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# Judging Condition and Utilization of Short-Grass Ranges

*on the Central  
Great Plains*

**FARMERS' BULLETIN NO. 1949  
U. S. DEPARTMENT OF AGRICULTURE**

**G**REATEST POSSIBLE LIVESTOCK production on western ranges is more essential now than ever before. But maximum livestock production requires adequate range forage or other feed at all times. Because of the relatively high grazing value of the central Great Plains, it is especially important to keep the range in its best possible condition at all times, year after year. For each range, this involves such questions as: Is the range in good shape and growing all the forage it can over the years? Are the important forage plants grazed too closely or are they so utilized that they are able to spread and produce their maximum next year and the year after? Is the forage production above or below normal this year? Is there enough forage on the range to carry the livestock through the grazing season?

This bulletin aims to give ranchers of the central Great Plains a basis for judging the condition and utilization of short-grass ranges, to help them attain maximum sustained production of forage and livestock.

# JUDGING CONDITION AND UTILIZATION OF SHORT-GRASS RANGES ON THE CENTRAL GREAT PLAINS<sup>1</sup>

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## IMPORTANCE OF APPRAISING FORAGE PRODUCTION ACCURATELY

WESTERN RANGES CAN PROVIDE their large quota of meat, wool, and hides only if the ranges and the animals on them are managed wisely and efficiently year after year. Adequate forage is the first requisite for sustained range livestock production. The key to ample forage on the range is grazing only such animal numbers as will allow a margin of safety in forage utilization, with a carry-over of forage at the end of all average or better years to maintain and build up the range. Only in this way can good or excellent range condition and good growth of animals be assured.

The central portion of the Great Plains, consisting of eastern Colorado and Wyoming, and western Nebraska and Kansas, is one of the most important range livestock areas in the United States. This great region includes about 50 million acres of short-grass range with an estimated annual grazing capacity of approximately 15 million animal-unit months under good management and can make a vital contribution to the Nation's food, leather, and fiber needs.

More conservative stocking and other good-management practices on much of the range land in the central Great Plains would yield

<sup>1</sup> Much of the information in this bulletin was developed on the Central Plains Experimental Range, which is a part of the Northeastern Colorado Land Utilization Project, in Weld County, Colo. The experimental range is maintained cooperatively by the Forest Service and the Soil Conservation Service, U. S. Department of Agriculture.

<sup>2</sup> Maintained and operated in cooperation with Colorado State College of Agriculture and Mechanic Arts Fort Collins, Colo.

increased pounds of beef and improved net ranch income almost immediately. The possibilities are illustrated by livestock gains obtained by cooperating stockmen on the 12,800-acre Central Plains Experimental Range, in northeastern Colorado. There, management has not only improved and maintained the forage supply but yielded high weight gains of beef per acre. Under a conservative rate of grazing for the period May 10 to November 10, long-yearling Herefords have made gains averaging approximately 325 pounds per animal; under heavy stocking for the same period they have made gains of only 190 to 250 pounds per animal, losing weight markedly as a rule in late September or early October. The weight when marketed of long yearlings grazed at a conservative rate on the experimental range has averaged approximately 750 pounds. The weight of comparable animals grazed on nearby ranges where all available grass was removed each year has averaged only 550 to 650 pounds.

Conservative stocking is largely credited with similar good results from the privately grazed herds on other parts of the more than 200,000 acres of range land included in the Northeastern Colorado Land Utilization Project, of which the Central Plains Experimental Range is a part. This project area was placed under management in 1937. Within 4 years the forage cover improved 100 percent and the average calf crop increased from 60 to 88 percent. Some misused range areas in the neighborhood have a poor forage cover. On such lands calf crops are no better than 70 percent and in many instances are as low as 55 percent.

The operator's first concern should be an accurate appraisal of (1) the condition of the range at the present time and the present trend for better or worse; (2) how this condition is being affected by yearly variations in quantity and seasonal distribution of rainfall; and (3) the further effect of current forage utilization. Between the dense, vigorous stands of palatable plants on one range and the thin cover of forage plants on another are several gradations in grazing capacity that must be accurately appraised. Also, regardless of prevailing condition, forage production varies from one year to another, and this variation requires careful evaluation each year if the livestock numbers and forage supply are to be so balanced that an adequate reserve of forage is maintained. Finally, a check is needed to make sure that unforeseen circumstances have not brought about overuse of the range and that livestock are removed before the forage reserve is depleted.

It is the purpose of this bulletin to furnish ranchers with guides for judging prevailing condition of the range, yearly forage production, and current forage utilization of the short-grass range on the central Great Plains. These guides will assist them to use range forage conservatively each year, and so to build up depleted ranges and maintain those already in good or excellent condition.

## JUDGING CONDITION OF SHORT-GRASS RANGE

Central Plains short-grass ranges may conveniently be divided into four condition classes—excellent, good, fair, and poor. These classes are distinguished by such characteristics as proportion of ground area covered by vegetation, presence or absence of taller grasses, and soil condition. These characteristics, as indicated in table 1

TABLE 1.—Standards for classifying prevailing condition of short-grass range

Plant and soil indicators	Range condition			
	Excellent	Good	Fair	Poor
Appearance of total vegetation cover.	An almost unbroken short-grass sod in which taller grasses are commonly present.	A broken but rather good sod of short grasses.	An open sod and relatively thin cover.	A very thin stand with most of the ground surface visible.
Turf condition:				
Blue grama.....	Almost continuous in some places but in others, up to 3 inches or less between bunches.	Broken; sod pieces 3 to 6 inches or more across; spaces 2 to 5 inches.	Sods generally 3 inches or less across at base; spaces 6 to 12 inches.	Scattered tufts or bunches 1 to 6 inches across, 1 to 3 feet and more apart.
Buffalo grass.....	Often continuous in swales; alternating in mats with blue grama on higher ground.	Thin mats; 1- to 2-inch spaces within clumps.	Thin mats, alternating with blue grama.	If present, in scattered mats or tufts.
Taller grasses:				
Wheatgrass.....	Common to abundant in swales and on low ground; elsewhere common and widely distributed as individual plants.	On moist ground, in thin stands mingling with short grass; elsewhere scarce or absent.	Scarce, and occurring only in swails and moist depressions.	Not evident.
Other species.....	Occasional to common (as needle-and-thread and red three-awn), usually as individuals uniformly scattered.	Individual plants or clumps, generally in the better locations only.	Not evident, or individuals widely scattered.	Do.
Perennial weeds.....	Species of fair to good forage value common, in small clusters or as scattered individuals; possibly 10 to 15 percent of total available forage.	Fair to good species occasional throughout; sometimes conspicuous clumps on bare spots; seldom more than 5 percent of total available forage.	Fair to good species infrequent, widely scattered, principally on margins of anthills; unpalatable species may be present.	Unpalatable species (as curlycup gumweed, poverty weed, and pricklepoppy) sometimes abundant; few of even fair forage value.
Soil condition:				
Signs of erosion.....	None; no rills or gullies which are not stabilized.	Slight sheet erosion from heavy rainfall; sod pieces not pedestaled (standing above ground surface).	Grass tufts and sod pieces may be slightly pedestaled. Sheet erosion clearly evident.	Grass tufts frequently pedestaled; sheet, wind, and gully erosion active; may have erosion pavement consisting of pebbles and rock fragments; heavy run-off usual, causing flooding and silting of lowlands.

for all condition classes, serve to reveal the extent of the improvement in forage conditions that may be brought about through improved management, and the desirability of establishing conservative rates of stocking.

The best time for judging short-grass ranges is in midsummer near the end of the active growing season—between mid-July and the end of August. True grazing capacity shows up best at that time. Growth of the important grasses is largely completed and the seed crop, if any, is usually ripening. Other herbaceous vegetation produced in spring and early summer is still present, although if rainfall is below normal for the season it may be brown and dry. Furthermore, the effects of utilization by livestock ordinarily have not greatly changed the aspect of the forage cover, even if summer grazing is being practiced.

#### EXCELLENT RANGE

Range in excellent condition, as the term implies, is at its highest productive capacity for both forage and livestock.

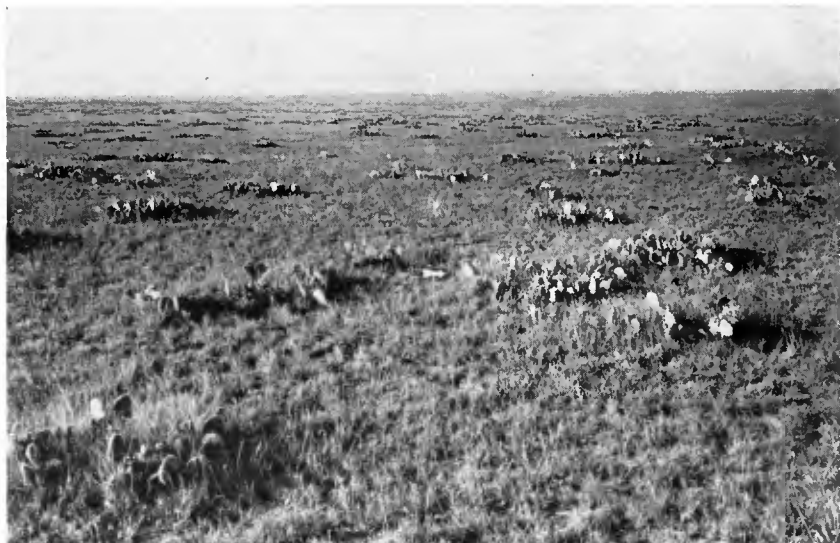
Excellent short-grass range is characterized by an almost continuous turf of blue grama<sup>3</sup> and buffalo grass in which taller grasses, such as bluestem wheatgrass, needle-and-thread, and red three-awn are commonly present (fig. 1). The tall grasses are particularly evident on such ranges in eastern Wyoming, northeastern Colorado, and western Nebraska, but less abundant on those in western Kansas. Some ranges of this class within the sand-hill areas of eastern Colorado have a sparse overstory of little bluestem and prairie sandreed.



FIGURE 1

FIGURE 1.—Excellent short-grass range, having an almost unbroken turf of blue grama and buffalo grass with a mixture of bluestem wheatgrass, needle-and-thread, and red three-awn. Maximum forage production can be attained only on ranges in excellent condition.

<sup>3</sup> Common and botanical names of plants mentioned in this bulletin are listed on p. 21.



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FIGURE 2.—Short-grass range in good condition. The bare spaces between the grass clumps are from 2 to 5 inches wide.

Over wide areas of eastern Wyoming, plains bluegrass, threadleaf sedge, bluebunch wheatgrass, and needle-and-thread are present on excellent range.

The weed population consists mainly of perennial species of fair or average palatability, such as scarlet globemallow, slimflower scurfp pea, and tansyleaf aster. Annual weeds are rare and inconspicuous. The shrubs sometimes present are usually good browse; particularly common are winterfat, found on the better sites, and fourwing saltbush, largely restricted to alkaline flats. Fringed sagebrush occurs in fair abundance in some localities. Plains pricklypear is never abundant.

Under careful management, excellent ranges can be maintained. A considerable residue of the abundant plant material should remain unused on the ground at the end of the grazing season. Overuse, particularly in dry years, will result in deterioration of the dense sod, disappearance of important secondary species, including both taller grasses and perennial weeds, and consequent loss in grazing value. Any disintegration of the sod into distinct bunches and any decrease in number of taller grasses are early signs of deterioration of the forage cover.

### GOOD RANGE

Good range is characterized by a broken turf in which the short-grass clumps are separated by spaces sometimes 5 inches wide. In swales and depressions, pure stands of buffalo grass sometimes form a turf broken only by spaces 1 to 2 inches wide; elsewhere the two short-grass species are intermingled. Taller grasses are much less prevalent than on excellent range, forming no appreciable part of the forage (fig 2).



Perennial weeds such as slimflower scurfpea, scarlet globemallow, scarlet gaura, and tansyleaf aster are rather uniformly distributed but not abundant. Annuals including tumbling Russian-thistle, woolly Indianwheat, and sixweeks fescue may be temporarily abundant in late spring and early summer after periods of relatively heavy precipitation. Weeds of low value are generally present in moderate numbers, particularly western stickseed, James cryptantha, loco, and curlycup gumweed. In very dry years weeds are not conspicuous. Pricklypear is not present in sufficient abundance to detract seriously from grazing capacity.

The prime management objective for range in the good class should be to improve it to an excellent condition. On very good soils and in favorable locations where moisture is plentiful owing to underground drainage or run-off from higher ground, good range may be changed to excellent in a very few seasons of conservative use. On poorer sites improvement would take much longer.

Improvement of good range is indicated by increase in the size of short-grass clumps and decrease in the width of spaces between them. Deterioration is indicated by increase in amount of bare ground between clumps and more or less complete disappearance of taller grasses and perennial weeds of fair or good forage value.

Most central Great Plains short-grass range is capable of being maintained in at least good condition and the majority of them can be improved to excellent with careful management.

### FAIR RANGE

On short-grass range of the fair class, the sod pieces are commonly separated by spaces 6 to 12 inches wide (fig. 3). Taller grasses are scarce and may be found only in swales and moist depressions.

Perennial weeds of fair to good palatability are scarce and may be found only around anthills and in places where moisture accumu-



FIGURE 3.—Fair short-grass range on which heavy grazing or drought or both have widened the bare spaces between grass clumps to as much as 12 inches and removed most of the perennial weeds.

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lates, as in small depressions. Low-value perennials such as curlycup gumweed, rush skeletonplant, wavyleaf thistle, and pricklepoppy may be fairly numerous. Annual weeds may be conspicuous after a wet spring, but may be practically absent if the spring and early summer are fairly dry. If the range is recovering from 1 or more years of drought, sixweeks fescue may be prominent between the short-grass clumps.

Pricklypear and low-value shrubby species such as broom snake-weed and rabbitbrush may be conspicuous on some ranges in this class. In many localities of the central Great Plains their occurrence appears to be correlated more closely with soil conditions and long-time weather trends than with grazing influences. Ranges with extensive stands of these low-value species should usually be classed as fair or poor.

Range is ordinarily brought down to fair condition as the result of drought or continued overgrazing or a combination of the two. Insofar as overgrazing is the cause, the cure is obviously a reduction of the numbers of livestock to safe grazing capacity. On drought-reduced range every effort should be made, by adjusting numbers of animals and by other desirable management, to keep the range from further deterioration, so that the full restorative effect of better moisture conditions may be realized when a good year comes.

#### POOR RANGE

The distinguishing characteristic of the poor class of range is a very thin stand of palatable vegetation with most of the ground surface visible. Short-grass bunches are often separated by spaces 3 feet wide or wider (fig. 4). The bunches are frequently raised above the general ground level, sheet erosion is evident, and except where the soil is sandy the ground surface usually cracks after rainstorms. Taller grasses are not evident.



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FIGURE 4.—Poor short-grass range, reduced to this condition by drought and overgrazing. The bare spaces between grass clumps are commonly 3 feet wide. Although fairly vigorous, the grass tufts have produced no seedstalks.

Perennial weeds having forage value are rare or completely absent. Annual weeds, particularly tumbling Russian-thistle, may form extensive stands in wet years following 1 or more years of drought. Low-value shrubs including broom snakeweed, rabbitbrush, and pricklypear are abundant on some areas and completely absent from others.

Poor range has in most cases been reduced to this condition by severe drought or long-continued overgrazing or both. The immediate objective should be to improve its condition to fair or good. To attain this, grazing must be carefully restricted. Heavy stocking will reduce the vitality of the remaining grass and will not permit the short grasses to fill in the bare spaces between tufts. Natural recovery may be a slow process if much of the topsoil has been removed by wind and sheet erosion. If depletion has progressed so far that recovery under use would be a very slow process, removal of livestock and artificial reseeding or other treatment may be the most economical step in the long run.

### VARIATION IN ANNUAL FORAGE PRODUCTION

On any short-grass range, regardless of whether its prevailing condition is excellent, good, fair, or poor, forage production varies considerably from year to year and should be observed with care annually in order to adjust livestock numbers as closely as possible to forage supply. The differences are primarily due to fluctuations in annual weather conditions, especially in the amount and distribution of spring and early summer rainfall. Heavy rainfall, especially if not well distributed through the growing season, does not necessarily result in high forage production. As much as one-third of the summer rainfall may occur in one or two storms. If this happens, much of the water may be lost in run-off and relatively little moisture added to the soil. Rains that are more gentle, smaller in amount per rain, more frequent,



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FIGURE 5.—Buffalo grass sod in a depression where run-off accumulates after rainstorms.



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FIGURE 6.—Excellent range at end of a season of high forage production (1941) during which it received approximately one-third of allowable use. Note the complete sod cover and the excellent stand of seedstalks, grazed only in spots.

and more evenly distributed often have greater value in producing a good forage crop. To a lesser extent annual differences in range forage production are due to contributive features such as topography (fig. 5), soil, and number of grazing animals, which not only affect the vegetation directly but also modify weather influences on forage production.

An understanding of what causes annual variations in forage production and the ability to recognize them are essentials in judging the current forage crop and also the average long-time productivity of a given range. For instance, in a year of high forage production a range may appear at the end of the season to be underutilized, if only an average number of animals has been permitted to use it. This should not be taken as a reason for increasing the number of animals on the range the next year. Rather consider leaner years to come. High forage production occurs on an average only about once in every 5 years in the central Great Plains. Annual variations in forage production on a given area do call, however, for shaping up the herd to fit each year's forage growth.

Three degrees of forage production are recognized for each of the four classes of short-grass range—high, average, and low. Short grasses practically complete their annual growth by late July, but continuance of ample moisture supply until the latter part of August permits them to store reserve food in the roots, which becomes available for growth in the next year and is essential to the development and maintenance of best forage conditions. Seasons of high production are those in which the moisture supply is sufficient to produce an excess of top growth over that needed for normal plant growth, storage of reserve plant-food supplies, reproduction, and maintenance of vigor (fig. 6). Seasons of average production are those in which rainfall is approximately normal in quantity and is fairly well distributed through

the growing season. Seasons of low production are those in which rainfall is definitely deficient. Weather records from various stations in eastern Colorado and Wyoming show that in a given locality the rainfall may be only one-sixth as great in some years as in others. A prolonged shortage of rainfall during the spring and early summer growing season is particularly detrimental to the forage crop. Identifying features of the appearance of the range at the height of the growing season in midsummer in years of high, average, and low production, respectively, are listed in table 2.

Visibility of bare ground is an especially important indicator in judging short-grass ranges. A stand-off view of the range should be taken with observations along the contour, not uphill or downhill, if the ground slopes. If the grass tufts are close together, or if the observer is at a distance, bare ground is not visible and the vegetation appears to cover the ground completely. The line of disappearance of bare ground is influenced by the height of the vegetation, the diameter of the clumps, and the size of the spaces between the clumps. Since grazing gradually reduces the height of the forage cover, the distance at which bare ground is visible becomes progressively greater as the season advances.

#### ON EXCELLENT RANGE

The density of the almost unbroken turf on excellent range appears to vary little from year to year. Appearance of the forage crop varies distinctly from season to season, however, principally because of fluctuations in vigor and amount of growth of the short grasses, in abundance of taller grasses, and in seed production by all grasses.



FIGURE 7.—Excellent short-grass range, the same shown in figure 6, at end of a drought season (1939). The grass is short, and no seedstalks were produced even inside the pen, which excluded cattle. However, few bare spaces are visible.

Perennial weeds also fluctuate in vigor and abundance. Annual weeds are usually scarce and exert little influence.

In years of high forage production the short grasses on excellent range usually remain green throughout the season or become dry for only short intervals. Many flower stalks and a profusion of seed are produced by all grasses. Perennial weeds may be conspicuous because of their height and vigor, but they are seldom numerous.

In average seasons the bottom lands commonly yield an abundant crop of grass and an excellent seed crop, but much less forage appears on the uplands and hillsides. If a marked dry period follows late spring rains, the forage crop, while reasonably good, may not reach its full development and the seed crop will be poor. In such a season the occasional taller grasses in the drier locations may produce no seed crop. Perennial weeds may be fairly numerous, especially if rain-storms have been frequent in the early part of the growing season.

In seasons of low production, even excellent ranges may yield relatively little forage (fig. 7), the vegetation becoming dry early in the season and remaining so throughout the summer. Growth may be negligible and the short grasses are not likely to produce a seed crop. Taller grasses and perennial weeds are not conspicuous and may remain dormant. If several drought years occur in succession, productivity may greatly decline and the forage cover may thin out to such a point that the condition class of the range drops to good or fair.

#### ON GOOD RANGE

Fluctuations in production on good range are manifested chiefly by the short grasses and the perennial weeds. The bare spaces between sod pieces permit weeds to come in, particularly in years when the soil-moisture supply is abundant.

In wet seasons the short grasses grow vigorously and produce a good seed crop. The seedstalks are rather uneven in length and are not scattered uniformly as on excellent range in wet years. Perennial weeds such as scarlet globemallow, tansyleaf aster, slimflower scurf-pea, curlycup gumweed, and rush skeletonplant may form an important part of the forage, but do not obscure the short grasses. Taller grasses such as bluestem wheatgrass, prairie junegrass, and needle-and-thread grow vigorously, but are seldom abundant. Annual weeds are not abundant, probably because of competition from the established perennial forage species.

In years of average forage production the short grasses characteristically produce a normal seed crop on bottom lands but little or no seed on hillsides and higher ground. Perennial weeds are numerous but too small to be very noticeable.

In years of low production on good range, the forage consists principally of blue grama and buffalo grass. Taller grasses and weeds are mostly dormant. Grass seedstalks as a rule are produced only on sites where the ground remains moist, as along streams. The breaks between sod pieces are conspicuous.

#### ON FAIR RANGE

Yearly variations in appearance of fair range result from differences in the amount of growth made by the short grasses and in the prominence of weeds, especially low-value perennials. Annual weeds are

TABLE 2.—*Appearance of range in midsummer<sup>1</sup> according to amount of forage production in current year*

Range-condition class and ground or plant indicator	Condition of indicator when forage production is—		
	High	Average	Low
<b>Excellent range:</b>			
Bare ground .....	None; short-grass turf resembles uncut bluegrass lawn.	None; short-grass turf resembles lightly cut bluegrass lawn.	Not evident beyond 40 feet; short-grass turf resembles dried-out bluegrass lawn.
Blue grama .....	Uniformly dense stand of seedstalks 12 to 18 inches high; leaf length 4 to 7 inches.	Seedstalks 10 to 15 inches high, in uneven stands, abundant in clusters 4 to 10 feet in diameter in depressions; scarce or absent between depressions; leaf length 3 to 5 inches.	Seedstalks 4 to 8 inches high where run-off accumulates; none on hillsides or higher ground, or even in swales in very dry years; leaf length 2 to 3 inches.
Buffalo grass .....	Seeds abundantly; leaf length 3 to 5 inches .....	Seed production good; leaf length 2 to 4 inches ..	Clumps form thin turf; individual plants easily discernible; leaf length 1 to 2 inches.
Taller grasses .....	Excellent vigor; seedstalks rather uniform throughout.	Seedstalks few and scattered, may be absent on higher ground; wheatgrass in swales may be uniformly distributed, with short grasses as understory.	Seedstalks scarce; if drought is pronounced, may be very inconspicuous or absent.
Perennial weeds .....	Vigorous and conspicuous .....	Common to abundant; those of low value sparse ..	} Mostly dormant or very low growing.
Annual weeds .....	Scarce, not conspicuous .....	Practically absent .....	
<b>Good range:</b>			
Bare ground .....	Not evident beyond 20 feet .....	Not evident beyond 40 feet .....	Not evident beyond 80 feet.
Blue grama .....	Seedstalks 10 to 15 inches high, in uneven stands; seedstalk production best in depressions 1 to 2 inches deep; leaf length 3 to 6 inches.	Seedstalks 9 to 12 inches high, in moderately dense to thin stands on bottom lands; scarce or absent on higher ground; leaf length 2½ to 4 inches.	Very few seedstalks; leaf length 1½ to 2½ inches.
Buffalo grass .....	Leaf length 2 to 4 inches .....	Leaf length 2 to 3 inches .....	On low level areas and in depressions may form thin turf with bare ground readily visible from above; on higher ground, in bunches or rows with last year's runners clearly showing through; leaf length 1 to 1½ inches.
Taller grasses .....	Seedstalks abundant on moist areas, infrequent on dry areas.	Thin stands of seedstalks in better locations; few or none on hillsides and higher ground.	Seedstalks generally not evident.
Perennial weeds .....	Conspicuous clumps common on ungrassed spots and around margins of anthills.	Numerous; those of low value infrequent .....	} Inconspicuous or absent.
Annual weeds .....	Not abundant or conspicuous .....	May form extensive patches and temporarily obscure short grasses in late spring and early summer.	

Fair range:			
Bare ground .....	Not evident beyond 40 feet.....	Not evident beyond 80 feet.....	Not evident beyond 100 feet.
Blue grama .....	Seedstalks 9 to 12 inches high, in uneven stands; fairly abundant on good sites, sparse on poor sites; leaf length 2 to 5 inches.	Seedstalks 8 to 10 inches high, in thin and uneven stands in moist situations; rare or absent on higher ground; leaf length 2 to 3 inches.	Very few seedstalks; leaf length 1½ to 2 inches.
Buffalo grass .....	Leaf length 2 to 4 inches.....	Leaf length 1½ to 3 inches.....	Forms very thin turf; network of runners is readily visible among leaves; leaf length 1 to 1½ inches. Seedstalks generally not evident.
Taller grasses .....	Commonly produce single seedstalks on individual plants.	If present, relatively few seedstalks, but moderately vigorous.	} Inconspicuous or absent.
Perennial weeds .....	Vigorous but infrequent.....	Rather vigorous but infrequent.....	
Annual weeds .....	May be temporarily prominent; also annual grasses such as false buffalo grass and sixweeks fescue.	May be moderately abundant after a wet spring (also annual grasses); or practically absent if spring and early summer fairly dry.	
Poor range:			
Bare ground .....	Usually evident up to 80 feet or more.....	Usually evident to 120 feet or more.....	Usually evident to 120 feet or more.
Blue grama .....	Seedstalks, if any, 6 to 12 inches high; abundant soil moisture throughout growing season may result in abundant seed production and pronouncedly vigorous appearance of scattered grass tufts; leaf length 2 to 4 inches.	Seedstalks 4 to 10 inches high in occasional patches, if any; leaf length 2 to 3 inches.	Usually no seedstalks; grass tufts with dead centers may appear; leaf length 1½ to 2 inches.
Buffalo grass .....	Leaf length 2 to 3 inches.....	Leaf length 1½ to 2½ inches.....	Mostly a network of runners, rooted at joints but with few leaves; leaf length 1 to 1½ inches.
Taller grasses .....	Seldom present.....	Seldom present.....	Not evident anywhere.
Perennial weeds .....	Isolated plants or entirely absent.....	Isolated plants, if any evident.....	} Almost entirely absent.
Annual weeds .....	Conspicuous or almost absent, depending on seasonal rainfall distribution.	Extensive stands or almost absent, depending on seasonal distribution of rainfall.	

<sup>1</sup> Usually late July; viewed at eye level.



relatively less abundant on fair than on poor range. Variations in the seasonal appearance of low-value shrubs such as broom snake-weed and rabbitbrush are difficult to evaluate.

In the years most favorable for forage growth blue grama may produce a rather abundant crop of seedstalks in swales and on bottom lands. On higher ground its seed crop is usually sparse. The short-grass foliage remains green through the greater part of the growing season. Low-value weeds including James cryptantha, pricklepoppy, western stickseed, and wavyleaf thistle are frequently conspicuous. Sixweeks fescue and false buffalo grass are occasionally abundant, particularly when late summer and fall rains in the preceding season have added more than the usual amount of moisture to the soil.

In average years fair range yields a poor seed crop of blue grama. Seedstalks are practically absent on all but the most favorable sites. Perennial weeds of fair or low value grow vigorously but may be rare. Highly palatable perennial weeds are practically absent. Annual and short-lived grasses and weeds such as sixweeks fescue, western stickseed, woolly Indianwheat, and tumbling Russian-thistle are not conspicuous except in seasons of early and abundant rainfall.

In seasons of deficient rainfall and high temperatures the short grasses grow practically alone and produce few, if any, seedstalks. Occasional weeds or taller grasses may be in evidence around the margins of anthills or in depressions.

#### ON POOR RANGE

Wide separation of grass tufts and general scarcity or absence of perennial weeds are almost constant features of poor short-grass range.



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FIGURE 8.—Poor short-grass range in year of high productivity (1941). Excellent rainfall conditions have resulted in good leafage growth and a fair stand of seedstalks, but much ground remains bare. Compare with excellent range under similar conditions, figure 6.



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**FIGURE 9.**—Poor short-grass range in season of low production. Blue grama has produced no flower stalks. Numerous root crowns of dead blue grama plants are seen.

Annual variations in appearance of the forage cover result primarily from differences in the vigor of the short grasses and in the quantity of seed produced, and the presence or absence of annual plants.

In years of high production, the scattered blue grama clumps on poor range may show pronounced vigor. The individual clumps may produce seedstalks in abundance, since much of the precipitation on the bare spaces becomes available for plant growth (fig. 8). Annual weeds such as tumbling Russian-thistle, peppergrass, and lambs-quarters goosefoot may be very abundant if rainfall greater than normal is received in consecutive years.

In average seasons poor range usually exhibits a scattered, thin crop of blue grama seedstalks, mainly in patches where rainfall accumulates in small depressions. Frequent rains of moderate amount from April to June may result in a conspicuous stand of woolly Indianwheat, tumbling Russian-thistle, or sixweeks fescue, or a combination of these with various other low-value species.

In years of deficient rainfall and high temperature poor ranges produce very little forage. The widely scattered short-grass plants are generally little more than tufts of leaves (fig. 9). In prolonged drought periods the leaves of the short grasses become dry and brittle and are easily destroyed by trampling. The buffalo grass may consist of little more than a network of runners persisting from preceding years. In the driest years taller grasses and weeds are not evident.

### SUGGESTED STOCKING RATES

As an indication of the number of animals that might be grazed to obtain the greatest livestock production that permits conserving or improving the range, approximate stocking rates for the four classes of short-grass range are given in table 3. These rates may be used when the range is grazed from early May to November, provided satisfactory

distribution of animals and other desirable management are obtained. They are based on range survey records representative of the central Great Plains, checked by records of actual use on the Central Plains Experimental Range and by other grazing records and observations. Suitable rates will vary slightly from one locality to another, and after careful range inspection and reference to records of actual use, adjustments should be made, where necessary, to fit conditions on the individual ranch or pasture.

The suggested stocking rates in the Average column of table 3 represent a basis for conservative stocking over a period of years. The rates suggested for the occasional years of high forage production may be considered for use on ranches where circumstances permit altering animal numbers to this extent in such years. In a year of high forage production additional livestock may be purchased for grazing during that summer and fall, or the grazing season may be extended to a greater length than usual. However, lack of full utilization in a year of high forage production is not a waste, since the unused forage decays and adds organic material to the soil. In a year of low production more than the usual number of animals should be sold, heifers and cows should be culled more closely, or the grazing season should be shortened and the winter feeding period extended. On ranges in poor condition, it may be best in order to avoid losses and excessive cost of supplemental feed and also to safeguard future forage and livestock production, to remove the livestock from the range.

On few ranches will it be possible to adjust size of herd to annual forage production so closely as to bring about exactly correct utilization of the forage every year. However, the range should be checked periodically, especially during the latter half of the grazing season, to see how the forage supply is holding out and to aid in anticipating needed adjustments in livestock numbers.

TABLE 3.—*Relative rates of stocking under proper management in surface acres per animal-unit month,<sup>1</sup> suggested for consideration for short-grass range, according to forage production in current year*

Range condition class	Stocking rate in acres per month in a year when forage production is—		
	High	Average	Low
Excellent.....	Acres 1.00	Acres 2.50	Acres 3.00
Good.....	3.00	3.75	4.75
Fair.....	4.75	5.75	7.75
Poor.....	7.75	10.00	15.00

<sup>1</sup> An animal unit, as used in this bulletin, is the equivalent of a 1,000-pound breeding cow or a horse. A calf is 25 percent of an animal unit, a yearling 60 to 70 percent, a 2-year-old 85 to 95 percent, and a sheep 20 to 25 percent. Animal-unit months are calculated by multiplying the number of animal units by the number of months in the grazing season.

### CHECKING FORAGE UTILIZATION

When a range has been classified as to condition and the correct number of animals to be placed on it, the effects of grazing should be watched closely. The degree of utilization of the principal forage plants that can take place during the grazing season without causing loss of plant vigor, disappearance of other palatable grasses and herbs, accelerated erosion, and decrease in weight gains of livestock is definitely limited. A check should be made at least twice during the

grazing season, so that any needed adjustments may be made of number of animals to amount of forage remaining.

In checking forage utilization, all parts of the pasture should be examined. A thorough check will show the extent of the overgrazed areas and suggest measures for correcting livestock distribution. The main concern should be the stubble height of blue grama and buffalo grass.

The final check on summer and fall range utilization should be made in late fall at about the time when the grazing animals are removed. It may be desirable to make it earlier, even though grazing is not complete, if there is likelihood that the ground will soon be covered with snow. Ranges grazed in winter should receive their final check before new growth appears in the spring, not later than May 1 in northern Wyoming or April 1 in southern Colorado. After new growth begins, the previous year's vegetation disintegrates very rapidly and dependable measurements of stubble height therefore cannot be obtained.

Standards of allowable use as of the end of the grazing season are presented in table 4.

End-of-season stubble heights of blue grama and buffalo grass on correctly grazed ranges have been determined through intensive experiments and from extensive records of stocking rates and forage conditions on short-grass ranges. Among the items considered in formulating these standards were the degree of grazing the plant can endure and remain in good vigor; the effects of varying degrees of forage removal on the soil, with particular reference to erosion; the variations in forage production induced by annual variations in the weather; and the effects of various degrees of forage removal on seasonal and total weight gains of livestock.

The desirable height of stubble of blue grama and buffalo grass at the end of the grazing season may differ from year to year but is essentially the same for all four range-condition classes within a given year (table 4). For blue grama the minimum final stubble height recommended for years of high forage production is  $1\frac{1}{4}$  inches. This, on an average, means utilizing approximately 50 percent of the total volume of herbage produced and leaving untouched the coarse and fibrous bases resulting from rank growth. For years of low forage production the recommended minimum for blue grama is  $1\frac{1}{4}$  inches. This does not mean heavier grazing in a dry year than in a wet year; in a dry year the total average height of this grass may not exceed  $1\frac{1}{4}$  inches, and grazing to a height of  $1\frac{1}{4}$  inches will ordinarily mean approximately 40-percent or even less utilization of the seasonal herbage production.

On fair and poor areas where run-off is excessive owing to a large proportion of bare ground and to pedestaling of the grass clumps, the available soil-moisture supply sometimes diminishes to such an extent that leaf length is distinctly less than on excellent or good ranges. On such fair or poor range the uniform stubble height of  $1\frac{1}{4}$  inches in a year of high forage production, for example, means that only about 30 percent of the volume has been removed.

In addition to the measurements of stubble height, a general examination of the range should be made at the end of the grazing season for other evidence of utilization. In average years one-fifth of the grass seedstalks should remain. If palatable shrubs are present, the twigs produced during the growing season should not have been

TABLE 4.—*Indicators of correct forage utilization at end of grazing season, according to whether current annual forage production is high, average, or low*

Range-condition class and ground or vegetation indicator	High	Average	Low
All classes:			
Average length of stubble .....	Blue grama, 1¾ inches; buffalo grass, 1½ inches.	Blue grama, 1½ inches; buffalo grass, 1¼ inches.	Blue grama, 1¼ inches; buffalo grass, 1 inch.
Seedstalks of palatable grasses .....	Approximately one-fourth remaining .....	Approximately one-fifth remaining .....	Very few remain, if any.
Excellent condition:			
Seedstalks of palatable grasses .....	Remaining blue grama usually in bunches 1 or several feet in diameter; grazed spaces conspicuous.	Blue grama in thin bunches; occasional single ungrazed stems between bunches.	Scarce or absent.
Bare ground .....	Not evident beyond 30 feet.	Not evident beyond 50 feet .....	Not evident beyond 80 feet.
Perennial weeds .....	Inconspicuous .....	May be fairly common; evidence of grazing difficult to find.	May be fairly common but not tall.
Annual weeds and grasses .....	Mostly absent .....	Practically absent .....	Practically absent.
Good condition:			
Seedstalks of palatable grasses .....	Blue grama usually single stems or small groups.	Thin bunches of blue grama in depressions; single scattered stems on hillsides and higher ground.	Rare or absent.
Bare ground .....	Not evident beyond 50 feet .....	Not evident beyond 80 feet .....	Not evident beyond 120 feet.
Perennial weeds .....	Mostly gone .....	Few, average vigor .....	} Scarce or absent.
Annual weeds .....	Mostly absent .....	If present, nowhere abundant .....	
Fair condition:			
Seedstalks of palatable grasses .....	Blue grama commonly as scattered stems and small groups protected by shrubs or prickly-pear clumps.	Blue grama, scattered stems on better sites; absent on hillsides and higher ground.	Rare or absent.
Bare ground .....	Not evident beyond 80 feet .....	Not evident beyond 120 feet .....	Not evident beyond 160 feet.
Perennial weeds .....	Mostly disappeared .....	Scarce .....	} Scarce or absent.
Annual weeds .....	Some sixweeks fescue between short-grass clumps; seedlings of woolly Indianwheat may be numerous on ungrassed spots.	Sixweeks fescue in dried condition; seedlings of woolly Indianwheat numerous on ungrassed spots.	
Poor condition:			
Seedstalks of palatable grasses .....	Scarce .....	Blue grama very infrequent even on the better sites.	Rare or absent.
Bare ground .....	Not evident beyond 120 feet .....	Not evident beyond 160 feet .....	Not evident beyond 180 feet.
Perennial weeds .....	Practically absent .....	Practically absent .....	} Scarce or absent.
Annual weeds .....	Dried stems of woolly Indianwheat, peppergrass, lambsquarters, goosefoot, and others may remain; seedlings of these species may be abundant on ungrassed spots; sixweeks fescue possibly in fair abundance.	Abundant dried stems may remain on ungrassed spots.	

browsed, on an average, more than a third of their length. Some of the twig growth of the current year should remain entirely unbrowsed, and none of the woody growth of previous years should have been used. The soil also should be observed for evidence of accelerated erosion. Livestock should be in good flesh. If the animals appear to have lost markedly in weight in the latter part of the grazing season, overuse of the forage is indicated.

### HOW TO MAKE STUBBLE-HEIGHT MEASUREMENTS

Grass stubble height can be estimated rapidly as one goes over the range, but before starting this it is well to train by making actual measurements. Later, making occasional measurements during regular inspection helps keep the judgment accurate.

To measure blue grama stubble, a rule is placed at the base of a plant with one hand and a bundle of leaves is grasped near the ground surface with the other; the fingers are then allowed to slide upward until the estimated average length of the stubble is reached, and the measurement shown by the rule is recorded. In deciding upon the average length of a given cluster of leaves, the various lengths must be mentally weighted according to number of leaves. For example, if a few leaves or flower stalks are considerably longer than the majority this should affect the estimated average length only in accordance with their relative number. Careful examination may reveal numerous leaves and flower stalks that have been grazed close to the ground early in the season. These should be represented in the estimate of average stubble height.

Buffalo grass leaves are somewhat more difficult to measure because they arise both from the ground surface and from runners. Those arising directly from the soil may be measured in the manner described for blue grama, but the others must be measured from the point of attachment to the runner. In no instance should any portion of the runner be included in the measurement of leaf length.

If it is desired to obtain a true average sample of utilization, a simple method of locating leaf clusters for recording is to walk over the range in fairly uniformly spaced lines about a hundred yards to one-fourth mile apart depending on the size of the pasture. At regular intervals—for example, at every fiftieth step—stop and measure the cluster of grass leaves nearest the toe of the right shoe. Sometimes the leaf cluster will occur in the center of the sod piece, sometimes near the edge. Record the average length to the nearest quarter inch. Then proceed the required number of paces to the next measuring point.

The average short-grass pasture of 300 acres or less may be sampled by 100 such measurements with sufficient accuracy for all ordinary purposes. On large ranches each pasture or grazing unit should be sampled separately.

### SUGGESTED GRAZING RECORDS

No less important to the progressive rancher than records of ranch expenditures and income are records showing rate of stocking and degree of use for each of his pastures each year. Only by these records can he judge the present trends of range condition and determine the requirements for conservative grazing and sustained production of

<i>South</i> PASTURE								
		Area <u>800</u> acres		Condition of range <u>Good</u>				
Class of livestock	Animals (number)	Date on	Date off	On pasture (days)	Animal-days (days x animals)	A.U. days (days x A.U.)	A.U. months (A.U. days ÷ 30)	
<i>Cows</i>	<i>20</i>	<i>5/10/42</i>	<i>10/30/42</i>	<i>173</i>	<i>3,460</i>	<i>3,460</i>	<i>115</i>	
<i>Calves</i>	<i>20</i>	<i>5/10</i>	<i>10/30</i>	<i>173</i>	<i>3,460</i>	<i>865</i>	<i>29</i>	
<i>Yearlings</i>	<i>10</i>	<i>6/1</i>	<i>10/30</i>	<i>152</i>	<i>1,520</i>	<i>1,064</i>	<i>35</i>	
<i>Cows</i>	<i>10</i>	<i>10/30/42</i>	<i>11/29/42</i>	<i>30</i>	<i>300</i>	<i>300</i>	<i>10</i>	
TOTAL USE								<i>189</i>

FORAGE RECORD				
Date	Forage production	Stubble height (inches)		Comments
		Short grass	Tall grass	
<i>7/1</i>	<i>Average</i>	<i>4</i>	<i>6</i>	
<i>10/30</i>	<i>Average</i>	<i>2</i>	<i>5</i>	<i>Very light use on west side</i>

FIGURE 10.—Suggested form for pasture-stocking and range condition records. (For definition of A. U. (animal-unit) see footnote to table 3.) In the "forage record," stubble height is average of grazed and ungrazed grasses.

forage and livestock. A suggested form for the pasture stocking record is shown in figure 10.

Stocking records should include the number, kind, and age of livestock and the length of the period during which they are permitted to graze each pasture. Frequently it is desirable to state the rate of stocking in terms of the animal unit (defined in the footnote to table 3) and the animal-unit month. A separate record for each pasture is recommended. When some of the animals of a certain class are removed and the remainder are left on the pasture, the entire number is recorded in the "Date off" column and the number remaining is entered as if placed on the pasture for the first time. This is illustrated by the cow entries in figure 10. At the end of the year or of the grazing season the total number of animal-months of use may be computed by adding the numbers in the last column. If the acreage of the pasture is divided by this sum the number of surface acres per animal-unit-month is obtained.

Observations on stubble height of blue grama and buffalo grass and on degree of utilization of the various other forage species in different parts of each pasture or range unit should be recorded at the end of each grazing season.

Comparison of the stocking record with the utilization record over a period of years will indicate needed adjustments in animal numbers, and, when combined with information on range condition and trend of changes therein, form the basis for a conservative estimate of the grazing capacity of the range.

## COMMON AND SCIENTIFIC NAMES OF SPECIES MENTIONED

Bluebunch wheatgrass.....	<i>Agropyron spicatum</i>
Blue grama.....	<i>Bouteloua gracilis</i>
Bluestem wheatgrass.....	<i>Agropyron smithii</i>
Broom snakeweed.....	<i>Gutierrezia sarothrae</i>
Buffalo grass.....	<i>Buchloë dactyloides</i>
Common winterfat.....	<i>Eurotia lanata</i>
Curlycup gumweed.....	<i>Grindelia squarrosa</i>
False buffalo grass.....	<i>Munroa squarrosa</i>
Fourwing saltbush.....	<i>Atriplex canescens</i>
Fringed sagebrush.....	<i>Artemisia frigida</i>
James cryptantha.....	<i>Cryptantha jamesii</i>
Lambsquarters goosefoot.....	<i>Chenopodium album</i>
Little bluestem.....	<i>Andropogon scoparius</i>
Loco; poisonvetch.....	<i>Astragalus</i> spp.
Needle-and-thread.....	<i>Stipa comata</i>
Peppergrass.....	<i>Lepidium densiflorum</i>
Plains bluegrass.....	<i>Poa arida</i>
Plains pricklypear.....	<i>Opuntia polyacantha</i>
Prairie junegrass.....	<i>Koeleria cristata</i>
Prairie sandreed.....	<i>Calamovilfa longifolia</i>
Pricklepoppy.....	<i>Argemone intermedia</i>
Rabbitbrush.....	<i>Chrysothamnus</i> spp.
Red three-awn.....	<i>Aristida longiseta</i>
Rush skeletonplant.....	<i>Lygodesmia juncea</i>
Scarlet gaura.....	<i>Gaura coccinea</i>
Scarlet globemallow.....	<i>Sphaeralcea coccinea</i>
Sixweeks fescue.....	<i>Festuca octoflora</i>
Slimflower scurfpea.....	<i>Psoralea tenuiflora</i>
Tansyleaf aster.....	<i>Aster tanacetifolius</i>
Threadleaf sedge; "niggerwool".....	<i>Carex filifolia</i>
Tumbling Russian-thistle.....	<i>Salsola kali tenuifolia</i>
Wavyleaf thistle.....	<i>Cirsium undulatum</i>
Western stickseed.....	<i>Lappula redowskii</i>
Woolly Indianwheat.....	<i>Plantago purshii</i>

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