

Journal of RANGE MANAGEMENT

Grazing Intensity Trials on Seeded Ranges In the Ponderosa Pine Zone of Colorado

W. M. JOHNSON

Range Conservationist, Rocky Mountain Forest and
Range Experiment Station¹, Fort Collins, Colorado.

Seeding ranges for the improvement of forage values is now a recognized practice. Depleted ranges and abandoned farmlands in the ponderosa pine zone of Colorado can be successfully seeded (Hull and Johnson, 1955). The kind of grass to plant, when, where, and how, have been determined through research, but comparable information on how to graze seeded ranges is scarce. Proper grazing use of established stands is essential to good management.

The Rocky Mountain Forest and Range Experiment Station conducted a study to determine the proper degrees of grazing use on some of the more important grasses used in seeding. The study was made from 1946 to 1956 at the Manitou Experimental Forest, 28 miles northwest of Colorado Springs, Colorado.

Seeded Ranges

Seeded ranges consisting of four separate grasses and one mixture were established on abandoned fields. Crested wheat-

grass (*Agropyron cristatum*), smooth brome (*Bromus inermis*) and a mixture consisting of two parts crested wheatgrass, two parts smooth brome, and one part yellow sweetclover (*Melilotus officinalis*) were planted in the spring of 1946. Intermediate wheatgrass (*Agropyron intermedium*) was planted in the spring of 1948. Russian wildrye (*Elymus junceus*) was planted in the spring of 1949. All seedings were given two complete growing seasons to become established before the grazing treatments were applied.

The study consisted of two blocks of experimental paddocks or units. In each block each species and the mixture were planted in a 10-acre area. The 10 acres were subdivided into one 5-acre unit for moderate stocking, one 3-acre unit for light stocking, and one 2-acre unit for heavy stocking.

Grazing Procedure

Grasses were grazed to certain stubble heights to represent the different grazing intensities. For all ranges except those seeded to Russian wildrye, these stubble heights were established as 2 inches to represent heavy grazing, 4 inches for moderate grazing, and 6 inches for light grazing. Corresponding stubble

heights for the shorter Russian wildrye were 1½ inches, 3 inches, and 4½ inches. Growth rate exceeded the rate of utilization, so that at the peak of growth leaf heights were usually well in excess of the prescribed stubble heights. Stubble height measurements were converted to percent-volume utilization by height-weight tables (Lommason and Jensen, 1943).

Following these guides, grazing ordinarily commenced in late April or early May, and continued through to the end of October. In years of low yields, however, cattle were removed somewhat earlier or intermittently as the desired stubble heights were reached.

Four yearling Hereford heifers were assigned at random to each 10-acre area. They were divided into two groups of two animals and rotated at weekly intervals in such a manner that two animals were always on the moderate-use unit. Grazing on the light- and heavy-use units was on a "week-on, week-off" rotation.

Whenever possible, heifers were placed on the seeded range when leaf height in the lightly-grazed units averaged 4 inches. This was sometimes delayed because of spring snow storms. They were left on the experimental areas, following the prescribed rotation, until the desired utilization was obtained. If sufficient regrowth occurred after the heifers were removed, they were again put on the range and the areas were re-grazed.

Response of the grasses to grazing intensity was measured

¹Maintained by the Forest Service, U. S. Department of Agriculture, in cooperation with Colorado State University, Fort Collins, Colorado. Author stationed at Laramie, Wyoming, in cooperation with University of Wyoming.

in terms of herbage production and vigor. These were measured each year.

The prescribed stubble heights were obtained within reasonable limits of variation. Average stubble heights at the end of the grazing period seldom varied more than 0.2 inch from the prescribed amount, except on the areas grazed to a 6-inch stubble height. Here the maximum average variation for any grass and any year was 1 inch. In most cases the deviation was within 0.5 inch of the 6-inch height.

Utilization

Utilization, when expressed as percentage of weight removed, varied greatly from year to year (Table 1). This was to be expected since the utilization goals were based on leaving an almost constant volume of the grasses ungrazed regardless of the amount of growth during the year. During years of poor growth, such as 1951, the percentage of herbage removed was very low. When the grasses made good growth, as in 1949, the percentage of herbage removed was high.

On crested wheatgrass, utilization averaged 67 percent for the 2-inch stubble height treatment, but varied from 45 percent to 84 percent. Average utilization for the 4-inch stubble height units was 46 percent; and for the 6-inch treatment, 31 percent. Variation between years for the 4- and 6-inch treatments was of about the same magnitude as for the 2-inch treatment.

Herbage utilization on smooth brome averaged 61 percent for the 2-inch stubble height treatment, 41 percent for the 4-inch stubble height, and 31 percent for the 6-inch stubble height. The variation between years was even greater than on crested wheatgrass. For example, the percent utilization on the 2-inch stubble height treatments varied from 32 percent in 1951 to 82 percent in 1949.

Table 1. Percent utilization of herbage on seeded ranges, 1949 to 1955, Manitou Experimental Forest.

Species	Stubble height Inches	Utilization							Average
		1949	1950	1951	1952	1953	1954	1955	
Crested wheatgrass	2	84	77	45	65	67	62	66	67
	4	69	66	32	36	46	32	40	46
	6	59	52	20	20	32	15	22	31
Smooth brome	2	82	69	32	62	58	59	64	61
	4	63	49	11	46	40	35	43	41
	6	56	37	10	35	31	25	25	31
Mixture	2	84	73	38	66	66	60	66	65
	4	66	54	30	49	46	39	36	46
	6	59	43	18	41	32	30	19	35
Intermediate wheatgrass	2	....	79	48	70	48	65	66	63
	4	....	66	31	46	36	52	50	47
	6	....	55	20	35	21	30	34	33
Russian wildrye	1½	....	....	39	42	50	33	41	41
	3	....	....	16	31	20	13	21	20
	4½	....	....	12	17	10	4	10	11

Utilization on the mixture units was similar to that on the smooth brome and crested wheatgrass units. Utilization averaged 65 percent on the 2-inch stubble height, 46 percent on the 4-inch stubble height, and 35 percent on the 6-inch stubble height. Variation in use between years was of about the same magnitude as for crested wheatgrass.

There was considerable difference in the utilization of crested wheatgrass and smooth brome in the mixture units, especially in the 4- and 6-inch stubble height treatments. Smooth brome was grazed more closely than crested wheatgrass. Comparative average stubble heights for the two grasses were:

Stubble height in inches	Actual stubble height in inches	
	Crested wheatgrass	Smooth brome
2	2.2	1.8
4	4.4	3.5
6	6.5	4.0

This indicates a preference by cattle for the smooth brome.

Utilization on the intermediate wheatgrass followed the same

pattern as on the other grasses. For the 2-inch stubble height, percent utilization averaged 63 percent, 47 percent on the 4-inch stubble, and 33 percent on the 6-inch stubble.

Average utilization of Russian wildrye was 41 percent on heavily grazed units, 20 percent on moderately grazed units, and 11 percent on the lightly grazed units. Because of the shorter type of growth, these rates of use were considerably less than those for other grasses. Variation in use from year to year was also less than for other grasses, because there was less variation in the height growth of the leaves.

Vigor

Plant vigor as reflected in height growth is often used as a measure of the effect of grazing intensity (Short and Woolfolk, 1956). In this study, leaf height at the start of the grazing period was used as an indication of relative vigor.

On crested wheatgrass grazed to a 2-inch stubble height during the last 7 years, the average ini-

tial height growth was 3.8 inches as compared with 4.5 inches for the 6-inch stubble height, and 4.4 inches for the 4-inch stubble height.

Similar differences in vigor were observed on all of the other grasses in the study, but the amount of change varied with the kind of grass. Comparable average initial heights for the four grasses are as follows:

Species	Treatment		
	2-inch	4-inch	6-inch
Crested wheatgrass	3.8	4.4	4.5
Smooth brome	3.4	4.1	4.2
Intermediate wheatgrass	3.6	4.4	4.5
Russian wildrye	3.8	4.2	4.2

Differences in initial height growth were most pronounced in intermediate wheatgrass and least in Russian wildrye. It is also apparent that the 4- and 6-inch stubble height treatments had no effect on height growth.

The initial heights of leaves showed a definite relation to grazing intensity and indicated that plant vigor was decreased or that initial rates of growth of all species were at least slowed down by the heavier rates of grazing.

Herbage Production

Herbage yields were obtained from plots protected from current grazing by portable enclosures or cages and clipped at maturity, air-dried, and weighed. Regrowth produced in 1953 was also harvested and added to the first clipping to give total production. Herbage yields of all the grasses varied widely.

After the initial period of establishment, rainfall seems to be the most important single factor in determining herbage yields (Fig. 1). During the third year after planting, the yield of herbage from all grasses except Russian wildrye reached a peak of

production, then stabilized in relation to rainfall. Yields of Russian wildrye continued to increase until the fifth year. However, precipitation also increased during the fourth and fifth years after the low of 9.70 inches in the third year; hence, the difference shown may be a response to increased moisture.

The peak yield for the crested wheatgrass, smooth brome, and mixture occurred in 1948; for intermediate wheatgrass in 1950, and for Russian wildrye in 1953. It would appear that during the first and second years the root systems are being established and by the third year are sufficiently strong to make full use of the available soil moisture. Average herbage yield for crested wheatgrass from all treatments ranged from 593 to 2,938

pounds per acre. For the other grasses it was as follows: smooth brome, 347 to 2,320 pounds per acre; mixture, 537 to 3,314 pounds per acre; intermediate wheatgrass, 406 to 1,769 pounds per acre; and for Russian wildrye, 506 to 1,683 pounds per acre. Regrowth was produced by all species in 1953 and was especially high in Russian wildrye, contributing 47 percent to total production.

During the period from 1947 to 1950, the mixture produced significantly more herbage than either the crested wheatgrass or smooth brome plantings. It is believed that the addition of the yellow sweetclover to the mixture of crested wheatgrass and smooth brome was largely responsible for the increase in yields.

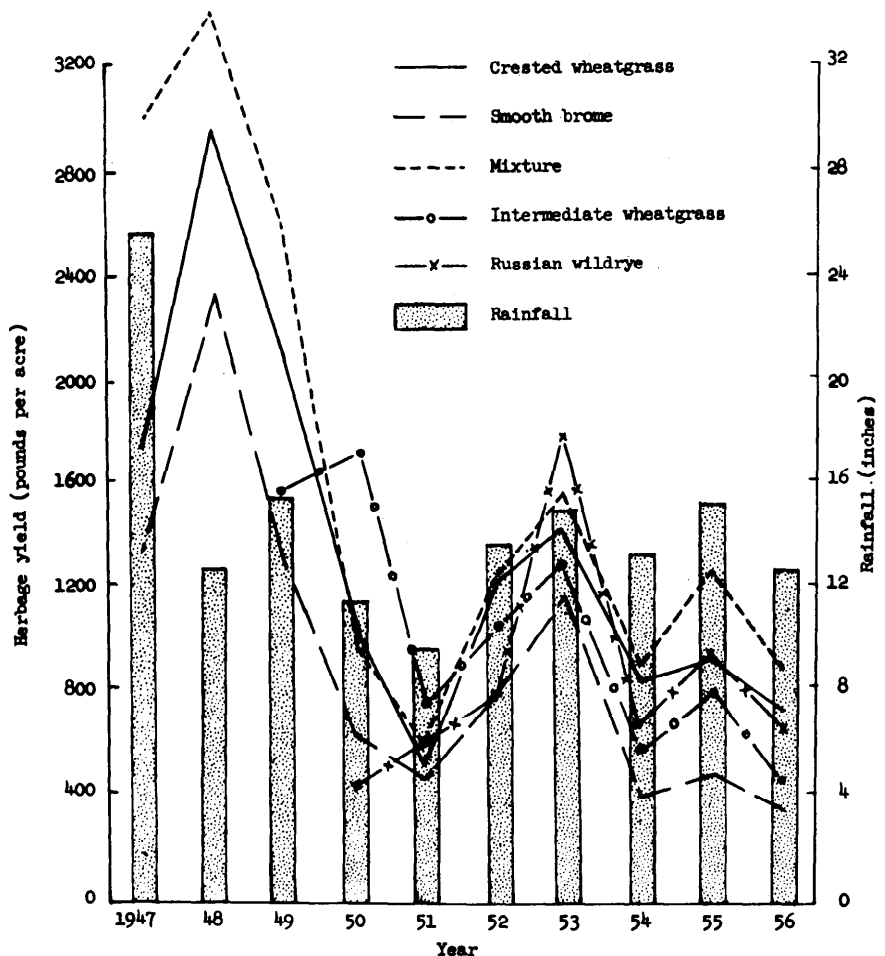


FIGURE 1. Average herbage yield of seeded grasses in relation to rainfall, Manitou Experimental Forest.

Grazing Intensity and Herbage Yields

Grazing crested wheatgrass to a 2-inch stubble height had little effect on herbage even after 9 years of use (Table 2). Under this intensity of grazing, all of the plants in the units were grazed rather uniformly. During some years, such as 1950, 1951, 1953, 1954, and 1956, yields were lower, but in other years yields tended to equal or exceed those from areas receiving the other treatments. Grazing use in the 4- and 6-inch stubble height treatments was very spotty. Some plants were grazed very closely, while others were untouched. Those plants left ungrazed one year were not grazed the following year because of the accumulation of old growth. This condition was corrected by mowing in early spring to remove the old growth in an attempt to obtain relatively uniform grazing.

In comparison with the 4- and 6-inch grazing treatments, smooth brome began to decline

in yield under the 2-inch treatment in 1952, but the big decrease was first noticeable in 1954. During the rest of the study, yields on areas grazed to 2-inch stubble were approximately half the yields on the areas grazed to 4- or 6-inch stubble heights. There was no significant difference between the yield of the areas grazed to the 4- and 6-inch stubble heights.

No significant decreases in herbage yield have occurred on the mixture pastures as a result of the grazing treatments. Yields decreased under all intensities of grazing from the high levels that were characteristic of the early years of the study. At the time of establishment the grass stands consisted of almost equal quantities of crested wheatgrass and smooth brome, and in 1950 the yield consisted of 522 pounds per acre of crested wheatgrass and 501 pounds per acre of smooth brome. By 1955, crested wheatgrass was producing 1,183 pounds per acre, as compared with 41

pounds for smooth brome. At this time, the mixture under all intensities of grazing was predominantly crested wheatgrass, and the few plants of smooth brome that remained were very low in vigor (Fig. 2).

As far as can be determined at the present time, the herbage yield of Russian wildrye has not been affected by any of the prescribed grazing intensities. Fluctuations in yield have occurred as a result of rainfall variation, but are not related to grazing use.

Damaging effects of grazing to a 2-inch stubble height were reflected in herbage yields of intermediate wheatgrass as early as the fourth year of grazing. By 1955, the sixth year of grazing, yields on the 2-inch stubble height treatment were only about one-third as much as on the lighter intensities of use. In 1956 the yield on areas grazed to a 4-inch stubble height were very low, but prior to 1956 they had not been significantly different

Table 2. Effect of grazing intensity on herbage production from seeded ranges and average of all units, 1947-1956, Manitou Experimental Forest.

Species	Grazing intensity as stubble height Inches	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
		Pounds per acre (air dry)									
Crested wheatgrass	2	1658	3293	2025	964	536	1210	1085	579	957	599
	4	1947	2640	1902	1045	618	1138	1422	848	828	683
	6	1610	2881	2347	1202	626	1237	1691	986	776	765
Average		1738	2938	2091	1070	593	1195	1399	804	854	682
Smooth brome	2	1439	2352	1330	627	410	596	918	259	264	253
	4	1274	2334	1432	734	470	832	975	454	548	413
	6	1182	2275	1162	647	443	820	1404	459	531	376
Average		1298	2320	1308	669	441	749	1120	391	448	347
Mixture	2	2972	3577	2017	933	440	1121	1398	615	1151	616
	4	3306	2721	2801	1120	604	1385	1575	837	1179	946
	6	2622	3645	2938	1017	568	1163	1666	941	1342	910
Average		2967	3314	2585	1023	537	1223	1546	798	1224	824
Intermediate wheatgrass	2	.....	.....	.....	1592	572	749	721	282	379	274
	4	.....	.....	.....	1954	809	1087	1630	835	937	367
	6	.....	.....	.....	1761	751	1230	1406	575	1074	576
Average				1769	711	1022	1252	564	797	406	
Russian wildrye	1½	.....	.....	.....	.....	475	685	1607	599	770	598
	3	.....	.....	.....	.....	532	839	1620	526	841	708
	4½	.....	.....	.....	.....	510	734	1824	743	1008	626
Average					506	753	1683	623	873	644	

from yields on the lightly grazed unit.

Stocking Rates

An average of 45.6 heifer-days per acre was obtained by grazing crested wheatgrass to a 2-inch stubble for 7 years. However, the fluctuations in use between years was very wide and, as expected, correlated closely with herbage yield. The least stocking for this degree of use was 19.5 heifer-days per acre in 1954, and the greatest was 63.0 heifer-days per acre in 1949 (Table 3). Average stocking for the 4- and 6-inch stubble heights was 32.0 and 27.3 heifer-days per acre, respectively. No definite trends in use as related to grazing intensity are shown by the data on crested wheatgrass. Throughout the study the number of heifer-days of grazing per acre was highest on the 2-inch stubble treatment, moderate on the 4-inch, and least on the 6-inch.

Unlike crested wheatgrass, the animal-months obtained from smooth brome reflect the effect of the different intensities of use. In the beginning, there was a relatively wide difference in stocking between the 2- and 4-

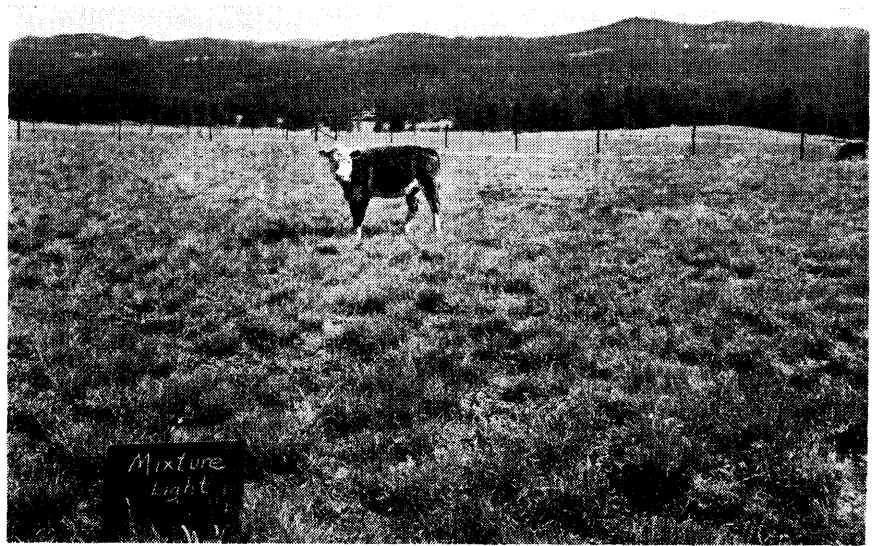


FIGURE 2. Original grass in the mixture pastures was half smooth brome and half crested wheatgrass. In 1955, smooth brome was confined to a few scattered plants and crested wheatgrass had taken over the site.

inch treatments. This difference was gradually reduced until in 1954 the two treatments required about the same stocking to give the required grazing intensities. In 1955, the 4-inch treatment actually produced more animal-months. This follows the same trend established for herbage yields. It further substantiates the conclusion that grazing smooth brome to a 2-inch stubble height is injurious to the plants.

Stocking on the areas seeded

to the mixture averaged higher than that of the other seeded areas. The 2-inch intensity averaged 47.2 heifer-days per acre; the 4-inch intensity averaged 36.6; and the 6-inch intensity, 30.7. The higher stocking occurred during the early part of the study, while yellow sweet-clover was still present and while smooth brome was still an important part of the forage. During the latter part of the study stocking on the mixture remained high, but was exceeded occasionally by other grasses.

Average stocking of the intermediate wheatgrass areas was 32.3 heifer-days per acre for the 2-inch intensity, 34.3 for the 4-inch intensity, and 29.2 for the 6-inch intensity. The decrease in stocking on the 2-inch grazing intensity was much more rapid and more pronounced than on smooth brome. During the second year of grazing, the 2-inch units had a lower stocking than the 4-inch units and, by 1955, had only about one-third the stocking of the 4-inch units (Fig. 3). This rapid and pronounced decrease, and the related decrease in herbage yield, illustrate the extreme susceptibility of this grass to heavy grazing.

Table 3. Heifer-days of grazing on seeded ranges, 1949-1955. Manitou Experimental Forest

Species	Stubble height	Heifer-days per acre								
		1949	1950	1951	1952	1953	1954	1955	Average	
	<i>Inches</i>				<i>Number</i>					
Crested wheatgrass	2	63.0	48.5	33.0	54.5	49.2	19.5	51.2	45.6	
	4	52.4	32.6	25.1	41.0	25.1	19.6	28.5	32.0	
	6	46.6	23.3	21.8	32.7	22.0	22.0	23.0	27.3	
Smooth brome	2	55.0	39.2	22.0	28.0	24.2	14.0	18.2	28.7	
	4	43.4	26.3	16.8	26.2	21.8	14.0	19.5	24.0	
	6	30.6	18.7	14.0	17.3	19.0	10.0	22.5	18.9	
Mixture	2	68.5	50.5	33.2	50.0	51.2	22.0	55.2	47.2	
	4	65.8	33.6	22.3	38.2	32.2	19.4	44.9	36.6	
	6	51.3	24.6	17.0	31.0	24.0	22.0	45.0	30.7	
Intermediate wheatgrass	2	.....	64.5	27.5	39.2	35.2	14.0	13.7	32.3
	4	.....	46.8	31.2	38.1	35.0	21.2	33.8	34.3
	6	.....	40.6	22.6	31.0	39.2	16.0	25.6	29.2
Russian wildrye	1½	.....	.....	39.7	48.2	53.0	36.5	52.2	45.9
	3	.....	.....	27.5	36.2	39.0	26.4	39.9	33.8
	4½	.....	.....	21.3	34.5	37.5	23.7	37.2	30.8

pounds of gain per acre; crested wheatgrass, 51.0 pounds; intermediate wheatgrass, 51.1 pounds; Russian wildrye, 50.2 pounds; and smooth brome, 36.7 pounds. Native ranges on the Manitou Experimental Forest have averaged 12.7 pounds gain per acre. However, these include forest types as well as grassland, so are not directly comparable. Gain per acre is a function primarily of stocking which, in turn, is determined by herbage yield. For this reason, the fluctuation in gain per acre is closely related to fluctuation in herbage yield.

Discussion and Summary

Successful seeding of depleted farm and rangelands results in highly productive ranges. The yield of herbage can be increased manyfold and may be increased 3 to 5 times over that of good adjoining native range. Grazing capacities and beef production are also greatly increased. Successful seeding of a few acres of land may thus be sufficient to fill existing gaps in the yearlong feed program for livestock. It may provide needed forage for spring or fall use, or supplement summer grazing lands, or furnish additional hay for winter feeding.

However, seeding is not a cure-all for the problems of the livestock operator. It in itself creates

additional problems of management that require careful consideration and wise planning.

One of the biggest problems centers around the large fluctuation in herbage yield from one year to the next. Herbage yields of crested wheatgrass, for instance, varied from 600 pounds per acre to 2,900 pounds per acre. Great flexibility in herd management would be needed to make wise and efficient use of the forage available.

Crested wheatgrass was grazed to a 2-inch stubble height without seriously injuring the ability of the grass to grow and produce normal amounts of herbage. At this rate of grazing, there was some reduction in the initial growth rate, but this was apparently overcome during the growing season and was not reflected in total herbage yields. Grazing crested wheatgrass to 4- or 6-inch stubble heights was not efficient from the standpoint of beef production and presented problems in uneven use of the forage. The relation of these grazing intensities to longtime range maintenance was not determined, but it was observed that the 2-inch stubble left very little litter for maintaining good soil conditions.

A 4-inch stubble should be left on smooth brome. Closer grazing injures the plants. Vigor, as

measured by early leaf growth, is reduced and herbage yields are lowered.

Intermediate wheatgrass is injured quickly and seriously when grazed during the spring and summer to a 2-inch stubble height. Plant vigor as measured by initial height growth and herbage yields was greatly reduced after only 2 years of grazing to this intensity. Grazing to a 4-inch stubble height did not appear to injure the plants.

Only 6 years of record are available for interpreting results on Russian wildrye, but so far grazing to a 1½-inch stubble height has had little effect on herbage yield and, therefore, little effect on stocking rates. Perhaps a more conservative grazing use, say 2 inches, would be a safer approach until more definite results are available.

LITERATURE CITED

- HULL, A. C., JR. AND W. M. JOHNSON. 1955. Range seeding in the ponderosa pine zone in Colorado. U. S. Dept. Agr. Cir. 953. 40 pp.
- LOMMASSON, T. AND CHANDLER JENSEN. 1943. Determining utilization of range grasses by height-weight tables. Jour. Forestry 41: 589-593.
- SHORT, L. R. AND E. J. WOOLFOLK. 1956. Plant vigor as a criterion of range condition. Jour. Range Mangt. 9:66-69.

NEWLY ELECTED SOCIETY OFFICERS FOR 1959

Officers of the American Society of Range Management elected for the year 1959 are:

President: DONALD F. HERVEY, Colorado State University, Fort Collins, Colorado.

Vice President: FRED H. KENNEDY, U. S. Forest Service, Albuquerque, New Mexico.

Board of Directors, 1959-61:

JOHN G. CHOHLIS, Western Livestock Journal, Sacramento, California.

C. H. MCKINNON, Rancher, Calgary, Alberta, Canada.