Rotating Access to Water to Improve Semidesert Cattle Range Near Water

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Highlight

Seasonal opening and closing of watering places in a 3,200-acre pasture on the Santa Rita Experimental Range in Arizona resulted in lighter use of perennial grasses near water if utilization for the pasture was moderate to light, and if the closed period included the summer growing season. Rotating use of watering places should work best in large range units with waters far apart.

Most semidesert grass-shrub cattle ranges are grazed yearlong. Even ranges that are properly stocked may be overgrazed every year near water, while remote areas are grazed lightly or not at all. Deferred-rotation grazing systems rest entire range units periodically, thereby giving all areas of concentrated use an opportunity to recover. However, the cost of fencing necessary for a deferred-rotation system may be hard to justify on many southwestern semidesert ranges. The objectives of this study were: (1) to determine whether cattle in a pasture with several watering places could be made to rotate their use of forage near water by opening one water at a time, and (2) to determine changes in cover, production, and utilization of perennial grasses near water under such a system.

Study Area and Methods

The study was conducted on a 3,161-acre range with three permanent watering places where water could be made available at any time, and two temporary ponds where water was available only after heavy rains (Fig. 1). Most of the range consists of gentle slopes ranging in elevation from 3,700 feet to 4,300 feet. The surface soils are mostly sandy loams and are relatively free of rock, except on steep slopes.

Average annual precipitation ranges approximately from 13 to 15 inches. Rains in July and August produce most of the year's forage (Culley, 1943).

Average July–August rainfall during the study was 6.12 inches; average stocking was 10.0 animal units per section, and the average utilization for the pasture was 52 percent (Table 1). Exceptionally good growing conditions in 1957–58 and 1958–59 had allowed perennial grasses to recover from the 1956 drought before the study began in July 1959. The average yield of perennial grass herbage during the study period was 187 pounds per acre.

Vegetation cover.—Vegetation on much of the study area is dominated by an overstory of velvet mesquite (*Prosopis juliflora* var. *velutina* (Woot.) Sarg.)[2] (Fig. 2). Other shrubs include catclaw acacia (*Acacia greggii* Gray), pricklypear (*Opuntia engelmannii* Salm-Dyck), cholla cactus (*O. fulgida* Engelm.), false-mesquite (*Calliandra eriophylla* Benth.), and burroweed (*Aplopappus tenuisectus* (Green) Blake).

Important perennial grasses include Arizona cottontop (*Trichachne californica* (Benth.) Chase), Santa Rita three-awn (*Aristida glabrata* (Vasey) Hitchc.), tall three-awns (*Aristida* spp.), black grama (*Bouteloua eriopoda* Torr.), slender grama (*B. filiformis* (Fourn.) Griffiths), Rothrock grama (*B. rothrockii* Vasey), and tanglehead (*Heteropogon contortus* (L.) Beauv.). The main annual grasses are six weeks three-awn (*Aristida adscensionis* L.), and needle grama (*B. aristidoides* (H.B.K.) Griseb.).

Grazing management.—The study range was grazed yearlong by replacement heifers and breeding cattle from July 1959 through June 1966. Cattle numbers were adjusted each fall in accordance with available forage, but adjustments in stocking were of smaller magnitude than changes

[1] Central headquarters maintained in cooperation with Colorado State University at Fort Collins, Colorado. Authors stationed at Tucson, Arizona, in cooperation with the University of Arizona. Received February 20, 1969; accepted for publication May 25, 1969.

[2] Nomenclature follows Kearney and Peebles (1951).

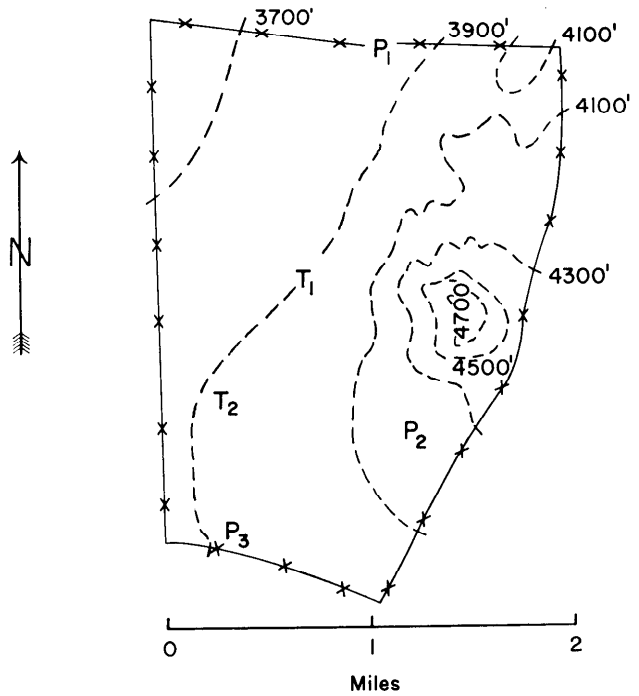

FIG. 1. Study pasture, showing permanent (P) and temporary (T) watering places and contour lines.

in forage yield. The water-rotation schedule provided that only one of the five waters would be open at a time, and that no water would be open during the growing season more often than 1 year out of 3.

Block salt was placed at the open water to concentrate grazing near that water and to help keep cattle away from the closed waters. This was done to meet peculiar requirements of the study. Salting at water is not recommended.

Table 1. July-August rainfall (inches), stocking (AU/section), and herbage production (lb/acre) and utilization (%) of perennial grasses on paced transects from July 1959 to June 1966.

Year	Rainfall	Stocking	Herbage	Utilization
1959–60	7.21	12.5	188	44
1960–61	5.44	11.4	177	57
1961–62	7.94	11.4	151	32
1962–63	2.75	9.3	86	77
1963–64	6.73	9.3	223	62
1964–65	6.93	9.2	205	52
1965–66	5.84	6.8	280	42
Average	6.12	10.0	187	52

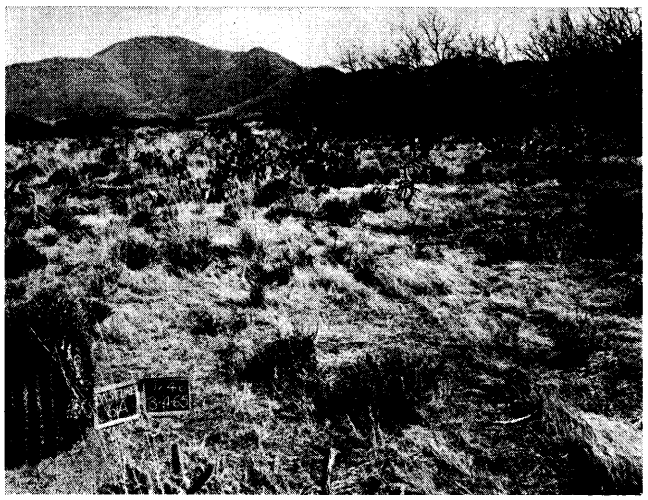

FIG. 2. Typical vegetation and topography in the study pasture.

Vegetation measurements.—To evaluate changes in vegetation near each water, two permanently marked 100-foot line transects were established at distances of 100, 200, 300, 400, and 500 yards from each water. The same transect arrangement was also established on the adjacent range at water P1, where cattle had access to the water yearlong for the entire study period.

Vegetation measurements made each year from 1959 to 1966 on these transects included: (1) crown intercept of shrubs and basal intercept of perennial grasses measured each fall (Canfield, 1942), (2) utilization around each transect estimated by the grazed-plant-count method each June (Roach, 1949), and (3) ocular estimates of forage yield each fall on five permanent plots (1 foot by 9.6 feet) at each transect, and one temporary plot at each transect that was estimated and clipped to provide regression data for adjusting the ocular estimates and herbage samples for moisture determinations.

Changes in vegetation near the part-time (periodically open) waters were evaluated by comparing average measurements for the first 3 years (1959–61) with those of the final 3 years (1964–66). The main effects in the analysis of variance were two periods, five waters, and five distances from water, with one replication within each three-way combination. The analysis of differences in vegetation at water P1 between (1) transects on the adjacent range, where water was open yearlong, and (2) transects on the study range, where water was open part-time, included the data for each year.

Line intercept data for the study range as a whole were obtained from 20 randomly located permanent line transects, all ¼ mile or more from water. Herbage production and utilization data for adjusting stocking were obtained from 10 paced transects that were ½ to 1 mile from water, and were rerun in the same locations each year.

Results

Cattle Responses

Cattle soon adapted to the rotation system. Water P3, at the south end of the unit, was open when the study started. During the first few weeks, calves weaned from pastures to the north and west drifted to the north end of the range several times and stayed around water P1 until driven away (Fig. 1). Cattle did not have to be driven away from the closed waters after the first year. Opening and closing waters forced the cattle to follow a rotation system of grazing with little extra cost for labor or improvements.

Differences Within the Study Range

Basal cover and herbage yield of perennial grasses were lower and utilization was higher near water than on transects ½ mile or more from water, both at the beginning and end of the study.

Perennial grass measurement	½ mile or more from water		100–500 yards from water	
	1959	1966	1959	1966
Basal intercept (%)	0.72	0.72	0.15	0.34
Herbage yield (lb/acre)	232	244	86	118
Utilization (%)	44	42	65	62

Utilization.—Average utilization of perennial grasses from 1960 to 1966 was 9 percent higher near water than for areas ½ mile or more from water (61% vs. 52%).

Utilization of perennial grasses 100 to 500 yards from water varied with: (1) perennial grass production, and (2) topography. Utilization near water was highest following years of low grass production, and lowest following years of high grass production. Utilization decreased 1.36% for each 10 lb/acre increase in perennial grass production near water and, on the average, varied from 74% with 10 lb/acre to 48% with 200.

Some differences in utilization between transects near water were associated with differences in species composition. For example, transects with a high component of black grama were used less heavily than transects dominated by Arizona cottontop and Santa Rita three-awn. The cause-and-effect relationship between species composition and current utilization was not clear, however, because both were affected by differences in soil, accessibility, and past use.

Utilization of different species within 500 yards of water was not consistently related to their abundance (r = 0.01). For example, plains bristlegrass (*Setaria macrostachya* H.B.K.) and side-oats grama (*Bouteloua curtipendula* (Michx.) Torr.) each made up 2% of the total perennial grass production in 1966, but average utilization was 80 and 43%, respectively. Black grama and Santa Rita three-awn each made up 25% of the total production that year, and their utilization was 24 and 63%, respectively. Finally, Arizona cottontop and tall three-awns made up 14 and 10%, respectively, of the total perennial grass yield and both were heavily used (69%).

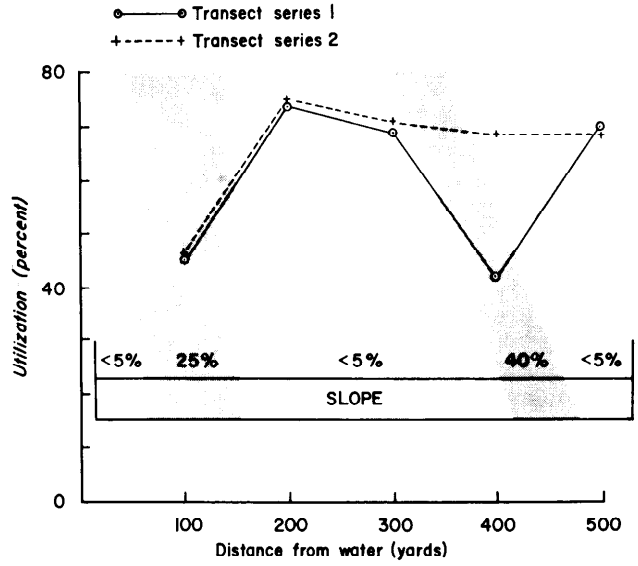

FIG. 3. Influence of slope on utilization near water. Shaded areas symbolize location of steep slopes in relation to transects, which cross a wide, flat-bottomed draw.

The average decrease in utilization of perennial grasses around waters, from 63% at 100 yards to 60% at 500 yards, was not significant. Topography influenced utilization more strongly than did distance. At water P3, where both 100-yard transects were on a 27% slope, utilization was lighter at 100 yards than at the 200-, 300-, or 500-yard transects which were situated on level ground (Fig. 3). At 400 yards, one of the transects was near the top of a 38% slope, and the other on relatively level terrain. Average use during the study period was 42% on the slope and 68% on the level.

Similarly, both series of transects at water T1 lay on gentle terrain; but the transects at 100 yards and 200 yards in one series were less accessible to cattle because a narrow, steep-sided ravine separated them both from the water and from the other eight transects. Utilization on these two transects was substantially less than would have been expected on the basis of their distance from water (Fig. 4). These results emphasize the importance of topographic barriers to cattle movement, as pointed out by Glendening (1944) and Mueggler (1965).

Perennial grass herbage production.—Perennial grass yields near water increased from 122 lb/acre (average 1959–61) to 156 lb (average 1964–66). Production was not consistently greater at 500 yards than at 100 yards, nor did average yields differ

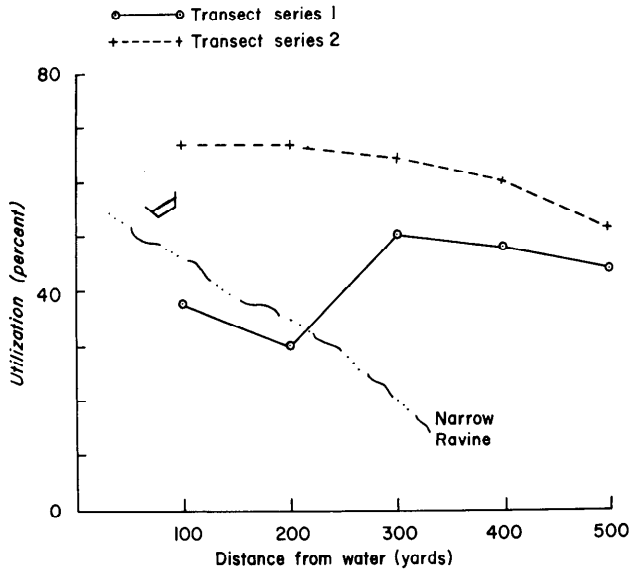

FIG. 4. Influence of a topographic barrier on average utilization of perrenial grasses. Wavy line symbolizes location of a narrow ravine crossed by transect series 1.

between watering places. Differences in topography and soil influenced production as well as utilization, and resulted in a strong watering place-distance interaction in perennial grass yields. The highest and lowest average yields, for example, were at 100 yards at waters P3 and P1, respectively (Table 2). At P3, the 100-yard transects lay on a moderately steep, rocky slope, while those at P1 were on flat, soft ground where cattle often loafed for several hours between the time they first came to water in the morning and the time they finally left to graze. Most of the obvious inconsistencies in Table 2 are related to such differences in topography or soil.

Table 2. Average yields of perennial grass herbage (lb/acre) 100 to 500 yards from each water from 1959–61 and 1964–66.

Watering place	3-year period	Distance from water (yards)					
		100	200	300	400	500	Average
P1	1959–61	13	128	178	53	110	96
	1964–66	20	103	169	89	112	99
P2	1959–61	141	123	167	242	45	144
	1964–66	181	140	145	272	112	170
P3	1959–61	297	57	41	116	163	135
	1964–66	416	40	55	155	138	161
T1	1959–61	102	148	155	138	121	133
	1964–66	176	196	153	177	256	192
T2	1959–61	87	152	78	98	85	100
	1964–66	88	189	151	150	209	157
Average	1959–61	128	122	124	130	105	122
	1964–66	176	133	135	168	166	156

Table 3. Average percent utilization for range where water P1 was open yearlong, and across the fence where water was open only part of the time.

Year July 1–June 30	Average use away from water		Use on transects near water		Seasons when part-time water was open
	Year-long	Part-time	Year-long	Part-time	
1959–60	34	44	73.4	64.7[1]	None
1960–61	48	57	77.5	73.4	Summer-fall
1961–62	20	32	62.6	44.5[1]	Spring
1962–63	67	77	79.8	79.2	None
1963–64	24	62	62.6	73.1[1]	Summer
1964–65	33	52	68.6	71.4	Summer-spring
1965–66	41	42	75.2	61.7[1]	Fall
Average	38	52	71.4	66.9	

[1] Years when difference in use near water between yearlong and part-time water was significant at 95 percent level.

Differences Between Part-time and Yearlong Water

Utilization.—Average utilization near water P1 for the 7-year study period was not significantly lighter in the pasture with water open part-time than across the fence where the water was open yearlong (Table 3). However, average utilization near the yearlong water was 1.9 times as great as away from water in the same pasture. Use around the part-time water was only 1.3 times as great as use away from water.

Differences in utilization near water between yearlong and part-time waters were negligible in 1961 and 1965, when water on the part-time side was open in summer, and in 1963, when the water was closed on the part-time side throughout the year, but very low forage production in 1962 resulted in excessive utilization in both pastures.

Utilization in 1964 was higher near the part-time water. Not only was the part-time water open during the summer of 1964, but average use for the entire pasture was 2.6 times as great as for the range with water open yearlong. Summer grazing and higher average utilization on the range with waters open part-time account for the higher utilization on the part-time side of the fence in 1964.

Utilization was lighter on the part-time side of the fence in 1960, 1962, and 1966. These were years when the part-time water was not open in summer, and average utilization on the study range was 44% or less. Thus, closing water for part of the year resulted in lighter use near water only if the closed period included the summer growing season, and if subsequent utilization was moderate to light for the whole range.

Perennial grass cover and yield.—Perennial grass cover during the 8-year study period was almost three times as great near the part-time water as

Table 4. Average cover (basal intercept in percent) and herbage yield (lb/acre) of perennial grasses (1959–1966) 100 to 500 yards from part-time and yearlong water.

Water availability	Distance from water (yards)					
	100	200	300	400	500	Average
			Basal intercept			
Part-time	T	0.26	0.50	0.35	0.22	0.26
Yearlong	0	0.08	0.05	0.17	0.16	0.09
Average	T	0.17	0.28	0.26	0.19	0.18
			Herbage yield			
Part-time	14.2	105.4	166.9	66.3	100.6	90.7
Yearlong	1.4	22.5	36.8	60.7	112.2	46.7
Average	7.8	63.9	101.8	63.5	106.4	68.7

near yearlong water (Table 4). Intercept was higher at the part-time water than at yearlong water at the intermediate distances, but differences were small at 100 and 500 yards. The lack of a difference at 100 yards is due to excessive use under both plans of management.

Average perennial grass production near water P1 was nearly twice as great where the water was open part-time as where the water was open yearlong (Table 4). Herbage production increased generally with distance from water but, as with cover, the effect of distance was inconsistent.

Summary and Conclusions

This study was set up to determine whether controlling access to water within a single range unit would lighten utilization and increase herbage production near water.

Only one water was open at a time, and the open water was changed about every 3 months. Each water was closed during the summer growing season 2 years out of 3. Cattle soon adjusted to the system. Cattle had to be driven away from the closed water only in the first fall-winter period. Within a year, the cattle had learned to move to and use range where the water was open.

Utilization averaged 9% higher within 500 yards of water than at locations ½ mile or more from water. In general, utilization was high following years of low herbage production, and low following high production.

Distances between waters were not great enough to prevent cattle from grazing near those that were closed if forage was scarce. Therefore, seasonal opening and closing of water failed to show strong benefits to perennial grass stands near water, partly because the pasture was too small.

Perennial grass production within 500 yards of water was higher in 1966 than in 1959. Yields near water were about half as great as on transects ½ mile or more from water.

Slopes of 25 to 40% and partial barriers to cattle movements markedly reduced utilization. Average utilization between 100 and 500 yards from water for the five rotated waters was not significantly related to distance.

Average perennial grass production was higher near part-time water than near yearlong water, even though average differences in utilization were small.

Utilization near part-time water was lower than around yearlong water only if the part-time water was closed during the summer growing season and if average use in the pasture with part-time water was moderate to light.

The results of this study show that utilization of perennial grasses near water can be reduced and herbage production increased by periodically closing the water in summer. Little may be gained, however, by closing waters that are close together, as in a small pasture, and closing water will not help if the entire range is closely grazed. The method should work best in large range units where cross-fencing is not feasible and watering places are far apart.

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