Vegetation response to the Santa Rita grazing system

S. CLARK MARTIN AND KIETH E. SEVERSON

Abstract

Changes in vegetation under yearlong grazing were compared with those under the Santa Rita grazing system, a rotation system designed for southwestern US rangelands where 90% of the forage is produced in mid- to late-summer. The study was conducted on the Santa Rita Experimental Range near Tucson, Arizona, from 1972 to 1984. In 1984 there were no differences ($P<0.05$) in grass densities (16 vs. 17 to 18 plants/m²), forb densities (0.6 vs 0.7 to 1.4 plants/m²), shrub densities (2.0 vs 1.9 to 2.4 plants/m²), or shrub cover (20 vs 21 to 26%) on pastures grazed yearlong or in the Santa Rita rotation, respectively. Lack of response to grazing schedules is attributed to initial plant densities near the maximum the sites could support and to moderate grazing during the study period.

Average herbage yields of pastures were not related significantly to grazing treatments but correlated strongly (r = 0.909) with long-time summer rainfall means. Results support the observation that rotation grazing may not improve ranges that are in good condition. It is concluded, however, that the Santa Rita Grazing System may accelerate recovery of ranges in poor condition.

Key Words: rotation grazing, semidesert grasslands, Arizona, 3-pasture, grass density, shrub intercept

The relative merits of specialized grazing systems have been debated by range scientists since the early 1900's. Most reviewers of the subject (e.g. Heady 1961, Herbel 1971) have concluded that specialized grazing systems are neither universally superior nor inferior to yearlong grazing. Gammon (1978) concluded that universal conclusions are inappropriate because study results are generally site specific, closely coupled to rate of stocking, and difficult to interpret because of differences in experimental design and procedural limitations. However, the collective results from such studies do provide a strong data base from which more effective grazing systems can be developed. The objective of this study was to compare the effects of the Santa Rita (SR) grazing system, a 1-herd, 3-pasture, 3-year rotation schedule (Martin 1978) with those of yearlong grazing on semidesert in southern Arizona.

Authors are professor emeritus, School of Renewable Natural Resources, University of Arizona, Tucson 85721; and research range scientist, Rocky Mountain Forest and Range Experiment Station, Arizona State University, Tempe 85287, respectively.
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Methods

Study Area

The study was conducted on a 15,000-ha, 12-pasture tract of land on the Santa Rita Experimental Range, Pima County, Arizona. The area slopes downward from southeast to northwest and is generally flat except for numerous shallow washes. Elevation ranges from 1,350 to 900 m. The alluvial soils form a complex pattern ranging from deep sandy mollisols of the Comoro series to dense rocky aridosols in the White House series (Clemmons and Wheeler 1970). Mean annual precipitation varies across the study area and ranges from 280 to 440 mm. About 60% of the precipitation is received in summer (June–Sep.). Native vegetation is a grass-shrub complex that increases in density with increasing elevation and precipitation. Velvet mesquite *(Prosopis juliflora* var. *velutina)* is the dominant woody plant. Associated woody and succulent species include jumping cholla *(Opuntia fulgida)*, pricklypear cactus *(Opuntia engelmannii)*, burroweed *(Aplopappus tenuisectus)*, broom snakeweed *(Gutierrezia sarothrae)*, false mesquite *(Calliandra eriophylla)*, spiny hackberry *(Celtis pallida)*, ocotillo *(Fouquieria splendens)*, and barrel cactus *(Ferrocactus wizlizini)*. Important perennial grasses include black grama *(Bouteloua eriopoda)*, Rothrock grama *(B. rothrockii)*, sideoats grama *(B. curtipendula)*, slender grama *(B. filiformis)*, sprucetop grama *(B. chondrosioides)*, Arizona cottontop *(Digitaria californica)*, tanglehead *(Heteropogon contortus)*, Lehmann lovegrass *(Eragrostis lehmanniana)*, tall threeawns *(Aristida hamulosa* and *A. ternipes)*, Santa Rita threeawn *(A. glabrata)*, and bush muhly *(Muhlenbergia porteri)*. Common annual grasses are annual threeawn *(A. adscenciones)*, and needle grama *(B. aristidoides)*. Common perennial forbs include silver nightshade *(Solanum eleagnifolium)*, Arizona evolvulus *(Evolvulus arizonicus)*, sida (*Sida* sp.) and spiderling

Table 1. Seasons of grazing (G) and rest (R) beginning 1 November 1972 for pastures in Santa Rita grazing system.

Grazing schedule	Year 1			Year 2			Year 3		
	Winter[1]	Spring	Summer	Winter	Spring	Summer	Winter	Spring	Summer
SR1	R	G	G	R	R	R	G	R	R
SR2	G	R	R	R	G	G	R	R	R
SR3	R	R	R	G	R	R	R	G	G

[1]Winter = Nov.–Feb., Spring = Mar.–June, Summer = July–Oct.

(*Boerhaavia* sp.)

Grazing Treatments and Experimental Design

The study treatments included continuous yearlong (YL), and the Santa Rita grazing system (SR) as described by Martin (1978). The SR rotation schedule, as presented in Table 1, was derived from the results of many grazing-rest schedules previously evaluated on the Santa Rita Experimental Range. Every 3 years, each pasture in the SR rotation is grazed once Nov.–Feb. and once Mar.–Oct. with 12 months rest after each grazing event.

The design of the study was a randomized block with 3 blocks and 4 treatments (Table 2). The study was blocked by elevation (Block I = high, Block II = intermediate, Block III = low) because precipitation, grass production, and stocking rates increase with increasing elevation.

Table 2. Area (ha) of treatment pastures and average precipitation (mm) during study period.

Block[1]	Grazing treatment	Area	Average precipitation June–Sept.	Average precipitation Annual
I	YL	403	247	436
	SR1	313	212	366
	SR2	308	244	423
	SR3	310	230	386
II	YL	1801	201	348
	SR1	1439	212	366
	SR2	1425	211	359
	SR3	1524	179	312
III	YL	2146	162	284
	SR1	1728	156	282
	SR2	1637	197	334
	SR3	1979	184	313

[1]Block elevations: I = 1,150–1,340 m, II = 1,040–1,220 m, III = 880–1,040 m.
[2]YL = yearlong. SR1, SR2, and SR3 are schedules of the Santa Rita 3-pasture rotation (see Table 1).

Planned rates of stocking were the average numbers estimated to be necessary to utilize 40% of the perennial grass produced in the study pastures from 1959 through 1968. Estimates were computed from records, for that period, of production and utilization of perennial grasses and actual stocking on Santa Rita pastures. Santa Rita treatment pastures in Blocks I, II, and III were initially stocked with 52 cows (18 ha/AUY), 172 cows (24–26 ha/AUY), and 90 cows (52–63 ha/AUY) respectively. YL units in Blocks I, II, and III were initially stocked with 20, 45, and 40 cows (19, 38 and 52 ha/AUY) respectively. Stocking rate adjustments for drought included a 50% reduction in Block I SR pastures in 1973 and 1974, a 25% reduction in the Block III YL pasture in 1981 and 1982, and a 25% reduction in the Block III SR pastures in 1982. Cows were straight Herefords except in Block III where one half were Barzona. Bulls were Hereford allotted at a cow/bull ratio of 20. The breeding season was from March to October.

Vegetation Sampling

Plant density (plants/m^2) and cover (%) were estimated at 3-year intervals on 10 permanent belt transects per pasture at locations 0.4 to 1.0 km from water. Density transects were 0.305 by 30.5 m. Densities of perennial grasses and shrubs were initially estimated in 1972. Forb density was first estimated in 1975. Crown cover of shrubs was measured along the edge of the plant density belt transect and was initially estimated in 1975.

Utilization (%) of perennial grasses was estimated by the ungrazed plant count method (Roach 1950), following each grazing period. The estimate at each transect location was based on 100 plants in a 30.5 by 61.0-m plot centered over the permanent belt transect. Standing crop (kg/ha) of annual and perennial grasses, in those pastures that would be grazed during the next 12 months, was estimated each fall on the permanent belt transects by the weight-estimate method (Pechanec and Pickford 1937).

Statistical Analysis

Study design consisted of 3 blocks, 4 grazing treatments (YL, SR1, SR2, SR3), and 5 observation years. Plant densities and shrub cover data were analyzed using a split plot analysis of variance model with years as subplots (Wilm 1945). Error terms for treatments and years were the block by treatment and the block by year interactions, respectively. Differences among means were evaluated using Duncan's new multiple range test ($P<0.05$). End of season standing crops were statistically analyzed using standard *t*-test procedures.

Results

Precipitation

June through September precipitation from 1972 through 1984 averaged 211 mm across all pastures, which was near the long-term average of 208 mm. However, considerable variation occurred among year's and ranged from severe drought in 1973 to well above average in 1983 and 1984 (Fig. 1). Rainfall was greater at the higher

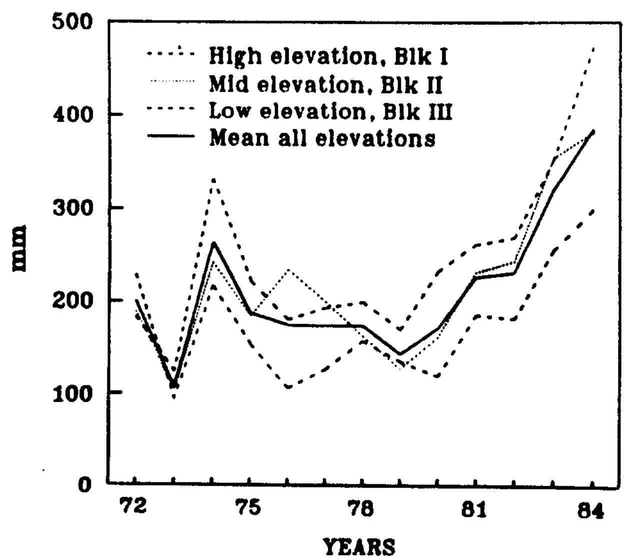

Fig. 1. *Total precipitation (mm) from June through September by block and year.*

elevations and was most variable at the lower elevation.

Plant Densities

The average density of perennial grasses across all years and treatments was 19 plants/m^2 (Table 3). Densities were greatest in Block I and least in Block III. Differences among grazing treatments were significant only in 1981 when density was greatest on SR2 and least on SR3. Across year trends suggested that treatment pastures with high initial density declined more than those with low initial density. Climatic variables probably were responsible for most year-to-year changes.

Table 3. Density (plants/m²) of perennial grasses by year, block, and grazing treatment.

Variable	Year					Average
	72	75	78	81	84	
Block						
I	32	34	30	32	21	30
II	18	19	17	13	17	17
III	11	10	8	6	12	10
Grazing treatment						
YL	15	20	18	18_{ab}[1]	16	17
SR1	23	21	17	14_{ab}	18	18
SR2	23	24	21	22_{a}	17	21
SR3	20	21	19	13_{b}	17	18
SR Average	22	22	19	17	17	19
Average	20	21	18	17	17	19

[1]Within years, treatment means followed by different letters differ at $P<0.05$.

Mean densities of some grass species differed among grazing treatments and elevations (Table 4). Most of these differences represent site specific associations rather than response to grazing treatment. Species which declined sharply from 1972 to 1975 were Santa Rita threeawn, tall threeawn, and slender grama. These 3 species occurred primarily on deep sandy or gravelly soils with low water holding capacities. The summer drought of 1973 had a profound effect on these and other shallow rooted species on such soils. Species whose density increased most from 1972 through 1975 were Rothrock grama and Lehmann lovegrass. These 2 species undoubtedly lost density in the summer of 1973 but both reproduce rapidly from seed if space is available and summer rainfall is high. High summer rainfall in 1974 (Fig. 1) enabled these species to invade bare areas created by drought. Rothrock grama filled voids more successfully at low elevation while Lehmann lovegrass not only filled the voids but replaced native species, even Rothrock grama, at the mid and upper elevations.

Densities of perennial forbs, first recorded in 1975, ranged from 0.5 to 3.6 plants/m^2 (Table 5). Forb densities were consistently greatest at mid elevations. Low forb densities in 1984 were probably the result of exceptionally high rainfall that produced such rank growth of the perennial grasses that the forbs were suppressed by shading.

Table 5. Forb density (plants/m²) by block, grazing treatment, and year.

Variable	Year				Average
	75	78	81	84	
Block					
I	2.2	1.7	1.2	0.9	1.2
II	2.6	3.2	2.7	1.3	2.0
III	1.2	2.2	2.3	0.5	1.2
Grazing treatment					
YL	2.2^{b}_{x}[1]	2.8^{a}_{x}	1.8^{b}_{xy}	0.6_{y}	1.4
SR1	2.6^{a}_{x}	2.3^{a}_{xy}	3.2^{a}_{x}	1.4_{y}	1.9
SR2	1.7^{b}	0.8^{b}	2.0^{b}	0.9	1.1
SR3	1.4^{b}_{y}	3.6^{a}_{x}	1.3^{b}_{y}	0.7_{y}	1.4
SR average	1.9	2.2	2.2	1.0	
Average	2.0_{x}	2.4_{x}	2.1_{x}	0.9_{y}	1.5

[1]Within same row or column, values followed by different letter differ at $P<0.05$. Superscripts indicate differences among grazing treatments in same year (column). Subscripts indicate differences among years (rows) for same grazing treatment.

Herbage Production and Utilization

Average perennial grass end-of-season standing crop was 403 kg/ha. Means for grazing treatments ranged from 296 for SR3 to 477 for SR2 (Table 6). Extremes ranged from 46 kg/ha for SR3 in Block III in 1976 to 1,354 for SR3 in Block I in 1977. Mean comparisons (*t* tests) for the period from 1972 through 1982 showed herbage standing crop was significantly less ($P<0.05$) for SR3 than YL, SR1, or SR2. However we hesitate to attribute low herbage yields on SR3 to the grazing treatment because regression analyses indicated that 84% of the difference in herbage production among pastures (1972–82) was associated with differences in average summer rainfall for the period (Fig. 2). Long term summer rainfall means correlated almost equally well ($r^2 = 0.826$) with grass production. This suggests that differences among pastures in herbage production were related mainly to climate and were not altered materially by grazing treatment.

Average utilization of perennial grasses on permanent transects was 52% for yearlong grazing, 49% for March–October grazing in SR pastures, and 47% for November–February grazing in SR pastures. Differences among rotation treatments were not significant and averaged 46, 49, and 51% for SR1, SR2, and SR3 respectively (Table 7).

Shrub Density and Cover

Shrub densities were consistently low (1.1–5.8 plants/m^2) throughout the study and showed no trends associated with grazing treatments (Table 8) although differences did occur among elevational blocks. Shrub density increased from 1972 to 1975 under all grazing treatments primarily as the result of an increase in burroweed (Table 9). Densities of burroweed and "other" shrubs were greatest

Table 4. Mean densities (plants/m²) of perennial grass species by grazing treatment, block, and year.

Species	Grazing treatment				Block			Year				
	YL	SR1	SR2	SR3	I	II	III	72	75	78	81	84
Santa Rita threeawn	1.1_{b}[1]	2.9_{a}	2.1_{ab}	2.0_{ab}	0.7	3.4	2.0	3.2	1.5	2.2	1.8	1.5
Tall threeawn	0.8	1.4	1.0	0.9	0.9	1.3	0.9	2.3_{a}	0.6_{b}	0.7_{b}	0.7_{b}	0.8_{b}
Sideoats grama	0.4_{a}	[2]$_{b}$	0.2_{ab}	[2]$_{b}$	0.5	0.0	0.0	0.2	0.2	0.1	0.2	0.1
Black grama	0.6_{b}	2.4_{a}	0.8_{b}	0.5_{b}	2.4	0.9	[2]	1.4	0.8	1.1	1.2	0.9
Slender grama	0.6_{b}	[2]$_{b}$	3.7_{a}	0.1_{b}	3.2	0.1	[2]	2.6	0.3	1.0	1.0	0.6
Rothrock grama	2.3_{bc}	4.4_{ab}	0.6_{c}	6.7_{a}	2.5	4.8	3.1	3.8_{ab}	6.2_{a}	2.8_{ab}	1.4_{b}	3.2_{ab}
Lehmann lovegrass	6.2_{ab}	2.8_{b}	10.1_{a}	3.3_{b}	13.8	2.6	0.4	1.2	7.5	6.1	6.9	6.3
Tanglehead	0.2	0.1	0.1	0.2	0.2	0.3	[2]	0.2_{ab}	0.1_{b}	0.1_{b}	0.1_{b}	0.4_{a}
Bush muhly	0.2	0.3	0.2	0.2	[2]	0.3	0.4	0.2	0.2	0.3	0.4	0.2
Plains bristlegrass	0.5_{ab}	0.7_{a}	0.2_{b}	0.4_{ab}	0.5	0.7	0.2	0.4_{ab}	0.7_{a}	0.5_{ab}	0.3_{b}	0.4_{ab}
Spike dropseed	0.2_{a}	0.1_{ab}	[2]$_{b}$	[2]$_{b}$	0.1	0.1	0.1	[2]$_{b}$	0.2_{a}	0.1_{ab}	0.1_{ab}	[2]$_{b}$
Arizona cottontop	1.6_{a}	1.1_{ab}	1.0_{b}	1.7_{a}	0.8	0.9	1.3	1.3	1.1	1.6	1.3	1.4
Other grasses	2.5	1.8	1.1	2.3	4.3	0.5	1.0	3.6	1.8	1.8	1.4	1.1
Total grasses	17.2	18.3	21.3	18.4	29.9	17.0	9.5	20.5	21.2	18.4	16.9	17.0

[1]Among grazing treatments and years species means followed by different letters differ at $P<0.05$.
[2]Indicates density 0.05 or less.

Table 6. Perennial grass end-of-season standing crop (kg/ha) by block, grazing treatment, and year.

Block	Grazing treatment	1972	1973	1974	1975	1976	1977	1978	1979	1980	1982	Average
I	YL	580	634	567	487	581	654	1340	1241	831	1198	811
	SR1	818	—[1]	406	304	—	745	686	—	318	—	546
	SR2	1006	359	—	287	479	—	725	1104	—	1145	729
	SR3	—	249	221	—	237	1354	—	459	423	574	502
	Mean	801	414	398	359	432	918	917	935	524	972	667
II	YL	452	217	272	254	201	396	564	407	317	396	348
	SR1	951	—	433	148	—	990	492	—	195	—	535
	SR2	685	169	—	134	394	—	717	951	—	504	508
	SR3	—	209	220	—	136	517	—	137	88	520	261
	Mean	696	198	308	179	244	634	591	498	200	473	402
III	YL	231	148	101	80	110	357	217	125	41	176	159
	SR1	331	—	187	120	—	496	170	—	148	—	242
SR2	325	193	—	165	113	—	258	186	—	114		193
	SR3	—	112	177	—	46	87	—	91	110	262	126
	Mean	296	151	153	122	90	313	215	134	100	184	176
Mean	YL	421	333	313	274	297	469	707	591	396	590	439
	SR1	700	—	342	191	—	744	449	—	220	—	441
	SR2	672	240	—	195	329	—	567	747	—	588	477
	SR3	—	190	204	—	140	653	—	229	207	452	296
Grand mean		598	254	286	220	255	622	574	522	274	546	415
SR average		686	215	273	193	234	698	508	488	214	520	403

[1]Herbage standing crop was not measured on units identifed by dashes because they had been grazed March–October and would not be grazed again for 12 months.

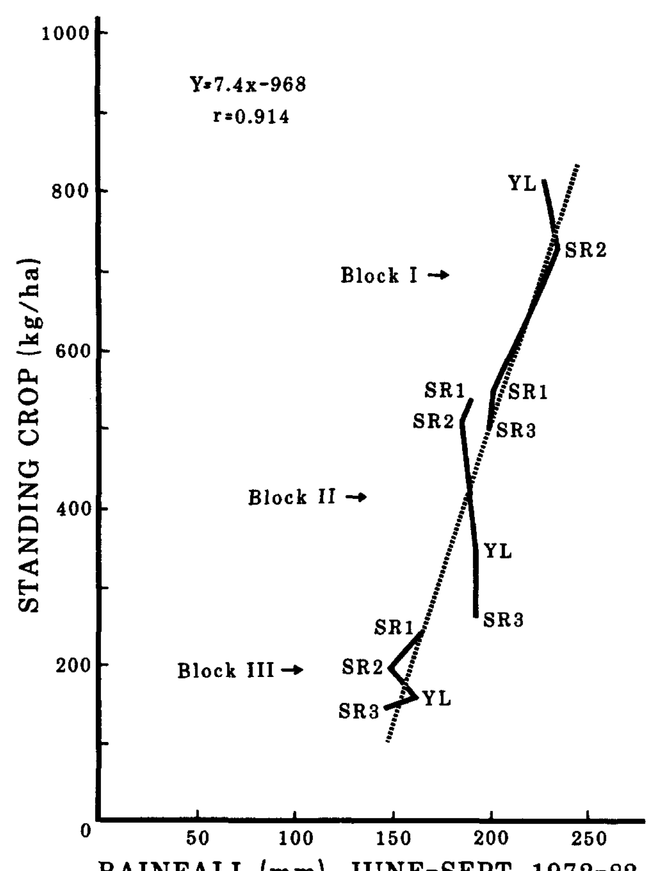

Fig. 2. *Linear model depicting relationship between average rainfall (mm), June through September from 1972 through 1982, and average end-of-season perennial grass standing crop (kg/ha), for the 12 study pastures.*

at low elevation, calliandra and velvet mesquite at high elevation, and pricklypear cactus at mid elevation.

Crown cover of shrubs increased from 14% in 1975 to 31% in 1984 but did not differ significantly among elevations or grazing treatments at any time even though cover was always greatest on SR3 (Table 10). Substantial increases were recorded from 1975 to 1978 and from 1981 to 1984 in all blocks and for all treatments. Grazing treatment apparently had no effect on these changes.

Discussion and Conclusions

This study employed pastures from 308 to 2,146 ha in area to compare vegetation response under yearlong grazing with vegetation response under the SR grazing system. It compares results of the SR grazing-rest schedule on a practical scale with results from a similar schedule applied to plots 6m^2 in an earlier experiment (Martin 1973). Density of perennial grasses, in the earlier study, increased much more on plots deferred from grazing from March through October, (2 out of 3 years) than on plots grazed yearlong. But, in this study differences between YL and SR pastures were small. We believe the lack of response to grazing treatment in this study is explained by relatively high initial grass density and relatively low intensity of grazing on the sample plots. In the decade before the earlier study (Martin 1973) was initiated, drought and heavy continuous grazing reduced grass densities to very low levels (1 to 3 plants/m^2). Then, as more favorable rainfall was received, some plant density increases occurred even under continuous grazing. But, the decade before this study was initiated, was favorable and this coupled with moderate to light grazing brought grass densities to such a high level (15 to 22 plants/m^2) that additional increases were effectively limited. Also, sample plots in the earlier study were located near the only available water. Thus, utilization was always high in the earlier study while sample plots in this study were located 0.4 to 1.0 km from water and utilization was moderate to light for all grazing treatments.

In summary, we believe these results support Heady's (1961) contention that favorable vegetation responses to rotation grazing were most apparent on ranges initially in poor condition. Our experience and the results of this study suggest that the Santa Rita grazing system, like other grazing systems, can accelerate range

Table 7. Perennial grass utilization (%) by block, grazing treatment, and year.[1]

Block	Grazing treatment	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Average
I	YL	63	69	50	29	55	34	[2]	61	50	45	50.7
	SR1		68^F	49^S	—	14^F	30^S	—	^{2F}	57^S	—	43.6
	SR2	55^S	—	52^F	13^S	—	55^F	^{2S}	—	21^F	16^S	35.3
	SR3	^{2F}	76^S	—	43^F	47^S	—	38^F	55^S	—	52^F	51.8
	Means: Mar.–Oct. grazing (F) 42.9, Nov.–Feb. (S) 44.2											
II	YL	48	54	60	31	48	22	[2]	49	59	29	44.4
	SR1	—	64^F	62^S	—	34^F	30^S	—	^{2F}	60^S	—	50.0
	SR2	56^S	—	62^F	46^S	—	63^F	^{2S}	—	70^F	56^S	58.8
	SR3	47^F	61^S	—	58^F	35^S	—	37^F	73^S	—	68^F	54.1
	Means: Mar.–Oct. grazing (F) 55.9, Nov.–Feb. (S) 47.9											
III	YL	50	62	66	62	57	47	[2]	66	69	58	59.6
	SR1	—	57^F	53^S	—	27^F	28^S	—	^{2F}	58^S	—	44.6
	SR2	46^S	—	40^F	50^S	—	56^F	—^{S}	—	68^F	50^S	51.7
	SR3	26^F	57^S	—	63^F	36^S	—	26^F	57^S	—	69^F	47.7
	Means: Mar.–Oct. grazing (F) 48, Nov.–Feb. (S) 48.3											

[1]Utilization on YL units was measured in June before the start of the summer growing season. On rotation pastures the superscript "S" identifies utilization as of 1 March on units grazed November–February; "F" indicates utilization around 1 November on units grazed March–October. Dashes indicate years pasture was not grazed.
[2]Scheduled utilization observations were not made.

Table 8 Shrub density (plants/m²) by block, grazing treatment and year.

Variable	Year 72	75	78	81	84	Average
Block						
I	3.0	2.9	1.8	2.6	2.6	2.6
II	1.4	2.7	1.5	1.5	1.4	1.7
III	1.1	5.8	2.5	2.1	2.2	2.8
Grazing treatment						
YL	2.3	3.0	1.8	2.0	2.0	2.2
SR1	1.1	4.7	1.4	1.5	1.9	2.1
SR2	1.8	4.1	1.8	2.2	2.0	2.4
SR3	2.1	3.3	2.8	2.7	2.4	2.7
SR Average	1.7	4.0	2.0	2.1	2.1	
Average	1.8_y[1]	3.7_x	2.0_y	2.1_y	2.1_y	2.4

[1]Means followed by different letters differ at $P<0.05$.

Table 10. Shrub intercept (percent) by block and grazing treatment and year.

Variable	Year 75	78	81	84	Average
Block					
I	14	19	23	30	22
II	14	19	25	32	22
III	14	21	24	31	22
Grazing treatment					
YL	12	18	21	28	20
SR1	14	19	25	29	22
SR2	12	18	21	32	21
SR3	18	24	29	35	26
SR Average	15	20	25	32	23
Mean	14_c[1]	20_b	24_b	31_a	21

[1]Means followed by different letters differ at $P<0.05$.

Table 9. Mean densities (plants/m²) of shrubs by grazing treatment, block and year.

Species	Grazing treatment YL	SR1	SR2	SR3	Elevation High	Mid	Low	Year 72	75	78	81	84	Average
Burroweed[1]	1.00	1.42	1.41	1.51	0.82	1.04	2.14	0.56_b	2.73_a	1.23_b	1.06_b	1.09_b	1.34
Calliandra	0.74	0.12	0.68	0.72	1.34	0.36	[2]	0.85	0.44	0.30	0.61	0.62	0.56
Prickly Pear	0.06_a	0.05_a	0.02_b	0.05_a	0.04	0.08_b	0.02	0.04	0.03	0.05	0.04	0.07	0.04
Cane Cholla	0.01	0.01	0.01	0.02	0.01	0.02	0.01	$(^2)_b$	0.02_a	0.02_a	0.01_{ab}	0.01_{ab}	0.01
Velvet Mesquite	0.03	0.03	0.02	0.03	0.05	0.03	0.01	0.03	0.03	0.03	0.03	0.03	0.03
Other shrubs	0.38	0.49	0.24	0.33	0.35	0.14	0.59	0.33	0.54	0.32	0.34	0.27	0.36
Total shrubs	2.22	2.13	2.38	2.66	2.60	1.68	2.76	1.82_b	3.78_a	1.96_b	2.10_b	2.08_b	2.35

[1]Among treatments and years species means followed by different letters differ at $P<0.05$.
[2]Indicates density less than 0.005.

improvement if the initial condition is poor to fair but may show little benefit on range initially in good condition.

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