Big galleta grass—a warm-season bunchgrass in the Sonoran and Mojave Deserts

Ronald Robberecht

The Sonoran and Mojave Deserts of the American southwest present formidable environments for the establishment and survival of plant species. Plants in these hot, arid environments have evolved many adaptations to the high temperatures and limited soil water supply, as exemplified by the numerous species of succulents in these areas. A dominant warm-season grass species in the hot deserts of southeastern California, southern Nevada and Utah, western Arizona, and parts of Baja California is big galleta grass (*Hilaria rigida* (Thurb.) Benth. ex Scribn). This perennial plant has a bunchgrass growth form and exhibits some interesting physiological adaptations to hot, arid environments. In addition to the stress imposed on plants by these desert habitats, this bunchgrass species may be subject to a high degree of utilization by native bighorn sheep and domestic livestock (Hughes 1982). Despite its potential importance as a forage species in these hot deserts, little is known about its life history, ecology, and response to grazing.

Life History

Big galleta grass ranges in height from 15 to 35 inches and appears to reach maximum size at about 200 to 300 culms. These culms typically branch up to three times, with each branch having five to 10 leaf blades. Taxonomic descriptions

Big galleta grass-dominated community in the Sonoran desert of southeastern California. This species can comprise up to 32% of the vegetation cover, which typically is about 50% of the ground surface.

indicate that this species is highly rhizomatous, with short and rather woody rhizomes from which new plants commonly arise (Cronquist et al. 1977). Plant establishment from seed appears to be rare, and is probably related to low seedling survival in these deserts where high temperatures and drought prevail for most of the year.

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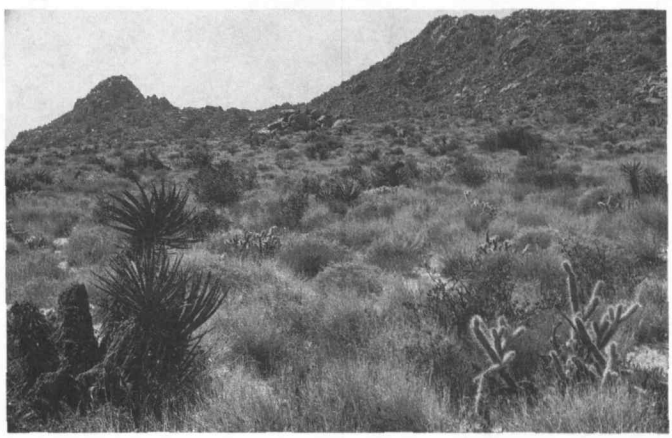
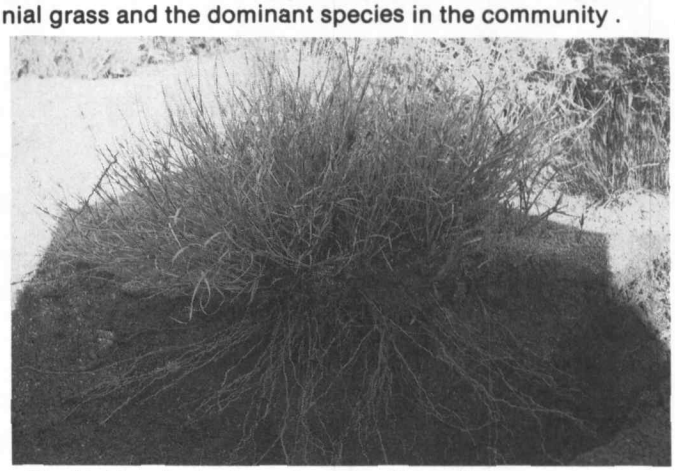


Small single-species stands of big galleta grass can occur, particularly in areas with uniformly sandy to sandy loam soils. Competition for water may be intensified among these bunchgrasses because of similarities in their growth pattern and physiological requirements for soil water.

The root system of big galleta grass is typical of hot desert plants. Highly suberized roots of relatively large diameter can extend one yard or more horizontally from the plant, and to about one-yard depth in the soil. The establishment of these bunchgrasses seems to be favored on sandy to sandy loam soils, though they can be found in small sandy soil pockets on rocky slopes. Under favorable soil conditions, it is not uncommon for big galleta grass to be the only perennial grass and the dominant species in the community .



The highly suberized woody roots of big galleta grass.

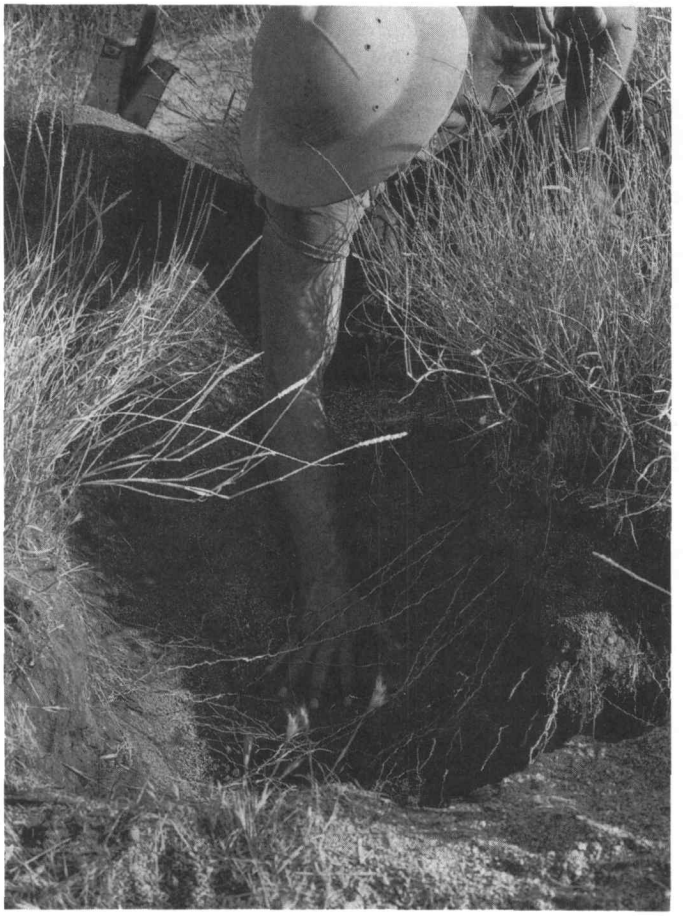
Adaptations to Desert Environments

Big galleta grass has several physiological adaptations to cope with the stress of high temperatures and drought com-

mon in the Sonoran and Mojave deserts. Since this warm-season bunchgrass species has the C4 photosynthetic pathway, very high levels of photosynthesis are possible at high ambient air temperatures. This species has one of the highest photosynthetic rates known (Nobel 1980). Furthermore, these photosynthetic rates are achieved with relatively low water loss by the plant. The capacity for high photosynthesis and low transpiration combine to make this bunchgrass a very efficient user of water. This can be a considerable advantage in desert environments where air temperatures can exceed 85° F for three months of the year and where the rainfall is unpredictable and as low as 5 inches annually.

The phenology of big galleta grass closely follows the occurrence of rainfall. Although two major growth periods generally occur, coinciding with the bi-modal annual rainfall pattern in the Sonoran desert of California, new leaf blades can be initiated in response to small isolated rainfall events. Vegetative growth occurs in the spring and fall, interrupted by a dormant period when temperature and drought extremes exist.

Competition for soil water may be a significant factor in the ecology and distribution of plants in hot desert environments. This interaction may be particularly intense in situations where members of the same species compete for soil water. This appears to be the case for big galleta grass. In habitats where sandy to sandy loam soils occur, big galleta is often the dominant species or may be the only species. In these situations significant competition among individual bunchgrasses of big galleta can occur, particularly during the transition from the wet to dry periods (Robberecht and Nobel 1983).



The root systems of big galleta grass can extend over one yard from the plant and to about one yard depth in the soil. Root length and distribution may be restricted in more rocky soils.

Considerable overlap in the root systems of neighboring bunchgrass plants may exist. This overlap results in significant competition for soil water among these plants.

Response to Grazing

Although big galleta grass is not particularly palatable, the presence of a semipalatable grass among spiny cacti, agaves, and shrubs presents pleasing forage for herbivores such as the desert bighorn sheep and domestic livestock. In some situations, utilization of big galleta grass by domestic livestock is relatively high (Hughes 1985). The studies by Hughes (1985 and personal communication) indicated that utilization of this warm-season grass ranged from 10 to 60% and averaged 32% over a ten-year period. Although the data were not extensive, the abundance of big galleta grass generally decreased during this period in response to domestic livestock grazing.

There are no detailed experimental studies on the response of this bunchgrass to grazing. Hughes (personal communication) suggests that big galleta grass is relatively resistant to heavy grazing by domestic livestock because of its coarse and rigid culms. However, when the stress of light to heavy utilization occur simultaneously with water and competition stress, growth and survival of this grass species may be significantly affected. This combination of factors may have caused the decreased abundance in big galleta grass after grazing was suggested by the studies of Hughes (1985). Although the physiological and growth characteristics of big galleta grass appear to be adaptive for survival in the hot and dry American southwest deserts, these traits may not be effective for tolerance to intense grazing by domestic herbivores.

Cited and Suggested Literature

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Comments on Skovlin's Article "Southern Africa's experience with intensive short duration grazing" Published in *Rangelands* 9(4):162-67.

Don Hedrick

My first reaction to this article was one of relief, i.e., we finally have an objective review whereas many have been largely emotional! Accordingly, I would like to congratulate Jon on his contribution.

While residing in Zimbabwe and after a trip to South Africa in which I visited with ecologists in the Botany Department at the University of the Witwatersrand in Johannesburg, I'm inclined to think some of the theoretical explanations for these apparent discrepancies in results have been left out of his review. This is not surprising since only one source has recently been published and two are theses from the University of the Witwatersrand.

One by Walker, Mathews and Dye (1986) has been published in the *South African Journal of Science* under News and Views and it contains the reference to two theses: one by Mathews, D.A. (1984) Grass dynamics in a southern African grass-herbivore system. MSc thesis, University of the Witwatersrand, Johannesburg; and the second by Dye, P.V. (1983) Prediction of grass growth in a semi-arid induced grassland. PhD thesis, University of the Witwatersrand, Johannesburg.

According to Walker et al. (1986) these two studies (theses by Mathews and Dye) suggest that, although the dynamics of a mixed sward are a function of numerous biological and environmental factors, variable rainfall (intra and interseasonally) with its consequences for the individual component grass species is likely to be the dominant influence. These authors stressed that we are not suggesting that competition, patchiness and grass growth responses to grazing do not contribute to sward dynamics, but rather that such factors are insignificant compared to the effects of rainfall.

These authors continue: "Such a suggestion in turn implies that management based on a constant strategy of manipulation of grazing (and hence grass growth responses and inter-tuft competition), regardless of rainfall characteristics, is bound to fall short of objectives, or at best produce disappointing results. The results of the two studies imply that a mixed sward is best managed by the application of management activities at certain critical times, coinciding with certain rainfall characteristics. For example, there may be certain times within seasons or even in certain years when either grazing or lack of grazing will have a significant effect on the dynamics of particular component species. It is vital that we learn to recognize these times and conditions, since management efforts independent of these are likely to be ineffectual or even deleterious."

Many of us over the years have noted similar effects when fixed grazing regimes are applied rigidly in the US and elsewhere.

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Literature Cited

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