Cheatgrass Range in Southern Idaho: Seasonal Cattle Gains and Grazing Capacities

R. B. MURRAY AND J. O. KLEMMEDSON[1]

Associate Range Scientist and Range Scientist, Intermountain Forest and Range Experiment Station, Forest Service, U.S. Dep. Agr., Boise, Idaho.

Highlight

Yearling cattle gained weight satisfactorily on cheatgrass range under rotational (moderate) and continuous (moderate and heavy) grazing systems during a 3-year study. This study was designed to determine effects of these systems on the rangeland—not on individual plant species. Assignment of these systems to different pastures each year precluded evaluation of long-term vegetal response to the treatments. Weight gain was greatest in late spring. Grazing capacity of the range and cattle gain per acre increased through the summer, then declined. Yearly variation in production of forage and beef was apparently due to weather. Grazing capacity and beef production increased under continuous heavy grazing, but possible vegetation changes not evaluated in this study make heavy grazing undesirable.

The maintenance or improvement of cheatgrass range, and efficient use of the vegetation, is an important goal of range management in the Intermountain and Columbia basins. In 1960 the Bureau of Land Management, U. S. Department of the Interior, and the Intermountain Forest and Range Experiment Station, Forest Service, U. S. Department of Agriculture, began a cooperative research project to explore ways to improve management of cheatgrass ranges. One of many objectives of this research is to measure livestock gains and grazing capacities on cheatgrass range. This information is essential for management planning. In this paper we report the results of studies relating cattle gain and grazing capacity to season of use under rotation and continuous grazing. At the outset, it should be emphasized that the rangeland dominated by cheatgrass (*Bromus tectorum* L.)[2], and not the plant itself, was the subject of this study.

Cheatgrass range occurs widely in the Intermountain and Columbia basins and supports large numbers of livestock. In this region, cheatgrass range provides the bulk of spring grazing for all classes of stock and is especially important as spring lambing range. Hull and Pechanec (1947) considered cheatgrass the most important forage plant in southern Idaho, mainly because it dominates such a large area, but many associated species are seasonally or periodically valuable forage, depending on weather cycles and other factors.

Despite the acknowledged importance of cheatgrass range, little is known of its forage value. In Nevada, Fleming et al. (1942) found that cattle

---

[1] Dr. Klemmedson is now Professor of Range Management, Department of Watershed Management, University of Arizona, Tucson.

[2] Plant names follow those published by R. J. Davis, *Flora of Idaho,* 828 p. Dubuque, Ia.: Wm. C. Brown Co. 1952.

gained on cheatgrass until August 1, maintained their weight until August 20, and then began to lose. Stewart and Hull (1949), however, found that cattle sometimes graze yearlong with satisfactory results. Generally, the grazing value of cheatgrass range after it reaches maturity in late spring or early summer has been heavily discounted (Fleming et al., 1942; Pechanec and Stewart, 1949; Reid, 1942).

Average grazing capacity of cheatgrass range in southern Idaho has been recently judged by the Bureau of Land Management to be 5 to 8 acres/animal unit month (AUM) (Klemmedson and Smith, 1964). On good cheatgrass range, the capacity is reported to be between 1.5 and 3 acres/AUM (Hurtt, 1939; Hull and Pechanec, 1947; Stewart and Hull, 1949), while on poorer, eroded rangeland, 4 acres/AUM are required (Stark et al., 1946). Since the annual yield of cheatgrass fluctuates widely (Klemmedson and Smith, 1964), the variation in these reported grazing capacity figures is understandable.

Experimental Area and Design

Studies described here were conducted at Saylor Creek Experimental Range, a joint facility of the Bureau of Land Management and the Intermountain Forest and Range Experiment Station. The range is on the Snake River Plains approximately 9 miles southwest of Glenns Ferry, Idaho. The topography is level to gently undulating; soils are derived from Black Mesa gravel and aeolian deposits (Malde and Powers, 1962).

The vegetation at Saylor Creek consists of a fairly uniform stand of cheatgrass, interspersed with varying amounts of Sandberg's bluegrass (*Poa secunda*), squirreltail (*Sitanion hystrix*), and streambank wheatgrass (*Agropyron riparium*), with minor amounts of needleandthread grass (*Stipa comata*). During certain seasons and years, Russian-thistle (*Salsola kali* v. *tenuifolia*) and pinnate tansy mustard (*Descurainia pinnata*) are prevalent. Repeated burning and grazing by both sheep and cattle over many years have transformed the original sagebrush–grass vegetation, probably *Artemisia tridentata–Stipa thurberiana*,[3] into the present seral communities. In much of the present cheatgrass type, bluebunch wheatgrass (*Agropyron spicatum*) was the original dominant grass species, rather than Thurber's needlegrass (*Stipa thurberiana*) or needleandthread.

Annual precipitation averages 8.59 inches at Glenns Ferry, the majority occurring in the period October through April. Total precipitation by crop years (September–August) for 1960–1961, 1961–1962, 1962–1963, was 6.06, 9.96, and 11.34 inches, respectively. The average annual temperature is 51.9 F. Monthly precipitation and mean monthly temperature regimes at the Experimental Range for the period of study, 1961 to 1963, are given in Fig. 1.

The experiment measured animal gains and grazing capacity of cheatgrass range at four consecutive seasons of use under both rotation and continuous grazing for 3 years (1961–1963). The seasons and their durations were early

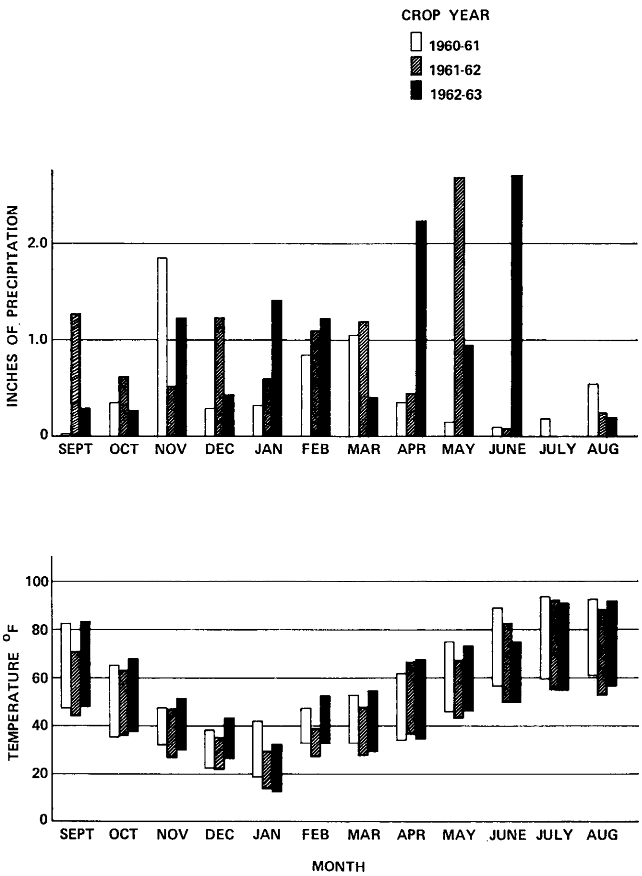

FIG. 1. Monthly precipitation and mean monthly maximum-minimum temperatures at Saylor Creek Experimental Range, September 1960 to August 1963.

spring, 6 weeks (April 1–May 12); late spring, 6 weeks (May 13–June 23); summer, 10 weeks (June 24–September 1); and fall, 8 weeks (September 2–October 27). These seasonal treatments were selected to coincide with developmental stages of the dominant vegetation: an early slow growth period, a rapid growth and maturing period, a long summer dry period, and a fall period when regrowth of perennials and germination of cheatgrass may occur. The early spring period began on or about April 1 each year, the date on which the Bureau of Land Management normally opens surrounding ranges to grazing. The rotation treatment was applied at a moderate rate of grazing that allowed about 40% of the available herbage to be consumed. The continuous treatment was applied at two intensities of grazing, moderate and heavy. About 60% of the available forage was consumed under heavy use. All treatments were replicated.

Local stockmen provided yearling cattle (averaging 330 lb on April 1) of beef breed (Angus, Hereford, and Angus–Hereford cross) for the experiments. The cattle arrived at the Experimental Range on April 1 each year, were ear-tagged, weighed, and assigned to treatment groups on a random basis. Once assigned, an animal remained in the same treatment group through all four seasons, unless removed for purposes of adjusting the stocking. Animals in the rotation treatment group were moved to fresh pasture at the start of each seasonal period while those in the continuous treatment groups remained on the same pasture

[3] Personal communications with M. Hironaka, University of Idaho, Moscow.

for all four seasonal periods. Since this study was not designed to measure the carryover effect of the applied treatments year after year, pastures were randomly selected for the treatments each year with the restriction that no pasture would receive the same use in consecutive years.

Cattle were weighed at the beginning and end of each treatment period and midway through the summer period. Since the "put-and-take" system was used to adjust stocking to prescribed utilization, it was necessary to weigh some animals periodically between regular weighing days. All animals were allowed to shrink overnight without feed or water before weighing.

Because the number of animals varied from treatment to treatment and year to year according to intensity of use and available forage, there were disproportionate numbers of animals. We chose to use the average response of animals in the statistical analysis rather than resort to an extensive analysis based on disproportionate subclass numbers, or an analysis based on proportionate but unequal subclass numbers (whereby much of the data would not be used). Animal days per acre and gain per acre were computed from the daily-gain data following the technique of Lucas and Mott (n.d.). This method gives reliable estimates for tester animals (animals which remain on the treated pasture for the entire season or year as opposed to put-and-take animals).

Results and Discussion

Seasonal Effects on Daily Cattle Gain.—To compare seasonal gains, data for all treatments and intensities were pooled. On this basis, over the 3-year study period, cattle gained an average of 1.70, 2.06, 1.38, and 0.82 lb daily for the early spring, late spring, summer, and fall periods, respectively. Statistical analysis showed that differences in daily gains between seasons were highly significant. Differential gains primarily reflect rapidly changing quality of forage on cheatgrass range through the normal growing season. As noted below, quantity of available feed may have affected early spring gains.

These results may be compared with the daily gain of yearling cattle on crested wheatgrass at Benmore Experimental Range in Utah. Gains reported (U. S. Forest Service, 1964) were 2.72, 1.87, 1.00, and 0.22 lb for early and late spring, summer, and fall grazing periods ranging from April 20 to about December 1. The elevation of Benmore is 5,700 ft; hence, seasonal development of forage would be comparable with that at Saylor Creek on the opening date of early spring grazing.

In contrast to the Benmore cattle, cattle on cheatgrass range made their best gain in late spring when vegetation was both abundant and presumably most nutritious. Successively lower gains occurred during early spring, summer, and fall when forage was either less abundant—allowing less selectivity on the part of animals—or less nutritious. Gains of cattle on cheatgrass range during the fall were exceptionally good compared with those on crested wheatgrass, even considering that the later fall grazing season at Benmore un-

Table 1. Grazing capacity (animal days per acre) of cheatgrass range by seasons under three systems of grazing.

Seasons	System		
	Rotation	Continuous	
		Moderate	Heavy
Early spring	5.7^{a}	1.4^{a}	2.2^{a}
Late spring	7.3^{a}	1.7^{a}	2.6^{a}
Summer	10.7^{b}	3.8^{b}	5.9^{b}
Fall	10.0^{b}	3.2^{b}	5.1^{b}

NOTE: Differences between within-system values not having the same superscript letters are significant at the 5% level.

doubtedly depressed livestock gains somewhat. The pattern of lower gain of cattle in early spring than in late spring on cheatgrass range is not unlike that found with many other forages. Although its nutrient content is high as measured on a dry-matter basis, vegetation on cheatgrass range is high in water content during early spring (Cook and Harris, 1952). Animals evidently have difficulty ingesting sufficient dry matter to satisfy nutritional requirements for optimum growth and maximum gains. Moreover, most species (except Sandberg's bluegrass) do not reach the rapid stage of growth until early May, and the forage supply is often limited, particularly at the beginning of the early spring period and in years of lower than normal spring temperatures. As a result, animals must forage further in search of preferred species, expending relatively more energy, so that less energy is available for weight gains.

The decline in cattle gain presumably parallels the steady decline in nutrient content of cheatgrass during the summer and fall seasons (Cook and Harris, 1952). After cheatgrass matures in June, green feed is furnished only by Russian-thistle and sparse needleandthread and squirreltail. Thistle is an undependable source of green feed; the volume depends mostly on summer moisture supply.

Seasonal Effects on Grazing Capacity.—For this study, comparison of differences in grazing capacity can only be made within a grazing system—or on the yearly basis. Differences in the manner in which pastures under rotation and continuous systems are grazed preclude realistic seasonal comparisons between systems.

Grazing capacity increased steadily with seasonal development of the forage crop, reaching a maximum in the summer period for all systems each year (Table 1). For each system and intensity, grazing capacity in the two spring periods was rather similar and lower than in summer and fall periods. Because growth of the vegetation is not complete until the late spring or early summer, the maximum capacity is achieved during summer and fall rather than in late spring when growth is

Table 2. Cattle gain (lb) per acre by seasons under three systems of grazing.

Seasons	Rotation	Continuous Moderate	Continuous Heavy
Early spring	10.2[a]	2.3[a]	4.1[a]
Late spring	14.5[b]	3.5[ab]	5.5[a]
Summer	13.2[b]	5.2[b]	8.2[b]
Fall	8.6[a]	3.0[a]	3.4[a]

NOTE: Differences between within-system values not having the same superscript letters are significant at the 5% level.

most rapid. Only in the occasional "thistle year" does significant summer growth take place. Although differences between summer and fall grazing capacities are not statistically significant for individual systems, the pooled effect would appear to indicate a slight drop in capacity during the fall. This apparent loss of forage results from seed and leaf shattering, mostly associated with livestock movements and trampling during the dry forage period. Losses from insects, rodents, and other causes were probably not as important for this range type as for others (Heady, 1960).

Seasonal Effects on Gain Per Acre.—Gain per acre on cheatgrass range was highest in the late spring and summer seasons (Table 2). For the rotation and continuous-moderate grazing systems, production per acre was about equivalent in both seasons. However, cattle gain per acre was significantly greater in the summer season under continuous heavy grazing. During early spring and fall, equivalent gains per acre were obtained within each of the three systems.

Effects of Grazing System on Gain Per Acre.—Yearling cattle gained equally well (Table 3) under rotation, continuous moderate, and continuous heavy systems. The difference between rotation and continuous systems was not statistically significant. These results indicate that the change to fresh, ungrazed feed periodically through the grazing season had no effect on the gaining ability of the cattle. Neither did the heavier rate of grazing under the continuous system have an effect; evidently cattle under the heavy grazing system still had access to forage comparable in quality to that available to animals under moderate grazing conditions.

Table 3. Cattle gain, grazing capacity, and gain per acre for three systems of grazing.

Item	Rotation	Continuous Moderate	Continuous Heavy
Daily gain, lb	1.39	1.45	1.45
Animal days/acre	8.4	10.2	15.8
Gain/acre, lb	11.6	14.0	21.2

Effects of Grazing System on Grazing Capacity.—Grazing capacity was lowest under rotation grazing at a moderate intensity (Table 3). Continuous moderate and continuous heavy grazing enabled 21 and 88% more stocking, respectively, than rotation over the 3-year period. Stocking under the continuous heavy system was 55% greater than for continuous moderate. Lower capacity obtained with the rotation system is due to timing of the seasonal treatments in relation to the growth cycle. Maximum forage for once-over grazing is not available until midsummer. Thus, in pastures grazed rotationally in early spring, a large percentage of the annual forage crop was produced after animals were removed from the pastures in mid-May. By late summer and fall these pastures appeared ungrazed. Even in pastures grazed only during late spring, a significant amount of forage is probably produced in good years after animals depart. Presumably, this "unused" forage could be regrazed in the fall or left for soil replenishment in a comprehensive grazing system. Undoubtedly, rotation systems that employed regrazing of spring-grazed pastures, even at moderate rates, would compare favorably in grazing capacity with continuous systems.

In the continuous systems, grazing pressure was necessarily light in the spring periods so as to leave sufficient forage for the remainder of the 7-month season. Moreover, since annual herbage yield of cheatgrass is so variable and is apparently highly dependent on spring precipitation,[4] the annual herbage crop can seldom be predicted before mid-May to late May. This explains the fact that grazing capacities for early and late spring seasons were more similar than those for late spring and summer.

Effects of Grazing System on Gain Per Acre.—Beef production per acre in the three combinations of grazing system and intensity (Table 3) paralleled that of the grazing capacity. In the continuous moderate and continuous heavy systems, 21 and 83% more animal gain per acre was obtained, respectively, than in the rotation system. Since daily gains were similar in the three systems, gain per acre is largely a function of carrying capacity. Because the gains per acre were nearly twice as great for the continuous heavy system as for the rotation system, it may appear logical to graze at the heavy rate. However, this cannot be recommended as yet, for to date we have no information regarding effects of various intensities of grazing on vegetation and soils. Presumably, such informa-

[4] Unpublished data, filed at Intermountain Forest and Range Experiment Station, Boise, Idaho.

Table 4. Cattle gain, grazing capacity, and pasture yield of cheatgrass range by year (data pooled for systems and intensities).

Item	1961	1962	1963
Cattle gain in lb/day:			
Early spring	1.47	2.10	1.52
Late spring	2.18	2.25	1.76
Summer	1.62	1.35	1.17
Fall	0.95	0.89	0.63
Yearlong (spring through fall)	1.52	1.55	1.21
Grazing capacity and pasture yield:			
Animal days/acre	5.4	16.3	12.7
Gain in lb/acre	8.2	23.4	15.3

tion will be forthcoming from studies currently underway.

Yearly Effects on Daily Cattle Gain.—When data for all treatments are pooled, cattle gain over the 3-year period of the experiment averages 1.43 lb/head daily for the 7-month grazing period. Unfortunately, we have no comparable data for bunchgrass or seeded range in southern Idaho. However, data obtained at Benmore Experimental Range (U. S. Forest Service, 1964) in Utah suggest that cattle can gain as well on cheatgrass range as on crested wheatgrass range. At Benmore, yearling cattle gained about 1.25 lb daily during a similar but slightly different spring-through-fall grazing season. The cattle gains on cheatgrass range seem particularly satisfactory when it is recalled that the green feed period is only 2 to 3 months long. Only in an occasional year does Russian-thistle contribute more than 5 to 10% of the total forage and thus provide significant green feed after July 1.

Daily gain of yearling cattle varied significantly between years (Table 4). The gains were similar in 1961 and 1962, but about one-third lb less in 1963. The low gain in 1963 cannot be attributed to a particularly low rate of gain during any one seasonal period. On the contrary, daily gains were low throughout the year. Pastures were grazed at the same intensity each year, and despite some problems in estimating utilization on cheatgrass range, we are confident that between-year variations were not large enough to result in the observed differences, particularly at the rates of utilization applied. Neither is the difference in forage production between years a likely cause, for the stocking rate was adjusted each year to the forage available. Moreover, the fact that individual cows gained at similar rates in 1961 and 1962, despite a threefold difference in herbage production, suggests to us that difference in amount of forage produced in 1962 and 1963 probably had little effect on daily gain in those years.

Although data are not at hand to support our suppositions, we believe that weather may influence animal weight gains as much from its effect on forage quality as on forage quantity, and that weather was the likely factor in low gains in 1963. The effect was twofold. In the absence of normal winter snows, much residue from the 1962 forage crop was left standing and available for grazing in the spring, 1963. With new forage in short supply in April (not an unusual circumstance), cattle grazed considerable amounts of this residue along with Sandberg's bluegrass, streambank wheatgrass, and whatever cheatgrass was available at that time. The resulting diet was probably of lower nutritional quality and less conducive to growth and weight gain than the diet of other years. Secondly, in June 1963, 2.71 inches of rainfall were recorded, about 97% more than in the corresponding month in either 1961 or 1962. This amount of moisture, coming when cheatgrass was maturing, probably leached plant nutrients, thus lowering forage quality for the remainder of the grazing year.

The high daily gains obtained in 1962 seem primarily attributable to the exceptionally good early spring gain of 2.10 lb/head daily. This was 0.6 lb higher than the corresponding gain of cattle in 1961 and 0.5 lb higher than the early spring gain of 1963. Presumably higher nutrient content of the forage during this period is primarily responsible, but nutrient analyses of the forage were not obtained to support these suppositions.

Yearly Effects on Gain Per Acre.—Productivity also fluctuated greatly between years; both grazing capacity and gain per acre increased threefold from the dry, poor forage year of 1961 to the good forage year of 1962, then decreased in 1963 to about double the 1961 levels. It is difficult to reconcile these results for 1962 and 1963 on the basis of forage yield. As measured in ungrazed exclosures, forage production was 79 and 132% greater in 1962 and 1963, respectively, than in 1961. From these yield data, higher grazing capacity would have been expected in 1963. The gain per acre in 1963, which was nearly 10 lb/acre or 38% lower than in 1962, primarily reflects the lower daily gain of cattle in 1963 and the 24% lower grazing capacity from the 1962 high.

Interaction Effects.—There were inconsistencies in the trends of data for seasons and systems. The explanation for this is shown in Fig. 2. For some unknown reason, in both 1961 and 1962, cattle in the heavy treatment seemed to fare better in the spring grazing period than cattle grazed at a moderate rate, thereby bringing the average for the 3 years to the level shown in the figure. However, this pattern did not maintain itself throughout the 7-month season; by fall the situation was reversed and in each year cattle grazed at the heavy rate gained less than those grazed at a mod-

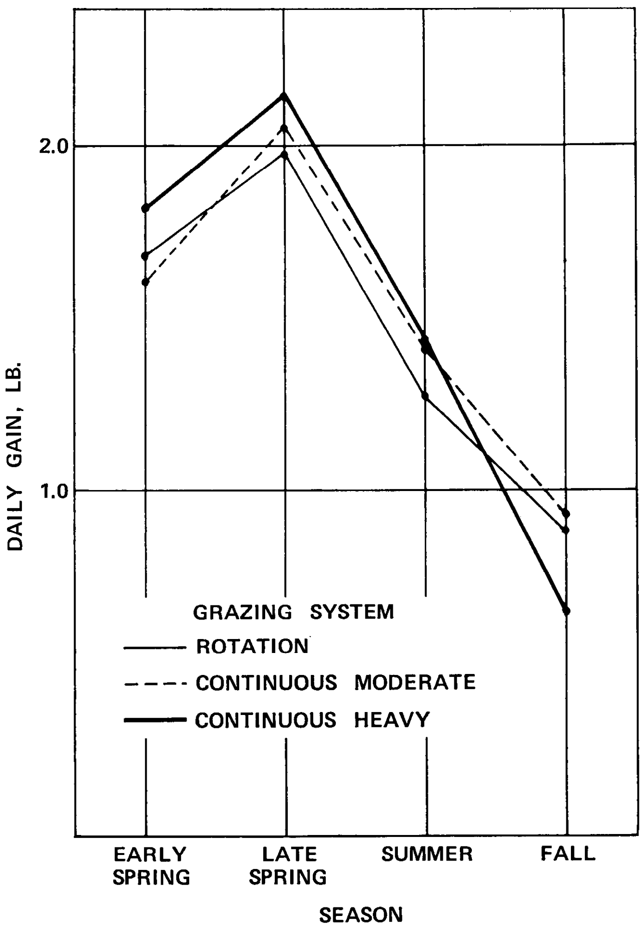

FIG. 2. Daily gains of cattle under three grazing systems, averaged over 3 years, by seasons. A change in pattern of daily gains for cattle in the heavy grazing treatment (relative to other treatments) seems responsible for the significant interaction between season and grazing system.

erate rate. Undoubtedly, by fall, forage in the continuous heavy pasture was relatively more scarce than in moderately grazed pastures, thereby forcing animals to forage longer and farther for desired herbage. Even so, over the entire season, cattle grazed at the heavy rate gained as well as those grazed at moderate rates.

The trend in daily gain by season in 1962 and 1963 showed a peak in the late spring and a steady decline through fall. In 1961, however, during the first 5 weeks of summer, cattle gained 1.43 lb daily, but in the late summer (last 5 weeks) they gained at an exceptional rate of 1.80 lb/head per day. Thus in 1961 cattle gain during the summer was actually higher than in early spring (Table 4). The most plausible explanation for the high late summer gain in 1961 is that during this season cattle foraged heavily on Russian-thistle plants that made up about 50% of the available herbage. In 1962 and 1963 the quantity of thistle was greatly reduced (less than 10% of total herbage); cattle gains were likewise reduced from the 1961 level.

LITERATURE CITED

COOK, C. W., AND L. E. HARRIS. 1952. Nutritive value of cheatgrass and crested wheatgrass on spring ranges of Utah. J. Range Manage. 5:331–337.

FLEMING, C. E., M. A. SHIPLEY, AND M. R. MILLER. 1942. Bronco grass (*Bromus tectorum*) on Nevada ranges. Nev. Agr. Exp. Sta. Bull. 159. 21 p.

HEADY, H. F. 1960. Vegetational characteristics as they relate to grazing management, p. 55–59. *In* Calif. Sect. Amer. Soc. Range Manage. Proc., Fresno, Calif.

HULL, A. C., JR., AND J. F. PECHANEC. 1947. Cheatgrass—a challenge to range research. J. Forest. 45:555–564.

HURTT, L. C. 1939. Downy brome (cheatgrass) range for horses. U. S. Forest Serv. Northern Rocky Mountain Forest & Range Exp. Sta. Appl. Forest. Note 89. 4 p.

KLEMMEDSON, JAMES O., AND JUSTIN G. SMITH. 1964. Cheatgrass (*Bromus tectorum* L.). Bot. Rev. 30:226–262.

LUCAS, H. L., AND G. O. MOTT. n.d. Methods of computing results of grazing trials. 8 p. North Carolina State College, Raleigh.

MALDE, HAROLD E., AND HOWARD A. POWERS. 1962. Upper Cenozoic stratigraphy of western Snake River Plains, Idaho. Geol. Soc. Amer. Bull. 73:1197–1220.

PECHANEC, J. F., AND G. STEWART. 1949. Grazing spring–fall sheep ranges of southern Idaho. U. S. Dep. Agr. Circ. 808. 34 p.

REID, E. H. 1942. Important plants on the national forest ranges of eastern Oregon and eastern Washington. U. S. Forest Serv., Pacific Northwest Forest & Range Exp. Sta. Range Res. Rep. 1. 64 p.

STARK, R. H., J. L. TOERS, AND A. L. HAFENRICHTER. 1946. Grasses and cultural methods of reseeding abandoned farmlands in southern Idaho. Idaho Agr. Exp. Sta. Bull. 267. 36 p.

STEWART, G., AND A. C. HULL. 1949. Cheatgrass (*Bromus tectorum* L.)—an ecologic intruder in southern Idaho. Ecology 30:58–74.

U. S. FOREST SERVICE. [1964.] The Benmore Experimental Range. Intermountain Forest & Range Exp. Sta. Brochure. 13 p.