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Experimental Cattle Grazing in a Relatively Undisturbed Shrubsteppe Community

Abstract

Yearling hereford steers were grazed for six to eight weeks in the spring months of April and May for three consecutive years on nine hectare pastures in a shrubsteppe community representative of the *Artemisia tridentata-Agropyron spictatum* association in undisturbed condition. Steers showed grazing preference for Cusick bluegrass (*Poa cusickii*) and hawk's beard (*Crepis atrabarba*). Three consecutive years of grazing diminished the amount of standing dead grass in the pastures by 50 percent but grazing did not significantly affect the ability of the plant community to sustain herbaceous shoot production in the fourth year when grazing was discontinued. Weight gains of steers averaged 24 kg per hectare during the grazing season with an average weight gain of 0.63 kg per day per animal. Trampling was the most obvious and persistent damage to the plant community. Trampling killed plants growing in fence corners at gates and near the water trough locations where steers tended to congregate. Trampled ground was promptly colonized by alien, annual plants especially cheatgrass (*Bromus tectorum*) and tumble mustard (*Sisymbrium altissimum*), but these plants did not invade other portions of the grazed pastures.

Introduction

Cattle grazing has been practiced in the semi-arid shrubsteppe region of eastern Washington since the middle 1800s (Galbraith and Anderson 1971). Years of over-grazing has resulted in the demise of native perennial grasses and encouraged a massive invasion by Eurasian annuals, especially cheatgrass brome (*Bromus tectorum*) (Daubenmire 1970). Shrubsteppe plant communities without substantial invasions of cheatgrass and other alien annuals are scarce. One of the few places with shrubsteppe plant communities in relatively undisturbed condition, as judged by the scarcity of cheatgrass and the dominance of native perennial grasses and forbs, is the United States Department of Energy's Hanford Site located in Benton County, Washington (Rickard *et al.* 1976). This article describes the effects of three consecutive years of experimentally controlled cattle grazing in a shrubsteppe community in relatively undisturbed condition by comparing treatment (grazed) and control (ungrazed) pastures using measurements of plant biomass.

Study Area

The vegetation of the study area is representative of the *Artemisia tridentata-Agropyron spicatum* association in relatively undisturbed condition as described by Daubenmire (1970). The study area is located at an elevation of 360 m on a gentle northeast facing slope of the Rattlesnake Hills on the U.S. Department of Energy's Hanford Site, Benton Co., Washington. A silt-loam soil at least one m deep overlying basalt rock provides the rooting substrate. The annual rainfall averages 25 cm. The plant community had not been grazed by livestock since 1943 when the land was incorporated into the Hanford Site.

The plant community supports populations of small mammals especially Townsend ground squirrels (*Spermophilus townsendi*) and Great Basin pocket mice (*Perognathus parvus*) (Hedlund and Rickard 1980). Jackrabbits (*Lepus californicus*) were never seen on the study area and the site was not visited by mule deer (*Odocoileus hemionus*). A portion of the plant community was burned by a wildfire in August of 1973. This called for the use of an adjacent control pasture that did not burn. In 1974 this unburned pasture served as a substitute for the original control pasture.

Methods

Steer grazing was conducted using two small pastures, each 300 x 300 m (9 hectares), established in a large homogeneous community representative of the *Artemisia tridentata-Agropyron spicatum* association in relatively undisturbed condition. The grazed pastures were fenced, gated, and provided with a shared 500 gallon water trough and a block of salt. Adjacent pastures of the same size served as ungrazed controls. Fifteen head of 400-500 lb yearling hereford steers were rotated at weekly intervals between two "grazed" pastures in 1971 and also in 1972. In 1973, only one of the pastures was grazed using seven steers. This yielded three consecutive years of grazing on one 9 ha pasture. In 1974, the other previously grazed pasture was grazed by five steers. Steers were weighed as a group on the day they entered the pastures. The steers were removed from the pastures held in a pen without food or water for one day and then weighed.

Within the boundaries of each 9 ha pasture six 450 m^2, 15x30 m, areas called blocks were randomly located. These were not located in fence corners or adjacent to the fence lines where cattle paths tended to form. At each sampling period, two 0.5 m^2 circular frames were randomly located in each block and these were hand clipped of all above-ground plant parts for biomass determinations.

Living shoots were segregated from the dead shoots by hand sorting. Live shoot biomass was further segregated into five generalized botanical categories; perennial grasses, perennial forbs, half-shrubs, annual grasses, and annual forbs (Table 1). Shoots were oven-dried at 50°C for 72 hours and weighed. Grass crowns were cut off at ground

TABLE 1. Mean dry weight g per m^2 of live shoot biomass ± standard error at peak yields grouped by botanical categories in control and grazed pastures in 1974 (n = 16).

Botanical Categories	Control pasture	% of total	Pasture with 3[1] years of grazing	% of total
Perennial grasses	54 ± 7.7	78	46 ± 5.3	72
Perennial forbs	4.5 ± 3.6	7	4.3 ± 1.2	7
Half-shrubs	4.2 ± 2.0	6	4.7 ± 1.4	7
Annual grasses[2]	4.8 ± .70	7	5.7 ± 1.2	9
Annual forbs	1.4 ± .49	2	3.0 ± .73	5
Total shoot phytomass	69		64	

Perennial grasses: **Agropyron spicatum, Poa sandbergii, Poa cusickii, Stipa thurberiana.**
Perennial forbs: **Crepis atrabarba, Astragalus purshii, Lupinus laxiflorus, Brodiaea douglasii, Calochortus macrocarpus, Lomatium macrocarpum** and others.
Annual grasses: **Bromus tectorum, Festuca octoflora.**
Annual forbs: **Draba verna, Microsteris gracilis, Descurainea pinnata, Plantago purshii.**
Annual forbs: **Draba verna, Microsteris gracillis, Descurainea pinnata, Plantago purshii.**
Half-shrubs: **Phlox longifolia, Erigeron filifolius, Antennaria dimorpha.**

[1]pasture not grazed in 1974.
[2]mostly **Festuca octoflora.**

level using a hacksaw blade. Crowns were not separated into live and dead parts. Litter was collected from the ground by using a gasoline powered suction device. Aliquots of grass crown and litter material were burned in a muffle furnace to obtain a measure of their ash content. Results are expressed as grams of crown or litter per m^2 with the ash subtracted from the total weights. Harvesting was done five times between March and June each year. In the years 1971 and 1972, six blocks were sampled in two pastures of both grazed and control treatments ($n = 24$). In 1973 and 1974 the number of blocks in each pasture was increased to eight, providing 16 harvested frames at each sampling date.

Results and Discussion

When the steers were introduced to the pastures in April of each year they selectively grazed cusick bluegrass, *Poa cusickii.* In the first week, virtually every bunch was grazed, some bunches were grazed down to crown level while others were only partially eaten. Bunches growing beneath the canopy spread of sagebrush, *Artemisia tridentata,* shrubs were protected by the shrubs' stiff branches and these clumps generally escaped being eaten. The palatability of cusick bluegrass to cattle has been previously noted by Rickard *et al.* (1975) and Uresk and Rickard (1976). In contrast, Sandberg bluegrass, *Poa sandbergii*, was seldom grazed. The most palatable forb was hawk's beard, *Crepis atrabarba.* At flowering time, its yellow blossoms were conspicuous throughout the ungrazed pastures but flowers were absent in the grazed pastures because shoots had all been removed by cattle grazing. Bluebunch wheatgrass, *Agropyron spicatum*, was selected after cusick bluegrass shoots became depleted as a forage source and it provided the bulk of cattle forage in the remainder of the grazing season. Sagebrush and half-shrubs, longleaf phlox, *Phlox longifolia*, and fleabane, *Erigeron filifolius*, were not grazed by cattle.

The shoot biomass on the "grazed" pasture in 1974, after being grazed for 3 consecutive years in 1971, 1972, and 1973 but rested in 1974, was compared with the shoot biomass from an adjacent ungrazed "control" pasture (Table 1). Total herbaceous shoot production at peak harvest in 1974 averaged 69 g per m^2 in the control pasture and 64 g per m^2 in the grazed pasture (Fig. 1). These means were not statistically different. Perennial grasses provided 78 percent of the total live shoot biomass on the control pasture and 72 percent on the grazed pasture (Table 1). Annual forbs were sparsely represented on both pastures and the most abundant annual grass was six week's fescue, *Festuca octoflora.* Controlled spring grazing did not have a measurble

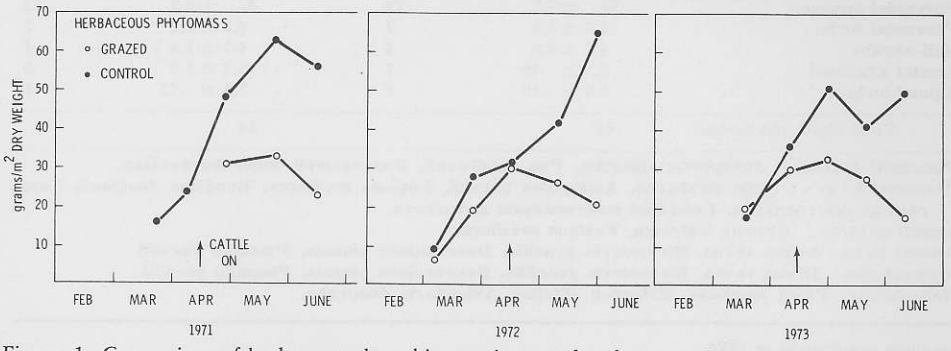

Figure 1. Comparison of herbaceous shoot biomass in grazed and ungrazed pastures from beginning to end of the growing season in 1974.

impact on shoot production after grazing was terminated. Nevertheless, spring grazing by steers did deleteriously affect the perennial grasses in other ways especially in their capacity to produce flowering culms (Rickard *et al.* 1975).

Grazing removed one-half to two-thirds of the new shoot growth in the years 1971, 1972, and 1973 (Fig. 2) and the amount of standing dead grass declined under grazing (Fig. 3). Crown weights averaged less on the grazed, than on the control, pasture but the total amount of litter showed no apparent changes under grazing (Fig. 3). Most of the plant material ingested by the steers remained on the pasture in the form of manure. Manure pats were especially concentrated near the water trough and in fence corners. In this way the presence of grazing cattle created a different distribution and form of dead plant matter on the grazed pastures as compared to the ungrazed pastures.

At places where steers tended to congregate (e.g., gate entries, water trough locations, and fence corners) cattle damaged the plants. Excessive trampling destroyed and/or

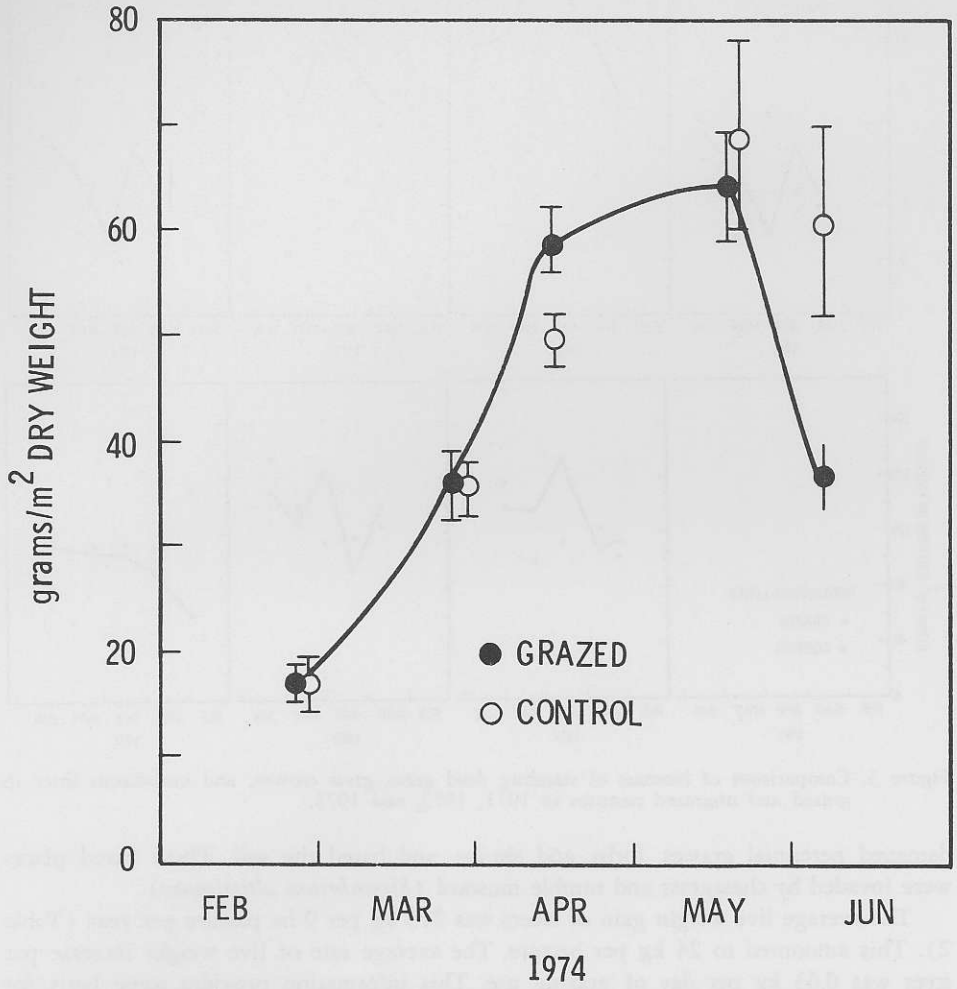

Figure 2. Comparison of live shoot biomass in grazed and ungrazed pastures in 1971, 1972, and 1973. The arrow indicates the date steers were introduced to the pastures.

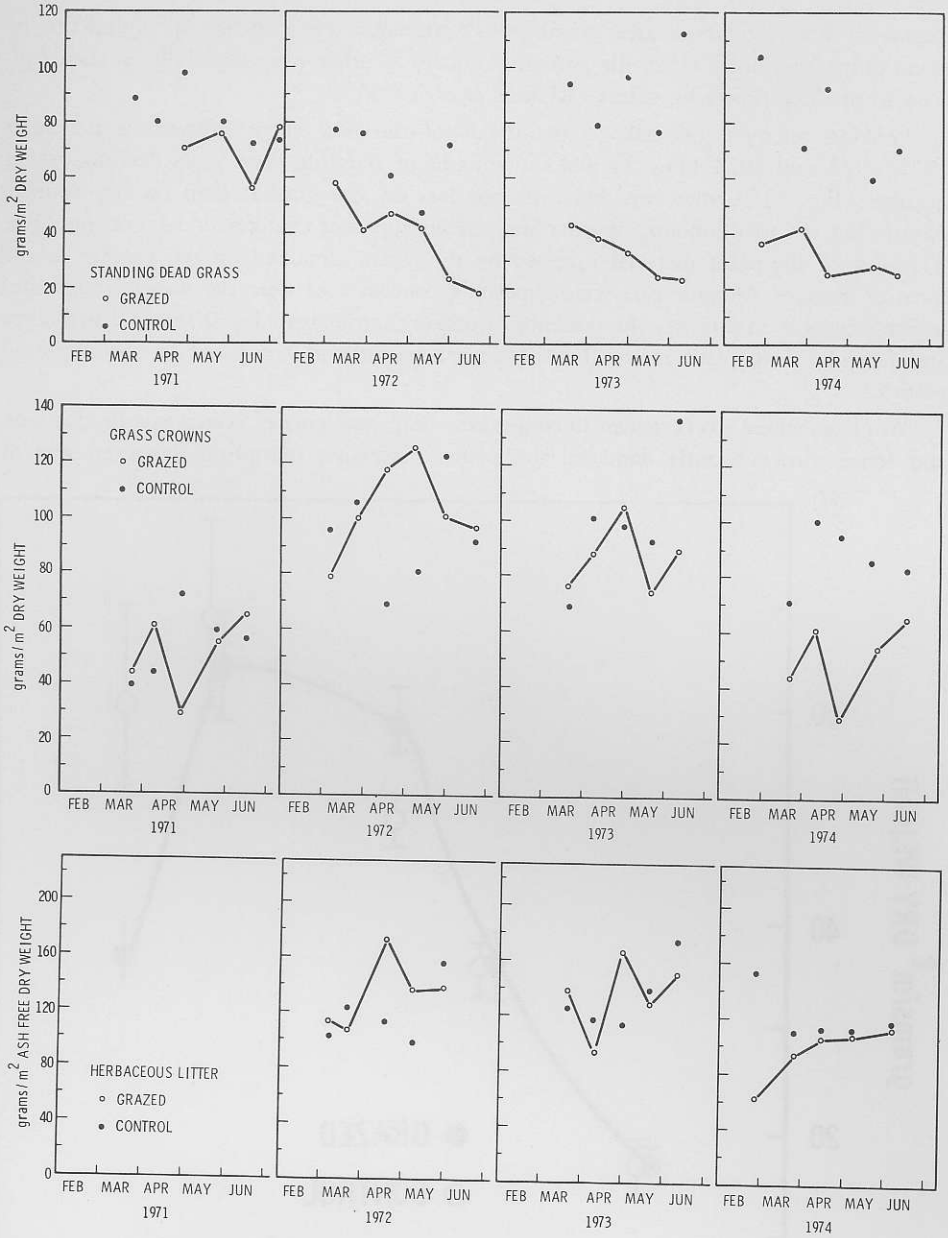

Figure 3. Comparisons of biomass of standing dead grass, grass crowns, and herbaceous litter in grazed and ungrazed pastures in 1971, 1972, and 1973.

damaged perennial grasses, forbs, and shrubs, and bared the soil. These bared places were invaded by cheatgrass and tumble mustard (*Sisymbrium altissimum*).

The average live weight gain of steers was 213 kg per 9 ha pasture per year (Table 2). This amounted to 24 kg per hectare. The average rate of live weight increase per steer was 0.63 kg per day of grazing use. This information provides some basis for judging the economic value of native shrubsteppe communities as a cattle grazing

TABLE 2. Weight gains of yearling steers during spring grazing in a 9 ha shrubsteppe pasture in the years 1971-1974.

Year	Days of grazing	Animal days per pasture	Total wt. gain (kg)	Wt. gain per animal per day (kg)
1971	58	435	308	.78
1972	41	307	193	.63
1973	49	343	156	.45
1974	57	285	194	.68
Average	51	342	213	.63

resource and also a way to compare weight gains by cattle grazing in plant communities that have been strongly modified by years of grazing use or those revegetated with alien perennial bunchgrasses. For example, a recent grazing study using steers in crested wheatgrass pastures showed weight gains of 0.85-1.20 kg per day of grazing use (Hart *et al.* 1983).

Historically the shrubsteppe region of Washington has not been subjected to centuries of intensive ungulate herbivory. Bison became extinct about 2000 years ago and antelope were scarce (Osborne 1953). The virtual absence of large grazing ungulates in Washington suggests that shrubsteppe communities are especially vulnerable to grazing damage as compared to other kinds of perennial grass dominated communities (e.g., shortgrass prairies) developed over long periods of time under grazing stresses imposed by large mobile herds of bison and antelope.

Livestock grazing is one of man's most important biological uses of semi-arid shrubsteppe lands, especially lands that are not suitable for dryland wheat farming or for irrigated agriculture. Nevertheless, grazing research on shrubsteppe ranges has been minimal. The virtual absence of experimentally derived information concerning cattle grazing has encouraged the use of casual observations and untested theories in range management practice (Valentine 1979).

The invasion of shrubsteppe communities by cheatgrass, and ways to economically eradicate cheatgrass and replace it with more productive forage grasses, are regarded as important contemporary rangeland research topics (Young *et al.* 1979). The role of shrubsteppe communities as habitat for wildlife, especially on federally owned lands, is also beginning to attract an increasing amount of attention (McAdoo and Klebenow 1979). In the future, large land areas, such as the Hanford Site that have been protected from livestock grazing for 40 years, will become especially meaningful as baseline cases for making comparisons with continuously grazed plant communities in Washington and elsewhere in the strubsteppe region which extends from eastern Washington and Oregon to western Wyoming.

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