Trampling Losses and Travel by Cattle on Sandhills Range[1]

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Highlight

Trampling losses by cattle on sandhills range varied from about 1% of the grass herbage or 20 pounds per acre under light grazing to 5% or 60 pounds per acre with heavy grazing. The various sandhill grasses differed in their susceptibility to trampling in July and September. In lightly grazed 50-acre pastures, yearling cattle averaged 1.5 miles of travel per day compared to 2.0 in moderate and heavily grazed pastures.

All of the primary productivity of a range area is not available for livestock production. Some is used by wild animals, large and small; some is lost through weathering and trampling. A knowledge of forage disappearances would permit a more accurate estimation of the forage available for livestock use. A series of studies have been conducted at the Eastern Colorado Range Station to determine disappearance of forage due to small mammals and weathering (Sanderson, 1959; Lovell, 1961; Myers, 1963; Sparks, 1967) and through grazing use by cattle (Reppert, 1957; Dahl and Denham, 1968). Since the other studies were not designed to provide an accounting of forage loss due to trampling, this study was initiated. Its objectives were to determine not only the actual losses from trampling, but also the relation of these losses to grazing intensity, plant species, and season of use.

The study areas were located at the Eastern Colorado Range Station, which is midway between Akron and Sterling in the sandhills range type. Annual precipitation is approximately 15 inches. Prairie sandreed (*Calamovilfa longifolia* (Hook.) Scribn.),[2] blue grama (*Bouteloua gracilis* (H.B.K.) Lag.), and needle-and-thread grass (*Stipa comata* Trin. & Rupr.) are the dominant grasses. Soils of the area are loamy sands or sands with a nearly level to rolling dune-type topography.

The study involved two approaches: (1) measurement of trampling losses with before-and-after sampling techniques in paddocks grazed at three different intensities during a short period of time in both July and September; and (2) determination of the relative amount of daily traveling done by yearling cattle in pastures grazed at three different intensities during the summer grazing season. The latter portion of the study was conducted because trampling losses occurring under pasture conditions would be related to the amount of travel or movement.

In this study, *trampling loss* refers to that portion of the current forage production which, through the action of grazing animals, has been detached or damaged to the extent that it will soon be lost from the plant and not available for consumption. By definition, this also includes severed forage dropped from the mouth of the grazing animal. *Travel* refers to the total distance covered by cattle in all their activities during the observation period.

Methods

Trampling loss was measured during 1962 in two one-acre enclosures which had been divided into three paddocks

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[2] Nomenclature from Harrington (1954).

FIG. 1. Trampling damage in a heavy-use paddock following the July grazing treatment.

of different grazing intensities for 1958–1961 utilization studies. In this study, one enclosure was subjected to short periods of intensive use on July 9–10 and September 5–6, while the other enclosure was grazed on July 10–11 and September 4–5. Designated paddocks were stocked with five, ten, or fifteen head of yearling heifers, respectively, to produce light, moderate, and heavy grazing intensities. The yearlings were left in the paddocks until ocular estimates of forage utilization indicated that approximately 20–30%, 40–50%, and 60–70% use, respectively, had occurred. The grazing period in each case was less than 24 hours.

In both July and September, all paddocks were presampled for herbage yield the day before putting the yearlings in the enclosures. Herbage yield by weight was determined by use of the "double sampling" method (Wilm et al., 1944). In each paddock, 96 plots (1.6 × 3 ft in size) were set up on a systematic grid system and marked at the corners by painted nails driven flush with the ground surface. Yield by green weight was estimated on all 96 plots; 12 of these were selected by a restricted random method and subsequently clipped. The air-dry clipped weights and percent of dry matter in the green weight of the 12 clipped plots were then used with the estimated weights for these 12 plots to construct a regression equation utilized to correct the mean of the estimations of herbage weight on all plots.

After presampling, each ⅓-acre paddock was grazed according to its assigned intensity. The 30 head of yearling heifers were used all at once on one enclosure and then transferred to the second after the desired use had been achieved in the first.

Sampling for trampling damage after the grazing period in the 3 intensities in each enclosure was done as follows: (1) the same plots used in presampling of yield were relocated; (2) all herbage affected by trampling was then collected from each of the 84 unclipped plots and 12 additional plots set up next to the clipped plots in each paddock (Fig. 1); and (3) the herbage affected by trampling was placed in paper sacks and weighed after air-drying. A record was kept of the amount of herbage loss, by species, which occurred on each plot.

Separate records were maintained on the 3 dominants—blue grama, prairie sandreed, and needle-and-thread. Aggregated as miscellaneous grasses were hairy grama (*Bouteloua hirsuta* Lag.), sand dropseed (*Sporobolus cryptandrus* (Torr.) A. Gray), western wheatgrass (*Agropyron smithii* Rydb.), and sand bluestem (*Andropogon hallii* Hack.).

The second phase of the study involved determination of the distance traveled by yearling cattle as influenced by grazing intensity on six adjacent pastures. Each of the 6 pastures was approximately 50 acres in size and had been grazed at a light, moderate, or heavy rate during the preceding 8 years. There were two replications of each grazing intensity. The number of animals put into these pastures varied according to grazing intensity and forage currently available, but averaged about 5 head on the light pastures, 10 on the moderate pastures, and 15 on the heavy pastures. The grazing season extended approximately from May 1 to October 1. Stocking rates in acres per yearling-steer month averaged 2.0, 1.1, and 0.7, respectively, on the light-, moderate-, and heavy-use pastures during 1962.

Each replication was observed separately on successive days at 6 different times during the grazing season. Sheppard, Blaser, and Kincaid (1957) had found observations on successive days to be more desirable since there was less variation in the total time spent grazing per day between consecutive days than among separated days. Observations were made between dawn and approximately 8 P.M. on May 19–20, June 12–13, July 3–4, July 30–31, August 21–22, and September 18–19. One replication of 3 pastures (light-, moderate-, and heavy-use) was simultaneously observed each day. The observation period utilized was selected since most grazing and travel had been shown by previous studies to occur between 5:00 A.M. and 8:00 P.M. (Hein, 1935; Culley, 1938; Atkeson, Shaw, and Cave, 1942; Hughes and Reid, 1951; Sheppard, Blaser, and Kincaid, 1957; Dwyer, 1961).

During each period of observation, the yearlings were observed periodically to note the amount of travel under each grazing intensity. Travel of the herd, rather than travel of individuals, was plotted. Observations were made with binoculars and from a pickup truck as much as possible so as not to disturb the yearlings any more than necessary. After plotting travel for each pasture on grid sheets, a map measurer was used to determine the total inches of travel plotted on the sheet.

Results and Discussion

In the small paddocks, trampling losses increased with increased grazing pressure (Table 1). An increase in grazing intensity produced both an increase in total trampling loss in pounds per paddock (see also Fig. 2) and an increase in percent of total production damaged and lost due to trampling. It was expected that increased grazing pressure would cause more forage loss from trampling damage because of the greater number of animals on the heavier grazed paddocks during the short period of grazing. However, the most significant aspect of the data is the slightly greater increase in trampling loss than would be expected in proportion to the increase in animal numbers. It is

Table 1. Total utilization (%), production (lb/acre), and trampling loss during July and September for the two enclosures.

Paddock	No. of animals	Utilization	Production	Trampling loss	
				lb/acre	% of production
Enclosure 1					
Light	5	26	1777	26	1
Moderate	10	32	1524	32	2
Heavy	15	60	1230	66	5
Enclosure 2					
Light	5	33	1571	17	1
Moderate	10	38	1382	42	3
Heavy	15	51	1278	58	4

thought that this could be due to the requirement for the soil to become loose or dislodged to a certain extent before significant trampling losses occur. After this condition is reached, trampling loss appears to increase rapidly with length of grazing period.

There was a change in the relative susceptibility to trampling loss by the different forage species from July to September (Table 2). In July, blue grama, the major short-grass species, and the miscellaneous grasses were less susceptible to trampling loss than prairie sandreed and needle-and-thread, while in September prairie sandreed and needle-and-thread were less susceptible than blue grama and the miscellaneous grasses. Definite trends are indicated by the data in Table 2 in most cases, and figures not conforming to the trend are generally from the light intensity paddocks. Evidently, use and travel were neither sufficiently uniform nor adequately distributed to give a precise measure of the comparative susceptibility of the various species to trampling in the light-use paddocks.

In July, when blue grama was green and growing, it contributed less to trampling loss than would be expected from its percentage composition. This difference was found to be statistically significant at the 0.05 level with the use of a "t"-test of significance of the differences between the paired measurements of each paddock. Blue grama contributed a greater percent of the trampling losses in September, when ¼ to ⅓ of its leaves were dry and there were numerous seedstalks in fairly mature stages.

Prairie sandreed seemed to be slightly more susceptible to trampling in July than most of the other species. It was green, growing, and succulent at the time of the July grazing period and appeared to be easily cut off by animal hooves, or pulled up from the base. However, in September, prairie sandreed showed a strong tendency to be less susceptible to trampling than other species. At this time, it was tough and wiry, with the bottom 3–4 leaves being dry and the entire plant showing less succulence.

Needle-and-thread showed more susceptibility to trampling than other species in July and less in September. This was apparently a result of needle-and-thread having seedstalks in various stages of maturity in July, while in September these seed heads were already shattered in most cases with less partially-mature or mature foliage available for trampling.

The miscellaneous grasses were less susceptible to trampling in July, and this would have been statistically significant if a light-intensity paddock

Table 2. Percent of total production contributed by each species contrasted with percent contributed to total trampling loss of herbage under three grazing intensities in July, September, and combined July-September (1962 growing season). Values are averages for the two enclosures.

Species	July			September			Combined July-September		
	Light	Mod.	Heavy	Light	Mod.	Heavy	Light	Mod.	Heavy
Blue grama									
Production	16	24	27	34	37	47	27	37	38
Trampling Loss	7	9	17	29	47	48	20	28	33
Prairie sandreed									
Production	57	58	54	46	50	40	49	48	46
Trampling Loss	62	63	58	52	37	32	57	51	43
Needle-and-thread									
Production	23	15	9	16	10	6	20	10	7
Trampling Loss	24	26	19	12	6	2	16	15	10
Miscellaneous[1]									
Production	3	4	9	3	4	8	4	4	9
Trampling Loss	6	2	6	7	10	19	7	6	14

[1] All grasses other than the three major species were placed in this category. The most abundant miscellaneous grasses were sand bluestem, western wheatgrass, and sand dropseed.

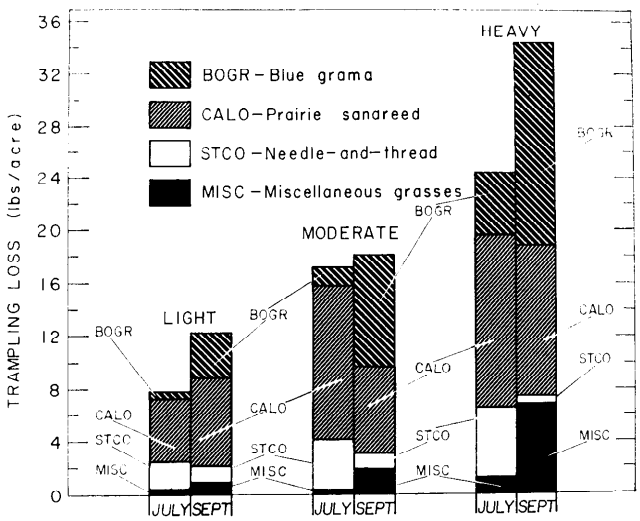

FIG. 2. Species components of the total trampling loss occurring on paddocks under different grazing intensities at the Eastern Colorado Range Station during July and September, 1962. Values are averages for the two enclosures.

had not given opposite figures. However, the increased susceptibility of the miscellaneous grasses to trampling in September was statistically significant at the 0.05 level. The miscellaneous grasses, which primarily included sand bluestem, western wheatgrass, sand dropseed, and hairy grama, were green and growing in July. In September a large amount of trampling loss was incurred on sand bluestem and sand dropseed, which were evidently highly susceptible to trampling damage at this time. Most of the leaves of sand bluestem were still green, but the seed heads ranged from the boot stage to near maturity. Most of the sand dropseed seed heads were mature, although the stems were not yet dry. In September, sand bluestem still appeared to be relatively palatable, as the yearling cattle concentrated on the patches of sand bluestem occurring within the paddocks.

The relative susceptibility of species to trampling during July and September is illustrated by Figure 2, which shows the various components of the total trampling loss occurring during July and September at each grazing intensity. The variation from July to September in relative susceptibility of the species to trampling is shown by the varying amount that is contributed by the species to the total trampling loss. It is also obvious that overall trampling loss (all species) increased from July to September under all grazing intensities.

Table 2 also includes the percent of total production for the summer made up by the various forage species and the percent of the total trampling loss contributed by each. The combined July and September data indicate the degree to which the trampling loss for a species is related to the total production of the species for the season.

Table 3. Miles traveled in 50-acre pastures during 15-hour observation periods at three grazing intensities on 12 observation dates.

Date	Grazing intensities		
	Light	Moderate	Heavy
May 19	1.5	1.7	1.7
May 20	1.1	2.2	1.9
June 12	1.5	2.4	2.7
June 13	2.4	3.1	2.6
July 3	1.6	2.0	2.0
July 4	1.5	2.0	1.8
July 30	2.1	2.3	2.8
July 31	2.0	2.3	2.6
August 21	1.0	2.2	1.6
August 22	1.3	1.5	2.2
September 18	0.8	1.0	0.8
September 19	0.8	1.1	1.2
Average Travel	1.5	2.0	2.0

Blue grama was less susceptible to trampling loss and contributed less to the total trampling loss for the total grazing period than would be expected if trampling loss occurred strictly on a proportional weight basis; the difference was statistically significant at the 0.05 level. This appears to be logical, because as long as the blue grama sod remains intact, it seems to cushion the damage done to individual stems.

Total trampling loss contributed by prairie sandreed and needle-and-thread was not significantly different from that which would be expected on a proportional weight basis for the total grazing period. These results were probably due to compensating effects of the variability between July and September in the susceptibility of these plants to trampling damage. It was also apparent that relative susceptibility of these species to trampling loss varied according to grazing intensity—needle-and-thread suffering less, proportionately, under light-use with the reverse being true for prairie sandreed.

In considering total trampling loss occurring in July and September, the miscellaneous grasses as a group showed more susceptibility than the other species (significant at the 0.10 level). It is believed that this was due to the upright growth of several of the species and the high palatability of sand bluestem with the resulting concentration of use.

Travel as Influenced by Grazing Intensity

Yearling steers averaged 1.5 miles of travel per 15-hour observation period in pastures grazed lightly and 2.0 miles in those grazed moderately and heavily (Table 3). Differences in the amount

of travel resulting from a light intensity of grazing as compared with travel resulting under moderate and heavy intensities of grazing were significant at the 0.01 level. There was no difference between the amount of travel recorded for moderate- and heavy-use pastures.

The lesser amount of travel in the light-use pastures appeared to be the result of more available forage. The steers on the light intensity pastures were able to eat their fill rapidly, and consequently they spent a great deal of time lying down and resting while the steers on the moderate- and heavy-use pastures were foraging for feed. These observations coincide with much that has been noted in previous studies on cattle habits and activities (Hein, 1935; Atkeson et al., 1942; Brinegar and Keim, 1942; Hancock, 1954; Peterson and Woolfolk, 1955; Arnold, 1960; and Cowlishaw, 1962). Although the amounts of travel recorded for the steers on the moderate- and heavy-use pastures were not different, an entirely different manner of travel was observed for the steers of these two intensities. The steers on moderate pastures had more available forage, and grazing was not as intensive as that by the steers on the heavily stocked pastures. The steers in the moderate intensity pastures spent more time lying down, but their high amounts of travel were due to failure to graze when moving to water or from one area to another. The steers on the heavy intensity pastures spent more time in grazing probably because the forage was not as abundant as it was in the other pastures.

Summary

Trampling losses of herbage within the enclosures were found to increase with increased grazing intensity and from July to September. Trampling losses during both July and September ranged from slightly more than 1% on the light-use paddocks to approximately 5% of the total production on the heavy-use paddocks. Trampling losses in pounds per acre for the combined July and September periods ranged from around 20 lb on the light-use paddocks to approximately 60 lb on the heavy-use paddocks.

Analysis of species effects on the amount of trampling loss occurring showed a change in the relative susceptibility to trampling loss of the different species from July to September. In July, blue grama and the miscellaneous grasses were less susceptible to trampling loss than prairie sandreed and needle-and-thread grass, while in September prairie sandreed and needle-and-thread were less susceptible than blue grama and the miscellaneous grasses.

Considering both July and September, grazing use on the paddocks showed blue grama to be less susceptible to trampling loss than the other species, while the miscellaneous grasses as a group showed more susceptibility than the primary species. Evidence was lacking that total trampling loss contributed by prairie sandreed and needle-and-thread during the grazing periods was significantly different from that which would be expected on a proportional weight basis.

Yearling steers averaged 1.5 miles of travel per 15-hour observation period in 50-acre pastures grazed lightly and 2.0 miles of travel in those grazed moderately and heavily. Travel by yearling steers was found to be significantly less in pastures grazed lightly than in those grazed moderately or heavily.

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