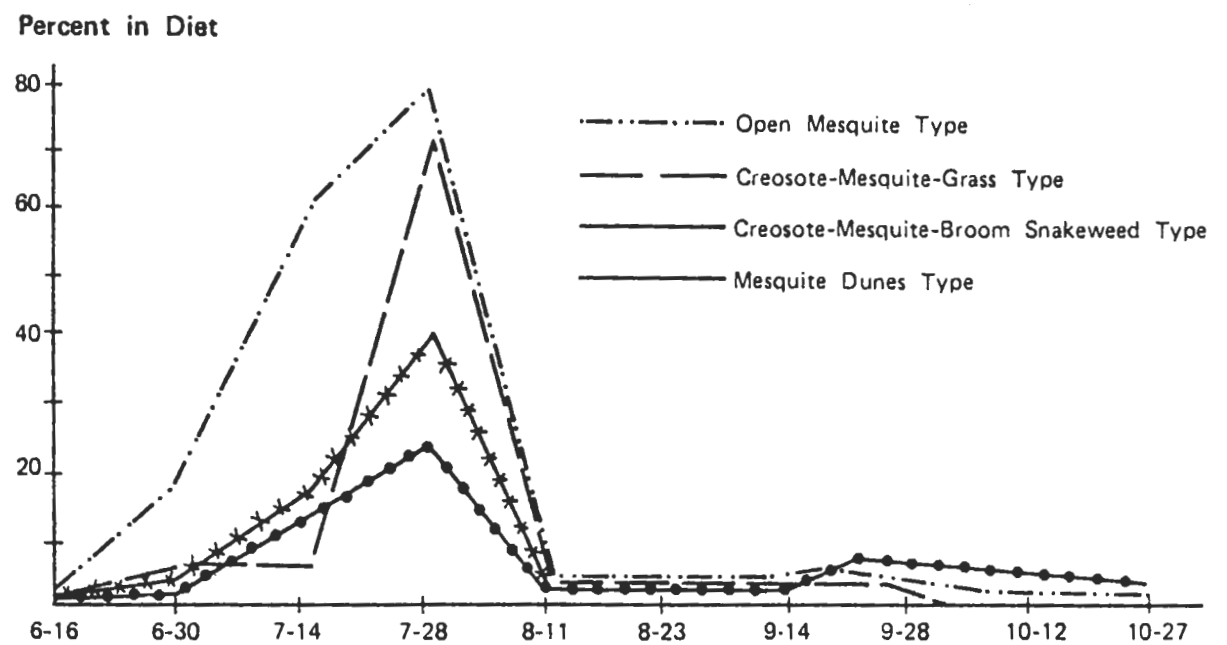


Fig. 7. Dietary content of faintcrown for blacktailed jackrabbits on several vegetational types

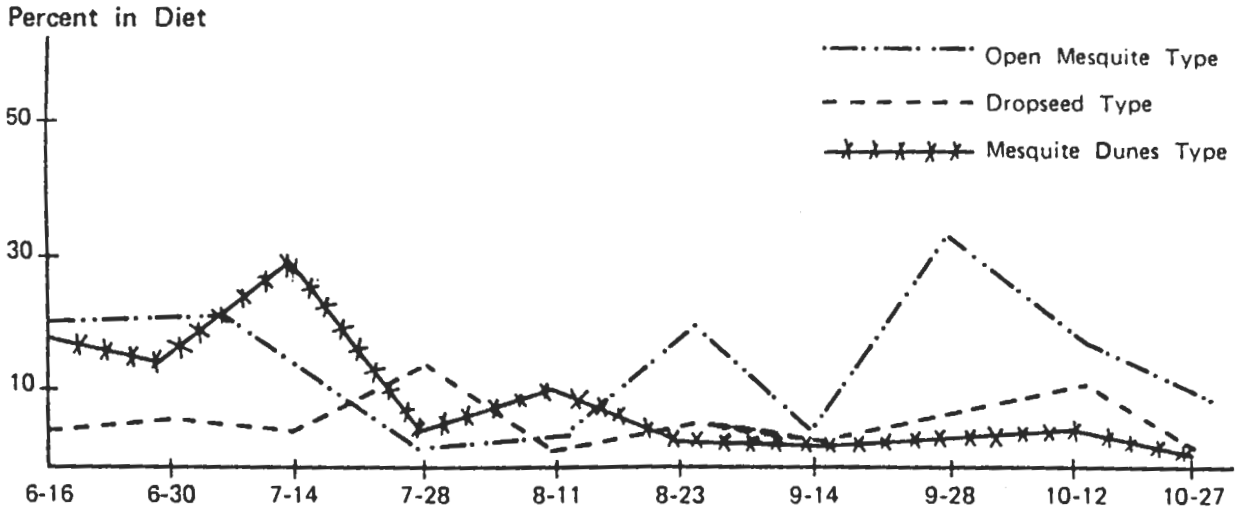
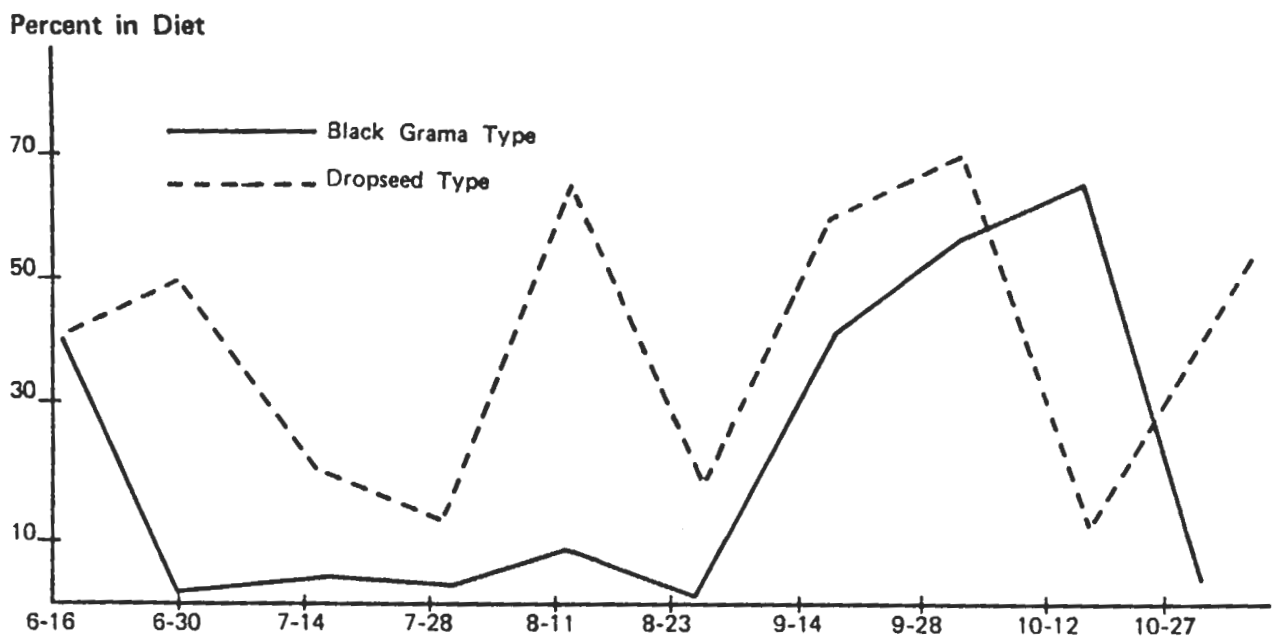


Fig. 8. Dietary content of dalea species for blacktailed jackrabbits on two grassland vegetational types

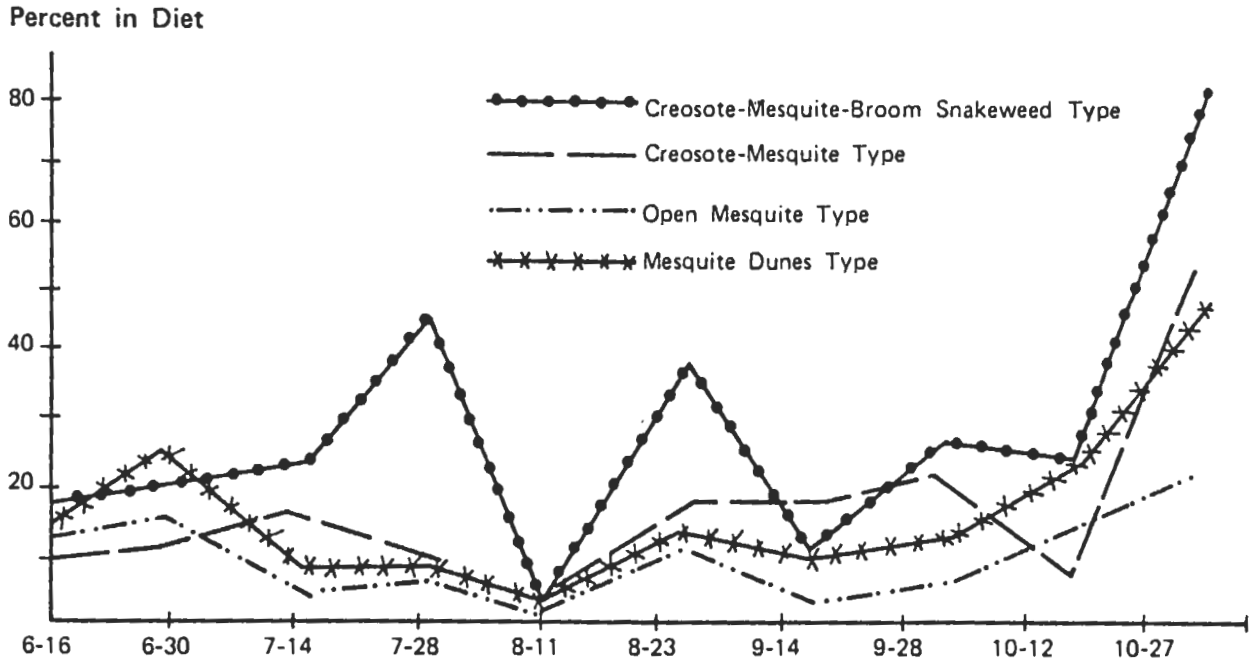


Mesquite contributed substantially to the diets of black-tailed jackrabbits on shrublands, but seasonal trends were somewhat uneven, especially on the creosote-mesquite-broom snakeweed type (figure 9). On the other shrublands there appeared to be a trend for increasing mesquite content of the diet as the herbaceous species matured and became dormant.

Somewhat surprisingly, creosotebush contributed as much as 35% of the diet for rabbits on the creosotebush-mesquite-broom snakeweed type in June (appendix table 2). Creosotebush biomass was actually greater (appendix table 1) but contributed much less to the diet (table 4) on the creosotebush-mesquite-broom snakeweed type.

Other shrubby species were less important in the diets than mesquite and creosotebush. Occasionally yucca showed up in samples collected in the grassland types (appendix tables 6 and 7).

Fig. 9. Dietary content of mesquite for blacktailed jackrabbits on several shrubby vegetational types



DISCUSSION

There is some concern that pellets found in some areas may not represent those where the jackrabbits were feeding, particularly if they defecate in areas where they do not feed. If this were true, then it would be difficult to determine dietary preference using pellets collected from several vegetational cover types. All vegetation types studied varied in size from several hundred to several thousand hectares. Attempts were made to collect fecal pellets toward the center of a vegetation type, away from any ecotones. Generally, species composition of the diets followed vegetational composition rather closely. For example, whitestem stickleaf and black grama were found mainly in pellets where these species were important components of the herbage.

Availability and water content seemed to be two factors governing preference for individual species. Generally, black-tailed jackrabbits ate grass and forbs when they were growing and shifted to shrubs, when available, as the herbaceous species became mature and dormant. However, black-tailed jackrabbits appear to be generalists and can likely make major shifts in food selectivity, depending on availability. Conditions during the summer of 1979 were atypical, with a much greater abundance of forbs than normal. This was primarily due to above average precipitation the previous winter. Consequently the quantity of forbs in the diets should be viewed in light of the high forb abundance during the study period.

Questions concerning dietary overlap between black-tailed jackrabbits and cattle cannot be answered completely from this study. Forbs are important components of cattle diets on southwestern ranges (Rosiere *et al.*, 1975; Gonzalez-Rodriques et al., 1978; Herbel and Nelson 1966), but there appear to be differences in species preferences for forbs between cattle and jackrabbits. There likely would be some competition in the summer for mesa dropseed, but utilization of black grama is higher for cattle in fall and winter. Additional data on jackrabbit diets are needed before firm conclusions can be drawn, concerning dietary overlap with cattle.

SUMMARY AND CONCLUSION

Botanical composition of black-tailed jackrabbit diets was determined for ten dates during the summer and early fall of 1979 by microhistological analyses of fecal samples collected from six different vegetational types. Forbs were the major components of the diets on grassland types, while grasses and shrubs were more important in some of the shrubby vegetation types.

Dropseed species, the major grass components of the diet, were more important during the summer and declined in the fall. Black grama was important mainly on the black grama type. Dalea, and wooly paperflower were major components on grassland types, while faint crown and white stem stickleaf were more important on some of the shrubby types. Mesquite was present in the diet of rabbits on vegetational cover types where it was present in relatively large amounts.

There would undoubtedly be some dietary overlap between cattle and black-tailed jackrabbits for grass (especially dropseed species) during the summer. However, jackrabbits apparently consume forbs and browse which are not preferred by cattle.

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APPENDIX

Table 1. Herbage availability (kg/ha) and composition (%) of selected herbaceous plants

	June 7, 1979		June 17, 1979		June 21, 1979		June 22, 1979					
							Creosote-Mesquite Grass		Creosote-Mesquite Broom Snakeweed			
Species	Black Grama		Dropseed		Open-Mesquite						Mesquite Dunes	
	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha
Grasses												
Dropseed	6.8	30.4	17.8	52.5	17.1	96.3	46.0	166.9	3.0	4.4	6.1	30.3
Black Grama	21.8	96.9	1.5	4.5	1.3	7.4	--	--	--	--	--	--
Fluffgrass	2.0	8.7	2.5	7.4	.4	2.1	--	--	.3	.4	1.7	8.4
Lovegrass	--	--	--	--	--	--	--	--	--	--	1.1	5.3
Threeawn	--	--	--	--	.9	4.9	--	--	--	--	--	--
Bush muhly	--	--	--	--	1.4	8.1	--	--	--	--	--	--
Subtotal	30.6	136.0	21.8	64.4	21.1	118.8	46.0	166.9	3.3	4.8	8.9	44.0
Forbs												
Broom snakeweed	24.2	107.7	5.6	16.6	55.5	372.6	40.2	145.7	81.5	118.3	59.8	302.3
Faint crown	29.9	133.0	52.9	155.8	2.7	14.9	--	--	--	--	.2	.9
Wislizenus spectaclepod	8.8	39.2	5.0	14.7	2.6	14.4	6.8	24.6	8.5	12.3	10.8	54.5
Paperflower	2.1	9.5	1.7	4.9	--	--	--	--	--	--	--	--
Purple roll-leaf	1.2	5.3	2.4	7.1	3.5	19.9	2.2	7.9	3.3	4.8	7.7	35.7
Desert baileya	.7	4.2	.3	1.0	--	--	1.1	4.0	2.4	3.5	1.2	5.8
Dalea sp.	--	--	1.8	5.0	--	--	--	--	--	--	--	--
Croton	--	--	3.8	11.1	--	--	--	--	--	--	6.2	31.3
Two leaf senna	--	--	.6	1.8	1.4	7.7	.1	.4	.1	.2	2.3	11.7
Whitestem stickleaf	--	--	--	--	3.0	17.1	.2	.6	--	--	.6	3.0
Globemallow	--	--	--	--	2.1	11.8	--	--	--	--	--	--
Hymenopappus	--	--	.7	2.1	3.8	21.7	--	--	--	--	.1	.4
Other forbs	2.0	9.8	3.3	9.8	4.5	25.6	3.4	12.5	.9	1.3	3.1	15.6
Subtotal	68.3	308.7	78.1	230.0	79.1	445.1	54	195.7	96.7	140.4	91.4	461.2
Total		444.7		294.3		563.9		362.6		145.2		505.2

	August 14, 1979											
							Creosote-Mesquite Grass		Creosote-Mesquite Broom Snakeweed			
Shrub	Black Grama		Dropseed		Open-Mesquite						Mesquite Dunes	
Species	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha
Mesquite (leaves)	2.9	3.3	1.1	3.1	52.2	211.7	20.7	30.7	19.9	302.3	43.6	55.4
Creosotebush (leaves)	--	--	--	--	--	--	39.3	171.3	22.6	342.72	--	--
Yucca Elata (green leaves)	97.1	109.3	96.7	265.7	4.6	18.8	22.1	96.2	50.1	758.1	20.5	26.0
Ephedra Trifurca (Green stems)	--	--	2.2	5.9	43.2	175.2	17.9	77.9	7.3	110.9	35.9	45.6
Total Shrubs		112.6		274.7		405.7		376.1		1514		127

Table 1. (Continued)

Species	August 23, 1979						September 1, 1979					
	Open Mesquite		Creosote-Mesquite Broom Snakeweed		Creosote-Mesquite Grass		Mesquite Dunes		Black Grama		Dropseed	
	%	kg/ha	%	Kg/ha	%	Kg/ha	%	kg/ha	%	kg/ha	%	kg/ha
Grasses												
Dropseed	26.7	102.3	6.1	14.9	63.7	254.5	29.9	186.9	9.2	60.5	14.2	62.4
Black Grama	.6	2.2	--	--	--	--	--	--	20.8	136.9	.6	2.7
Fluffgrass	.4	1.4	.2	.5	.5	1.8	3.3	20.7	.4	2.5	2.3	9.9
Lovegrass	--	--	--	--	--	--	2.9	18.5	--	--	--	--
Subtotal	27.7	105.9	6.3	15.4	64.2	256.3	36.1	226.1	30.4	200.0	17.1	75.0
Forbs												
Broom snakeweed	49.8	190.6	57.4	139.3	9.9	39.7	21.6	135.2	27.5	181.6	10.7	47.0
Faint crown	10.4	40.0	--	--	--	--	.3	1.8	26.6	175.4	50.7	223.4
Wislizenus spectaclepod	5.7	21.9	24.6	59.7	7.8	31.0	8.9	55.8	--	--	.6	2.5
Paperflower	--	--	--	--	--	--	--	--	9.6	63.2	4.9	21.4
Purple roll-leaf	1.3	5.0	1.9	4.4	.2	.7	2.8	17.7	--	--	--	--
Desert baleya	--	--	7.5	18.3	12.6	50.3	5.7	35.8	.3	2.1	.1	.5
Dalea sp.	--	--	--	--	--	--	.3	1.8	--	--	.7	3.1
Croton	--	--	--	--	--	--	10.9	68.2	--	--	7.2	31.8
Two leaf senna	--	--	--	--	.3	1.2	5.3	33.2	.2	1.3	1.6	7.0
Whitestem stickleaf	3.6	14.4	--	--	4.9	19.5	1.4	8.7	--	--	--	--
Hymenopappus	.4	1.4	--	--	--	--	.5	3.7	--	--	1.7	7.4
Russian thistle	--	--	--	--	--	--	3.9	24.0	.2	1.1	.2	1.0
Other forbs	1.0	3.9	2.3	5.5	.2	.6	2.1	13.1	5.3	34.8	4.7	20.4
Subtotal	72.2	227.2	93.7	227.2	35.9	143.0	63.7	398.4	69.7	459.5	83.1	365.5
Total		383.1		242.6		399.3		624.5		659.5		440.5

Table 2. Dietary composition (% dry weight) of black-tailed jackrabbit diets on the creosote-mesquite-broom snakeweed vegetation type

Species	6/16/79	6/30/79	7/14/79	7/28/79	8/11/79	8/23/79	9/14/79	9/28/79	10/12/79	10/27/79
Grasses										
Dropseed	14.3	23.6	46.5	4.9	45.3	25.5	20.7	12.6	20.2	2.1
Fluffgrass	--	--	--	--	--	--	43.9	44.1	27.5	3.5
Threeawn	--	.2	--	1.6	.3	.1	1.4	--	--	--
Others	--	.4	--	3.1	--	.6	--	--	--	1.3
Subtotal	14.3	24.2	46.5	9.6	45.6	26.2	66.0	56.7	47.7	6.9
Forbs										
Broom snakeweed	2.8	--	--	--	3.6	--	--	--	--	--
Desert baleya	.6	10.7	--	--	--	--	--	6.7	13.2	1.3
Paperflower	1.5	--	.6	.2	45.9	28.3	11.4	--	--	.6
Purple roll-leaf	2.1	1.1	--	--	.6	--	.6	1.5	1.5	--
Spectaclepod	6.9	8.9	7.3	8.0	--	.3	1.1	.9	3.1	.3
Whitestem stickleaf	--	1.3	12.6	24.8	--	.2	3.6	--	--	--
Wooton loco	--	--	--	--	--	--	--	--	2.5	4.8
Croton	.1	1.2	.3	--	--	--	--	--	.61	--
Others	12.6	4.4	.8	1.1	.4	1.9	5.7	4.1	4.0	.2
Subtotal	26.6	27.6	21.6	34.1	50.5	30.7	22.4	13.2	24.9	7.2
Shrubs										
Mesquite	17.4	22.1	24.5	46.6	3.7	39.9	10.7	28.1	25.6	83.5
Creosotebush	35.4	25.4	7.3	9.7	--	2.9	.5	1.6	1.5	1.9
Yucca	--	--	--	--	--	--	--	--	--	--
Other	4.7	.6	--	--	--	--	.3	.2	.3	.3
Subtotal	57.5	48.1	31.8	56.3	3.7	42.8	11.5	29.9	27.4	85.7

Table 3. Dietary composition (% dry weight) of black-tailed jackrabbit diets on mesquite dunes type

Species	6/16/79	6/30/79	7/14/79	7/28/79	8/11/79	8/23/79	9/14/79	9/28/79	10/12/79	10/27/79
Grasses										
Dropseed	17.5	23.5	37.3	33.7	73.1	27.1	21.0	7.3	6.6	3.3
Threeawn	--	.2	.5	12.0	6.9	3.8	.4	--	--	--
Lehman lovegrass	--	--	--	--	--	2.5	--	--	--	--
Fluffgrass	.6	--	--	--	--	--	34.9	35.4	56.7	6.0
Plains bristlegrass	12.3	.2	.2	.2	.5	--	--	--	--	--
Others	2.2	.2	--	.4	--	1.2	.4	--	.9	.8
Subtotal	32.6	24.1	38.0	46.3	80.5	34.6	56.7	42.7	64.2	10.1
Forbs										
Faint crown	19.0	14.9	29.8	3.9	11.3	2.3	4.3	6.1	4.8	1.2
Purple roll-leaf	2.0	1.2	.4	--	--	--	.8	--	--	.2
Croton	2.7	10.1	1.8	.4	--	.2	1.9	13.3	.3	16.7
Spectaclepod	--	11.6	--	--	.3	22.9	1.6	1.5	--	.9
Silver nightshade	--	5.3	.4	.2	--	17.3	.4	12.2	1.1	9.9
Whitestem stickleaf	.5	2.3	17.6	42.1	--	.2	1.1	--	.3	--
Paperflower	1.1	2.9	--	--	3.7	8.6	12.3	--	--	--
Two leaf senna	1.8	3.9	--	--	--	--	--	--	--	5.5
Desert baleya	.9	.2	--	--	--	--	--	5.3	1.1	2.5
Wooton loco	3.1	.2	--	--	--	--	--	--	1.5	2.1
Others	15.5	2.6	2.2	.2	4.1	--	10.3	1.3	1.3	.8
Subtotal	46.0	55.2	52.2	46.8	19.4	51.5	32.7	38.7	10.4	39.8
Shrubs										
Mesquite	13.7	23.9	9.1	6.8	--	13.3	9.7	13	24.6	49.7
Creosotebush	2.9	.4	.2	--	--	--	.3	.53	--	.4
Yucca	--	--	.3	--	--	--	--	--	--	--
Others	3.9	--	--	--	--	--	.4	3.7	.9	--
Subtotal	20.5	24.3	9.6	6.8	--	13.3	10.4	17.2	25.5	50.1

Table 4. Dietary composition (% dry weight) of black-tailed jackrabbit diets on the creosote-mesquite grass vegetation type

Species	6/16/79	6/30/79	7/14/79	7/28/79	8/11/79	8/23/79	9/14/79	9/28/79	10/12/79	10/27/79
Grasses										
Dropseed	58.3	71.9	70.9	14.9	77.8	47.9	17.4	21.8	13.7	9.9
Black Grama	--	--	.1	--	--	--	--	--	--	--
Fluffgrass	--	--	--	--	--	--	43.0	43.6	50.6	19.4
Threeawn	--	--	--	1.8	--	--	2.1	--	2.5	--
Others	--	--	--	.2	--	.3	4.7	--	.5	4.8
Subtotal	58.3	71.9	71.0	16.1	77.8	48.2	67.2	65.4	67.3	34.1
Forbs										
Broom snakeweed	--	--	--	--	10.3	--	--	--	--	--
Faint crown	2.3	--	--	--	--	.4	--	.7	1.0	--
Croton	5.2	3.3	1.1	--	.3	--	--	--	.2	2.4
Globemallow	13.8	--	--	--	--	--	--	--	--	--
Spectaclepod	.7	1.5	1.9	--	--	--	--	--	--	--
Paperflower	--	5.2	5	71.8	2.3	.3	4.3	.7	.7	1.1
Desert baleya	.3	--	--	--	.6	--	.4	4.4	.2	--
Dalea	--	--	--	--	--	2.2	--	.3	--	.5
Sunflower	--	.9	.5	--	--	--	1.8	1.9	2.3	--
Silver nightshade	--	.6	.5	--	--	.4	--	--	2.4	3.6
Trailing four o'clock	--	--	.2	--	.4	.8	1.4	--	3.1	.9
Wooton loco	.4	1.4	--	--	.7	--	--	.2	6.3	1.5
Others	4.2	--	1.4	.6	1.21	.3	2.4	.3	4.6	.2
Subtotal	26.3	12.7	11.0	72.4	21.3	31.1	13.2	8.5	20.8	10.2
Shrubs										
Mesquite	11.3	12.9	17.8	9.5	.2	19.0	19.3	24.3	12.3	55
Creosotebush	3.4	1.4	--	1.8	.2	1.4	--	.5	.2	--
Yucca	--	--	--	--	.5	.2	--	--	--	--
Others	--	--	--	--	--	--	--	--	--	--
Subtotal	14.7	14.3	17.8	11.3	.9	20.6	19.3	24.8	12.5	55

Table 5. Dietary composition (% dry weight) of black-tailed jackrabbit diets on the open-mesquite type

Species	6/16/79	6/30/79	7/14/79	7/28/79	8/11/79	8/23/79	9/14/79	9/28/79	10/12/79	10/27/79
Grasses										
Dropseed	33.4	24.9	16.1	1.9	58.7	38.4	21.3	9.8	18.9	5.5
Threeawn	--	.3	--	5.5	5.8	.8	6.8	.5	--	--
Fluffgrass	--	--	--	--	--	--	31.2	34.8	21.9	6.8
Others	7.8	--	.4	2.0	.8	.6	13.7	.7	.1	5.7
Subtotal	41.2	25.1	16.5	9.4	65.3	39.8	73.0	45.8	40.9	18.0
Forbs										
Desert baleya	.3	--	--	--	1.9	--	--	1.9	6.7	12.7
Faint crown	18.5	21.3	14.1	--	3.4	22.5	2.8	37.0	20.3	11.7
Croton	5.1	3.3	.2	--	1.9	.2	--	.4	1.5	2.0
Whitestem stickleaf	1.1	17.7	59.4	80.5	1.6	1.4	--	.3	2.7	1.3
Silverleaf nightshade	.1	7.0	--	2.3	7.1	9.0	1.9	1.2	3.2	5.6
Trailing four o'clock	--	2.9	5.1	.04	1.2	3.8	1.5	1.1	4.0	3.2
Spectaclepod	--	4.2	.4	1.4	5.3	2.0	8.7	1.1	1.7	.7
Purple roll-leaf	1.7	--	--	--	--	--	--	--	--	.4
Globemallow	10.8	.2	--	--	.5	2.0	--	.2	--	7.3
Others	8.5	2.6	.21	--	11.8	8.4	8.1	1.7	3.9	8.4
Subtotal	46.1	59.2	79.4	84.2	34.7	49.3	23.0	44.9	43.9	53.3
Shrubs										
Mesquite	12.0	15.1	3.9	6.4	--	10.8	4.1	6.5	13.5	22.2
Creosotebush	.1	--	--	--	--	--	--	--	--	--
Others	.4	.6	--	--	--	--	.5	2.8	1.5	6.3
Subtotal	12.5	15.7	3.9	6.4	--	10.8	4.6	9.3	15.0	28.5

Table 6. Dietary composition (% dry weight) of black-tailed jackrabbit diets on black grama vegetation type

Species	6/16/79	6/30/79	7/14/79	7/28/79	8/11/79	8/23/79	9/14/79	9/28/79	10/12/79	10/27/79
Grasses										
Dropseed	5.2	4.6	11.5	20.5	17.6	14.6	10.5	4.8	10.3	.8
Black grama	15.0	8.9	1.3	70.6	6.5	12.1	3.9	1.3	--	.1
Fluffgrass	--	--	--	--	--	--	--	6.8	1.8	1.1
Other grasses	1.5	.8	1.4	1.5	1.0	--	.7	1.8	.6	.5
Subtotal	21.7	12.7	14.2	92.6	25.1	26.7	15.1	14.7	12.7	1.9
Forbs										
Dalea sp.	43.0	--	3.7	2.1	9.9	.2	40.5	56.7	65.0	1.7
Faint crown	6.0	6.0	.9	--	.1	4.1	3.8	13.0	6.9	1.3
Paperflower	7.5	17.9	54.3	1.1	59.9	67.4	31.4	--	7.5	85.4
Whitestem stickleaf	.2	8.1	21.2	.4	.6	--	--	.1	--	--
Croton	4.4	7.7	.04	--	--	.1	.2	--	2.4	1.1
Alin	--	5.5	--	--	1.5	.6	1.7	1.9	.5	.2
Desert baleya	1.5	--	--	-	--	--	--	12.5	--	--
Two leaf senna	--	25.3	.2	1.2	--	--	--	--	--	--
Hymenopappus	3.0	--	--	--	--	--	.2	--	--	--
Purple roll-leaf	.2	--	--	--	--	--	--	--	.04	--
Other forbs	5.9	5.5	.5	1.6	1.7	.4	1.6	.9	.9	1.3
Subtotal	71.7	76.0	80.8	6.4	73.7	72.8	79.4	85.1	83.2	91.0
Shrubs										
Mesquite	4.9	7.8	3.7	.8	--	.50	2.0	.2	2.6	6.4
Creosotebush	--	1.2	--	--	--	--	--	--	--	--
Yucca	1.5	.8	1.3	--	1.1	--	--	--	--	--
Other shrubs	.3	--	--	.3	--	--	3.5	--	.3	.1
Subtotal	6.7	9.8	5.0	1.1	1.1	.50	5.5	.2	2.9	6.5

Table 7. Dietary composition (% dry weight) of black-tailed jackrabbit diets on the dropseed vegetation type

Species	6/16/79	6/30/79	7/14/79	7/28/79	8/11/79	8/23/79	9/14/79	9/28/79	10/12/79	10/27/79
Grasses										
Dropseed	18.7	21.6	36.1	51.1	9.2	39.7	13.1	8.6	11.6	.3
Black grama	5.1	.1	.8	10.3	--	.8	--	--	2.5	--
Fluffgrass	--	--	--	--	--	--	--	2.1	7.9	1.6
Other grasses	2.8	.04	.4	.6	.5	.7	.5	.2	1.6	.2
Subtotal	26.6	21.7	37.3	62.0	9.7	41.2	13.6	10.9	23.6	2.1
Forbs										
Dalea sp.	14.2	51.5	22.6	14.4	66.7	20.0	60.1	69.9	14.0	47.7
Faint crown	6.4	7.2	5.7	16.4	1.5	5.8	2.4	7.2	12.4	.8
Paperflower	10.6	3.2	19.5	1.4	20.4	30.8	17.9	.4	37.4	46.9
Whitestem stickleaf	.2	--	--	1.1	--	--	--	.6	--	--
Croton	3.2	1.8	2.0	--	--	.6	--	.5	.6	.5
Four O'clock	--	1.8	3.7	1.9	.1	.7	2.1	--	2.8	.1
Desert baleya	3.2	5.6	--	--	--	--	--	7.0	--	--
Hymenopappus	3.3	.04	--	--	--	--	--	--	--	--
Purple roll-leaf	18.2	--	.3	--	--	--	--	--	--	--
Other forbs	9.4	5.1	3.7	.7	1.4	1.5	1.3	.7	3.8	.1
Subtotal	68.7	76.2	57.5	35.9	90.1	59.4	83.8	86.2	71.0	96.0
Shrubs										
Mesquite	.5	.9	2.8	2.1	--	--	2.5	1.7	1.9	1.9
Creosotebush	.8	--	--	--	--	--	--	--	--	--
Yucca	.2	.9	2.3	--	.2	--	--	.2	--	--
Other shrubs	3.1	--	--	--	--	--	--	.5	.8	--
Subtotal	4.6	1.8	5.1	2.1	.2	--	2.5	2.4	2.7	1.9