FORAGE YIELD AND QUALITY TRENDS OF ANNUAL GRASSES IN THE GREAT BASIN

H. F. Mayland
R. B. Murray
G. E. Shewmaker

ABSTRACT

*Grazing animals readily eat medusahead (*Taeniatherum asperum *[Sim.] Nevski) and cheatgrass (*Bromus tectorum *L.) during the short time when plants are green and succulent. Cheatgrass, the more important of the two, is a primary source of spring forage in the Great Basin. It is characterized by a short green-feed period, large yearly variations in yield, and declining forage quality as plants dry. However, cattle eat mature cheatgrass and gain as well as cattle grazing on matured perennial grasses growing in the same area.*

INTRODUCTION

Fall-germinating winter annual grasses occur throughout the rangelands of the Great Basin and adjacent Snake River Plains. Most are introduced weedy species that complete their life cycle in late spring or early summer. When mature, some species develop hardened and sharp-awned florets and become potentially injurious to grazing animals. These plants are generally considered to have little forage value beyond the short green-feed period (fig. 1). Little is known about their nutritive value. However, the forage value of two species has been studied. These are medusahead (*Taeniatherum asperum* [Sim.] Nevski) and cheatgrass (*Bromus tectorum* L.).

Medusahead was first identified in southwestern Oregon in 1884 (Turner and others 1963). It quickly spread across the Pacific Northwest and inland to south-central Idaho. Its invasion is confined to clay-type soils in the lower desert where it tends to replace cheatgrass. On the edge of the Great Basin near Adin, CA, medusahead often invaded low sagebrush (*Artemisia arbuscula* Nutt.) communities that were at a low seral stage (Young and Evans 1970). In eastern Oregon and western Idaho where medusahead was found, we estimated (unpublished) dry matter yields ranging from traces to 400 lb/acre. Annual yields undoubtedly vary because of composition, edaphic, and climatic differences.

Medusahead is sometimes perceived as having no forage value. But the nutritive value of the immature plants is similar to cheatgrass. Sheep, if given free choice, eat the green, but not the dry, plants. However, they eat the dry and headed-out plants if that is the only forage available (Lusk and others 1961).

Medusahead plants accumulate high silica concentrations (11.3 percent compared with 4.4 percent for cheatgrass), probably accounting for the rapid loss in palatability of maturing plants (Van Dyne and Heady 1965). The high silica concentration seems also to slow decomposition of old plant material (Lusk and others 1961), promoting dense fiber mats that are sometimes observed on medusahead-colonized areas.

CHEATGRASS DISTRIBUTION

Cheatgrass is widely distributed throughout Canada, Mexico, and the United States except for five southeastern States. It was introduced to the eastern U.S. prior to 1861 and by 1900 had spread to the West (Klemmedson and Smith 1964; Mack 1981). It is especially abundant in

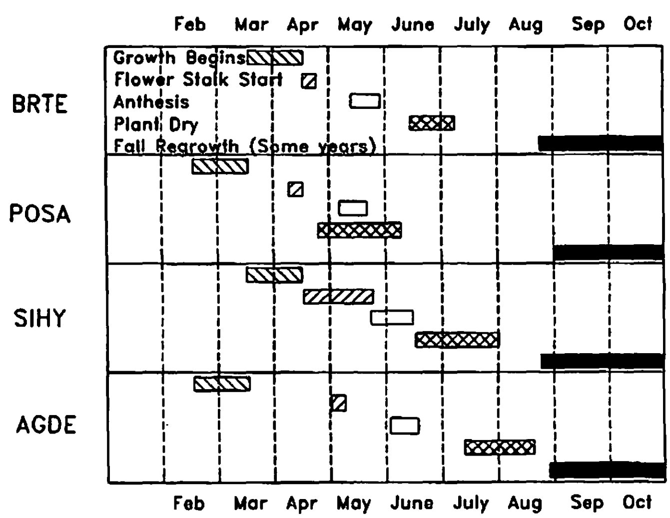

Figure 1—Plant development of cheatgrass (*Bromus tectorum*, BRTE) and three perennials; Sandberg's bluegrass (*Poa sandbergii*, POSA), bottlebrush squirreltail (*Sitanion hystrix* [Nutt.] Smith, SIHY), and crested wheatgrass (*Agropyron desertorum* Fisch., AGDE). Data are from the Saylor Creek Experimental Range in south-central Idaho for the period 1960 to 1969 (Murray and others 1978).

Paper presented at the Symposium on Ecology, Management, and Restoration of Intermountain Annual Rangelands, Boise, ID, May 18-22, 1992.

H. F. Mayland, Research Soil Scientist; R. B. Murray, Range Scientist (retired); G. E. Shewmaker, Biological Technician, Agricultural Research Service, U.S. Department of Agriculture, Kimberly, ID 83341.

the upper Great Basin and Columbia Basin. Stewart and Hull (1949) estimated that cheatgrass was the dominant species on approximately 4 million acres in southern Idaho and constituted from 75 to 95 percent of the herbage production. Furthermore, they reported that it was the principal herbaceous species on another 2 million acres and made up part of the cover on another 10 to 15 million acres in Idaho alone. Cheatgrass has also been regarded as a dominant species on about 10 million acres in Oregon (Klemmedson and Smith 1964). Overall, it was found on 60 million acres of rangeland in the 11 western States. Hull and Pechanec (1947) considered cheatgrass an important forage plant in the Great Basin, particularly in southern Idaho.

Like other winter annuals, cheatgrass is an opportunistic plant, a prolific seeder that germinates and grows at cool temperatures. It grows mostly in the 6- to 22-inch precipitation zones, but has been found on more xeric sites in the Columbia Basin (Klemmedson and Smith 1964). It completes its life cycle over a range of soil water conditions. Plant height can range between 2 and 24 inches, although it is ordinarily 10 to 12 inches.

FORAGE YIELDS

Considerable variation occurs in the annual forage yield, ranging from near zero to more than 3,000 lb/acre. At Arrowrock, ID, Klemmedson and Smith (1964) measured 360 pounds of cheatgrass per acre one year and 3,460 the next year. Yields of *Agropyron desertorum* for those same years were 1,290 and 2,470 pounds, respectively. They also reported that the average dry matter yield on four sites in southern Idaho over 4 years was 1,230 lb/acre for cheatgrass and 1,540 for *Agropyron cristatum*.

Native range in eastern Washington yielded 760 lb/acre, of which 13 percent was cheatgrass. Application of 80 pounds nitrogen per acre increased total grass yield to 3,900 lb/acre, of which 82 percent was cheatgrass (Patterson and Youngman 1960). Murray and others (1978) applied different levels of nitrogen fertilizer to cheatgrass range in southern Idaho and measured a near-linear yield response to rates as high as 200 pounds nitrogen per acre (fig. 2). Their yield responses to nitrogen illustrated the remarkable ability of the species to respond to favorable edaphic and climatic conditions.

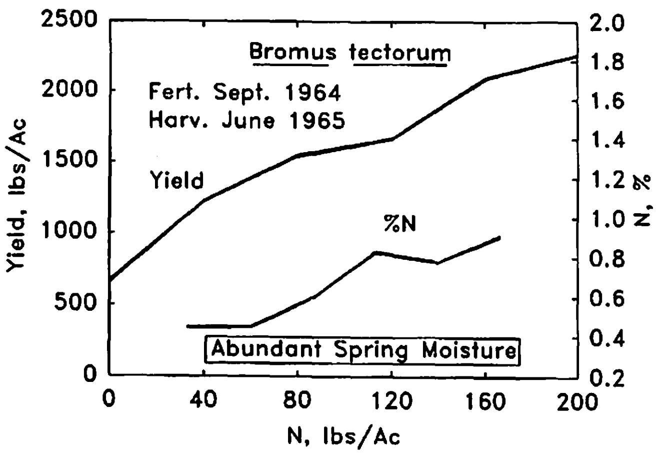

Figure 2—Dry matter yield and nitrogen (N) concentration of cheatgrass (*Bromus tectorum*) during a year of abundant spring moisture after fall fertilization with different nitrogen (NH_4NO_3) rates. Data were taken in June 1965 at the Saylor Creek Experimental Range in south-central Idaho (Murray and others 1978).

UTILIZATION

Fleming and others (1942) reported that both cattle and horses utilized cheatgrass. Animal preference was largely determined by herbage water content. Cheatgrass may be fully dried by mid-July, whereas perennials can still contain 65 percent moisture (Murray and others 1978). Cattle and horses continue to use cheatgrass when it is mature and dry if ample water is present or the herbage has been softened by rain (Hull and Pechanec 1947).

Early studies reported that cattle on cheatgrass gained weight through July, but then began to lose weight (Fleming and others 1942). A later study showed that yearling cattle grazing in southern Idaho on cheatgrass continued to gain weight from April to October (Murray and Klemmedson 1968). The yearlings gained 1.70, 2.06, 1.38, and 0.82 lb/animal-day corresponding to (1) slow vegetative growth, (2) rapid growth and maturation, (3) matured and dry, and (4) fall germination and emergence of new seedlings. These weight gains compared favorably with the 2.72, 1.87, 1.00, and 0.22 lb/animal-day gain for yearlings grazing crested wheatgrass (during similar time periods) on the Benmore Experimental Range in Utah (Harris and others 1968).

Murray and Klemmedson (1968) found that there was no advantage to rotational grazing. Animals gained 1.39, 1.45, and 1.45 lb/animal-day when grazing was rotated or continuous at moderate (40 percent utilization) or heavy stocking (60 percent utilization) rates, respectively. In a related study, daily gains were sharply depressed in early spring and least affected in summer by increased stocking rates (fig. 3). Overall, yearling cattle gained 1.43 lb/animal-day during the 7-month grazing period on cheatgrass at the Saylor Creek Experimental Range in south-central Idaho and 1.25 lb/animal-day when grazing crested wheatgrass for a similar time period on the Benmore Experimental Range in north-central Utah.

Weight gain data for yearling cattle were pooled across different grazing systems (fig. 4). Results from the 7-year study substantiate the ability of cattle to utilize cheatgrass. Weight gain performance by other classes of cattle, like calves, first-calf heifers, and mature cows, was also determined (fig. 5). The cheatgrass forage provided sufficient energy to first-calf heifers to produce milk for their calves, but not enough energy for their own growth. Other classes of cattle gained at acceptable levels.

Sheep utilized cheatgrass during the green-feed period, but not after it dried (Cook and Harris 1952). Studies quantifying sheep performance when grazing cheatgrass in April and May were conducted at the Saylor Creek Experimental Range (Murray 1971). Sheep carrying capacity was similar on perennial and cheatgrass sites during wet

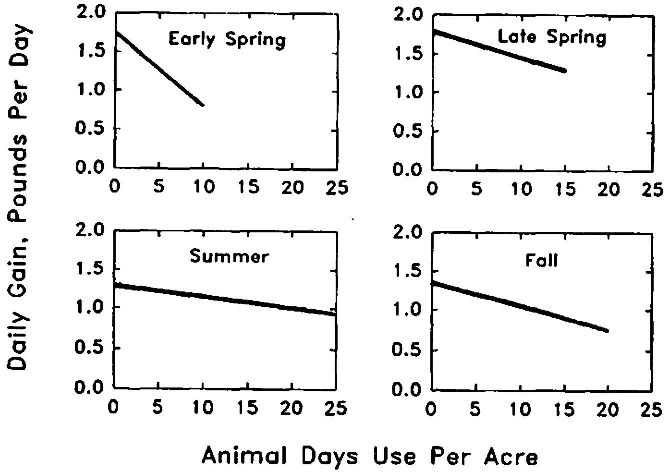

Figure 3—Daily weight gains by yearling cattle grazing cheatgrass (*Bromus tectorum*) at several stocking intensities on the Saylor Creek Experimental Range during early spring (April 1-May 5), late spring (May 6-June 9), summer (June 10-September 1), and fall (September 2-October 27). Data are means of 5 years (Murray and others 1978).

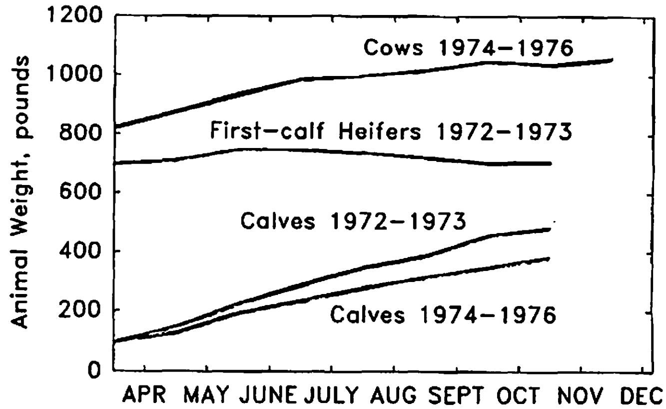

Figure 5—Mean animal weights when grazing cheatgrass (*Bromus tectorum*). Data are from the Saylor Creek Experimental Range in south-central Idaho (Mayland and others 1980; Murray and others 1978).

years, but during dry years the perennial pastures produced 60 percent more forage. Sheep (ewes) gained an average 0.34 and 0.29 lb/head-day when grazing cheatgrass and native bunchgrass, respectively. Perennial bunchgrass provided 15 percent more forage.

Cook and Harris (1952) showed that sheep grazed cheatgrass in Utah earlier than perennial grasses, but that the forage quality (protein, Ca, P, and gross energy) of cheatgrass decreased rapidly with increasing plant maturity. Lignin and ash increased with plant maturity, and cellulose and other carbohydrates changed little. Similar changes in forage quality have been noted for perennial grasses (Murray and others 1978), but the decline was delayed considerably by the longer green-feed period.

Murray and others (1978) evaluated forage quality changes in cheatgrass and perennial grasses at the Saylor Creek Experimental Range. Nitrogen, phosphorus, and zinc concentrations declined in the maturing cheatgrass

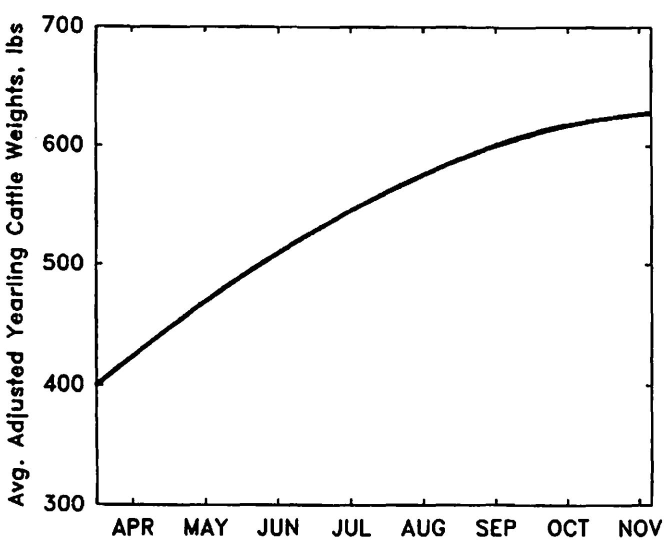

Figure 4—Seven-year mean weights (adjusted to 400 pounds) of yearling cattle grazing cheatgrass (*Bromus tectorum*) on the Saylor Creek Experimental Range in south-central Idaho (Murray and others 1978).

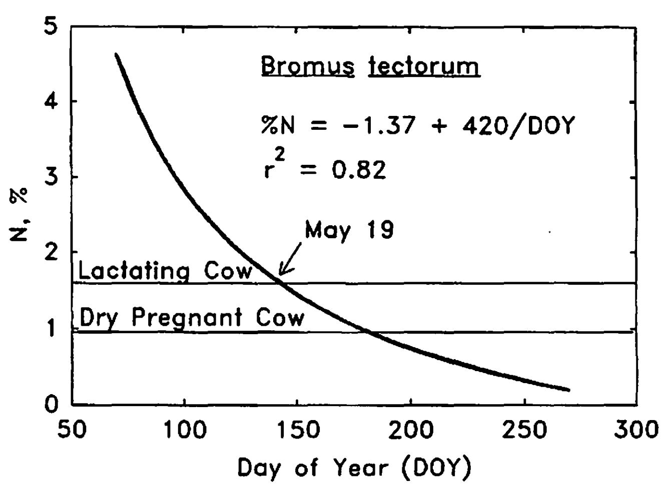

Figure 6—Forage nitrogen (percent N x 6.24 = percent crude protein) requirements of cows and the mean 7-year nitrogen concentration in cheatgrass (*Bromus tectorum*) related to day of year (DOY). Data are from the Saylor Creek Experimental Range in south-central Idaho (Murray and others 1978).

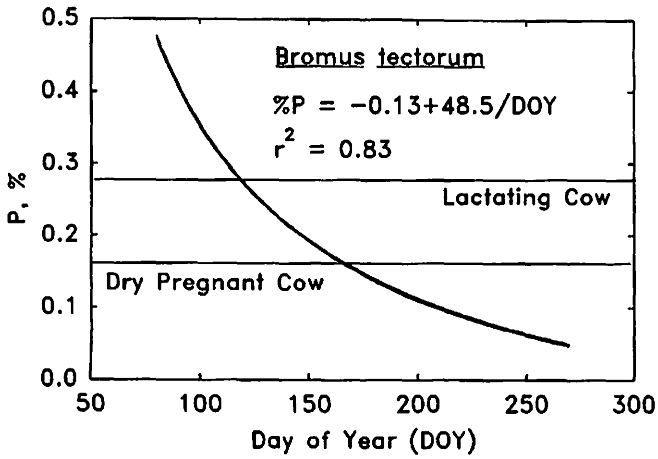

Figure 7—Forage phosphorus (P) requirements of cows and the mean 7-year phosphorus concentration in cheatgrass (*Bromus tectorum*) related to day of year (DOY). Data are from the Saylor Creek Experimental Range in south-central Idaho (Murray and others 1978).

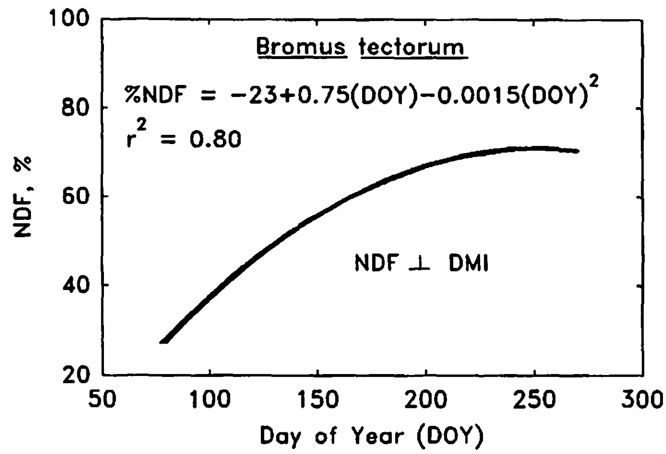

Figure 9—Mean 7-year neutral detergent fiber (NDF) concentration in cheatgrass (*Bromus tectorum*) related to day of year (DOY). NDF is inversely proportional to dry matter intake (DMI). Data are from the Saylor Creek Experimental Range in south-central Idaho (Murray and others 1978).

(figs. 6, 7, 8). Neutral detergent fiber concentrations increased as plants matured (fig. 9), and these increases were accompanied by decreased dry matter intake by the grazing animal. Another measure of forage quality was total digestible dry matter, which also decreased with time (fig. 10). On June 12 and October 14, respectively, cheatgrass forage contained 1.11 and 0.79 percent N, 0.219 and 0.086 percent P, 13.7 and 12.6 ppm Zn, and 49 and 56 ppb Se (unpublished). These forage data were regarded as deficient in N, P, and Zn for growing cattle. However, these values were obtained for hand-clipped forage samples. Animals usually select plants and plant parts that provide a higher level of nutrition than that represented by the clipped samples.

Olsen (1971) examined yearling beef cattle response to various supplements while they grazed cheatgrass. He found that supplemental protein increased dry matter digestibility and total dry matter intake (TDDM). Supplemental energy increased energy digestibility during early spring, but depressed dry matter intake. Supplemental P

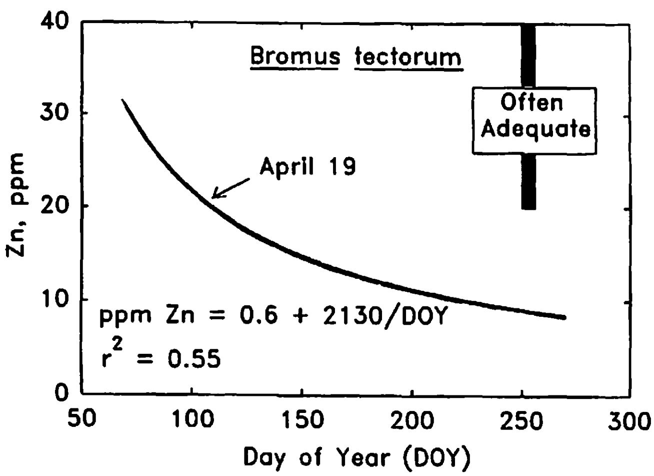

Figure 8—Approximate range in forage-zinc (Zn) levels required by cows and the mean 7-year zinc concentration in cheatgrass (*Bromus tectorum*) related to day of year (DOY). Data are from the Saylor Creek Experimental Range in south-central Idaho (Murray and others 1978).

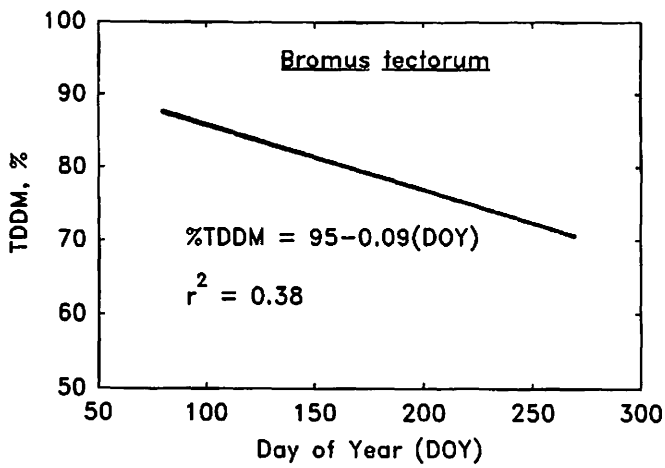

Figure 10—Mean 7-year total digestible dry matter (TDDM) concentration in cheatgrass (*Bromus tectorum*) related to day of year (DOY). Data are from the Saylor Creek Experimental Range in south-central Idaho (Murray and others 1978).

did not significantly increase daily weight gains compared to control animals (1.42 vs. 1.39 lb/animal-day).

Zinc concentrations in the cheatgrass, and other grasses, were generally below levels recommended for cattle. Mayland and others (1980) later reported that supplementing the zinc intake with 900 mg zinc per cow-calf pair significantly increased calf-weight gains by 6 percent.

SUMMARY

Two winter annual grasses, medusahead and cheatgrass, are important to grazing animals in the Great Basin. Horses, cattle, and sheep eat both species while the plants are green and succulent. Of the two grasses, more attention is given to cheatgrass because of its more extensive distribution and availability as spring forage. Yearly variations in dry matter yield and the short green-feed period, however, reduce the reliability of cheatgrass as a dependable forage base. The dry herbage is less desirable, but most cattle having easy access to water will continue gaining weight while grazing matured cheatgrass.

Nitrogen (crude protein), energy, phosphorous, zinc, and other nutrient concentrations decline with the maturation process, and herbage may become deficient in these nutrients for some livestock classes. Benefits have only been shown for zinc supplementation. Forage value of cheatgrass may be regarded as equivalent to other perennial species found in the area. However, perennial species would likely provide a more stable yield, have a longer green-feed period, and produce more usable forage per acre.

REFERENCES

Cook, C. W.; Harris, L. E. 1952. The nutritive value of cheatgrass and crested wheatgrass on spring ranges of Utah. Journal of Range Management. 5: 331-337.

Fleming, C. E.; Shipley, M. A.; Miller, M. R. 1942. Bronco grass (*Bromus tectorum*) on Nevada ranges. Bull. 159. Reno, NV: Nevada Agricultural Experiment Station. 21 p.

Harris, L. E.; Frischknecht, N. C.; Sudweeks, E. M. 1968. Seasonal grazing of crested wheatgrass by cattle. Journal of Range Management. 21: 221-225.

Hull, A. C.; Pechanec, J. F. 1947. Cheatgrass—a challenge to range research. Journal of Forestry. 45: 555-564.

Klemmedson, J. O.; Smith, J. G. 1964. Cheatgrass (*Bromus tectorum* L.). The Botanical Review. 30: 226-262.

Lusk, W. C.; Jones, M. B.; Torell, D. T.; McKell, C. M. 1961. Medusa palatability. Journal of Range Management. 14: 248-251.

Mack, R. N. 1981. Invasion of *Bromus tectorum* L. into western North America: an ecological chronicle. Agro-Ecosystems. 7: 145-165.

Mayland, H. F.; Rosenau, R. C.; Florence, A. R. 1980. Grazing cow and calf responses to zinc supplementation. Journal of Animal Science. 51: 966-974.

Murray, R. B. 1971. Grazing capacity, sheep gains: cheatgrass, bunchgrass ranges in southern Idaho. Journal of Range Management. 24: 407-410.

Murray, R. B.; Klemmedson, J. O. 1968. Cheatgrass range in southern Idaho: seasonal cattle gains and grazing capacities. Journal of Range Management. 21: 308-313.

Murray, R. B.; Mayland, H. F.; van Soest, P. J. 1978. Growth and nutritional value to cattle of grasses on cheatgrass range in southern Idaho. Res. Pap. INT-199. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 57 p.

Olsen, T. E. 1971. Utilization and supplementation of cheatgrass in southern Idaho. Moscow, ID: University of Idaho. 52 p. Thesis.

Patterson, J. K.; Youngman, V. E. 1960. Can fertilizers effectively increase our range land production? Journal of Range Management. 13: 255-257.

Stewart, G.; Hull, A. C. 1949. Cheatgrass (*Bromus tectorum* L.)—an ecological intruder in southern Idaho. Ecology. 30: 58-74.

Turner, R. B.; Poulton, C. E.; Gould, W. L. 1963. Medusahead. Spec. Rep. 149. Corvallis, OR: Oregon Agricultural Experiment Station. 22 p.

Van Dyne, G. M.; Heady, H. F. 1965. Botanical composition of sheep and cattle diets on a mature annual range. Hilgardia. 36 (13): 465-491.

Young, J. A.; Evans, R. A. 1970. Invasion of medusahead into the Great Basin. Weed Science. 18: 89-97.