Value of Crested Wheatgrass for Big Game

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ABSTRACT: Crested wheatgrass (Agropyron desertorum, Agde "Standard," A. cristatum, Agcr "Fairway") have had great impact on western North America rangeland habitats of mule deer (Odocoileus hemionus) and pronghorn antelope (Antilocapra americana). The contribution of crested wheatgrass to seasonal diets and nutrition of deer is controversial and appears to vary widely by region and location. Nevertheless, green growth of these exotic grasses has been shown in some cases to be very important from fall to mid-spring, supplementing browse diets of frequently modest or low value until new forb growth in spring. A major general benefit of these exotic grasses has been a reduction of conflicts between deer and livestock on foothill ranges via extensive seedings in broad valley floors that tend to separate ungulate species during critical periods. Antelope have received less direct value from crested wheatgrass than deer. Forbs associated with grass seedings (some themselves seeded) are avidly sought by and of considerable value to antelope. Comparatively few areas of elk (Cervus elaphus) and bighorn sheep (Ovis canadensis) habitat have been seeded to crested wheatgrass, but where available they are used by these strongly graminivorous species. Any serious assessment of the pros and cons of seeding on big game ranges must be more comprehensive than a mere examination of diet composition. Moreover, trends away from grass monocultures toward simple grass-forb mixes or complexes of all three forage classes are commendable, albeit more difficult to establish and manage.

INTRODUCTION

Concerns that crested wheatgrass seedings could be detrimental to big game winter range values were expressed as early as the 1950's when large projects on burned, plowed, chained or sprayed areas began to reduce shrub forages in the sagebrush-grass and juniper-pinyon zones (Wagner 1983). However, little effort to assess impacts occurred until the early 1960's (Urness 1966). Since then a large number of studies have been published on various aspects of the problem. This paper attempts a synthesis of the overall topic and, by inference, points to the gaps in our knowledge at present.

MULE DEER

The myth that mule deer are obligate browsers on winter range dies hard despite many literature sources, citing importance of green grass and forbs to their diets, over a period of at least 50 years (Dasmann 1949, Dietz et al. 1962, Dixon 1934, Edwards 1961, Kufeld et al. 1973, Leach 1956, Leckenby 1969, McLean and Willms 1982, Plummer et al. 1968, Robinette et al. 1973, Skovlin and Vavra 1979, Willms et al. 1979, and many others). Granted that browse is an indispensible component of deer winter diets when snow depths prevent access to short forb and grass forages, the fact remains that on many deer wintering areas snow cover is often alternated with snow-free periods on south and west-facing slopes. Consequently, green growth initiated in fall by perennial and annual grasses is periodically available. Where snow cover is deep and continuous, or in drought years when fall regrowth is sparse or absent, herbaceous forages obviously have minimal importance to wintering deer. Adequacy of shrub resources then becomes critical.

These contrasts between years, regions and locations within regions have developed conflicting viewpoints regarding the value to deer of grass in general and crested wheatgrass in particular. For instance, Vavra et al. (1982) found very low spring use of green Agde on the Keating unit near Baker, Oregon. Although total grass consumption exceeded browse use, Sandberg bluegrass (Poa sandbergii) was the preferred species. Tausch (1973) studied sagebrush and juniper-pinyon chainings in Nevada; those seeded to Agcr had low deer use compared to treated areas where native grasses such as squirreltail (Sitanion hystrix) and Sandberg bluegrass dominated the understory. Cole (1968) discussed the potential for deer of monotypic Agde

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seedings as generally developed in Nevada in the 1950's and 1960's; he found no extension of deer range due to seedings, at best peripheral use, and lowest use levels where Agde was most abundant. Providing herbaceous forages on seedings when prolonged winter conditions kept deer at lower elevations was considered one of the limited benefits.

Terrel and Spillett (1975), investigating seeded juniper-pinyon conversion areas in Utah, found grass use by deer in winter to be less than expected on the basis of its contribution to the total forage resource; however, grasses were first and third in dietary importance over the two years of the study. They were vague in identifying species, but indicated that Agcr dominated the conversions, so one can infer that it also dominated use. The authors implied that Agcr is less desirable or less attractive to deer than bluegrasses (Poa spp.), Russian wildrye (Elymus junceus), and cheatgrass (Bromus tectorum). Terrel (1973) made a rough calculation of the amount of grass needed for deer on winter range based on (1) green grass comprising 25% of deer diets, (2) an average consumption of 1 pound (0.45 kg) air-dry grass per day, (3) a 180-day season, (4) an effective availability of 200 pounds per acre (200 kg/ha), and (5) the number of deer using a wintering area. He concluded that grass need could be satisfied with far fewer seeded acres (ha) than were present on his study area. While one might quarrel about some of the assumptions, his calculation probably is reasonable except that no parallel calculation was made of shrub needs of deer. If those resources again exceeded need, such an exercise might have revealed that the larger seedings, while not contributing to deer, also did not limit them.

Vale (1974) speculated that large seedings of crested wheatgrass would decrease carrying capacity of deer winter ranges and discounted any real benefits except during the late spring fawning period. The latter point seems odd since few large seedings are located at intermediate elevations where deer fawns are born. Moreover, it is the very broad Intermountain Region valleys he emphasized that were seeded in large tracts and that tend to have minimal values as winter range for deer under any conditions. Commonly, a narrow belt of steeper lands along mountain toe slopes or bajadas are typically deer concentration areas. Indeed, Vale (1974) stated that valley-bottom seedings have improved foothill areas by concentrating livestock on seedings so that native ranges could recover from excessive past use. Heady and Bartolome (1977) made essentially the same point relative to the Vale Program in southeastern Oregon.

Conversely, a number of studies have shown that green crested wheatgrass can provide valuable nutrients to otherwise browse-dominated diets on many deer winter ranges throughout the western United States and Canada. For example, Austin and Urness (1983) found green Agde percentages in seasonal deer diets of 51 (Nov.), 2 (Dec.), 3 (Jan.-Feb.), 38 (Mar. 1-20), 90 (Mar. 21-Apr. 10), and 57 (Apr. 11-30). The low levels from December through February reflected snow depths that limited access to green leaves near ground level. Leckenby (1969) reported Agde as constituting 35 (Feb.), 45 (Mar.), and 30 (Apr.) percent of feeding observations of mule deer in central Oregon. Over the entire winter 1968-69 (Dec.-May), Agde comprised 34 percent of total feeding observations; green grass of all species totaled 72 percent. In British Columbia, green Agcr was second in importance to Sandberg bluegrass in deer diets from a seeded habitat during the period 6 March to 5 May; Agcr was most important from 6-31 May (Willms and McLean 1978).

Nutritional value of green Agde to mule deer is quite important when consumed in dietary percentages as high as noted above. Urness et al. (1983) showed that digestibilities of pure Agde diets in April averaged 62 percent over 20-day in vivo feeding trials with four deer, a figure generally much higher than those for available browse forages in late winter and early spring. Similarly, in vitro trials showed dry matter disappearance percentages for green Agde of 58 (fall), 51 (winter), 58 (at greenup in late March to early April), and 76 (spring). Crude protein levels for the same periods were 23, 15, 23, and 30 percent. The two primary browse plants, mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and Douglas rabbitbrush (Chrysothamnus viscidiflorus), ranged from 14-19 and 6-8 percent crude protein, respectively. The contribution of green Agde to deer diets was compared by weighting dietary crude protein and digestibility levels with and without grass. Fall (Nov.-Dec.) and greenup (Mar. 21-Apr. 10) diets showed significantly higher values with grass added, whereas mid-winter and spring diets were not different. Moen (1978) emphasized the critical importance of the greenup period to deer reproduction and overwinter survival.

Koehler and Leckenby (1970) conducted a preliminary analysis of the costs and benefits of chaining and seeding vs. artificial feeding of a commercial pelleted ration, based on estimated costs per pound of total digestible nutrients (TDN) and projected TDN needs of wintering mule deer. They concluded it was less costly to artificially feed deer (both approaches were expensive in terms of the revenues generated under existing management systems), but entire costs of seedings were charged to deer as though that were the only benefit. Inclusion of other values (e.g. livestock forage, soil stability) and greater-than- estimated future costs of the artificial ration could easily reverse the ranking. Nevertheless, it was a useful attempt to sort out various aspects of the value of seeded grass to wild ungulates. The authors made an important additional point: rehabilitation efforts, when placed in optimal pattern with native vegetation types, appear to increase efficiency of use of native range. Therefore, they provided greater value than just the available AUMs of seeded forage by improving the balance of dietary nutrients.

A number of investigators (Koehler and Leckenby 1970, Leckenby 1968, Leckenby et al. 1982, Lamb 1966, Willms and McLean 1978, Willms et al. 1979) have mentioned the greater accessibility to wintering deer of green grasses when standing dead straw has been removed or reduced by prior grazing of livestock. While this is generally true for snow-free periods, Austin et al. (1983) showed that ungrazed straw can significantly increase the amount of green Agde in deer diets under certain snow-cover conditions via a black-body effect. Thus basal green leaves on previously ungrazed plants become available through differential snowmelt whereas

those on heavily grazed plants do not. Moreover, they found that the production of basal green leaves was usually as great or greater on plants ungrazed by livestock, especially in years when conditions favored abundant fall growth. This is, perhaps, the only solid evidence in support of a rest-rotation management system for Agde and, even then, it means that only about 1/3 of seeded areas where deer concentrate in winter need be rested. Preferably this would be in many scattered small units, rather than a few large ones.

Recent emphasis on smaller seeded areas and mixtures of seeded species may reduce the objections of many wildlife biologists to crested wheatgrass, especially if interseeding of shrubs and forbs are successfully achieved on existing monoculture stands (Rumbaugh et al. 1982). However, despite the advantages of mixed seedings, the fact remains (Leckenby and Towell 1983 a and b) that exotic wheatgrasses are the primary species that establish on the drier end of the seeding range. Costs of other less-commercially-available species are often too high, and examples of successful establishment too few, to justify risking scarce range-and habitat-development capital. Therefore, in my opinion, one can expect to see a very important role for crested wheatgrass on semi-arid shrublands used by deer far into the future. Research has shown that grass can be a positive element if management is keyed to optimizing the benefits of seedings.

PRONGHORN ANTELOPE

Pronghorn consume even less grass on an annual basis than deer, therefore they have benefited directly to a lesser extent from crested wheatgrass seedings. Actual use of crested wheatgrass is quite low, only a few percent, even when pronghorn winter on seedings (Kindschy et al. 1982, Spalinger 1979); use is a bit more on spring range perhaps. Early-growth leaves appear most attractive (Heady and Bartolome 1977).

Moreover, the patterns of antelope range use on the broad valley-bottoms of the Great Basin, typically seeded in large tracts, indicate a greater potential for negative impacts on important forb and browse forage resources. This appears especially true where herbicides constituted the pretreatment (brush control) in advance of drill seeding.

There are two general viewpoints regarding required habitat for antelope. One is that pronghorns need strongly shrub-dominated ranges, especially species of sagebrush, because their diets are mostly browse (Pyrah 1971, Sundstrom et al. 1973, Vale 1974). In this view, loss of shrub dominance via herbicidal, pyric, and mechanical treatments is a major cause of low antelope densities in some areas. The other school of thought emphasizes the importance of grasslands as historic antelope range, and the fact that their greatest densities were attained on the prairies east of the Rocky Mountains, not on the shrublands of the Intermountain West (Kindschy et al. 1982, Leopold 1959, Yoakum 1978, 1983). In the latter view, increased height and density of sagebrush resulting from (1) reduced perennial grasses and forbs with heavy continuous livestock grazing and (2) reduced fire frequency (active fire suppression) was not a boon to antelope.

On the contrary, it was Leopold's (1959) conclusion that loss of valley grasslands where antelope once thrived was the cause of their low numbers in present-day Nevada. He predicted that increased range seeding of perennial grasses after removal of some dense shrub stands would lead to gradual increases in antelope numbers with proper management. Leopold gave as evidence citations of early explorations in the Great Basin. Bryant (1848) saw hundreds of pronghorns along the Humboldt River in 1846. However, Simpson's 1859 expedition for the US Army across the central Great Basin, from Salt Lake City to Genoa (in Carson Valley), recorded few pronghorn except in Antelope Valley, where they were abundant. Sightings by his party were also sparse on the return trip via a more southern route (Simpson 1876). The reader must conclude that antelope were strongly aggregated and abundant only in the most favorable habitats composed of the more open grassy valleys, especially on well-watered lowlands. The interminable stretches of sagebrush across the wide valleys of the eastern Great Basin, cited ad nauseum by Simpson, yielded few or no sightings of antelope despite the fact that indigenous peoples could not effectively capture the few that were there.

Thus, it appears that presence of abundant sagebrush did not assure more than scattered populations of antelope in the pristine Great Basin, nor did absence of sagebrush prevent their existing in hordes on the prairies of the Great Plains. If sagebrush and grass are not the key to antelope abundance, what is? The common thread through this apparent conflict of views resolves to the relative availability and importance of the forb class of forage, and the variety and adequacy of shrubs (not the superabundance of one). While many studies indicate the dominance of big sagebrush in antelope diets at the present time (extensively reviewed by Sundstrom et al. 1973), this may reflect only great availability and the depletion of "something" that once occurred (i.e. a sagebrush disclimax induced by heavy long-term livestock grazing). Deming (1963) hypothesized that that "something" was forbs and shrubs more palatable to livestock than big sagebrush.

The importance of forbs to pronghorn during the growing season, and therefore to satisfying the high nutritional demands of late gestation and lactation, appears generally accepted by biologists. The association of forbs with seeded grasses make crested wheatgrass projects valuable to antelope. This association may be relatively short-lived unless forbs are part of the seeding mixture (Heady and Bartolome 1977, Reeher 1969, Yoakum 1980 and 1983). Native and adventive forbs can be lost rather quickly where grasses establish at levels most range managers term successful; for pronghorn marginal seedings may be the most used (Reeher 1969). For example, the Chicken Creek project on the Vale Program in southeast Oregon showed a ground cover of only 35% grass, 20% forbs and 2% shrubs; 43% was bare ground. Antelope pellet groups were over three times more numerous on the seeding than on the adjacent sagebrush area that served as the control.

While most seeded mixtures on pronghorn ranges in the Great Basin have been simple Agde and dryland Nomad alfalfa (Medicago sativa), it is Yoakum's (1983) opinion that more complex mixtures should

receive greater research effort. This is based on the greater availability of a wider variety of forb seeds today than when most monoculture grass seedings were established 20-30 years ago. The potential for more complex seedings is, however, most likely better at the higher end of the precipitation spectrum (Leckenby and Towell 1983 a and b). Interseedings of forbs and shrubs show some promise, but are expensive (Rumbaugh et al. 1982).

Structure of managed rangelands, including Agde seedings, has recently been suggested to be as important to antelope as composition (Kindschy et al. 1982, Yoakum 1980, 1983). Their guidelines give very specific characterizations of optimal height (averaging 38-61 cm, 15-24 inches), composition (40-60% grasses, 10-30% forbs, 5-20% shrubs), variety (5-10 species of grasses, 20-40 forbs, 5-10 shrubs), ground cover (averaging 50% live vegetation), and other habitat factors. Biologists in the drier regions of antelope range would no doubt agree but they hardly can expect such luxury except, perhaps, in the wettest cycles. Their options, while limited, should still focus on forb and shrub variety to the extent possible. Weedy annual forbs, the bane of the "true-believer" range conservationist, may be quite satisfactory for antelope. Indeed, the extent to which introduced exotic weeds contribute seasonally to pronghorn diets and nutrition is a poorly researched topic.

The value for antelope of many seeded ranges in summer has been the provision of dependable water sources in otherwise dry valleys (Heady and Bartolome 1977, Kindschy et al. 1982, Yoakum 1980). The distribution of seasonal use may have more to do with water availability than forage kind or amount in the arid Great Basin. Development of large numbers of watering points likely benefits antelope by allowing them to disperse over a greater area. Conversely, limited water points can concentrate use, restrict expression of selective forage preferences (and thus nutritional intake), and possibly influence predation on fawns.

Improved range conditions resulting from a combination of better livestock management, a series of wet years, and rangeland seedings have generally resulted in expanding antelope populations in the US (82% increase aided by transplanting populations into new or former habitats) in the past two decades. Increases have been even greater in the northwestern states except Oregon where the population has remained unchanged (Table 1). The Vale Program population in southeastern Oregon showed an approximately 3-fold increase from 1961 to 1976 (Heady and Bartolome 1977). Thus, it appears that at worst extensive seedings in the Great Basin have had little negative impact. They may have been, as predicted by Leopold (1959), an important factor in gradual population increases. There seems no reason to doubt that, with greater attention to management with antelope needs as an integral element, population levels will continue to increase. The complementarity between pronghorn and cattle diets, and the steady decline in the range sheep industry, indicates a reduction of conflict despite expanded antelope populations.

Table 1.--Antelope population levels in four western states (data supplied by Don Klebenow, University of Nevada--Reno).

	Oregon	Idaho	Nevada	Utah
1964	8,950	4,700	4,500	970
1982	8,900	17,500	9,000	5,000

ELK, BIGHORN SHEEP, and BISON

Little information is extant on use of crested wheatgrass by elk. Kirsch (1962) indicated Agcr use was greater than bluebunch wheatgrass (Agropyron spicatum) in a ponderosa pine-grassland type in Montana, despite the greater abundance of the latter species. Agcr was seeded with smooth brome (Bromus inermis) on abandoned farmland and brome was much preferred. However, since the majority of total grass items in the diet analysis was unidentified, the relative usage stated may have limited utility. Kufeld (1968) reported various conversion of extensive areas of juniper-pinyon and sagebrush-grass types in Colorado. Of those seeded, 84% were seeded to Agcr, and nearly half to sweetclover (Melilotus spp.). Thirty-eight percent of the treated lands in Colorado was elk range, with two-thirds used by elk from fall through spring. Effects on elk were not evaluated except on sagebrush spraying treatments and most of those were not seeded.

Brooks and Urness (1984) fed crested wheatgrass at two phenological stages to tractable elk. Organic matter digestibilities were 74% for the late vegetative stage and 53% for the late bloom stage. This indicates a very high value of green leaves and a moderately high value for nearly mature forage. Voluntary intakes of forage in the late vegetative stage were as high as good quality alfalfa hay, thus elk seemed to relish crested wheatgrass in hay form. Observation of elk feeding on crested wheatgrass seedings in early spring at several locations in Utah (James Bates, Utah Division of Wildlife Resources) supports the view that elk find Agde palatable. A seeding on a 10-year-old, juniper-pinyon burn at Boulder Mountain was especially heavily used by elk in winter and early spring, as was a seeding at Johns Valley. Although relatively few areas of elk range have been seeded to crested wheatgrass, it appears they will eat it readily when available and derive adequate or better nutrition when it is green. Obviously elk can also utilize mature crested wheatgrass much better than either mule deer or antelope.

Even less information was found regarding bighorn sheep use of crested wheatgrass. A recent book on desert bighorn sheep (Ovis canadensis mexicana) ecology (Browning and Monson 1980) gave no data on foods eaten in the Great Basin, nor mentioned crested wheatgrass elsewhere. They emphasized the importance of grass and browse to

yearlong sheep diets, so it is likely if sheep encounter seedings they would use them. A radio-telemetry study of desert bighorn on Dark Canyon Plateau and Horse Flats in Glen Canyon National Recreation Area showed sheep traversing seeded stands, but it was not known if they actually used seeded grass (Michael King, Utah State University). King also said Bureau of Land Management personnel reported bighorns using seeded ranges near the Colorado River rim across the river from Canyonlands National Park. James Bates believes heavy cattle grazing limits bighorn sheep use of seedings in this area.

McQuivey (1978) gave a brief summary of desert bighorn sheep diets in Nevada but only discussed forage classes rather than species. Grasses predominated (65%) in all rumens analyzed and it is therefore likely that crested wheatgrass would be used if available. The very rocky and arid locations that desert bighorns generally occupy restricts opportunities for seeding any significant area.

No reference to use of crested wheatgrass by mountain sheep (Ovis canadensis canadensis) was found. Heady and Bartolome (1977) mentioned an introduction in 1965 in the vicinity of the Vale Rehabilitation Program area in southeastern Oregon, but no use of seedings by the expanding population had been observed by 1975. It was their opinion that improved native ranges resulting from reduced livestock pressure were a derived benefit from seeding at lower elevations.

Finally, a study by Van Vuren and Bray (1983) of bison (Bison bison) and cattle diets on seeded range in the Henry Mountains of southcentral Utah, showed diets of both animal species were dominated (over 80%) by Agropyron spp., presumably mostly crested wheatgrass.

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