Stocking Desert Rangelands: What We've Learned

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Five stocking rate studies from three different locations in the southwestern United States have arrived at essentially the same management recommendations. Desert forage plants can sustain about 40% use of annual herbage production. Use in the drought years approached 55–60% while use in the wet years was near 20–25%. The researchers recommended that desert ranges be routinely stocked for around 30–35% use of average forage production with some destocking in drought years. All the studies have indicated that conservative grazing is a reliable way to increase forage production and improve vegetation composition on degraded rangelands.

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The selection of the correct stocking rate is the most important range management decision. Stocking rate selection is a major problem on desert rangelands in the southwestern United States, where forage production can fluctuate 100% among years (Figure 1). Ranchers on public rangelands are expected to comply with vegetation residue and stubble height guidelines to protect soil, watershed, and wildlife resources during periods of extended drought. There is less tolerance for heavy grazing near sacrifice areas (now called sensitive areas) such as creek bottoms, watering points, roads, and corrals. Grazing management plans must now include grazing intensity checks on an annual or semi-annual basis. Declining profit margins and public scrutiny are forcing ranchers to be more careful in stocking rate selection than in the past. At the same time, it is recognized that various rotation grazing systems cannot overcome the rangeland degradation associated with chronic overstocking.

Past long term research on stocking rate outcomes on desert rangelands is limited to three primary locations. These include the Desert Experimental Range in southwestern Utah (Figure 2), the Santa Rita Experimental Range in southcentral Arizona (Figure 3), and the Jornada Experimental Range and Chihuahuan Desert Rangeland Research Center (Figure 4) in southcentral New Mexico. Research involving replicated pastures assigned different stocking rate levels is available from the Desert Experimental Range and Chihuahuan Desert Rangeland Research Center. Studies on the Desert Experimental Range in Utah have involved wintering sheep while year-long cow-calf operations were evaluated in Arizona and New Mexico.

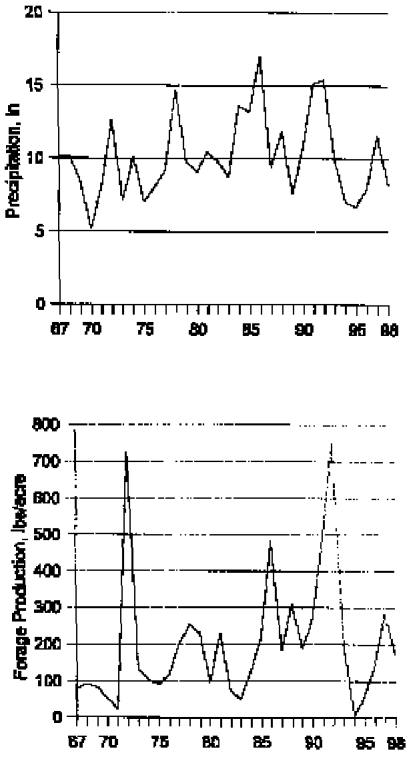

Fig. 1. *Annual precipitation and forage production for the 1967-1999 period on a conservatively grazed pasture on the Chihuahuan Desert Rangeland Research Center in south-central New Mexico. The top graph represents inches of rain and the bottom graph represents pounds of forage production per acre. Annual precipitation averaged 9.67 inches and forage production averaged 185 lbs/acre for the 30 year period. Sources for these data were Beck et al., 1987; Beck and McNeely 1993; and Molinar et al., 1999.*

Fig. 2. *A winterfat plant community under long term moderate grazing on the Desert Experimental Range in southwestern Utah (photo courtesy of Dr. Phil Ogden).*

Table 1. Influence of grazing intensity on winter sheep production at the Desert Experiment Range in Utah.

	Grazing Intensity	
	Moderate	Heavy
Duration of study (years)	13	13
Average precipitation (inches)	6.7	6.7
Utilization of forage (%)	35	60
Forage production (lbs/acre)	198	72
Ewe weight change (fall to spring) (lbs)	+9.3	+1.1
Average fleece weight (lbs)	10.6	9.7
Lamb crop (%)	88	79
Death loss (%)	3.1	8.1
Lamb weaned per ewe (lbs)	77.0	67.0
Net income (3,000 head flock) ($)	10,400	5,100
Net income/ewe ($)	3.45	1.69
Estimated net return ($/acre)	0.39	0.14

Source: Hutchings and Stewart (1953).

Desert Experimental Range

Primary results from the Desert Experimental Range reported by Hutchings and Stewart are summarized in Table 1. The moderate stocking rate was superior to the heavy stocking rate in vegetation, sheep, and financial performance characteristics.

Average percent use of all forages across years was 35 and 60% for moderate and heavy grazing intensities, respectively. Shadscale dominated vegetation composition, but winterfat was considered the most desirable forage species. Under moderate winter grazing, winterfat received 55% use of current year growth compared to 66% under heavy grazing. Winterfat production during the last year of study (1947) increased 54% over the first year (1934) under moderate grazing but did not improve under heavy grazing. The most striking improvement in forage production was the recovery of black sagebrush winterfat pastures (Table 2) under moderate compared to heavy grazing. Another interesting observation was that small rabbitbrush, an unpalatable species, drastically declined under moderate grazing but increased under heavy grazing. Follow up studies summarized by Blaisdell and Holmgren further confirmed these trends in vegetation productivity and composition.

In their recommendations, Hutchings and Stewart suggested that salt desert rangelands should be routinely stocked at 75% of grazing capacity. Grazing capacity refers to the maximum stocking rate possible year after year without causing damage to vegetation or related resources. This would involve about 35—40% use of winterfat in most years and 25—30% use of all forage species. Their rationale for this recommendation was that routinely stocking at capacity will result in overgrazing in one half the years and necessitate heavy use of supplemental feed. The extra herbage left from under grazing in the wet years will help plants recover from drought and build some feed reserves. Even with this approach some destocking will be required in 2 to 3 years out of every 10. After several more years of study on the Desert Experimental Range, Blaisdell and Holmgren strongly reaffirmed these same recommendations.

Santa Rita Experimental Range

The primary study evaluating grazing management on the Santa Rita Range involved 2 blocks with 3 pastures that were assigned to year-long, summer-fall, or winter-spring grazing by cow-calf herds. Over the 10 year study period (1957 - 1967), Martin and Cable reported that perennial grass cover and yield showed a strong decreasing relationship to increasing forage use. At the same time burroweed, an undesirable species, was positively associated with increasing forage use. Year-long pastures received lower forage use than those grazed seasonally. They, in turn, had higher perennial grass cover. Herbage yields on year-long pastures showed more increase than on seasonally grazed pastures. The authors concluded the consistency with which higher perennial grass

Fig. 3. *A long term moderately grazed pasture on the Santa Rita Experimental Range in southcentral Arizona (photo courtesy of Dr. Phil Ogden).*

Table 2. Herbage production per acre within a depleted black sagebrush-winterfat subtype in 1934 and after 4 and 13 years of grazing under moderate and heavy intensities.

	Initial Yield	Moderate Grazing		Heavy Grazing	
Species	1934	1938	1947	1938	1947
	(Pounds)				
Shrubs:					
Black sagebrush	21	45	296	14	28
Small Rabbitbrush	66	100	28	162	247
Winterfat	181	370	279	205	153
Other	3	4	4	4	4
All shrubs	271	514	604	381	425
Grasses:					
Galleta	3	6	3	5	3
Indian ricegrass	10	15	41	11	19
Squirreltail	3	4	28	1	5
Other	4	4	4	4	4
All grasses	16	25	72	17	26
Forbs:					
Globemallow	4	5	2	4	5
Russian-thistle	4	4	6	3	97
Other	4	1	1	4	1
All forbs	4	6	9	3	102
Total	287	545	685	401	553
Usable forage	142	284	443	161	168

Source: Hutchings and Stewart (1953).

cover and yield were associated with lower utilization levels was too great to be coincidental. On the basis of this study, the authors recommended that a 40% use level be used when assigning stocking rates.

Jornada Experimental Range

Over a 37 year period (1916–1952) forage plant basal cover and production responses to different grazing intensities were evaluated on 6 pastures stocked for 40% use of forage on an annual basis. Paulsen and Ares reported that black grama, the primary perennial forage grass, maintained the highest basal cover through time on conservatively grazed areas where use was about 35%. Black grama cover was lowest on heavily grazed areas (over 55% use) followed by intermediately grazed areas (40–55% use). It is important to note that protected areas maintained less black grama cover than those conservatively grazed.

Tobosa, the second most important perennial forage grass in the Chihuahuan Desert, maintained the highest basal cover under intermediate grazing (40–55% use). It is associated with lowland areas with clay soils where periodic flooding often occurs.

Important recommendations regarding stocking rates were made by Paulsen and Ares. Sampling errors in evaluating forage production, uneven distribution of cattle grazing, wind erosion, and rabbit and rodent use are unaccountable factors frequently overlooked. They suggested that a coefficient of 30% be used when stocking rates are assigned to black grama rangelands, and not more than 40% of the black grama be removed in any year.

Chihuahuan Desert Rangeland Research Center

A second study similar to Paulsen and Ares was conducted on the Chihuahuan Desert Rangeland Research Center adjacent to the Jornada Experimental Range. In this 10 year study (1954-1963) cattle grazing treatments involving 20, 35, 50 and 60 percent use were applied annually during dormancy to plots in 3 different pastures. At the end of the study in 1964 Valentine reported that light (20% use) and moderate grazing (35% use) produced 70% more forage than proper (50% use) and more than double heavy grazing (60% use). He concluded that conservative grazing involving about 30–35% use was a sound management approach for improving black grama rangelands.

Cattle Productivity and Financial Returns

Using computer simulations, Martin evaluated cattle productivity and financial returns under different stocking strategies in the Sonoran Desert. Initially, he concluded from previous studies that moderate stocking across years involves an average of 40% use of perennial grasses. He then went on to calculate net financial returns for cow-calf operations for a 29 year period (1941–1969) varying herd composition and level of stocking relative to the moderate rate (40% use). He based calculations on a 100 animal unit herd and assumed 90 percent calf crop, no death losses, and no influence of stocking rate on cattle productivity. He did acknowledge that in real world situations cattle productivity would be affected by stocking rate. His conclusions were: 1) the cow herd should be maximized rather than keeping a portion as yearlings; 2) flexible stocking is difficult to administer and has major hazards (introducing disease to the herd and reluctance to sell in dry years); and 3) constant stocking at 90 %

Table 3. Influence of grazing intensity on cow-calf production at the Chihuahuan Desert Rangeland Research Center in south-central New Mexico.

	Grazing Intensity	
	Conservative	Moderate
Duration of study (years)	6	6
Average annual precipitation (inches)	8.6	8.6
Utilization of forage (%)	33	45
Forage production (lbs/acre)(1995, 1996)	115	130
Forage production (lbs/acre)(1997, 1998)	197	176
Fall cow weights (lbs)	1,059	1,067
Calf crop (%)	85	78
Calf weaning wt. (lbs)	485	476
Net income/AU ($)[1]	52.50	8.50
Net income/acre ($)[1]	0.52	0.31

[1]Financial analyses are only for 1993 and 1994 (Source: Winder et al. 1999).
Sources: Molinar et al. 1999, Thomas et al. 1999, and Winder et al. 1999.

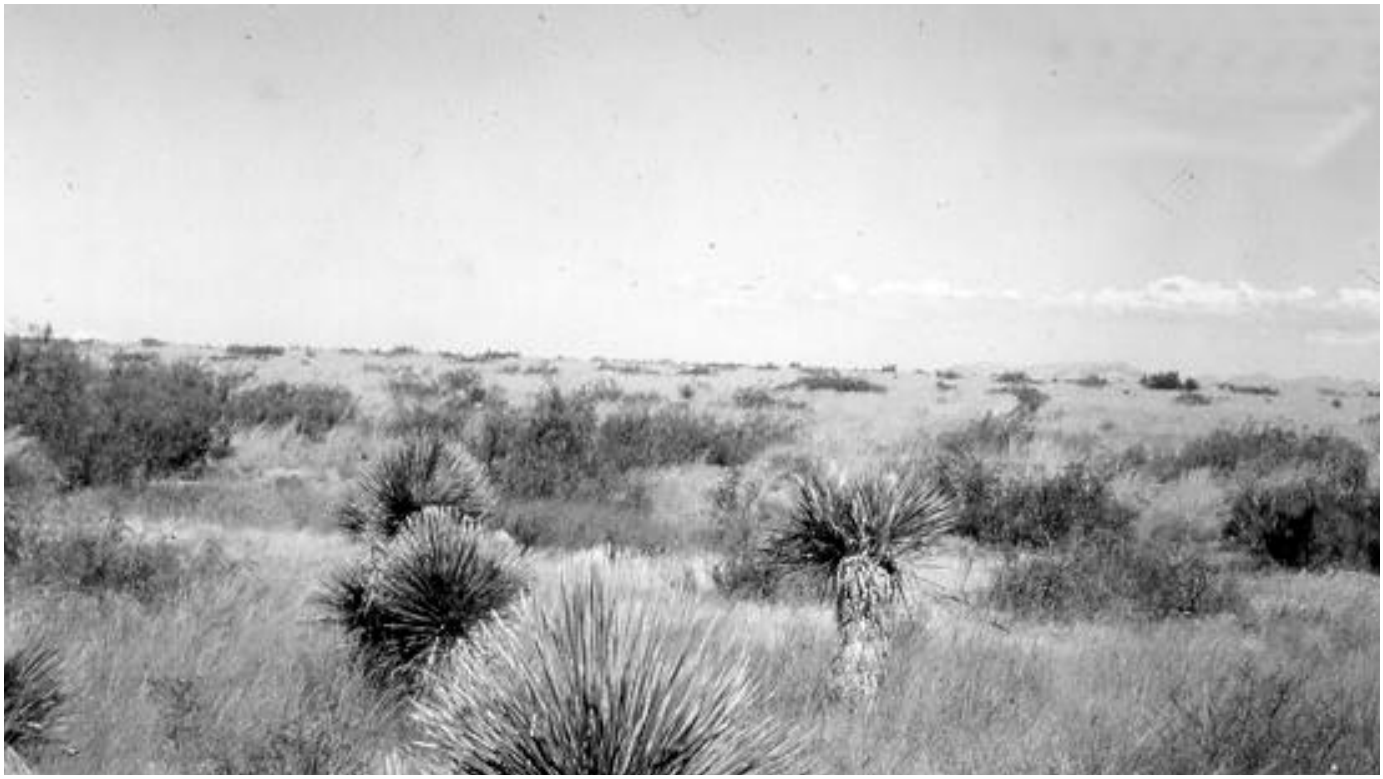

Fig. 4. *A long term conservatively grazed pasture on the Chihuahuan Desert Rangeland Research Center in southcentral New Mexico.*

of the proper level with some destocking under severe drought would yield the most income with the least risk. A relatively constant stocking rate that would use about 35% of the forage in an average year was considered the best approach.

Holechek examined the same issue for Chihuahuan Desert ranches in New Mexico using a different modeling approach. First he compared long term cattle productivity and financial returns from conservatively stocked pastures on the Chihuahuan Desert Rangeland Research Center with those of surrounding ranches. He found per acre returns on the experimental area were more than triple those of the surrounding ranches. This was due in large part to higher calf crops, higher calf weaning weights, lower supplemental feeding costs, and higher grazing capacity. He then assumed modest increases in calf crops (5%) and weaning weights (30 lbs) would occur if the surrounding ranchers reduced their forage use levels from 45–50% to 35–40%. Under his model, total net income immediately increased under the lower stocking rate compared to what the rancher previously received even though the ranch was supporting 20% fewer cattle. Further exposure to risk from drought and low cattle prices was reduced, and the probability of improved forage production was higher. This resulted in a team of researchers at New Mexico State University implementing a replicated long term stocking rate study on the Chihuahuan Desert Rangeland Research Center.

Current Research

We designed the current study on the Chihuahuan Desert Rangeland Research Center to evaluate the effects of 30% and 40% forage use levels on long term vegetation productivity, cow-calf productivity, and financial returns. A complete description of the study is provided by Winder et al. A design involving 2 blocks with 2 pastures each about 2,700 acres in size was used. Stocking recommendations of Paulsen and Ares and Martin and Cable are being closely followed. Each fall, on the basis of quantitative forage inventories, stocking rates are assigned. Depending on pasture stocking treatment, either a 30 or 40% harvest coefficient of current years growth of perennial grasses is used. Sale or retention of replacement heifers and old cows (8 years of age) is used to balance livestock numbers. In June, grazing intensity is evaluated using a combination of clipping, stubble height, and ocular reconnaissance techniques. A minimum stubble height of 3 inches for black grama and 6 inches for mesa dropseed is desired at all times. If stubble heights drop below 2.7 inches on black grama and/or 4.5 inches on mesa dropseed, that pasture is destocked for two consecutive growing seasons. Using these criteria, all pastures were destocked in summer of 1994 and moderately stocked pastures (40% use) had to be destocked in May of 1999. After livestock removal due to drought the pasture is rested for two growing seasons and then stocked in late fall in accordance with current year forage production.

A summary of our findings from initiation of the study in winter 1992 to spring 1999 is provided in Table 3. Our actual use levels have averaged about 10% higher (33 and 45% use) than our targets. We attribute this to forage loss from trampling, rabbits and rodents, and weathering. So far the 30% harvest coefficient has proven superior in vegetation productivity, livestock productivity, and financial returns. After drought in 1994 through 1996, forage production on the con-

servatively stocked pastures increased 71% (1997 and 1998) compared to 35% on those moderately stocked. Calf crops were more influenced by stocking than calf or cow weights. Our financial data cover only the first two years of study (1993–1994). We believe 1997 through 1999 analyses may show more financial benefit from conservative stocking than the 1993–1994 period because the moderately stocked pastures had to be completely destocked in June 1999 while only 40% of the cattle had to be removed from those conservatively stocked.

Management Implications

The effects of grazing intensity on livestock production and financial returns have been poorly understood. Here the research is remarkably consistent in showing that conservative grazing involving about 30–35% use of forage will give higher livestock productivity and financial returns than stocking at grazing capacity. This is because of higher calf/lamb crops, higher calf/lamb weaning weights, lower death losses, and lower supplemental feed costs. Large financial losses typically occur when livestock must be liquidated due to drought. Conservative stocking greatly reduces these losses compared to moderate stocking. This is because fewer animals must be liquidated during drought and repurchased after the drought ends. Typically, local cow prices are depressed during drought when most ranchers are selling cattle, and sky high afterwards when they are trying to restock their rangelands. In the favorable years, the extra income from stocking at capacity is small compared to the losses that can occur under drought.

Studies from Australia as well as in the United States have shown that in arid and semi-arid areas profit maximizing stocking rates are well below those that would degrade the rangeland resource. Rather than focusing so much on rotation grazing systems and trying to maximize forage harvest efficiency, we believe public rangeland managers and ranchers should place greater emphasis on keeping animal numbers in balance with forage supplies. Studies from desert rangelands in Arizona and New Mexico have shown no advantage of various rotation grazing schemes over continuous grazing in either vegetation or livestock performance. The critical aspects of range management in desert areas are to keep livestock in balance with forage supplies and well distributed over the range. In closing, we hope greater use will be made of the stocking rate technologies and the information we have reviewed in this paper.

Suporting Literature

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