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Relative Preference and Productivity of Species on Summer Cattle Ranges, Big Horn Mountains, Wyoming

RICHARD M. HURD AND FLOYD W. POND

Forester and Range Conservationist, respectively, Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Fort Collins, Colorado¹

Cattle ranges in the Big Horn Mountains of north central Wyoming contain many herbaceous species. Grasses, sedges, and forbs are all well represented. In general, the non-timbered areas of the cattle ranges are well covered by the herbaceous vegetation. The abundant ground cover suggests that an ample supply of palatable feed is present.

Palatability of a forage has been attributed to a number of things. In some instances, soil fertility, mineral content, sugar content, vitamin A, protein, moisture content, succulence, and fineness or coarseness of plant material, have been associated with palatability. While some workers have found palatability to be directly related to such things as phosphorus and crude protein content, others found no such relationship. Instinct of the grazing animal to choose species of the greatest value has been advanced and rejected. Ivins (1952) states that "Until such times as the theory of nutritional wisdom is con-

clusively confirmed or disapproved for such an animal as the dairy cow, then the selection of herbage by the animal is a factor which must be respected by both grassland and livestock authorities alike." Undoubtedly beef cattle and sheep, grazing on range vegetation, could also be included in this statement.

Research on livestock ranges has shown that some species are grazed readily while others are not grazed or only lightly grazed. In an attempt to so classify species on Big Horn Mountain cattle

ranges, both utilization and herbage production were studied from 1951 to 1954. This permitted the species to be ranked for preference (palatability), herbage production, and forage production.

As used here, preference is the same as palatability defined by Ivins (1952) and the Society of American Foresters (1950), in that the term includes the sum of all factors that operate to determine whether and to what degree the forage plants are consumed by domestic livestock or other animals. This differs from the concept that considers palatability to include the degree to which the plant species should be utilized under certain conditions (Inter-Agency Range Survey Committee, 1937).

The Study Area

Summer cattle ranges of the Big Horn Mountains support a variety of plant species, most of



FIGURE 1. Large brush-free openings are characteristic of much of the cattle range.

¹ Central headquarters maintained in cooperation with Colorado State University at Fort Collins. Research being reported was conducted in cooperation with the University of Wyoming, Laramie, Wyoming.

which are perennials. These ranges are characterized by large parks or openings rimmed by dense stands of lodgepole pine (*Pinus contorta*), as seen in Figure 1. Engelmann spruce (*Picea engelmannii*) and alpine fir (*Abies lasiocarpa*) are sometimes associated with the pine or may, in some cases, form the forest canopy. Willows (*Salix* spp.) are common along the drainages and in the wet meadows. Shrubby cinquefoil (*Potentilla fruticosa*) is often locally abundant. Big sagebrush (*Artemisia tridentata*) is common on some south and west slopes, particularly on soils derived from limestone. Here, as well as in the brush-free parks, perennial grasses, grasslike plants, and forbs are common. Idaho fescue (*Festuca idahoensis*) is often the dominant grass. Some of its common associates are needleleaf sedge (*Carex obtusata*), bluegrasses (*Poa* spp.), wheatgrasses (*Agropyron* spp.), needlegrasses (*Stipa* spp.), silky lupine (*Lupinus sericeus*), avens (*Geum triflorum*), starry cerastium (*Cerastium arvense*), yarrow (*Archillea lanulosa*) and herbaceous cinquefoils (*Potentilla* spp.) (Beetle, 1956, Hurd and Kissinger, 1952).

Preference studies were confined to non-timbered upland sites, since these were believed to be the principal forage producing areas. Much of the vegetation growing along stream bottoms and wet meadows is readily grazed by cattle, but such sites are relatively small in aggregate area. Timber stands, because of the tree growth and sparseness of herbaceous vegetation, are used primarily for resting, shading, and protection. The grazing season on these cattle ranges is limited to about a four-month season beginning in June and ending in late September.

Areas of investigation ranged from 7,200 to 9,000 feet in elevation. Average annual precipita-

tion varies from 19 to 30 inches, depending upon the elevation, exposure, and local topography. Soil depth is variable, as is apparent fertility and moisture holding capacity. Both granite and sedimentary parent rocks are present, and, in general, soils derived from sedimentary rocks support a greater and more diversified herbaceous vegetative cover. In addition, there are several areas where crystalline and sedimentary rocks are intermixed. In these deposits of Tertiary age (Darton, 1906) the vegetation is similar to that on residual soils formed from granite rocks.

Methods

Utilization estimates were the basis for determining species preference. The assumption was that, since cattle had a free choice of species in the sampled area, they would eat those that they liked. This in turn would be reflected in the utilization estimates. Thus, preference varied directly with utilization, and always the preference of the species could be ranked in a 1, 2, 3, order.

Utilization was determined by estimating the percentage of herbage weight the grazing animals removed from each species growing within the sample plots (Pechanec and Pickford, 1937a). The utilization transects consisted of ten 25-sq. ft. circular plots spaced approximately 50 feet apart. These transects sampled the grass-forb cover type on (1) the residual and colluvial soils from sedimentary rocks (limestones, sandstones, and shales), and (2) the residual soils from granite rocks (including here those soils derived from Tertiary deposits). The big sagebrush cover type was sampled also. It constituted the third plant-soil condition studied.

Utilization studies were made in the grass-forb vegetation in each of the 4 years of the study and in the sagebrush cover type

in 1953 and 1954. Every year utilization was estimated at the end of the grazing season on all grasses and grass-like plants. Additional estimates were made at mid-season in 1951 and 1952; at this time utilization of forbs was also estimated. In 1953, utilization was estimated on approximately July 10, August 10, September 10, and October 3. Both grasses and forbs were estimated on the first three dates, but forbs were omitted in October because most had withered.

Ground cover and herbage production were estimated on a species basis in each area sampled by utilization transects. A square frame containing 9.6 sq. ft. was used to outline individual plots, and ten such plots spaced approximately 50 feet apart constituted a transect. Cover and herbage production estimates are made at the time most of the perennial grasses had reached maximum height growth. The percentage of ground cover (vertical crown projection) was estimated for each species providing it amounted to at least 1 percent of the plot area. Lesser amounts were classified as "other grasses" or "other forbs." Herbage production for each species was estimated and recorded in grams; the technique followed was that described by Pechanec and Pickford (1937b). Herbage samples of most species were collected and air dried, so that estimated green weights could be converted to an air dry basis.

A total of 340 utilization transects and 65 cover herbage production transects were used during the 4-year period. These transects sampled 23 areas on 11 cattle allotments that ranged from 4,000 to 30,000 acres in size.

Some species were found so infrequently or in such small amounts on the sample plots that they could not be adequately evaluated. Consequently, they are omitted from the tables.

Specimens of many of the species mentioned are on deposit at

Table 1. Average preference rating of major grasses and sedges at end of grazing season—1951-54.*

Species	Preference rating		
	Grass-forb cover		Sagebrush cover
	Sedimen- -tary soils	Granit- -ic soils	Sedimen- -tary soils
Big bluegrass (<i>Poa ampla</i>)	High-1	—	High-1
Idaho fescue (<i>Festuca idahoensis</i>)	High-2	High-1	High-2
Pumpelly brome (<i>Bromus pumpellianus</i>)	High-3	—	—
Spike fescue (<i>Hesperochloa kingii</i>)	High-4	High-3	Int**-7
Wheatgrasses (<i>Agropyron</i> spp.)	Int-5	Int-4	Int-5
Sandberg/Canby bluegrass (<i>Poa secunda/canbyi</i>)	Int-6	Int-6	Int-9
Inland bluegrass (<i>Poa interior</i>)	Int-7	—	Low-13
Timber oatgrass (<i>Danthonia intermedia</i>)	Int-8	Int-5	Low-11
Subalpine needlegrass (<i>Stipa columbiana</i>)	Low-9	Int-7	High-4
Sedge (<i>Carex petasata</i>)	Low-10	Low-8	Int-8
Needleleaf sedge (<i>Carex obtusata</i>)	Low-11	Low-10	Low-12
Prairie Junegrass (<i>Koeleria cristata</i>)	Low-12	Low-9	Low-10
Needleandthread (<i>Stipa comata</i>)	—	High-2	—
Raynolds sedge (<i>Carex raynoldsi</i>)	—	—	High-3
Nodding brome (<i>Bromus anomalus</i>)	—	—	Int-6

* 1953-54 only for sagebrush.

** Intermediate.

the Rocky Mountain Herbarium, University of Wyoming, Laramie. Appreciation is extended to Dr. C. L. Porter, Curator, for identifying those species.

Results

Preference varied greatly among species. As a group, the grass and grasslike species have a higher preference than forbs. Average utilization for grasses and sedges was 21 percent, compared with 2 percent for forbs. All grasses and sedges were grazed to some extent, but many of the forbs were not. For those forb species that were grazed, the utilization averaged 8 percent.

Grasses and Sedges

Cattle were also selective in their choice of grasses and sedges. For example, throughout the 4-year period big bluegrass (*Poa ampla*) and Idaho fescue ranked high in preference. In contrast needleleaf sedge and prairie Junegrass (*Koeleria cristata*) were consistently low in preference. Wheatgrasses usually occupied an intermediate po-

sition. Thickspike wheatgrass (*Agropyron dasystachyum*) was the only wheatgrass encountered on the granitic soils. It, as well as slender wheatgrass (*A. trachycaulum*), and bearded wheatgrass (*A. subsecundum*), was found on the other two plant-soil conditions. The preference of the major grasses and sedges are given in Table 1.

Generally, soil and cover types appear to have little effect on preference (Table 1). However, the relationships are not always clear-cut. Idaho fescue and big bluegrass had a high preference wherever they grew. There was a tendency for subalpine needlegrass (*Stipa columbiana*) and the closely allied William's needlegrass (*S. williamsii*) to have a higher preference in the sagebrush cover type than in the grass-forb cover. In contrast, timber oatgrass (*Danthonia intermedia*), when growing in the sagebrush cover, had a lower preference ranking than it did on the other two plant-soil conditions. Some species were not found on all three soil-plant conditions.

Preference for a particular species did not change much as the grazing season progressed. The 1953 data, which contain four periodic observations, show that, in general, the preference position at the beginning of the grazing season is maintained. The 1951-52 supplemental information tends to support these results. However, occasional variations did occur. For example, Idaho fescue had an intermediate preference during the first half of the grazing season, but it finished with a high preference rating except on granitic soils, where it had a high preference ranking at all times. In contrast, subalpine needlegrass declined in preference as the grazing season progressed.

Heavy grazing had no material effect on preference. Usually, the preferred species were grazed more intensively, without any switch to the less palatable species. When the estimated utilization of Idaho fescue increased 15 to 60 percent, it and big bluegrass were still the preferred species. Needleleaf sedge and prairie Junegrass still had low preference ratings despite 60 to 70 per cent use of the fescue.

The high preference of Idaho fescue together with its high ranking in pounds per acre of herbage produced make it the leading forage grass (Table 2). Pumpelly brome and needleandthread, although having high preference (Table 1), occurred infrequently and in small amounts. Consequently, they were of little importance as forage producers. In contrast, those grasses having intermediate or low preference ratings but producing substantial amounts of herbage per acre, often assumed more importance as forage plants. This can be illustrated by subalpine needlegrass growing in the grass-forb-sedimentary soil condition (Tables 1 and 2). Here, it ranks low in preference, but because it is a relatively high herbage pro-

Table 2. Herbage and forage production rating for major grasses and sedges.

Species	Production rating					
	Grass-forb cover				Sagebrush cover	
	Sedimentary soils		Granitic soils		Sedimentary soils	
	Herbage	Forage	Herbage	Forage	Herbage	Forage
Idaho fescue	High-1	High-1	High-1	High-1	High-1	High-1
Wheatgrasses	High-2	High-3	Int-5	High-2	High-3	High-2
Subalpine needlegrass	High-3	Int-4	Int-6	Int-6	High-2	High-3
Big bluegrass	High-4	High-2	—	—	*	—
Sandberg/Canby bluegrass	Int-5	Int-5	High-3	High-3	Int-7	Int-6
Needleleaf sedge	Int-6	Int-6	High-2	Int-4	Int-5	Low-9
Inland bluegrass	Int-7	Int-7	—	—	*	—
Timber oatgrass	Int-8	Int-8	Int-7	Low-8	Low-9	Low-10
Sedge (<i>C. petasata</i>)	Low-9	Low-9	Low-10	Low-10	Low-10	Int-8
Prairie Junegrass	Low-10	Low-11	Int-4	Int-7	Low-11	Low-11
Pumpelly brome	Low-11	Low-10	—	—	—	—
Spike fescue	Low-12	Low-12	Low-8	Low-9	High-4	Int-5
Needleandthread	—	—	Low-9	Int-5	—	—
Raynolds sedge	—	—	—	—	Int-6	High-4
Nodding brome	—	—	—	—	Int-8	Int-7

* Not present on composition and production sample plots, although occasionally found on the more numerous utilization plots.

ducer, it assumes an intermediate position as a forage plant.

Forbs

Forbs were common in all soil-plant conditions (Fig. 2). As many as 45 species were found on the sample plots. However, only 19 species were estimated to have been utilized 1 percent or more. The average utilization of these grazed forbs ranged from 6 percent in the sagebrush cover type to 11 percent in the grass-forb-granitic soil condition.

Light and spotty grazing of forbs tends to mask clear-cut preference trends among years. However, blueleaf agoseris (*Agoseris glauca*), dandelion (*Taraxacum officinale*), and white loco (*Oxytropis sericea*) had high preference ratings. Silky lupine, one of the two dominating forbs, was grazed sporadically. In some areas all or most of the lupine leaves were removed; in other areas, no evidence of grazing was detected. This was particularly noticeable on granitic soils.

Observations suggest that grazing by mule deer and possibly by elk may contribute to

the high preference rating of such species as white loco, hoary balsamroot (*Balsamorhiza incana*), elkweed (*Frasera speciosa*), and ballhead sandwort (*Arenaria congesta*). No attempt was made to separate game use from cattle use. However, the high preference ranking of blueleaf agoseris and dandelion is attributed to cattle because of the consistency with which these species were grazed on the cattle ranges.

Utilization of forbs increased as the grazing season progressed. Based on the 1953 data, the average percentage utilization for the grazed forbs was 1, 5, and 10 percent on July 10, August 10, and September 10, respectively. Frosts made utilization estimates unreliable after September.

The importance of forbs as forage plants increased directly with an increase in the utilization of grasses and sedges. When the utilization of Idaho fescue increased from 20 to 65 percent, the pounds of forb herbage consumed increased as much as 12 times in some areas. In one sampled area where Idaho fescue was utilized 85 percent, the forbs

supplied 53 percent of the forage. In another area where Idaho fescue was utilized 20 percent, the forbs supplied 8 percent of the forage.

Silky lupine contributed 67 percent of the total forage provided by forbs. It, together with various combinations of blueleaf agoseris, white loco, and dandelion, produced 86 percent of the forb forage. Average herbage production of silky lupine during 1953 was 186 pounds per acre air dry. Blueleaf agoseris averaged 19 pounds per acre. Dandelion and white loco were abundant only in local situations.

Average forb herbage production was twice that of grasses and sedges (560 and 285 pounds per acre air dry, respectively). Forb production was least on the granitic soils. Of the forbs that were grazed, many produced small amounts of forage because of either low preference (light utilization) or small amounts of herbage produced. Some forbs, although abundant, were grazed little or not at all. Starry cerasium, pussytoes (*Antennaria rosea* and *A. media*) showy phlox (*Phlox multiflora*), paintbrushes (*Castilleja* spp.), fleabanes (*Eriogonum* spp.), and avens are examples. Avens, when growing in the grass-forb-sedimentary soil condition, produced more herbage than any other forb and yet was rarely grazed. Forbs accounted for 5, 8, and 13 percent of the forage consumed on the grass-forb-granitic, sagebrush, and grass-forb-sedimentary conditions, respectively.

Discussion

Surprisingly few species carried the major portion of the grazing load. Within the grass-forb-granitic soil condition, Idaho fescue contributed approximately 75 percent of the forage taken by cattle. Consequently, maintaining or improving the productivity of this single species appears to be of paramount importance in managing

such ranges. In the sagebrush cover type, Idaho fescue, the wheatgrasses, (largely slender wheatgrass), and subalpine needlegrass provided 65 percent of the total forage. Again, these species ranked high in preference and herbage production. A similar situation existed on the grass-forb-sedimentary soil condition, where Idaho fescue, big bluegrass, and the wheatgrasses ranked in that order as forage producers. These species provided 69 percent of the forage obtained from grasses and sedges, although as many as 17 grasses and sedges were sometimes present. Here, subalpine needlegrass ranked fourth in forage production, third in herbage production, and ninth in preference. The combination of these characteristics suggests that management practices that would cause this needlegrass to decrease and favor the increase of Idaho fescue, big bluegrass, and the wheatgrasses would result in more pounds of desirable herbage.

Forbs are a minor portion of the cattle diet even when it is assumed that cattle are responsible for all utilization. Although forbs may supply a relatively small quantity of forage, they may be of some importance nutritionally. Cook and Harris (1950) conclude that preference shown by sheep for certain types of forage was important in the nutritional value of the diet. As has been pointed out, forb utilization increases as the season progresses. Furthermore, as the utilization of the grasses and sedges increased from light to heavy, the pounds of forbs taken increased as much as 12 times in some areas. This suggests that, under these circumstances, the increase in forb utilization was due to a decrease in availability of the more highly preferred herbage rather than any tendency for the cattle to select the forbs.

The utilization of forbs and, to a large measure, grass and

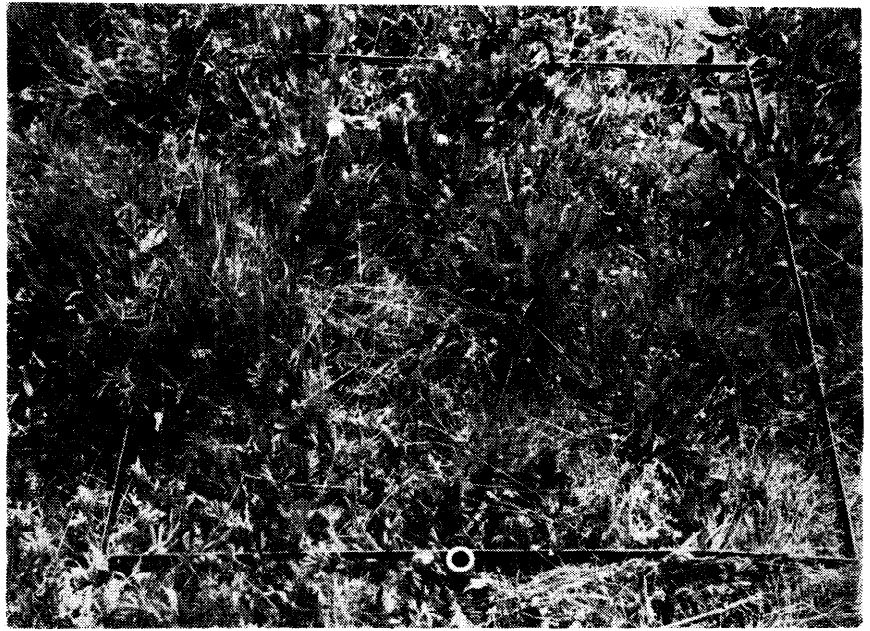


FIGURE 2. Forbs were common on the cattle ranges, produced twice as much herbage as grasses and sedges combined, and were lightly grazed.

sedges appears to hinge largely on the preference of the species itself rather than such factors as herbage production, percentage ground cover, or distribution. Several species illustrate this. Silky lupine ranked high in preference among forbs as well as in herbage production and ground cover; also, it is common on the upland sites. Avens, when in the grass-forb-sedimentary soil condition, produced more herbage than any other forb, had an 80 percent frequency (3.1 x 3.1 ft. plot) and yet was rarely grazed. Blueleaf agoseris also had an 80 percent frequency but was a minor species in the vegetative cover, and yet it ranked high in preference. Idaho fescue was abundant, uniformly distributed (91 percent frequency), provided more ground cover than any other grass or sedge and was a preferred species. In contrast, subalpine needlegrass within the grass-forb-sedimentary soil condition had a low preference, although it ranked high in herbage production and was fairly well distributed—62 percent frequency. Similar examples indicating that utilization is

due to preference rather than amount of herbage produced have been reported by Richards and Hawks (1954), Hurd and Pearse (1944), and Cook and Harris (1950).

On the cattle ranges sampled, forbs out-yield grasses and sedges approximately 2 to 1. However, only 6 percent of the total forb herbage produced was taken, and the forbs furnished 9 percent of the forage. The general conclusion, then, is that a shift in the balance toward equal production of forbs and grass-like plants would provide a considerable increase in palatable herbage. If this were achieved there would still be ample amounts of forb herbage available for selective grazing. Investigations on very lightly used areas and protected exclosures indicate that herbage production of forbs is essentially the same as that of grasses and sedges (Hurd and Kissinger, 1952).

Summary and Conclusions

From 1951 to 1954 investigations were made in the Big Horn Mountains of north central Wyoming to determine the species preferred by cattle grazing on

upland sites. Utilization estimates formed the basis for giving species a preference rating. In addition, herbage production was estimated for individual species. Utilization estimate multiplied by herbage production for a species indicated the importance of the species as a forage plant. A total of 340 ten-plot transects were used for the preference work, and 65 transects, for herbage production. These transects sampled 23 areas on 11 cattle allotments ranging from 4,000 to 30,000 acres in size.

Grasses and sedges were preferred to forbs. Within the grass-sedge group, some species were consistently high in preference while others were low. Throughout the 4-year period, both Idaho fescue and big bluegrass were preferred grasses wherever they occurred. Wheatgrasses were generally in the intermediate preference category, while needleleaf sedge and prairie June-grass were least preferred.

Generally, there were no striking changes in preference for grass-sedge species as the grazing season progressed. Similarly, no preference changes were noticeable when the grazing pressure increased; instead, the preferred species were grazed more closely.

Idaho fescue was the number one forage plant. On granitic soils, it alone supplied 75 percent of the forage. On the other two plant-soil conditions, it, together with the wheatgrasses,

big bluegrass, and subalpine needlegrass, provided 65 to 70 percent of the forage.

Forbs, although abundant, were generally lightly grazed. Estimated utilization averaged 8 percent for those species grazed 1 percent or more. Many species were not grazed. Blueleaf agoseris, dandelion, silvery lupine, and white loco were the preferred species. Various combinations of these four species account for 86 percent of the forb forage.

Forb herbage production was double that of the grass-sedge group. However, only about 6 percent of it was eaten. As grazing pressure increased on the grass-sedge group, the utilization of forbs rose. Under these conditions, silvery lupine became an important producer of forage.

Utilization of a species did not appear to be influenced by frequency, abundance, or amount of herbage produced. A species was selected or rejected by cattle because of its preference or palatability. Accordingly, those species having a relatively high preference and high herbage production were the important forage producers. Management practices should be aimed at maintaining or improving the production of these important forage species.

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CALL FOR PAPERS FOR THE 1959 ANNUAL MEETING

Members who wish to present papers at the next annual meeting of the Society to be held in Tulsa, Oklahoma, in January 1959, are requested to submit titles and short abstracts to the Program Committee. Final date for titles to reach the Committee is July 15, 1958.—E. H. McILVAIN, Chairman Program Committee, U. S. Southern Great Plains Field Station, Woodward, Oklahoma.