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Utilizing Blue Grama Rangelands in Arizona

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Introduction

Many factors make sustainable rangeland management and livestock production difficult for land managers and livestock producers. Although some of these factors, such as drought, are difficult to predict, it is critical that as much information as possible be incorporated into rangeland management plans (for information on managing for drought, see *"Rangeland Management Before, During, and After Drought; The University of Arizona Cooperative Extension Publication AZ1136*). Familiarity with key forage species and their traits and characteristics, along with skill in general plant identification are at the foundation of an informed decision-making process.

Blue Grama

One key forage species common to most Arizona range types is blue grama (*Bouteloua gracilis*; Figure 1). Blue grama is a low growing warm season, perennial bunchgrass, that can grow in either erect or open sod forms depending on management practices and/or ecological site. The species has widespread distribution throughout the southwest U.S. and most commonly occurs from 4,000′-8,800′ elevation in Arizona, spanning from desert grasslands to upper elevation pinyon-juniper woodlands and conifer forests (Anderson 2003). The grass is most identifiable by 2-3 flaglike seed heads extending from each stalk. It has a grayish-green color curing to gray or straw yellow. Leaves are fine, of variable length, and sometimes curled or inrolled and borne close to the ground. Vegetative leaves of blue grama typically grow 6 to 12 inches tall, but seed stalks occasionally reach a height of 4 feet (Ruyle and Young 2003). It is the dominant livestock forage species in many short-grass prairie ecosystems, is also valuable wildlife forage and habitat, and has long been considered a great soil stabilizer (Smith et al. 2004). Blue grama growth and

Figure 1. *Blue grama*. Arizona Range Grasses, 2003. Ruyle and Young.

productivity can be site-specific and dependent on moisture availability, soils, elevation and utilization. The grass occurs in many ecological sites, but is most prevalent in sands, loams, and shallow sites. It is tolerant of many conditions, enduring great temperature extremes and short-term drought conditions (Anderson 2003). Growth forms may vary between a typical bunchgrass in low-to-mid elevation rangelands to a sod-bound turf in others (Figure 2a, b; Sims et al. 1973). The sod-bound form is more common at higher elevations, such as Arizona's pinyon-juniper woodlands, where cooler temperatures and low evaporation rates combine with relatively high precipitation. Some researchers suggest continual overgrazing promotes a more sod-bound growth (Weaver and Albertson, 1940). Either

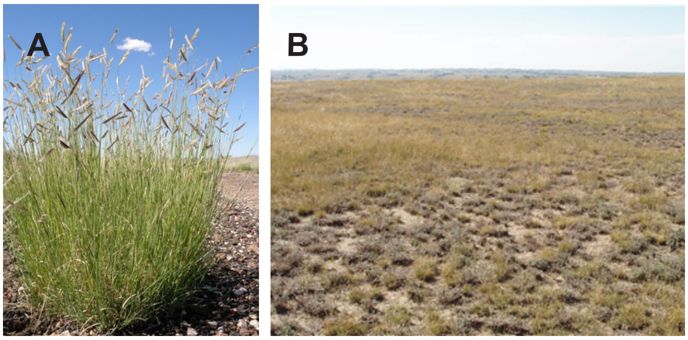

Figure 2. Blue grama may grow in a typical bunchgrass form with productive leaf growth (A), or as a sod-bound turf grass (B), creating dense ground cover. Photo credits: (A) Sue Smith, Yavapai Co., (B) USDA-NRCS

Figure 3. White grub larvae of June Beetle feeding on blue grama roots in Coconino County. Summer 2018. Photo: J. Grace.

growth form can provide valuable forage for livestock. Blue grama's ability to withstand disturbance and harsh conditions allow for this species to form nearly pure stands in some range types. This is particularly evident across rangelands of northern Arizona. In fact, blue grama may account for 75-90% of net primary production in many short-grass ecosystems (Costello 1944).

Key Characteristics

Although blue grama is considered grazing tolerant and drought resistant, the species has several characteristics requiring special management considerations. Seed production can be good in favorable years, but the species is generally considered a low seed producer in most rangeland systems and long-distance seed dispersal is limited (Laughlin 2003). The grass rarely establishes from seed in rangeland settings, rather establishment is typically dependent on the formation of adventitious roots. Adventitious roots arise from an area other than a root on the plant, such as rhizomes or stolons. This extended root requires 2-3 days of damp conditions for establishment. Failure to establish during an initial period of growth can result in seedling death. Blue grama, therefore, depends more on vegetative reproduction through shoots spreading laterally from existing plants than seed production (Wilson and Briske 1979). Adventitious tillering generally allows for stand expansion and helps offset plant mortality under normal conditions (Hyder et al. 1971). A small percentage of tillers are reproductive, however, and dry conditions or continuous heavy grazing may cause tiller death (Sims et al. 1973). Maintaining the health of existing plants is important to sustaining forage production of blue grama.

These reproductive characteristics leave blue grama susceptible to prolonged drought. Up to 40% reduction in density has been observed in plant communities and stand-level mortality has been recorded as high as 75% after severe drought (Savage and Jacobson 1935). For example, University of Arizona researchers conducting long-term rangeland trend monitoring found an almost complete loss of blue grama in a site once dominated by the species (K. McReynolds, unpublished data). In northeastern Arizona, local ranchers and land management agencies estimated upwards of 80% plant mortality in some sites following drought conditions in 2017 and 2018. These areas received minimal summer and winter precipitation during 2017 and were in a D1 or greater drought for more than 45 weeks during 2018, with extreme drought taking place during the growing season (US Drought Monitor). Stressed plants are also susceptible to pests during drought periods. Pedestalling of plants, a condition where the soil has eroded from around individual plants and an indicator of worsening range condition, exposes roots to parasites and disease resulting in reduced vigor and potential mortality (White 1989). Insects known to impact blue grama rangelands include *Phyllophaga* larvae (more commonly known as June beetles) and grasshopper. The white grub larvae of the June beetle (Figure 3) feeds on roots during times of plant stress and may cause localized stand mortality. Large-scale stand mortality in blue grama rangelands could severely alter plant community composition, species diversity, and forage production; each component is integral to livestock production systems.

Nutritional Value

Forage quality varies greatly in Arizona rangelands and different nutrients may be deficient during certain times of year or precipitation conditions (Sprinkle 2015). Blue grama is considered a very palatable forage for wildlife and all classes of livestock (Hoffman et al. 1995, Hart & Ashley 1998). Plants cure well and may retain up to 50% of their nutritive value after curing (Humphrey 1955, Ruyle and Young 2003). Protein is often considered one of the most limited rangeland forage nutrients and varies seasonally in blue grama. Crude protein (CP) during active growth typically exceeds 9-10% and is adequate for maintenance of adults and yearling growth. During dormancy, however, CP of blue grama in Arizona has been recorded between 1.6-7.55%, below most livestock maintenance requirements (Sprinkle 2011). Vitamin A in blue grama also fluctuates throughout the growing season, generally adequate during the growing season, but decreasing as the plant matures and enters dormancy (Smith 1938). In upper elevation rangelands the grass has little to no spring growth from winter and spring precipitation due to cool spring temperatures. Thus, the grass is poor spring forage during a period when livestock nutritional requirements are high. Browse, cool season grasses, and nutritional supplements may be critical components of an animal's diet during, and leading up to, the growing season in blue grama rangelands. Blue grama in low-mid elevation rangelands and southern portions of the state may grow more readily if optimum temperature and soil moisture are adequate for this warm season grass. In short, blue grama growth and nutritional value can vary greatly during the growing season due to both spatial (e.g., ecological site) and temporal (e.g., temperature and precipitation) factors.

Grazing Blue Grama

Blue grama is adapted to grazing and many southwestern livestock operations are highly dependent on its production (Crafts and Glendening 1942). Growth points (apical meristems) of blue grama are low on the plant, allowing for close utilization without much negative effect. This trait, however, may also lead to unintentional over-utilization of blue grama. Continual heavy defoliation has been found to reduce plant productivity, height, vigor, and belowground production (Sims et al. 1973). This effect is compounded in the presence of drought conditions. On the other hand, light to moderate grazing over the growing period may not affect total yield (Trlica et al. 1977). Identifying proper utilization and developing grazing techniques promoting this are key when managing for blue grama's variable production.

Blue grama is considered a key forage, or indicator, species in many Arizona rangelands, meaning it can be used to measure range utilization for planning purposes. Care should be taken to monitor utilization of blue grama in rangelands where it is abundant or highly preferred. In rangelands where blue grama comprises a small part of the plant community, however, the condition of more preferred species should be monitored as well. Despite its value as a forage species, a substantial increase in blue grama where it has not been a dominant species may indicate worsening range condition. The transition of diverse plant communities to monotypic blue grama stands may result in less productive and diverse forage communities (Albertson et al. 1966).

Proper utilization of blue grama should result in plants being grazed at a variety of levels while leaving enough leaf tissue for growth and recovery when moisture is present (Bement 1969). Researchers have identified a desired minimum post-grazing stubble height of 1.0-2.5″ to help achieve continued blue grama plant growth and recovery (Table 1; Holechek & Galt 2000, 2004, Smith et al. 2004). In a shortgrass ecosystem, this residual stubble height generally corresponds with a conservative to moderate grazing intensity (e.g., 30-50% utilization). The recommended residual stubble height varies within the provided range based on the growth form of blue grama plants and the desired grazing intensity and management. For example, in blue grama rangelands with predominantly sod-bound growth forms, conservative grazing guidelines recommend leaving 120 lbs./ac residual herbage, or 1.0-1.2″ stubble. When grazing blue grama rangelands with predominantly bunchgrass growth form greater residual herbage and higher stubble is recommended. Researchers in Colorado found that animal and herbage production was optimum when 300 lbs./ac. blue grama remained following grazing (Bement 1969). These findings correspond to recommendations made in New Mexico rangelands more representative of those found in Arizona. This residual herbage (300 lbs./ac.) corresponds to 2.0-2.5″ stubble height and represents a conservative utilization of 31-40% (Holechek and Galt 2004). It is important to realize residual stubble height recommendations provided here are not a management goal to achieve, but rather an indicator to use within vegetation monitoring programs and grazing management plans to promote sustainable blue grama plant communities.

Table 1. Conservative use recommendations for blue grama and indicators of declining range quality in blue grama rangelands.

	Sod-bound Sites	Bunchgrass Sites
Stubble Height	1.2-1.0”	2.5-2.0”
Residual Herbage	95-120 lbs./ac.	200-300 lbs./ac.
Percent Use by Weight	31-40%	31-40%

Indicators of declining blue grama rangelands:

- Surface rocks and debris are visible above grazed plants
- Pedestalling of plants
- Loss of plant vigor
- Accelerated erosion

(Holechek and Galt, 2000, 2004

Although blue grama rangelands have relatively high grazing capacity due to morphological and physiological characteristics, they are less dependable in drought years. Increasing intensity and frequency of drought warrants increasingly conservative use of blue grama. In planning for variability in production and nutritional quality of blue grama, producers and managers must rely on flexible stocking rates based on forage availability. This is particularly true in a continuous grazing regime, as forage availability may fluctuate greatly throughout the year. The ideal grazing system for blue grama rangelands includes deferred grazing during the growing season every 2 to 3 years and the use of rest-rotation techniques. During drought years, stocking rates should be monitored closely, and the use of reserve pastures with deferment of previously grazed pastures can be highly beneficial in aiding plant community recovery (for a brief tutorial on stocking, see *"How many animals can I graze on my pasture? Determining carrying capacity on small land tracts, Extension Publication AZ1352.* Flexible stocking rates on blue grama rangelands are critical, and one should be evaluating the quality and quantity of forage, along with the quantity of residual leaf tissue for promoting sustainable plant production, throughout the grazing season.

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