USE OF LIVESTOCK TO CONTROL CHEATGRASS—A REVIEW

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ABSTRACT

Proper grazing management appears urgent in preventing or delaying further encroachment of cheatgrass (Bromus tectorum) *into perennial vegetation on western grazing lands and subsequently gaining site dominance. In mixed stands with desirable perennials, livestock grazing might be directed to (1) reducing cheatgrass competition by concentrating grazing of cheatgrass during dough seed stage, providing perennials still have opportunity to complete their life cycles, or (2) basing grazing on the needs of perennials while mostly ignoring cheatgrass. When cheatgrass domination results in a closed community, alternatives appear limited to (1) managing as annual grassland, or (2) revegetation using intensive cultural practices. In conjunction with revegetation, livestock might conceivably be employed for "graze out" in site preparation and/or for selective plant control during germination and emergence of the seeded perennials. However, with these possible limited exceptions, grazing is concluded not to be an effective general tool for cheatgrass control.*

INTRODUCTION

Livestock grazing is generally considered a factor in enabling and promoting the establishment and prominence of cheatgrass (*Bromus tectorum*) on western grazing lands. This introduced, aggressive plant species is considered much less desirable than the original perennial vegetation it has commonly replaced; and dry cheatgrass, because of its high flammability, constitutes a fire hazard contributing to repeated wildfires and the further reduction of many less fire-tolerant native perennials.

Partially redeeming aspects of cheatgrass—these seemingly elevating the species from a classification of worthless to only mediocrity at best—include some forage and site protection potential. Cheatgrass has become the principal forage species on some dry western grazing lands (Fleming and others 1942; Whitson and others 1991); it offers high levels of nutrition for grazing animals during rapid spring growth (Cook and Harris 1952; Murray and others 1978); and has given good animal gains under spring grazing with cattle (Murray and Klemmedson 1968) and sheep (Murray 1971). Although cheatgrass is generally most valuable as spring forage, this is also the time of year when perennial cool-season grasses are most susceptible to damage from grazing (Young and others 1987).

Cheatgrass provides a short period of high palatability in the spring but becomes unattractive to grazing animals as seedheads develop (Hull and Pechanec 1947; Klemmedson and Smith 1964; Vallentine 1989). After the potentially mechanically injurious awns are shed and the herbage has been softened by fall rains, it offers some opportunity for winter grazing on drier areas through curing and reduced weathering on such sites (Deflon 1986; Hull and Pechanec 1947; Young and others 1987). Its major handicaps as a forage producer are its short green forage period, great annual fluctuations in yield (depending on seasonal and annual growing conditions), and rapid weathering and deterioration under moist conditions (Murray 1971; Platt and Jackman 1946; Stewart and Young 1939; Swanson and others 1987). Adjusting animal numbers to properly utilize cheatgrass and optimize animal gains is made particularly difficult by high variability in annual forage yield (Murray and others 1978).

Cheatgrass provides varying levels of protective soil mulch, this favored by reduced levels of herbivory and more biomass being left unburned, and may offer some control against the invasion of even more undesirable green migrant plants. While providing dry, fine fuel to expedite prescribed burns, mature cheatgrass biomass also creates an extreme fire hazard in high herbage production years (Young and others 1984).

A speculative question is whether livestock grazing, in fact, might be used to manipulate cheatgrass stands and help in reducing population levels of this introduced species. This paper explores the interrelationships between cheatgrass and livestock grazing and the opportunities, if any, for using livestock grazing as a biological tool for controlling cheatgrass.

AN AGGRESSIVE INVADER

Cheatgrass is well equipped to be an aggressive invader (Vallentine 1989). It is a prolific seed producer, and seeds normally have high viability. Seeds germinate rapidly when soil conditions become favorable, but adequate numbers of viable seed may stay dormant in the litter and soil to survive 1 or even 2 unfavorable years in a row (Young and others 1987). However, there is a point where reproductive potential in a given year falls below levels where one year's seed production can restock next year's stand; and heavy grazing can potentially reduce the seed stocking ability of a stand (Young and others 1969).

Although typically a winter annual, cheatgrass can germinate in the spring under favorable conditions and still

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produce seed. When seedling density is inadequate to occupy the site to potential, cheatgrass can deplete soil moisture and other resources by growing larger and by prolific tillering (Ganskopp and Bedell 1979). In the more arid portions of the Great Basin, Young and others (1987) found that cheatgrass often fails to germinate in the fall, thereby becoming more dependent upon favorable conditions for spring germination.

A large portion of cheatgrass' competitive ability comes from its ability to germinate and establish in the fall as a typical winter annual and develop rapid root growth (Ganskopp and Bedell 1979). While overwintering in a prostrate rosette form, root growth continues even under low temperatures and reaches nearly its full complement of roots by spring. By the time of active spring top growth, cheatgrass is able to quickly resume growth and effectively remove soil moisture from the upper foot of soil before native perennial grasses can complete their growth, thus providing cheatgrass with a competitive advantage (Swanson and others 1987; Upadhyaya and others 1986; Young and others 1987). This phenomenal ability to consume soil moisture on which perennial seedlings depend and also endure drought enables it to control vast areas for long periods.

INVASION AND SITE DOMINATION

Having first appeared in the Western United States at least by the late 1890's, cheatgrass now occupies large areas in the Intermountain region from the moister part of the blackbrush and shadscale zones, through the sagebrush and juniper zones, and up into the mountain brush zone (Vallentine 1989). Its invasion into the lower, drier sagebrush zone and margins of the salt-desert shrub zone was particularly aggressive and seemingly met with little resistance. It was noted early (Stewart and Young 1939) that cheatgrass usually first established in bare or nearly bare areas where plant cover was deteriorated or absent. Platt and Jackman (1946) promoted the working hypothesis that cheatgrass did not drive out the bunchgrasses but merely followed them.

The rapid invasion and subsequent often near dominance of cheatgrass was expedited if not enabled by the disturbance or loss of the natural perennial cover through cultivation and abandonment, poorly managed cropland, unmanaged grazing, repeated fire, and road construction (Beetle 1954; Klemmedson and Smith 1964; Stewart and Hull 1949). Hull and Pechanec (1947) proposed that it was unlikely that cheatgrass would have invaded unless it had been preceded by disturbances of the previous, original plant cover. In the tallgrass prairies, patchy grazing by cattle has left niches open for the more unpalatable species to inhabit (Collins 1987).

While proposing that the original spread of cheatgrass had little to do with grazing, Beetle (1954) found it apparent that its subsequent local abundance in the West was due to many aspects of mismanagement including grazing. Based on his studies at the Nevada Test Site, Hunter (1991) concluded that the spread of cheatgrass does not require the direct activities of humans and that its spread should be considered a natural phenomena. While pointing to disturbance by humans, including grazing, off-road vehicles, commerce, and recreational use, he also noted the impact of disturbance by burrowing animals, frequent and/or natural fires, and abnormal short-term climatic cycles. Localized big-game impact or disease or insect damage might be added to the latter list.

While Young and others (1987) proposed that cheatgrass moved into sagebrush rangeland largely as a result of the biological vacuum created by excessive grazing, Young and Tipton (1990) considered both this hypothesis and a contrasting hypothesis that cheatgrass may partially grow in environmental potential that native plants never evolved to occupy. They suggested this may have application on the margins of the more arid plant communities within the sagebrush/bunchgrass zone where cheatgrass has been able to insert itself successfully even into climax stands that have been protected from grazing and fire for many years. While concluding that widespread floristic change in the drier parts of the sagebrush zone occurred regardless of grazing use history, Swanson and others (1987) held that cheatgrass is not as well adapted on higher elevation mountain big sagebrush-Idaho fescue sites and gains dominance there only as the result of disturbance.

Young and Evans (1973) investigated succession on six big sagebrush sites of different potential ranging from the edge of the salt-desert shrub to seral communities in the pinyon-juniper. They found that providing a seed source (either artificially or naturally) resulted in establishment and near-total dominance by cheatgrass; and the established populations persisted and continued to dominate the communities. Once cheatgrass becomes well established on its drier adaptation sites, the community is essentially closed to reoccupation by native perennial species (Swanson and others 1987).

After 13 years of livestock grazing exclusion on sagebrush semidesert in west-central Utah, West and others (1984) found that cheatgrass actually increased with no grazing, while it decreased or stayed the same in adjoining grazed areas; they concluded that direct manipulation would be required if rapid return to perennial grass dominance was desired. Robertson (1971) reported on Nevada studies in which sagebrush-grass range was left ungrazed for 30 years; while overall cover increased and bluebunch wheatgrass (*Agropyron spicatum*) minimally reestablished on naturally favored spots, cheatgrass actually increased by 38 percent.

Concern was expressed early that cheatgrass may only be a pause on one of the downward steps on rangeland (Platt and Jackman 1946). Young and others (1972) found in Nevada that continued disturbance pressure on cheatgrass communities caused them to regress even further into Russian thistle (*Salsola iberica*) communities. Tisdale (1986) noted that a major characteristic of annual grass-dominated communities in west-central Idaho canyonlands was their instability, as marked by the continued invasion of worthless exotics such as klamathweed (*Hypericum perforatum*), medusahead (*Taeniatherum asperum*), and *Centaurea* species.

Cheatgrass seedling establishment is favored by a rough microtopography (Tisdale and Hironaka 1981; Young and Evans 1973); this favored roughened surface environment along with the planting action of hoof impact with grazing may actually enhance cheatgrass seed germination and emergence. When managed as annual grassland, DeFlon

(1986) recommended running sheep over the area in the fall to increase cheatgrass density the following spring. Seeds of cheatgrass are readily distributed mechanically by grazing animals: (1) by having barbed spikelets that attach to the haircoat, and (2) by incomplete digestion and spread through the droppings.

GRAZING AS A CONTROL TOOL

Mechanical defoliation within a week after flowering was found by Finnerty and Klingman (1961) to be effective in preventing seed formation by annual bromes. Laude (1957) found in working with soft brome (*Bromus mollis*) that removing the terminal buds prevented leaf elongation and seed production. In clipping studies made by Hulbert (1955) on planted cheatgrass plots in the Lewiston, ID, area, clipping at the dough seed stage when purple coloration was just starting caused death of many plants and serious damage to the remainder. When clipped while plants were still green and anthesis was incomplete, few inflorescences subsequently emerged. The potential for plant regeneration decreased as the plants advanced in development through flowering to fruiting. Clipping of plants at a height of 1 cm prior to emergence of the inflorescences reduced the subsequent biomass yield only slightly; progressively later clipping caused progressively greater reduction in subsequent yield. However, Tisdale and Hironaka (1981) found that simultaneous clipping appeared to deleteriously affect the associated perennials even more than cheatgrass.

Stewart and Hull (1949) noted that closely grazing cheatgrass in the early spring with sheep can greatly reduce the height and number of plants or even kill them. Although heavy grazing then reduced the height and numbers of cheatgrass plants, concern was expressed that this level of defoliation would cause loss of soil through erosion. While opting against spring grazing of cheatgrass on low-elevation, saline soils in order to maximize forage production for winter grazing, DeFlon (1986) observed that spring grazing greatly hindered the growth of cheatgrass. Ganskopp and Bedell (1979) reported that utilization or clipping of cheatgrass during the growing period typically reduces total herbage production. However, when moisture is available for subsequent regrowth, production on grazed plants may even exceed that of ungrazed plants.

Young and Tipton (1990) concluded that many individuals, ranchers, land managers, and scientists fail to appreciate that heavy grazing cannot help but partially suppress cheatgrass. They concluded that heavy grazing not only reduces seed production of cheatgrass but also reduces the potential of seedbeds to support the germination of seeds through mulch reduction. However, they concluded that such grazing on a sustained basis is even harder on perennial grasses and does not lead to the eradication of cheatgrass. They further noted that, on the drier cheatgrass habitats on salt-desert ranges, cheatgrass seeds stay in inflorescences much longer than at higher elevation in the sagebrush zone; at these lower elevations cattle readily pick seeds from the plants, thereby directly reducing cheatgrass reproductive potential with minimum consumption of herbage.

Does this suggest any opportunity for imposing selective grazing pressure on cheatgrass in mixed stands with perennial grasses? A rather narrow window of opportunity may exist in early spring for using defoliation by grazing to suppress cheatgrass growth, seed production, and excessive mulch buildup. This would seemingly require high-density grazing for a short duration of time during which time the cheatgrass was closely defoliated and/or seed production was prevented. However, the precise timing would necessarily be when perennial grasses were still dormant or otherwise not selected by grazing livestock or had opportunity later to recover from limited defoliation by regrowing and reaching maturity before the end of the growing season. Sufficient information probably does not presently exist for developing the precise grazing plan needed for exerting biological control, but further research seems warranted.

Heavy grazing of cheatgrass might be beneficially employed in "graze out" just before seed production as part of seedbed preparation for artificial seeding of desirable perennials; or selective suppression of cheatgrass might be exacted during seed germination and emergence of seeded forage species if carefully administered. Launchbaugh (1976) has recommended cattle grazing be used on warm-season, native grass seedings during seed germination, seedling emergence, and initial plant development for weed suppression as well as utilizing the weeds for forage. If this technique were to be effectively applied to enhance establishment of seeded perennials on cheatgrass sites, a high degree of grazing control would be required to prevent damage to the perennial plant seedlings, and this may be a major limitation under practical management situations.

MANAGING CHEATGRASS FOR FULL USE

Where sufficient perennial grasses remain to provide seed or vegetative reproduction, there is some promise of the perennials replacing cheatgrass in mixed stands over time if season and intensity of grazing is based on optimizing the perennial grasses. However, this is likely to be a difficult and slow process even under light grazing (Hull and Pechanec 1947; Pechanec and Stewart 1949) and is apt to constitute inefficient use of the areas involved during the interim period (Cook and Harris 1952). On range with a mix of perennials and cheatgrass, Swanson and others (1987) concluded that dormant-period grazing (late summer, fall, winter, and even early spring if ended while sufficient soil moisture remains to allow the perennial plants to grow) should favor the perennial species on these mixed ranges. When such range is to be managed to prevent further loss of perennials and to enhance their return, Pechanec and Stewart (1949) recommended two-thirds of the bunchgrasses and 40 to 60 percent of associated desirable grasses should remain ungrazed each year. Stewart and Hull (1949) suggested cheatgrass utilization levels of 35 to 40 percent under such management objectives.

Deferment for 2 or 3 successive years is unlikely to benefit bunchgrasses present in minimum stand and may only serve to build up an accumulating mat of dead, ungrazed herbage/mulch and result in a fire hazard. If a rancher has both cheatgrass range and perennial bunchgrass range, it may be more appropriate to defer the bunchgrass area occasionally and fully graze the cheatgrass in early spring (Platt and Jackman 1946). Swanson and others (1987) suggested that spring grazing of cheatgrass may also reduce the fire hazard and provide deferment for seedings of native perennial range in other pastures.

Deferment is not required for perpetuation of annual grass range grazed in the spring—this often results in almost complete waste of the forage crop—and may provide minimal advantage to any remaining perennial plants (Vallentine 1990). Continuous grazing (or repeated seasonal grazing) of annual grasslands during the green-growth period favors nutrient value, uniform utilization, and animal performance over rotation systems (Heady and Pitt 1979; Murray and Klemmedson 1968; Ratliff 1986).

The breaking up of multiple-permittee allotments into single-permittee allotments in the Intermountain West has permitted fencing and reduced trespassing, thus greatly benefiting range conditions (Young and Tipton 1990). However, Young and others (1987) suggested that the apparent spread of cheatgrass and wildfires onto the margins of the salt deserts and into sand-dune range may be a product of the recent innovations in grazing management. They noted that in recent years many yearlong grazing permits have been changed to 9- or 10-month grazing under some form of deferred management system. This form of grazing management may have permitted cheatgrass to increase and result in hazardous fuel accumulation leading to still further loss of perennials from more frequent wildfires.

Where cheatgrass has gained dominance to the virtual exclusion of more desirable perennial plants, the resulting closed community may be virtually immune to benefits from either nongrazing or prescribed grazing treatment. Protecting from grazing dense stands of competitive annuals such as cheatgrass, medusahead, or tarweed (*Madia glomerata*) is apt to be hopeless unless there is a fair remnant of the original cover remaining (Vallentine 1989).

The resulting management opportunities on cheatgrass-dominated range then appear only twofold: (1) manage as annual grassland, or (2) resort to complete seedbed preparation including intensive cheatgrass control and reseeding (Hironaka and others 1983). On low-potential sagebrush sites, either because of soil or rainfall deficiencies, or on shadscale sites, the sole option is apt to be to manage as annual grassland because of difficulty and uncertainty of employing intensive cultural practices in restoring perennials. Here the pristine plant community is no longer the potential, and realistic management goals should reflect this situation (Swanson and others 1987).

Key considerations for managing cheatgrass areas as annual grasslands are adequate seed production, plant litter, and microtopography relief. Being an annual, its forage production annually depends on an adequate seed source, germination, and favorable weather conditions. A roughened soil surface aids in providing more adequate seed coverage and in retaining more favorable moisture and temperature regimes for improved seed germination and emergence (Tisdale and Hironaka 1981; Young and Evans 1973). Leaving 500 lb of herbage residue at the end of the spring-summer grazing season has been recommended for a typical annual grassland site in California (Hooper and Heady 1970), but similar guidelines are not available for the Intermountain annual grasslands.

Even though individual cheatgrass plants will tolerate more severe defoliation than perennial grasses, continued heavy grazing pressure reduces growth rate, size, and density of cheatgrass plants as well. However, because of the importance of leaving adequate plant litter on annual grasslands for soil protection and optimal seedbed conditions, overgrazing should be prevented. Adequate mulch enhances soil moisture and moderates soil temperatures for improved germination of cheatgrass and protects new seedlings through fall and winter. Proper use levels for cheatgrass have been given as 50 percent under spring grazing (Klemmedson and Smith 1964) and 60-70 percent for winter grazing (DeFlon 1986). Continued heavy spring grazing favors the entry and survival of halogeton (*Halogeton glomeratus*) and noxious perennial green migrant species.

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