Impact of Grazing on Crested Wheatgrass in Relation to Plant Size

B. E. Norton and Patricia S. Johnson

ABSTRACT: Utilization of crested wheatgrass on a plant-by-plant basis was studied using heifers for a six-week grazing period on foothill rangeland in Utah seeded almost 30 years previously. The cattle preferred medium-sized plants with basal areas ranging from 11 to 200 cm^2. Smaller plants seemed more likely to be damaged by trampling than by defoliation. Larger plants contributed relatively less to forage harvested, receiving some protection from grazing due to the physical impediment of standing stalks from old inflorescences. Many plants were not grazed at all (20 percent of plants with basal area larger than 10 cm^2). The probability of regrazing was low (less than 17 percent) and most of it occurred after the first two weeks of grazing. Regrazing was concentrated on plants lightly grazed at first and on portions not previously utilized. There was an observable change in the character of grazing impacts during the grazing season. The number of small plants defoliated in a two-day period increased steadily for the first two weeks and then rapidly declined, reflecting an apparent shift in grazing behavior.

INTRODUCTION

Converting native range vegetation to crested wheatgrass pastures has been the major success story of range improvement on the Great Plains and Intermountain regions of North America (Holochek 1981). Many indigenous forage species, especially bunchgrasses, have a low tolerance of livestock grazing and give way to less palatable woody species and exotic weedy annuals.

Introduced from Eurasia, crested wheatgrass by comparison exhibits remarkable persistence under grazing pressure and is adapted to a cold continental climate with dry summers. It begins spring growth early, reaches maturity in June, enters a post-reproductive dormancy and then resumes growth following fall rains. This growth pattern supplies highly nutritious forage at a critical period for ranchers who need to move their livestock off costly winter supplements onto spring pastures, awaiting access to mountain ranges (Cook and Harris 1952, Frischnecht and Harris 1968). The stock can return to wheatgrass pastures in the fall and continue grazing them into December if snow depth permits (Harris et al. 1968).

Crested wheatgrass pastures require a substantial investment for site preparation and stand establishment, but they can be maintained for decades under proper management. In order to make the best use of the abundant but expensive grass grown in a crested wheatgrass pasture it is important to know how forage removal impacts the forage resource. Even in an almost monotypic stand, as crested wheatgrass pastures often are, livestock appear to exercise selectivity in defoliation, leaving some portions of the pasture more heavily used than others. This is most apparent when pastures are grazed continuously to a moderate level of utilization for the entire grazing season, and when there is a relatively large number of "wolf" plants present -- large plants that retain the old stalks of flowering culms from year to year. The character of grazing impacts may change during the grazing season as the forage on offer is depleted of the more preferred material and as the livestock are presented with an opportunity to consume regrowth on previously defoliated plants. Estimates of gross utilization do not provide sufficient detail. We are interested in answering questions like: Is grazing random or uniform? Is there a grazing preference for certain kinds of plants within the same species and, if so, what plant or pasture characteristics are correlated with apparent preferences? What is the probability that plants will be regrazed during the grazing season? How often will they be regrazed? Is regrazing likely to occur on parts of the plant that were previously defoliated?

In order to describe defoliation at this level of specificity it is necessary to observe individual plants in a grazed pasture on a regular basis. Not surprisingly, given the effort required to collect such data and the difficulties of analysis, the

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available information on this subject is very limited. More studies have been reported on patterns of defoliation by sheep (e.g., Hodgson and Ollerenshaw 1969, Greenwood and Arnold 1968, Hodgkinson 1980) than cattle (e.g., Gammon and Roberts 1978), and nothing at the detail addressed here has been attempted with cattle grazing crested wheatgrass, apart from work done by the authors (Norton and Johnson 1983). The present paper is concerned with the plant component at the plant-animal interface in grazing of crested wheatgrass by cattle.

RESEARCH AREA AND TECHNIQUES

Crested wheatgrass pastures at the Tintic Range Research Station near Eureka, Utah, were seeded in the early 1950's. Several of them, including pastures 8 and 19 where our grazig study was conducted, retain an almost pure stand of crested wheatgrass (Agropyron desertorum) with the rhizomatous native western wheatgrass (Agropyron smithii) contributing the minor grass component. Scattered remnants of juniper occur in pasture 8. Basin big sagebrush (Artemisia tridentata ssp. tridentata) covered these foothill ranges prior to clearing the vegetation in preparation for seeding. It is now reappearing, but not yet in sufficient quantity in pastures 8 and 19 to substantially influence crested wheatgrass production.

The Tintic research pastures provide spring and summer forage for Angus heifers. Traditional management has been to graze each 28-ha pasture for six to eight weeks with 30 heifers and two bulls to achieve at least 50 percent forage utilization, usually more. Under a rotational grazing system, such as short-duration grazing being tested in a companion study, it may be possible to improve efficiency of forage utilization and increase livestock production. But in order to describe changes in pasture utilization due to rotational grazing one must first understand the nature of defoliation under continuous grazing, in this case continuous grazing for a six to eight-week period. The information on grazing reported here was developed as part of a baseline study of traditional pasture management to serve as a reference in the evaluation of rotational grazing schemes.

Nearly 300 permanent plots (0.5 m^2) in the two pastures were inspected every second day for six weeks beginning May 31, 1979 when the heifers were introduced. Evidence of grazing was recorded on a plant-by-plant basis noting the stubble height of the grazed portion and the area of defoliated crown cover. Initial plant heights were marked on basal outlines of perennial grass plants drawn on plot maps; ungrazed plant heights were remeasured halfway through the study. The total number of plants sampled was 4,566.

RESULTS

Size Class Utilization

A breakdown of the plant population by nine arbitrary size classes appears in Figure 1. The smallest plants were somewhat neglected by the cattle. Only 40 percent of plants less than 0.5 cm^2 basal area, and 59 percent of plants with basal area between 0.5 and 10 cm^2, were grazed to any degree. These two smallest size classes contained 42 percent of the number of plants sampled but together represented only 1.5 percent of the available forage, calculated on a volume basis, and contributed only 2.0 percent of harvested forage. The average plant was nibbled down from a height of 15 cm to 9 cm. The very smallness of these crested wheatgrass plants, their obscurity in the foraging environment of grazing cattle, appears to confer a degree of protection from defoliation. Such small plants are probably damaged more by livestock trampling than by defoliation.

Plants larger than 10 cm^2 basal area were more likely to be grazed, an 80 percent probability over the six-week period. It is perhaps surprising that one fifth of all plants of 11 cm^2 basal area or larger failed to experience observable defoliation while 32 cattle spent six weeks roaming a pasture of 28 ha! Severity of grazing impact was inversely related to plant size. Grazed plants with a basal area from 11 to 50 cm, the major group among these larger size classes, were reduced from an average height of 18 cm to 10 cm, and an average 83% of the crown cover was defoliated.

In contrast, grazed plants in the largest class of >500 cm^2 basal area, which included the wolf plants, retained a 21 cm stubble from an initial average height of 33 cm, and only an average 31 percent of the crown area was grazed. These largest plants, although making up only 1 percent of the total plant population, comprised 20 percent of the total available forage and contributed 16 percent of the forage harvested.

An additional measure of selective grazing was calculated by comparing the percent of available forage in each size class with the relative contribution to harvested forage, all on a forage volume basis. The results in Figure 2 indicate that livestock were placing the greatest grazing pressure

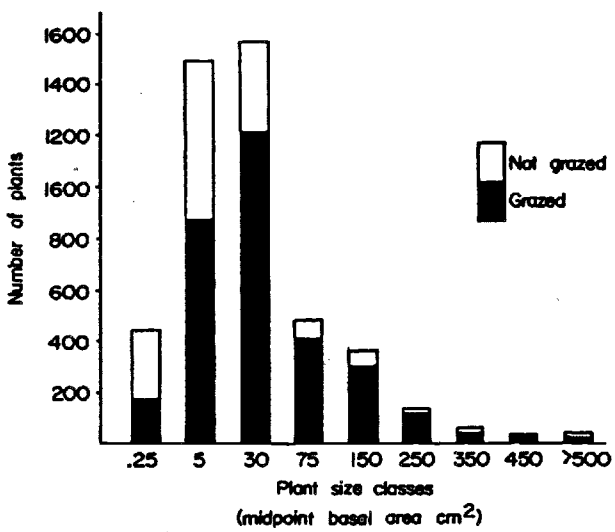

Figure 1.--Distribution of plants sampled according to size classes. The solid portion of each bar represents the number of plants that were grazed to any degree during the six-week grazing period.

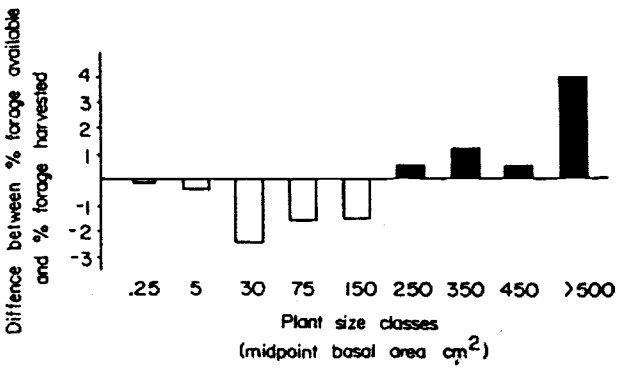

Figure 2.--Percent of available forage in each size class relative to percent of forage consumed from the size class. Forage amounts were calculated in terms of volume.

on medium-sized crested wheatgrass plants, those with basal areas from 11 to 200 cm^2. For example, plants in the 11-50 cm^2 basal area class contained 11.75 percent of the total available forage, but the heifers took from these plants 14.25 percent of what they harvested overall. Altogether the plants in this medium-sized group contributed 49 percent of the forage consumed from an offering of 43 percent of the forage available.

Wolf Plants

The relative neglect of the largest plants requires explanation. Wolf plants carry a substantial amount of standing stalks left over from the culms of old inflorescences. This residual straw could constitute a physical impediment to livestock grazing (Willms et al. 1980) and deter herbivory. This hypothesis was tested by comparing grazing impact on plants with and without over-winter stalks. Prior to spring grazing a number of matched pairs of plants with heavy over-winter stalk accumulations were identified and from a randomly chosen member of each pair the stalks were removed by hand. As previously reported by Norton et al. (1983) plants without standing straw were grazed more. The impediment of stalks increased with increasing plant size, and the influence of old culms on grazing was most pronounced in early spring and declined with the rising growth of new foliage (Johnson and Norton, manuscript submitted). We conclude that wherever there is moderate utilization of crested wheatgrass under continuous season-long use, nonuniform grazing will allow a residue of flowering stalks to be carried into the winter and initiate or exacerbate the self-perpetuating problem of wolf plants. Large plants neglected one year will tend to be neglected the next, and so on.

Regrazing

The data on incidence of regrazing were unexpected. Of all plants that were grazed during the study, only 16.6 percent were regrazed. Of all those that were regrazed, 86.5 percent were grazed twice and 11.4 percent were grazed three times. Only 11 plants in the whole study were grazed more than three times. If continuous season-long grazing has a detrimental impact it is not likely to be caused by repeated grazing on preferred plants, at least within the same grazing season. Analysis of data from the same plots from subsequent years, still incomplete at this time, will enable us to address the proposition that any danger of pasture deterioration from continuous grazing is more likely due to repeated defoliation of the same plants or patches of plants year after year or season after season, rather than the result of repeated grazing over the short term.

The following analysis of regrazing was confined to plants of at least 101 cm^2 basal area, large enough for a heifer to discriminate between the ungrazed and previously grazed portions. Evidence of regrazing was not apparent until the cattle had been in the pastures for 8 days. Over 90 percent of regrazing occurred after the first 14 days of use. The cattle did not prefer to regraze plants that were more extensively defoliated at the first grazing. Plants grazed just once had on average 66 percent of their crown cover defoliated and were reduced to a stubble of 16 cm. Regrazed plants had on average 48 percent of their crown cover affected at the first grazing event with a remaining stubble of 15 cm. The second grazing event defoliated 49 percent of crown cover on average with stubble height again at 15 cm. The second grazing overlapped the first only 32 percent of the time, and where overlap occurred only 44 percent of the crown cover was subjected to two defoliations. When these data are related to the low probability of a plant being regrazed, there was obviously only light grazing pressure on regrowth. On the other hand, the study was conducted in early summer when rate of regrowth after defoliation was much slower than in spring, so that there may have been less growth on grazed portions than if the grazing had occurred in late April or May. It is also probable that repeated grazing and defoliation of previously grazed portions would have been more severe if the overall utilization of the two pastures at the end of the study had been greater than the moderate 50 percent level achieved.

Plant Use Through Time

As the grazing season progressed, the total number of plants defoliated (to any degree) in a two-day period steadily rose to a maximum of almost 450 (about 10 percent of the sample population) at 16 days of grazing and then declined as steeply for the next 8 days, finally levelling out at around 200 plants per two days of grazing (Figure 3). The shape of this curve is due almost entirely to the pattern of utilization of the smaller plants, up to 100 cm^2 basal area. Medium-sized plants, 100-300 cm^2 basal area, exhibit a faint echo of the trend, but at the peak only 50 of these plants were being grazed every two days. These patterns could reflect an exploratory phase of grazing behavior lasting for two weeks, during which time the larger and more readily accessible members of the small size class were selected. These data do not provide a self-evident behavioral explanation. It is clear from Figure 3, however, that for the first 16 days of grazing the herbage consumed was coming from an increasingly larger number of plants, almost all of them plants not previously grazed.

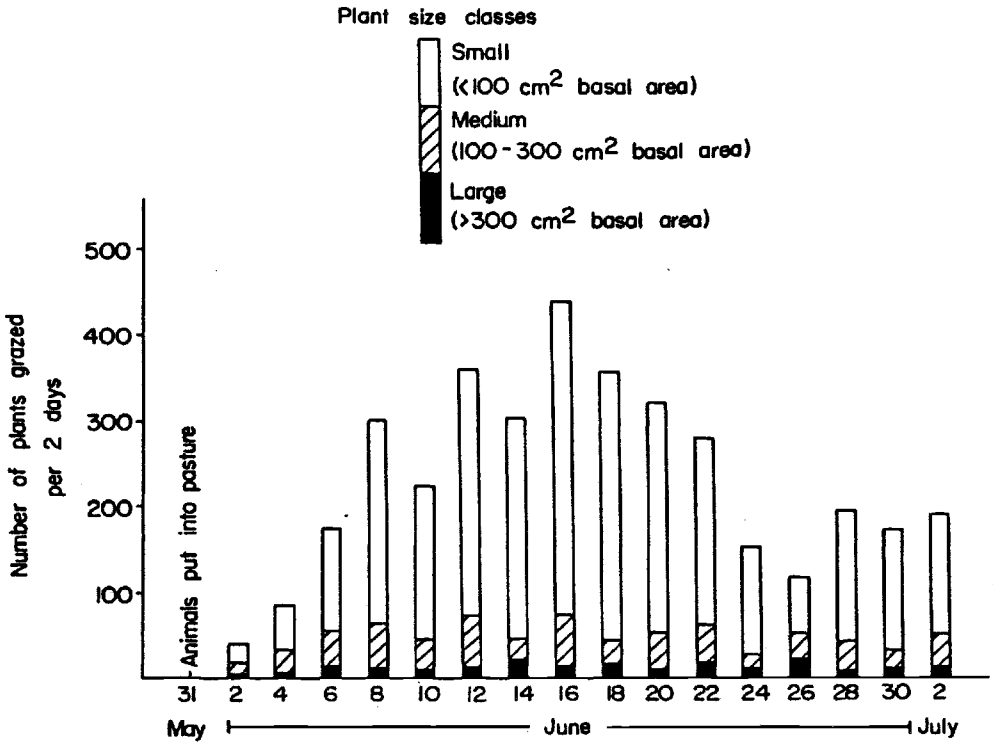

Figure 3.--Number of plants, in 3 size classes, grazed to any degree in 2-day grazing periods.

DISCUSSION

This rather superficial, single-season investigation of defoliation set out to answer questions about the dynamics of cattle grazing crested wheatgrass under traditional management on Utah's foothill ranges. We discovered that grazing is not a random process and that utilization is far from uniform. Medium-sized plants were preferred over either small or large plants; the proportion of forage they contributed to consumption was in excess of their proportion of total forage on offer. The cattle appeared to seek out small plants for the first 16 days of the grazing season, however.

The probability of a plant being grazed at all in six weeks was only 69.3 percent; this increased to 80 percent for plants which had a basal area of at least 11 cm^2. The probability of a grazed plant being defoliated again, to any degree, was only 16.6 percent, and nearly nine out of ten of these repeated grazings stopped there. A very small proportion of grazed plants, 2.2 percent, was defoliated three or more times. We found no evidence that regrazing was concentrated on parts of the plant that had been grazed before, although we must note that the study was conducted after the spring period when rapid and substantial regrowth would be expected. Perhaps the most provocative portion of the data revealed changes through time in the grazing behavior of cattle on the pastures, which raises a fresh set of questions and underscores the limitations of the information we have gathered so far.

PUBLICATIONS 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.

Frischnecht, N.C. and L.E. Harris. 1968. Grazing intensities and systems on crested wheatgrass in central Utah: response of vegetation and cattle. U. S. Dep. Agr. Tech. Bull. 1388. 47 p.

Gammon, D.M. and B.R. Roberts. 1978. Pattern of defoliation during continuous and rotational grazing of the Matopos sandveld of Rhodesia. Rhod. J. Agr. Res. 16:117-131.

Greenwood, E.A.N. and G.W. Arnold. 1968. The quantity and frequency of removal of herbage from an emerging annual grass sward by sheep in a set-stocked system of grazing. J. British Grassland Soc. 23:144-148.

Harris, L.E., N.C. Frischnecht and E.M. Sudweeks. 1968. Seasonal grazing of crested wheatgrass by cattle. J. Range Manage. 21:221-225.

Hodgkinson, K.C. 1980. Frequency and extent of defoliation of herbaceous plants by sheep in a foothill range community in northern Utah. J. Range Manage. 33:164-169.

Hodgson, J. and J.H. Ollerenshaw. 1969. The frequency and severity of defoliation of individual tillers in set-stocked swards. J. British Grassland Soc. 24:226-234.

Holochek, J.L. 1981. Crested wheatgrass. Rangelands 3:151-153.

Johnson, P.S. and B.E. Norton. The effect of plant size, phenology, and presence of standing dead culms on utilization of crested wheatgrass. Submitted to Journal of Range Management.

Norton, B.E. and P.S. Johnson. 1983. Patterns of defoliation by cattle grazing crested wheatgrass pastures, p. 462-464. In: J. A. Smith and V. W. Hays (eds.). Proceedings of the XIV International Grassland Congress. Westview Press, Boulder, Colo. 876 p.

Norton, B.E., P.S. Johnson and M.K. Owens. 1983. Increasing grazing efficiency on crested wheatgrass. Utah Science 43:110-113.

Willms, W., A.W. Bailey, A. McLean and R. Tucker. 1980. The effect of fall grazing or burning bluebunch wheatgrass range on forage selection by deer and cattle in spring. Can. J. Animal Sci. 60:113-122.

In: Johnson, K. L. (ed.). 1986. Crested wheatgrass: its values, problems and myths; symposium proceedings. Utah State Univ., Logan.