Figure 1. *Bouteloua diversispicula.* A. Plants. Rancho El Carrizal, Sonora. March 2003. B. Plants with stolons. Near Nácori Grande, Sonora. July 2012. C. Ruby-colored spiklets. Near Cucurpe, Sonora. August 2018. *Photos A and B by T.R. Van Devender, C by Elizabeth Makings.*

SPOTLIGHT ON A NATIVE PLANT *by Thomas R. Van Devender[1], Ana L. Reina-Guerrero[1], John F. Wiens[2], John F. Scheuring[3], and Michael Bauer[4]*

A Keystone Desert Grass Reaches Arizona: *Bouteloua diversispicula* Columbus

Introduction: False Grama Grasses

The genus *Cathestecum* was described by J. Presl in 1830 (Hitchcock 1920). By 1987, eight species of *Cathestecum* had been described. *Cathestecum brevifolium* was described by Swallen (1937) based on a Cyrus G. Pringle collection from Jalisco (Figure 1A). Eventually there were four varieties of *C. brevifolium* described, including *C. b.* var. *sonorense*. *Cathestecum erectum* described by Vasey and Hackel in 1884 mostly occurs in the Chihuahuan Desert in northeastern Mexico and Texas. Swallen (1937) reported both *C. brevifolium* and *C. erectum* in Sonora. These are strange grasses with all kinds of reproductive configurations. Vegetatively they clone by stolons (Figure 1B). Sexually, it is all over the spectrum, with some populations that are dioecious and others monoecious (Figure 1C).

In 1999, Travis Columbus at the Rancho Santa Ana Botanical Garden synonymized the genus *Cathestecum* into *Bouteloua* based on molecular evidence. *Cathestecum brevifolium* became *Bouteloua diversispicula* Columbus and *C. erectum* became *B. erecta* (Vasey & Hack.) Columbus. The false gramas became true gramas!

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Richard Felger: Pax et Prosopis *continued from page 41*

Long-time friend Marc Baker writes, "Richard had an enormous heart and, in spite of his obsession with plant life, was very compassionate and wanted only the best for the natural world, including his own, often undeserving, species." Jesús Sánchez-Escalante, Richard's and my coauthor on *The Desert Edge: Flora of the Guaymas—Yaqui Region of Sonora, Mexico* (forthcoming), says, "lo único que superaba a su extenso conocimiento como botánico era su gran calidad humana" (the only thing that surpassed his extensive knowledge as a botanist was his great quality as a human being). Bill Broyles, coauthor and colleague, exclaims, "How could I ever forget a friend with the productivity and strength of a velvet mesquite, the singularity of a boojum, the curiosity of dodder, the intensity of cholla, the open smile of a Peniocereus, and the legacy of ironwood!" Ed Gilbert, another friend of Richard's, comments, "There was a part of me that thought he was going to be around forever." I think he is still here and will be staying a while. Rather than say good-bye, I'll borrow Richard's favorite sign-off: *Pax et Prosopis.*

Figure 2. *Bouteloua diversispicula.* A. B. *Zacate raiz* grassland and closeup. Rancho El Carrizal, Sonora. March 2003. C. Turf. Near Rayón, Sonora. February 2011. *Photos by T.R. Van Devender*

SPOTLIGHT ON A NATIVE PLANT *Bouteloua diversispicula* Columbus *continued*

Desert Grassland and Grasslands in the Desert

Since about 10 million years ago in the middle Miocene, grasslands have dominated the north-central part of North America in the eastern rain shadow of the Rocky Mountains (Van Devender 1995). The drier western part of this continental grassland —in Texas, New Mexico, Arizona, Chihuahua, and Sonora — is called desert grassland (McLaran and Van Devender 1995). Desert grassland has two faces — one dominated by C4 grasses in periods of sufficient summer rain and another dominated by shrubs in drier periods. Human disturbance, especially by cattle grazing, has favored increases in shrubs. It is important to point out that desert grassland is a distinctive vegetation type, that except for velvet mesquite (*Prosopis velutina*), does not share any important dominant species with the adjacent Arizona Upland Subdivision of the Sonoran Desert (Turner and Brown 1994). An important difference is that fire is a natural ecological process in grasslands and higher woodlands and forests, but not lower Sonoran desertscrub and more tropical vegetation types to the south.

There are few true grasslands in the Sonoran Desert. In the Vekol Valley of Arizona, there is an extensive stand of tobosa (*Hilaria mutica*). Tobosa grass is a widespread dominant in swales in desert grassland to the east. In the Plains of Sonora Subdivision of the Sonoran Desert in Central Sonora, there is true desert grassland dominated by *zacate raiz* (*Bouteloua diversispicula*) that has received extraordinarily little attention (Reina-G. and Van Devender 2012), Figure 2A. This area was designated as Sonoran Savanna Grassland by Brown (1982), presumably dominated by perennial grasses and maintained by periodic fires. This vegetation type is not a valid vegetation type because perennial grasses except for *zacate raiz* are not dominant. In this area, fires have only been recorded in mesquite *bajíos* (broad densely vegetated arroyos) dominated by non-native Johnsongrass (*Sorghum halepense*), and its

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Figure 3. A. Dense *Bouteloua diversispicula* in wet summer. Near Moctezuma. August 2011. B. *Bouteloua diversispicula* and dried annual grasses in Plains of Sonora desertscrub. Rancho San Fermín, Sonora. October 2011. *Photos by T. R. Van Devender*

Figure 4. A. Ragged Top Peak, Arizona. *Photo by J.F. Wiens.* B. *Bouteloua diversispicula* on Ragged Top. August 2013. *Photo by Julie Wiens.* C. Charlotte and John Reeder in University of Arizona Herbarium. March 2003. *Photo by A.L. Reina-G.*

SPOTLIGHT ON A NATIVE PLANT ***Bouteloua diversispicula* Columbus** *continued*

geographic location and climate within the Plains of Sonora (Turner and Brown 1994).

Zacate raiz is a dwarf, tufted, stoloniferous perennial grass that often forms a turf-like ground cover in open areas in desertscrub (Figure 2A, B, C). *Zacate raiz* catches wind-blown particles and anchors the thin desert soils, forming seed and insect banks. During wet summers, *zacate raiz* with 10 cm tall inflorescences and 20 cm tall annual grasses (*Bouteloua aristidoides, B. barbata, Dinebra panicea* subsp. *brachiata, Muhlenbergia microsperma, Panicum hirticaule, Setaria liebmannii, Setariopsis auriculata,* and *Urochloa arizonica*) often form very grassy landscapes without accumulating enough fine fuel to burn (Figure 3A, B). This grass-dominated vegetation type in the Sonoran Desert is a unique desert grassland.

Unfortunately, cattle ranchers and wildlife biologists did not realize that *zacate raiz* was the keystone species in the ecosystem. This soil-binding desert turf is fragile and easily damaged. Clearing to plant buffelgrass (*Pennisetum ciliare*) and treatments with disks and rippers intended to increase grass production of the taller annuals has eradicated the *zacate raiz* grassland in large areas. Without *zacate raiz*, annual grasses dry up and surfaces are typically bare in dry periods.

Bouteloua diversispicula Distribution

In Sonora, *B. diversispicula* is widespread in most of Sonora except the Central Gulf Coast Subdivision of the Sonoran Desert along the Gulf of California and the hyperarid Lower Colorado River Valley Subdivision in northwestern Sonora. It is common in Sonoran desertscrub and foothills thornscrub and open areas in oak woodland. It even trickles into open areas in pine-oak forest near Yécora in the Sierra Madre Occidental in easternmost Sonora (Van Devender et al. 2005). However, its general northern limits are about 34 mi (55 km) south of the Arizona border.

Ragged Top

In October 1989, John Wiens was doing an inventory of the flora of Ragged Top Peak, a spectacularly rugged, isolated peak on the northeast corner of the Silver Bell Mountains about 25 km west of Marana in Pima County, Arizona (Figure 4A, B). The area was included in Ironwood Forest National Monument established in 2000 and managed by the Bureau of Land Management. He discovered a stand of a unique, tufted grass reproducing by stolons (Wiens 1990). John R. Reeder, the renowned grass specialist in the University of Arizona Herbarium (Figure 4C), identified the grass as *Cathestecum erectum*, the eastern Chihuahuan species rather than *C. brevifolium*, the Sonoran species. There are 27 Sonoran specimens in the SEINet database network identified as *C. erectum,* among 425 identified as *C. brevifolium.* The differences between species are relatively minor based on characters that are not easily seen, may be variable, and are possibly influenced by environmental conditions. In this paper, we view all of the Sonoran and Arizona records as *Bouteloua diversispicula*, but wonder if a careful reevaluation might lump the species together under *B. erecta*, the older species. Later, two additional populations of *B. diversispicula* were discovered from within six kilometers west-northwest and southeast of the original population. The Ragged Top population is a disjunction of 96 miles (155 kilometers) north of the nearest (and northernmost) Sonoran record of *B. diversispicula* (Reina-G. 2004-1030, 50.6 km SSW of Sásabe).

In the 1850s, Pedro Aguirre, Jr., started a stagecoach and freight line that would connect Tucson, the mining town of Arivaca,

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Arizona, and the town of Altar in Sonora, Mexico. In 1864, he homesteaded the Buenos Ayres ranch in the Altar Valley, which eventually became the Buenos Aires National Wildlife Refuge. The Aguirre freight business had extensive contracts with the U.S. Army to carry supplies to mines in Arizona. Eventually the Aguirre family became extensive ranch owners as far north as Marana. Ragged Top was originally on an Aguirre Ranch. The Aguirres regularly went back and forth to their family near Altar, Sonora. It is possible that the *B. diversispicula* was introduced into Arizona as a seed contaminant in wild grasses collected in Sonora to feed the mules that pulled the freight wagons. **https://www.fws.gov/refuge/Buenos_Aires/about/history.html** and **https://arizonadailyindependent.com/?s=Pipeline+Altar+Valley**

Oro Valley

In September 2020, John Scheuring was a volunteer spot-spraying buffelgrass along Arizona 77 between Catalina and Oro Valley, just north of Tucson, Arizona. The roadside plants there are diverse, clearly enriched by the Arizona Department of Transportation (ADOT) hydroseeding. He discovered a population of a grass identified by Michael Bauer as *B. diversispicula* with both male and female plants present. A thriving population is present for at least 2.2 mi (3.5 km) along AZ 77 and west along Tangerine Road. This locality is 31.8 mi (51.3 km) east of the Ragged Top population. The seeds of *B. diversispicula* may have been contaminants in seeds of *B. aristidoides* collected in Sonora for the 2016 ADOT hydroseed project (Thomas Ohmart, AZ Dept. of Transportation, personal communication, 2020).

Discussion

Bouteloua diversispicula is a keystone species in large portions of the Plains of Sonora Subdivision in central Sonora, where it plays an important ecological role in binding fragile desert soils. Widespread clearing for buffelgrass planting has severely impacted these desert grasslands formed by this tufted, stoloniferous grass, although the distribution of the species has likely not changed.

The Wiens and Whittemore report (1990) of *B. diversispicula* in Arizona added a new native species to the United States. We present the possibility that it was an early introduction from Sonora to Arizona in livestock feed for the Aguirre freight line. More recently, *B. diversispicula* was accidentally introduced in Oro Valley north of Tucson by the Arizona Department of Transportation as a probable contaminant in Sonoran seeds in roadside hydroseeding. It was not observed pioneering in adjacent Sonoran desertscrub away from roadsides and has such a unique growth form that it is unlikely to compete with native species in natural habitats. *Bouteloua diversispicula* holds tremendous potential for roadside erosion control and urban landscapes.

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