

Judging and Evaluating Range and Pasture Forage Utilization (Proper Grazing Use) for Certain Portions of the Central Great Plains

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On the Ground

- Many guidance documents and references have been prepared by federal and state agencies on proper grazing use. This article summarizes these documents for use by field personnel.
- Proper grazing use or acceptable forage utilization can be judged by the use of key forage plants in designated key grazing areas.

Keywords: forage utilization, proper grazing use, range and pasture appraisal, key forage plants, key grazing area.

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The purpose of this paper is to provide the rangeland management specialist, professional agriculturalist, soil conservationist, and extension agent and specialist the basis for making sound and informed conservation planning, decision-making, and livestock grazing management decisions that are ecologically and biologically based for ranch planning and public lands planning within the region of the Central Great Plains.

Many guidance documents and references have been prepared by various federal and state agencies on the subject of proper grazing use throughout the years. I have determined to bring many of these documents and references into one summarized article for efficient use by field personnel. Here is my summary of these documents and references.

Judging Proper Grazing Use

Proper grazing use or acceptable forage utilization by livestock can be judged by the use of key forage plants in design-

nated key grazing areas. According to Stoddart¹ and Smith,² the use of key grazing areas and key forage species in appraising the degree of range or pasture utilization was originated by Standing.³ Proper use of key forage plants benefits the key grazing area. When the key area is properly used, the grazing management unit as a whole is not overused. For clarity's sake, the grazing management unit is defined here as synonymous with such terms as pasture, paddock, etc. However, proper grazing use should not be considered as applied if more than 10% of the grazing management unit is overgrazed or used excessively.

Key Forage Plants

The key forage plants for judging degree of use for each key grazing area should be selected with the stock raiser's participation after considering the plant needs, the area and its potential vegetation, present plant composition, kind of grazing animals, season of grazing, and frequency and length of rest periods. When the key forage plants are properly selected and grazed, the key grazing area should also be properly grazed. The grazing animal will generally have a relatively high preference for the key forage plants. Normally, the key forage plants provide more than 15% of the available forage on the area and are accessible.⁴ Generally, one to three plant species are used as key forage plants.⁵

Key Grazing Areas

The key grazing area is that representative part of a grazing management unit that indicates the grazing pressure being applied to the entire grazing management unit. Identifying and locating the key grazing area is done after considering grazing use patterns and preference areas within each grazing management unit. The key grazing area provides a significant amount, but not necessarily the majority of the available forage in the grazing management unit. For relatively small grazing management units (e.g., paddocks), particularly with

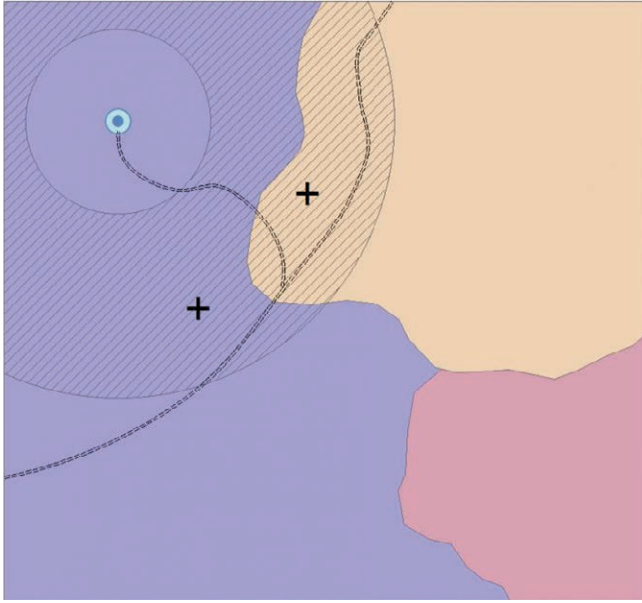


Figure 1. An example of a key-area approach to selecting monitoring locations. The square represents a portion of the monitoring area of interest (e.g., ranch pasture) and the different color subdivisions stand for different rangeland ecological sites. The light blue point is a water feature, and the dashed line is a road. The appropriate area for monitoring grazing impacts (hatched ring) is typically beyond the high-impact zone around the water feature, but within the area actually used by livestock. In this case, two random utilization measurement areas (crosses) were selected to represent the two ecological sites included within the key grazing area. Adapted from The Nature Conservancy and USDA, Agricultural Research Service.¹⁸

management-intensive grazing systems, where the vegetation type is basically composed of one plant species, or there is low plant species diversity or very homogeneous vegetation (e.g., tame pasturelands in particular), then the entire grazing management unit can be evaluated as the key grazing area.

The former USDA Soil Conservation Service's 1976 *National Range Handbook*⁶ recommended that cattle, on average, travel three-fourths mile to 1 mile from water on level to nearly level terrain. This is reflected in one notable study by Valentine,⁷ and also reported by Vallentine,⁸ on gentle terrain near Las Cruces, New Mexico. Valentine found that the average percentage of forage utilization was determined in half-mile-wide concentric circles on a single livestock water development. The respective utilization is as follows: 1) 0–0.8-km-wide (0–0.5 mile) circle was 50% utilized, 2) 0.8–1.61-km-wide (0.5–1.0 mile) circle was 38% utilized, 3) 1.61–2.41-km-wide (1.0–1.5 mile) circle was 26% utilized, 4) 2.41–3.22-km-wide (1.5–2.0 mile) circle was 17% utilized, and 5) 3.22–4.02-km-wide (2.0–2.5 mile) circle was 12% utilized. Within these distance-from-water zones, the location of palatable plants determined where cattle actually grazed. Cattle do not necessarily graze in a perfect circle around livestock watering points, but such circular-shaped key grazing areas (with livestock watering points as the epicenters) provide a point of reference to study the impact of livestock grazing on rangelands.

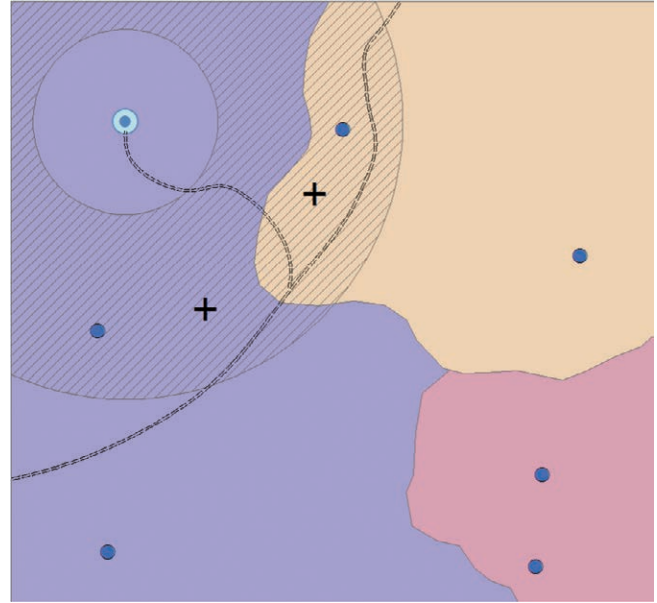


Figure 2. An example of a set of stratified random points for conducting utilization measurements (blue dots) that have been selected for the example in Figure 3. In this example, two random locations (for utilization measurements) were selected within each rangeland ecological site. In this instance, the stratified utilization measurement areas are located within the key grazing area and outside the key grazing area in order to make comparisons of utilized vs. under- or unutilized areas. Adapted from The Nature Conservancy and USDA, Agricultural Research Service.¹⁸

Vallentine⁸ cites Roath and Kruger⁹ and Rowland and Stuth¹⁰ as noting that the location and number of livestock watering points on grazing lands are important in controlling the movement, distribution, and concentration of livestock. Although forage factors are a major role in determining where livestock will actually graze (this factor sets the inner boundary of the key grazing area), distance from water will set the outer boundary within which domestic animals will graze. Water is the major focal point from which livestock radiate out. Concentric rings of utilization are generally found around the water point on level terrain with utilization decreasing as distance from the watering point increases. Cattle often heavily graze forage plants near water rather than traveling long distances to better qualities and quantities of forage. This results in deterioration of most forage plant resources near the livestock water development or water supply, and leaves forage under- or unutilized at long distances from water. Vallentine⁸ further states that in the past that it has been common range management practice to locate water developments no more than 1 mile from forage resources, but travel distances by cattle far beyond these distances have been reported. Vallentine⁸ makes the valid statement based on Kothmann¹¹ that it is apparent that it is not the domestic grazing animal's ability to travel that primarily restricts utilization away from water resources, but rather their willingness to do so.

With beef cow-calf pairs in particular, the impact of concentric-ring grazing on rugged terrain and tablelands,

Table 1. Suggested general guidelines for judging proper grazing use on rangeland and dryland and irrigated pastureland

Recommended maximum allowable use of key forage plants* (Determined at the end of a grazing period and expressed as % used by air-dry weight)	
Type of grazing system	% Use of current year's growth
Deferred rotation	50 (maximum)
Rest rotation	50 (maximum)
High intensity–low frequency	60*
Short duration	60*
Other management-intensive grazing systems	15–30 (during each occupation during major growth period only)
Forage use for the entire growing season for other management-intensive grazing systems	60–65*

*% Use is due to the fact that periods of grazing are usually less than periods of nongrazing or rest.

Table 2. Suggested percentage of use of key forage plants (air-dry weight) under moderate grazing for rangelands in portions of the Central Great Plains (active growing season)

Rangeland type	% Use
Tallgrass prairie	45–55
Northern mixed (midgrass) prairie	35–45
Southern mixed (midgrass) prairie	40–50
Shortgrass prairie (steppe)	35–45
Eastern deciduous forest (Eastern Great Plains)	50–60
Western coniferous forests (ponderosa pine)	30–40

* Adapted from Holechek et al.⁵

particularly on rangeland, is variable at best in many instances. On rugged terrain, cattle may only graze ridges and tabletops, and low-lying areas between ridges and tables (on tablelands) as well as the toe and foot slopes of ridges and tables. Utilization measurements should be made in these areas.

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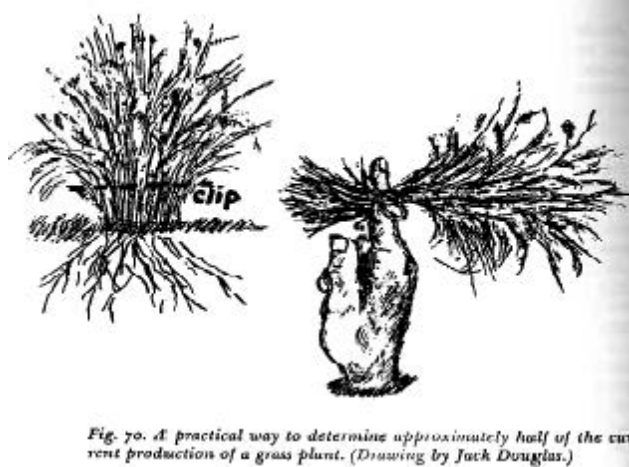


Figure 3. Simple height/weight determination. Adapted from Bell.¹⁵

The following are my suggested general guidelines for developing key grazing area concentric rings (based on my personal field experiences) on a conservation plan map, with a watering point at the epicenter:

- 1) *Level to gently rolling terrain.* Four concentric rings spaced 0.4 km (0.25 miles) apart. Example: first ring will be 0–0.4 km (0–0.25 miles) and last ring will be 1.21–1.61 km (0.75–1 mile).

Table 3. Suggested general guidelines for judging proper grazing use on rangeland grasses

Key grass/grasslike plants	Average minimum plant height to begin grazing		Average maximum-use plant height to remove livestock	
	(cm)	(inches)	(cm)	(inches)
Big and sand bluestem	25.4–30.5	10–12	15.2–20.3	6–8
Little bluestem	15.2–20.3	6–8	10.2–12.7	4–5
Indiangrass	25.4–30.5	10–12	15.2–20.3	6–8
Nebraska sedge	15.2	6	7.6	3
Eastern gamagrass	45.7–50.8	18–20	20.3–25.4	8–10
Virginia and Canada wildrye	20.3	8	15.2	6
Switchgrass	20.3	8	15.2	6
Western wheatgrass	15.2	6	7.6	3
Needle-and-thread	15.2	6	7.6–10.2	3–4
Green needlegrass	15.2	6	7.6–10.2	3–4
Prairie junegrass	12.7	5	7.6	3
Prairie sandreed	25.4–30.5	10–12	15.2–20.3	6–8
Blue grama	15.2	6	5.1–7.6	2–3
Buffalograss	15.2	6	5.1–7.6	2–3

Notes:

- 1) Remove livestock before minimum height is reached on the majority of the forage.
- 2) Recovery period will vary according to the climatic conditions, soil moisture and fertility, and amount of leaf area remaining after grazing.
- 3) This table can be used concurrently with Table 1 as a general guide on rangeland. Table 3 guides must be used with considerable judgment and care on rangeland.

- 2) *Rolling terrain.* Three concentric rings. Example: first ring, 0–0.4 km (0–0.25 miles) and last ring, 0.60–1.21 km (0.375–0.75 miles).
- 3) *Rough terrain.* Two concentric rings. Example: first ring, 0–0.4 km (0–0.25 miles) and second ring, 0.4–0.8 km (0.25–0.50 miles). Remember the discussion of beef cattle grazing habits on rough tablelands.

Remember to avoid roads, trails, high-impact areas adjacent to or near watering facilities (i.e., “sacrifice areas”), alley ways, utility/pipeline right-of-ways, and the like when con-

ducting field utilization measurements in all key grazing area concentric rings.

The final point is that anything that induces grazing animals to forage radially from some more-or-less fixed attraction point (e.g., water, salt, shade, bedding area in rangeland sheep grazing, etc.) results in a heavily exploited zone nearest that point and a gradient of decreasing resource exploitation that diminishes with distance from that point.¹² In the case of livestock water developments, Lange¹³ referred to this as the “piosphere.” The term “pio” was derived from Greek meaning to drink, and sphere obviously referring to a circle.

Table 4. Suggested general guidelines for judging proper grazing use on pastureland (dryland and irrigated) grasses

Key grass plants	Average minimum plant height to begin grazing		Average maximum-use plant height to remove livestock	
	(cm)	(inches)	(cm)	(inches)
Kentucky bluegrass	12.7	5	7.6	3
Smooth brome	15.2	6	10.2	4
Meadow brome	15.2	6	10.2	4
Reed canarygrass	20.3	8	10.2	4
Creeping foxtail	15.2	6	10.2	4
Meadow foxtail	15.2	6	10.2	4
Russian wildrye	15.2	6	7.6	3
Tall wheatgrass	25.4	10	10.2	4
Pubescent wheatgrass	20.3	8	10.2	4
Intermediate wheatgrass	20.3	8	10.2	4
Orchardgrass	15.2	6	10.2	4
Tall fescue	15.2	6	10.2	4
Timothy	20.3	8	10.2	4
Crested/Siberian wheatgrass	15.2	6	10.2	4
Cereals	20.3	8	10.2	4
Sudangrass/sorghum-sudan	20.3	8	10.2	4
Millets	20.3	8	10.2	4

Notes:

- 1) Remove livestock before minimum height is reached on the majority of the forage.
- 2) Recovery period will vary according to the climatic conditions, soil moisture and fertility, and amount of leaf area remaining after grazing.

The single key grazing area is usually the norm, and usually no more than two to three key forage plants should be designated for each grazing management unit. The only exceptions are these:

- 1) When the grazing management unit is grazed for a 12-month period and has a mixture of warm-season and cool-season forage plants. In these cases, it may be necessary to designate the key forage plant(s) for different periods during the year.
- 2) When the key grazing area concentric rings encompass more than one rangeland ecological site polygon or forage suitability group polygon, and the plant community

Table 5. Suggested general guidelines for judging proper grazing use on pastureland forage legumes

Key forage plants	Average minimum plant height to begin grazing		Average maximum-use plant height to remove livestock	
	(cm)	(inches)	(cm)	(inches)
Alfalfa	20.3	8	10.2	4
Ladino clover	10.2	4	7.6	3
Alsike clover	15.2	6	7.6	3
Red clover	15.2	6	7.6	3
White clover	10.2	4	7.6	3
Cicer milkvetch	20.3	8	10.2	4
Sainfoin	20.3	8	10.2	4
Birdsfoot and big trefoil	20.3	8	7.6	3
Common and hairy vetch	20.3	8	10.2	4
Sweetclover (white and yellow)	20.3	8	7.6	3

Notes:

- 1) Following initial planting, legumes should not be grazed until they have set seed.
- 2) Remove livestock before minimum height is reached on a majority of the forage.
- 3) Recovery period should vary according to climatic conditions, soil moisture and fertility, and amount of leaf area remaining after grazing.
- 4) Trailing legumes need about 46 cm (18 inches) of stem as residual.

of each intersected polygon is significantly different. In such circumstances, representative field utilization measurements will need to be conducted within the different polygons within the key grazing area concentric rings (Figs. 1 and 2).

- 3) When the grazing management unit is grazed by two kinds of animals, and each animal has distinctly different forage preferences for grazing.
- 4) When a riparian area occurs in a grazing management unit. The conservationist should identify a key grazing area in the riparian area and a key grazing area that represents the rest of the grazing management unit.
- 5) When there is more than one watering facility per grazing management unit.
- 6) When all or most of the plants are in relatively small acreage paddocks, in management-intensive grazing systems, or in ultrahigh stocking density grazing systems (i.e., “mob

grazing” systems). Make utilization measurements in at least two to three paddocks per cell system. Make future utilization determinations in different paddocks in future field checks. Avoid alleys and any immediate high-impact areas adjacent to or near watering facilities while conducting utilization measurements.

Degree of Use

The following are suggested methods for determining degree of use of key forage plants in the grazing management unit:

- 1) Manage the intensity of grazing to remove no more than the specified percentage of the annual forage production (air dry weight) of the key forage plants. Field determinations should be made by the end of the grazing season (from the key forage plants on the key grazing area) on each grazing management unit.

Table 6. Suggested general grazing intensity guides for converting average stubble heights into approximate percentage of utilization*

Shortgrasses		Midgrasses		Tallgrasses		% Forage used by weight	Qualitative grazing intensity class
(cm)	(inches)	(cm)	(inches)	(cm)	(inches)		
6.4+	2.5+	23+	9+	41+	16+	0–30	Light use to nonuse
5.0–6.4	2.0–2.5	20–23	8–9	36–41	14–16	31–40	Conservative
4.0–5.0	1.5–2.0	15–20	6–8	31–36	12–14	41–50	Moderate
2.5–4.0	1.0–1.5	10–15	4–6	25–31	10–12	51–60	Heavy
<2.5	<1.0	<10	<4	<25	<10	>60	Severe to extreme

* Adapted from Holechek et al.⁵

- 2) Determine grazing use by comparing grazed plants of the key forage plants with ungrazed plants of comparable size and vigor on the key grazing area. It may be necessary to use ungrazed plants from a nearby area having similar soils or to install a livestock use exclusion cage that protects the key forage plants for comparison.
- 3) Evaluating percentage of use of current year's growth of key forage plants or total annual herbage has been a traditional and historical method used by the USDA, Natural Resources Conservation Service. Table 1 provides suggested general guidelines for use of current year's growth and Table 2 provides suggested percentage of use of key forage plants, for the active growing season, for the major rangeland types of the Central Great Plains. When grazing is limited to the dormant season, proper grazing use generally leaves a minimum of 35% to 40% of the current year's growth of the key forage plants. In other words, generally 60% to 65%, by air-dried weight, of the current year's growth is utilized when grazing is limited to the dormant season.
- 4) The height/weight method is an evaluation that is similar to the percentage of use method described above. A more comprehensive description of this method and other methods can be found in the Interagency Technical Reference "Utilization Studies and Residual Measurement."¹⁴ A recommended tool for the height/weight method is the USDA Forest Service's "Utilization Gauge: An Instrument for Measuring the Utilization of Grasses." Still another rather simple height/weight measurement can be determined by clipping an entire ungrazed representative sample of the key forage plant.¹⁵ Tape or rubber-band your small, bundled sample. Then simply balance the sample on your index finger; this is usually done most easily in your vehicle. The conservationist can readily and easily note from the balanced key forage sample what is approximately half of current year's growth relative to the length/height of the plant. Take a black marker and mark the desired utilization level on the plant or simply clip off the upper end of the key forage plant. Conduct at least 50 compared measurements of key forage plants on a simple line transect in each concentric ring of the key grazing area. Refer to Figure 3 for a general view of the simple height/weight method.
- 5) Measurement of average stubble height is another historically acceptable and alternate method for determining proper grazing use. Acceptable postgrazing stubble heights of the key forage plants are measured in the key grazing area. An average stubble height is determined by measuring the average height of grazed key forage plants. A minimum of 50 stubble height measurements should be conducted within each concentric ring of the key grazing area for determining an average stubble height of key forage plants. When measuring stubble heights of key forage plants, good professional judgment is needed (Tables 3–6).
- 6) In the grazed/ungrazed plant method,¹⁶ all perennial grasses and forage legumes are considered. Should this method be employed, the conservationist should conduct at least a 200-point linear step transect counting grazed or ungrazed plants, whatever may occur, at each point. The sum total of grazed plants is simply divided into the sum total of ungrazed plants to determine a percentage of utilization number. There should be at least one such

Table 7. Utilization–landscape appearance method (herbaceous plants)*

Percentage-class interval	Grazed-class category adjective†	Grazed-class description
0–5%	Nonuse	The rangeland shows no evidence of grazing or negligible use.
6–20%	Light	The rangeland has the appearance of very light grazing. The herbaceous plants may be topped or slightly used. Current seedstalks and young plants are little disturbed.
21–40%	Conservative	The rangeland may be topped, skimmed, or grazed in patches. The low-value herbaceous plants are ungrazed and 60% to 80% of the number of current seed stalks of herbaceous plants remain intact. Most young plants are undamaged.
41–60%	Moderate	The rangeland appears entirely covered as uniformly as natural features and facilities allow. 15% to 20% of the number of current seed stalks of herbaceous plants remain intact. No more than 10% of the number of low-value herbaceous forage plants is utilized. (Moderate use does not imply proper use.)
61–80%	Heavy	The rangeland has the appearance of complete search. Herbaceous plant(s) are almost completely utilized, with less than 10% of the current seed stalks remaining. Shoots of rhizomatous grasses are missing. More than 10% of the number of low-value herbaceous forage plants has been utilized.
81–94%	Severe	The rangeland has a mown appearance and there are no indications of repeated coverage. There is no evidence of reproduction or current seed stalks of herbaceous plants. Herbaceous forage plants are completely utilized. The remaining stubble of preferred grasses is grazed to the soil surface.
95–100%	Extreme	The rangeland appears to have been completely utilized. More than 50% of the low-value herbaceous plants have been utilized.

*From the Bureau of Land Management.¹⁴

†Adapted from Holechek et al.¹⁷

200-point linear step transect conducted for each concentric ring of the key grazing area.

- 7) The landscape appearance method^{14,17} uses a visual estimate of forage utilization based on the general appearance of the tract of rangeland being assessed. Seven utilization classes are used to demonstrate relative degrees of use of herbaceous plants (i.e., grasses, grasslike plants, and forbs). Each class represents a numerical range of percentage of utilization. The conservationist should estimate utilization within one of the seven classes. Table 7 provides a general overview of the seven landscape appearance utilization classes for herbaceous rangeland plants. The landscape appearance method for determining utilization is not a quantitative method, but a qualitative method. Good pro-

fessional judgment should be exercised in the field when conducting this method.

When using percentage of utilization in particular, the conservationist must again use good professional judgment and consider the following when measuring proper grazing use of the key forage plants: 1) season of use, 2) plant phenological state (e.g., consider initial growth stage, headed out and boot stage, seed ripe and seed set), and 3) time of use. You should consider that a producer may, for instance, graze the selected key forage plants during the initial growth stage, allow for regrowth, and then graze the selected key forage plants again. By conducting this kind of grazing practice, the operator may actually allow livestock

Table 8. Utilization–landscape appearance method (browse plants)*

Percentage-class interval	Browsed - adjective†	Browsed-class description
0–5%	Nonuse	Browse plants show no evidence of use, or only negligible use.
6–20%	Light	Browse plants have the appearance of very light use. The available leaders of browse are little disturbed.
21–40%	Conservative	There is obvious evidence of leader use. The available leaders appear cropped or browsed in patches and 60–80% of the available leader growth of browse plants remains intact.
41–60%	Moderate	Browse plants appear rather uniformly utilized and 40–60% of the available leader growth of browse plants remains intact.
61–80%	Heavy	The use of the browse gives the appearance of complete search. The preferred browse plants are hedged and some plant clumps may be slightly broken. Nearly all the available leaders are used and few terminal buds remain on browse plants. Between 20% and 40% of the available leader growth of browse plants remain intact.
81–94%	Severe	There are indications of repeated coverage. There is no evidence of terminal buds and usually less than 20% of available leader growth on browse plants remains intact. Some patches of second and third years' growth may be grazed. Hedging is readily apparent and the browse plants are more frequently broken. Repeated use at this level will produce a definitely hedged or armored growth form.
95–100%	Extreme	Less than 5% of the available leader growth on browse plants remains intact. Some, and often much, of the more accessible second and third year's growth of the browse plants have been utilized. All browse plants have major portions broken.

*From the Bureau of Land Management.¹⁴

†Adapted from Holechek et al.¹⁷

to utilize more than targeted percentage of the current year's growth. Therefore, you should interview the operator as to how many actual periods of grazing the grazing management unit has undergone for the desired period of measurement. This can also be true when you utilize average stubble height field measurements.

Percentage of utilization or average stubble height target levels are tools that can be used in conjunction with long-term monitoring to help ensure that resource conservation and producer objectives are met. Suggested long-term monitoring methods can include, but are not limited to, livestock use exclusion cages, photo plots, and permanent transects.

You should determine the utilization at or near the end of the grazing period. This determination should all be made no later than the beginning of the new major plant growth period.

Browse Resource Evaluation

Browse plants include most half-shrubs, shrubs, woody vines, and trees. A key browse plant and a key browsing area should be determined for each grazing management unit, when applicable.

Proper use of preferred and desirable browse plants can be recorded if utilization of current year's growth of an identified key browse plants is 50% or less by air-dried weight during the major plant growth period or 60%–65% or less during dormant periods.

There is a landscape appearance method for evaluation of browse plants.^{14,17} This method also has seven classes like the method of herbaceous plant utilization. These seven classes demonstrate relative degrees of use of available current year's growth (leaders) of browse plants (shrubs, half shrubs, woody vines, and trees). Each class represents a numerical range of

percentage of utilization. To evaluate, estimate utilization within one of the seven classes. Refer to Table 8 for a general overview of the seven landscape appearance utilization classes for woody rangeland or forestland plants. The landscape appearance method for determining browse utilization is not a quantitative method, but a qualitative method. Good professional judgment should be exercised in the field when using this method.

Conservation Application

I wrote this article to give an effective overview of the subject of proper grazing use by livestock on rangelands and pasturelands of the Central Great Plains. There have been many articles, federal and state agency documents, and references developed over the years concerning proper grazing use. It was my intent to bring together as many of these pertinent documents as possible in one summary article.

Once again, my purpose in writing this paper is to provide the rangeland management specialist, professional agriculturalist, soil conservationist, and extension agent and specialist the basis for making sound and informed conservation planning decisions that are ecologically and biologically based for ranch planning and public lands planning in the Central Great Plains. I have emphasized proper grazing use for livestock grazing management, as opposed to adding wildlife and wildlife habitat concerns, as this has been my area of professional expertise.

Acknowledgments

The author would like to dedicate this article to the past and present faculty of the Warner College of Natural Resources and College of Agricultural Sciences, Colorado State University, Fort Collins, and to the faculty of the School of Natural Resources and the Environment at The University of Arizona, Tucson. This article is further dedicated to the memory of the late Dr Harold Goetz, former Head of the CSU Range Science Department, whom we all highly esteemed and respected, and held in such high regard. Dr Goetz is greatly and sincerely missed by all those who knew him.

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