

## HEIGHT-VOLUME DISTRIBUTION IN RANGE GRASSES

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There are 137 million acres of usable range in Arizona and New Mexico, and livestock production is an outstanding industry in the Southwest. Basic resources of this industry are the soils and the vegetation they support. Continued production of range grasses is, in a large measure, dependent on forage utilization. The importance of knowing what constitutes proper use of a given kind of grass and of having an accurate method of measuring its utilization becomes evident when one realizes that a 10-per cent variation in the use of the herbage volume may result in continued productivity or gradual death of the plant.

PERCENTAGES have long been used to express degree of utilization. The various methods of determining percentage utilization in range grasses have been discussed by Pechanec and Pickford<sup>2</sup> and others. The palatability ratings assigned to various forage grasses express the percentage of herbage that is grazed when use is proper. Most grazing men interpret the palatability percentages as referring to volume; a few maintain that the percentages refer to height; still others think that height and volume are analogous, and it therefore makes little difference whether percentages refer to height or to volume. In actual practice, range examiners use height reduction as a guide in estimating utilization without taking into full consideration the true relationship between height and volume in the species concerned. There is a tendency to conclude that if the percentage height reduction is equivalent to the palatability rating the grass is properly grazed.

In order to tentatively determine the relationship between height and volume in certain important southwestern range grasses, and to develop a possible method for measuring volume utilization in the

field, preliminary clipping studies, similar to those developed by Lommasson and Jensen,<sup>3</sup> were initiated in 1937 at four points in Arizona and New Mexico.

### PROCEDURE

In these studies, from 2 to 20 tufts of each species were clipped when mature at 1- or 2-inch intervals from the top of the tallest flower stalk to the ground surface. The herbage in each clipping interval was air dried and weighed. The relation between the dry weight of each clip and the total dry weight of the tuft was then computed and expressed in percentage. Weight was used to represent volume, because the two are highly correlated in range grasses. After the percentage of total volume in each clipping interval had been determined, it was possible to relate percentage of height to percentage of volume.

The grasses selected for clipping were chosen because of their importance on southwestern grazing lands and particularly on national-forest ranges. All the species, except possibly Rothrock grama, are key utilization indicator plants, and these are listed below in the approximate

<sup>1</sup>Maintained at Tucson, Arizona, by the Forest Service, U. S. Department of Agriculture in cooperation with the University of Arizona, and covering Arizona, New Mexico, and the western third of Texas.

<sup>2</sup>Pechanec, J. F., and G. D. Pickford. A comparison of some methods used in determining percentage utilization of range grasses. Jour. Agric. Research 54:753-765. 1937.

<sup>3</sup>Lommasson, T., and C. Jensen. Grass volume tables for determining range utilization. Science 87:444. 1938.

order of their importance on southwestern national forests.

1. *Bouteloua gracilis*—Blue grama
2. *Muhlenbergia montana*—Mountain muhly
3. *Festuca arizonica*—Arizona fescue
4. *Bouteloua eriopoda*—Black grama
5. *Bouteloua curtipendula*—Side-oats grama
6. *Hilaria belangeri*—Curly-mesquite
7. *Lycurus phleoides*—Wolf-tail
8. *Bouteloua hirsuta*—Hairy grama
9. *Muhlenbergia emersleyi*—Bullgrass
10. *Hilaria mutica*—Tobosa
11. *Bouteloua rothrockii*—Rothrock grama

Grass numbers 1, 2, and 3 were clipped near the Fort Valley Experimental Range on the Coconino and Kaibab National Forests in northern Arizona. Grass numbers 1, 4, 6, and 11 were clipped on the Santa Rita Experimental Range bordering the Coronado National Forest in southern Arizona. Grass numbers 4 and 10 were clipped on the Jornada Experimental Range in southern New Mexico, and grass numbers 5, 7, 8, and 9 were clipped near the Parker Creek Experimental Forest on the Tonto National Forest in central Arizona.

### RESULTS

Blue grama is the most important forage plant in the region, being the dominant species on about 35 per cent of the usable range in Arizona and New Mexico, and for this reason it will be discussed in more detail than the other species.

Figure 1 presents the blue-grama clipping results. The average height of the tallest blue-grama flower stalks was 24 inches, as can be read from the first and fifth columns of the table in which the one column is the complement of the other. The first column is to be read from the bottom up and the other from the top down. Columns 2 and 6 simply express the height in percents instead of inches. The two center columns give the percentage of volume left or taken and

these columns also complement each other. From the table it may be noted that when 92 per cent of the height growth is taken (col. 6), 55 per cent of the volume will be taken (col. 4), 45 per cent of the volume will be left (col. 3), and the grass may be grazed evenly to 2 inches above the ground (col. 1). The curve of the chart presents columns 4 and 6 of the table. It is plain from both the chart and the table that the volume is concentrated near the ground surface and that there is considerable spread between 85 per cent (accepted palatability rating) of the height and the same percentage of volume. If volume were evenly distributed throughout the height, the curve would be a straight line at a 45° angle.

The same data may be presented in another form (Fig. 2) which illustrates how closely to the ground blue grama is grazed when 85 per cent of its volume is taken. It rather commonly has been accepted that in order to utilize 85 per cent of the herbage blue grama should be cropped to about 2 inches above the ground, with about 25 per cent of the flower stalks left standing. But actually, only 55 per cent of the forage will be utilized when the grass is grazed uniformly to 2 inches, even if all the flower stalks are taken, as is shown in Figures 1 and 2.

Results in all other species resemble those for blue grama. The curve of height against volume approaches a parabola in every case, and there is always a great concentration of volume close to the ground. The volume is better spread out in Rothrock grama than in any other species, and even, in this grass, 20 per cent of the volume occurs in the lowest 10 per cent of the height (Fig. 3). In general only 15 per cent of the volume is in the upper 50 per cent of the height; 65 per cent of the volume is in the lowest 25 per cent of the height, and 37 per cent of the volume occurs in the lowest 10 per cent of the height. Height was always measured from the tallest flowerstalk, and

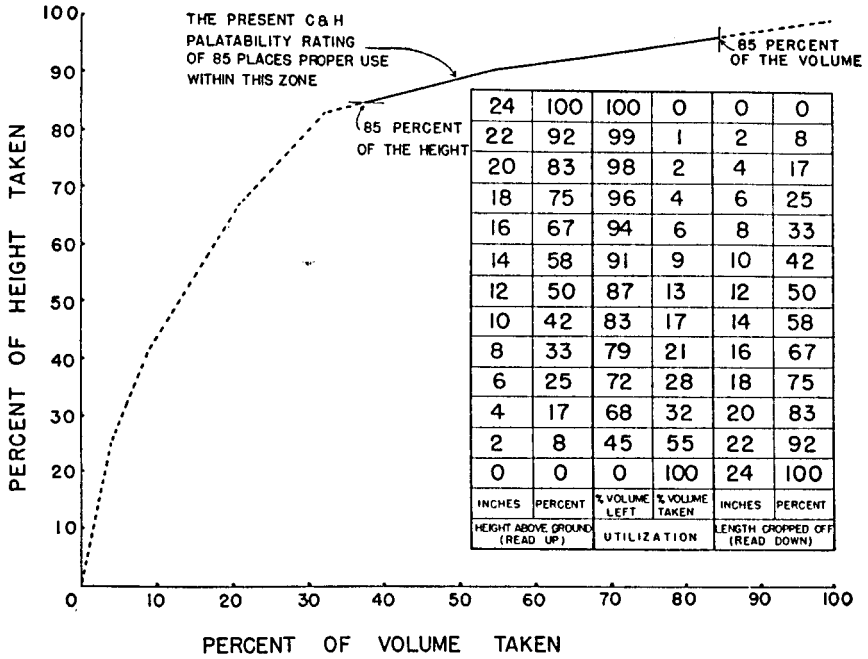


Fig. 1.—Blue grama (*Bouteloua gracilis*) utilization table and chart.

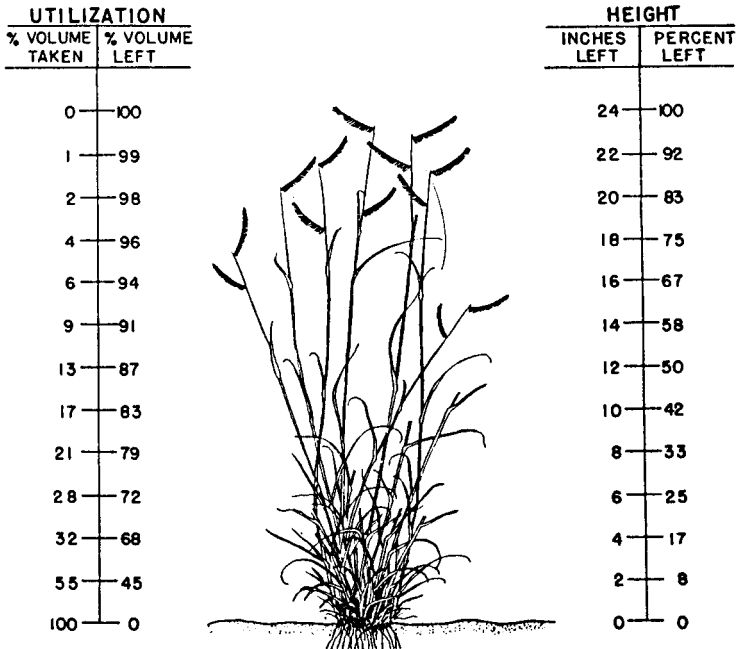


Fig. 2.—Blue grama (*Bouteloua gracilis*) volume distribution in relation to height.

this emphasizes the concentration of volume at the lower height levels. The data collected were not sufficient for statistical analysis, but results of the tentative height-volume determinations are similar for all species and this gives them added significance.

Height-volume calculating charts were prepared for 8 of the 11 species studied (Fig. 3). The dotted lines block out the zones of difference between the palatability percentage of the volume and the same percentage of the height. If palatability percentages are correct, proper use for each species lies within this zone of difference. These charts facilitate the field determination of volume utilization. From simple measurements with a ruler, the average height of the tallest flower stalks on ungrazed range, and the average forage height on grazed range may be obtained. From these two figures compute the per-

centage height taken, and read opposite this percentage on the chart the corresponding percentage volume taken.

CONCLUSIONS

1. In the 11 grasses clipped there is similar concentration of herbage volume at the lower height levels.
2. Because volume is not evenly distributed throughout the height growth, it is erroneous to apply volume palatability percentages to height without using a converting factor.
3. Line-charts which relate height to volume offer a simple and fairly satisfactory field method of determining volume utilization of range grasses.
4. The accuracy with which height measurements can be made in the field and the variation in volume distribution by height classes are limiting factors needing further study.

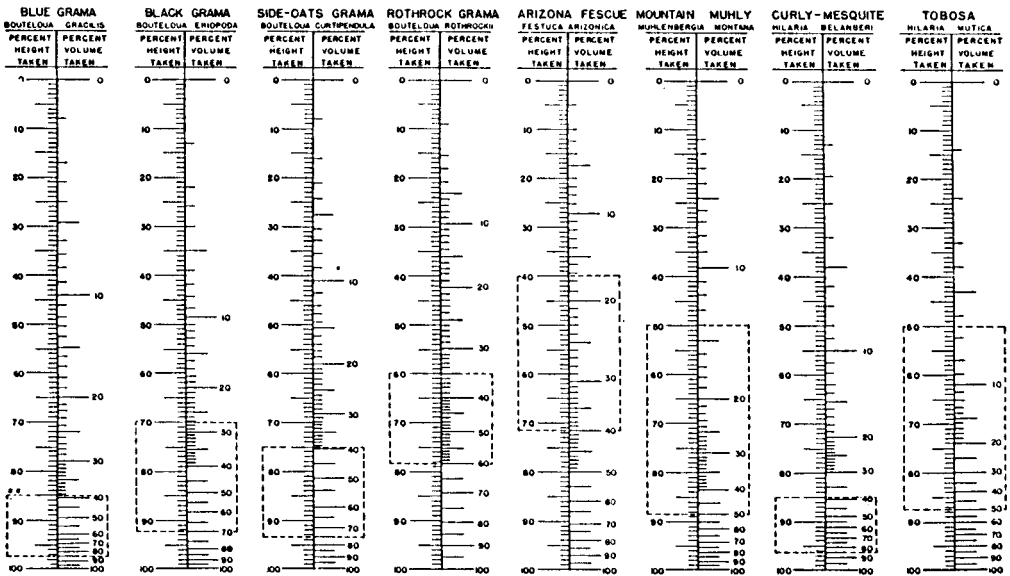


Fig. 3—Range utilization calculating charts. Height-volume distribution.