

TAXONOMIC IDENTITY AND HISTORICAL ACCOUNTS OF *DALEA CYLINDRICEPS* (FABACEAE), A SPECIES OF CONSERVATION CONCERN IN THE GREAT PLAINS (U.S.A.)

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ABSTRACT

Dalea cylindriceps Barneby (Fabaceae) is a perennial herb native to the western Great Plains of North America. Despite a large area of historical distribution, *D. cylindriceps* has been collected infrequently and is a species of conservation concern. This species has a complex nomenclatural history, clarification of which enabled search of floristic and ecological literature for information on distribution, abundance, and ecological associations. *Dalea cylindriceps* is associated with sandy habitat and in the central Great Plains is often associated with sandsage prairie, a steppe community type dominated by the shrub *Artemisia filifolia*. Further study of *D. cylindriceps* is warranted for the conservation of the species, and holds promise for enhanced understanding of the ecology and dynamics of sandsage prairie, a plant community that is of conservation concern throughout most of its distribution in the Great Plains.

RESUMEN

Dalea cylindriceps Barneby (Fabaceae) es una hierba perenne nativa del oeste de las Grandes Llanuras de Norte América. A pesar de la gran área de distribución histórica, *D. cylindriceps* ha sido colectada con poca frecuencia y es una especie de preocupación en su conservación. Esta especie tiene una historia nomenclatural compleja, cuya clarificación necesita la búsqueda de bibliografía florística y ecológica para la información sobre su distribución, abundancia, y asociaciones ecológicas. *Dalea cylindriceps* se asocia con habitats arenosos y en las Grandes Llanuras centrales está a menudo asociada con paraderas de *Artemisia*, un tipo de comunidad de estepa dominada por el arbusto *Artemisia filifolia*. Se necesita más estudio de *D. cylindriceps* para la conservación de la especie, y contiene la promesa para un conocimiento mejorado de la ecología y dinámica de la pradera, una comunidad vegetal que es de preocupación por su conservación en la mayoría de su distribución en las Grandes Llanuras.

INTRODUCTION

Dalea cylindriceps Barneby (Fabaceae) is a perennial herb (Figs. 1 & 2) native to the western Great Plains of North America. Occurrences are known from the states of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. Despite the large extent of its historical distribution, *D. cylindriceps* has been collected infrequently and occurrences are scattered and local. As noted in the recent *Flora of Nebraska* (Kaul et al. 2011), "This distinctive species is rare almost throughout its wide geographic range." *Dalea cylindriceps* is tracked as a species of conservation concern in all but two of the states in which it has been documented, and is ranked by NatureServe (2013) as G3G4 (vulnerable).

Initial field survey by the author in the northern part of the range of *D. cylindriceps* indicates this species may have experienced considerable population decline. In 2010, I searched the sites of 22 historical occurrences of *D. cylindriceps* (derived from herbarium specimen locality data) in Colorado, Nebraska, and Wyoming and found existing populations at only 4 sites. It should be noted that *D. cylindriceps* is a relatively large plant (generally 3–6 [up to 8] dm tall) with distinctively elongate (up to 18 cm long) flowering spikes, making it a noticeable object in the landscape.

Analysis of floristic and ecological literature informs conservation assessment by yielding historical information on distribution, abundance, ecological associations, etc. In the case of *D. cylindriceps*, such an analysis is made difficult by the complex nomenclatural history of this taxon. Clarification of the nomenclature used for this species will allow for more accurate assessment of its conservation status.



FIG. 1. Illustration of *Dalea cylindriceps*, reproduced from *Common Legumes of the Great Plains: An Illustrated Guide* by James Stubbendieck and Elverne C. Conard, illustrated by Bellamy Parks Jansen, by permission of the University of Nebraska Press, copyright 1989 by the University of Nebraska Press.



FIG. 2. *Dalea cylindriceps*, Sheridan County, Nebraska. Photo James Locklear.

Taxonomic Identity

The taxonomic history of this species was reviewed by Barneby (1977) in his monograph on the genus *Dalea* L., in which he determined that a new binomial was required and proposed the currently accepted name, *D. cylindriceps* Barneby.

The earliest published name for this taxon is *Petalostemum macrostachyum* Torr., described in 1827 from material collected in 1820 by Edwin James in present-day Nebraska (see below). In *Flora of North America*, Torrey and Gray (1838, p. 309) altered the rendering of the generic name to *Petalostemon* (giving the full binomial as *Petalostemon macrostachyum*) and listed *P. ornatum* Douglas ex Hook. as a synonym. Gray later (1848) distinguished *P. ornatum* from *P. macrostachyum*, and the former is now recognized as *Dalea ornata* (Douglas) Eaton & Wright, a species of the Columbia Plateau and northern Great Basin. This early taxonomic confusion resulted in *P. macrostachyum* being treated in certain 19th century botanical literature as a plant of the Pacific Northwest as well as the Great Plains (e.g., Coulter 1885).

Torrey and Gray later (1840, p. 690) added *Dalea compacta* Spreng. as a synonym under *P. macrostachyum* but, as determined by Barneby (1977), *D. compacta* is a separate species that occurs in eastern Texas and adjacent Arkansas and Oklahoma. Misinterpretation of *D. compacta*, along with misapplication of the specific epithet, has been at the root of much of the nomenclatural confusion surrounding *D. cylindriceps* (Peterson 2000).

Torrey's *Petalostemum macrostachyum* (correctly rendered *Petalostemon macrostachyus* in accord with the masculine gender of *Petalostemon*) appears in the early botanical literature of the Great Plains region (Eastwood 1893; Engelmann 1862; Gray 1848, 1863; Parry 1870; Porter & Coulter 1874), but subsided after publica-

tion of *Petalostemon compactus* (Spreng.) Swezey in 1891 in *Nebraska Flowering Plants* (Doane College Natural History Studies No. 1), a 17-page pamphlet written by Goodwin D. Swezey, professor at Doane College in Crete, Nebraska. Swezey cited "*P. macrostachyus* Torr." as a replaced synonym of his *P. compactus*. While proposed in a relatively obscure publication, Swezey's name apparently gained recognition and adoption thanks to the review of his pamphlet by Nathaniel Lord Britton (1891) published in the widely-circulated *Bulletin of the Torrey Botanical Club*.

Swezey's *P. compactus* was a new combination based on *D. compacta* (Sprengel 1826), which Torrey and Gray (1840, p. 690) included in the concept of *Petalostemon macrostachyum* (Torrey 1827) but which Swezey elevated based on prior publication. It should be noted that Swezey applied the name *P. compactus* to specimens of what is in fact *D. cylindriceps*. Two such specimens are known to the author. One is in the herbarium of Doane College in Crete, Nebraska, collected by E.E. Sprague (s.n.) on 25 July 1890 near Lewellen in Garden County, Nebraska (annotated by S. Rolfsmeier [1987] as *D. cylindriceps*). The other is at NY (1259224) and appears to be a duplicate of the Sprague collection (with same collection date and locality) distributed under an "Herb. of G.D. Swezey" label (annotated by D. Isely [1958] and D. Wemple [1961–1965] as "*P. compactum*").

Further clouding the nomenclature of this taxon was the reduction of *Petalostemon* Michx. and Dalea L. to the genus *Kuhnistera* Lam. by Kuntze (1891), in which he proposed *K. compacta* (Spreng.) Kuntze, under which he placed *D. compacta* and "*Petalostemon macrostachyum*" as synonyms. Heller later (1896) added "*Petalostemon compactus* Swezey" to the list of synonyms under *K. compacta*. Use of the name *K. compacta* for what is clearly *D. cylindriceps* occurred in a number of botanical and ecological publications in Great Plains states (Hitchcock 1896; Pound & Clements 1900; Saunders 1899).

The publications of Per Axel Rydberg were foundational to state and regional treatments of the flora of the Great Plains in the first part of the 20th century. Regarding *D. cylindriceps*, Rydberg initially (1894, 1895) took up *K. compacta* for the taxon, citing *Petalostemon macrostachyus* and *D. compacta* as synonyms, but subsequently adopted *Petalostemon compactus* (Spreng.) Swezey, first in *Flora of Colorado* (1906), then in *Flora of the Rocky Mountains and Adjacent Plains* (1917) and *Flora of the Prairies and Plains of Central North America* (1932). During this same period, Britton and Brown (1897) treated this taxon as *K. compacta* but later (1913) adopted Swezey's name, rendering it "*Petalostemon compactum* (Spreng.) Swezey."

Subsequent treatments of this taxon in the flora of the Great Plains region followed Rydberg in using Swezey's *Petalostemon compactus* (often rendered *P. compactum*). These include floristic and ecological works for the states of Colorado (Harrington 1954; Ramaley 1939), Kansas (Bare 1979; Barkley 1968; Gates 1940), Nebraska (Petersen 1923; Webber 1892), New Mexico (Wooton & Standley 1915; Martin & Hutchins 1980), Texas (Correll & Johnston 1970; Turner 1959), and Wyoming (Dorn 1977b), as well as other regional literature (Barr 1983; Coulter & Nelson 1909; Dorn 1977a; Rogers 1953) including *Atlas of the Flora of the Great Plains* (GPFA 1977).

The taxonomic identity and nomenclatural problems associated with *P. compactus* (Spreng.) Swezey received further consideration and clarification in the 1970s. In his revision of the genus *Petalostemon*, Wemple (1970) recognized "*Petalostemon compactum* (Spreng.) Swezey," treating both *P. macrostachyum* and *D. compacta* as synonyms. But, in his monograph on the genus *Dalea*, Barneby (1977) separated *D. compacta* from the taxon originally described as *P. macrostachyum*, which excluded the type of *D. compacta* from his concept of *P. macrostachyum*, making the latter the oldest available name for the species. Since Barneby was reducing the genus *Petalostemon* to *Dalea*, he needed to transfer *P. macrostachyum* to *Dalea*, but there was already a *D. macrostachya* Moric., necessitating the "unwelcome new epithet" of *cylindriceps*. *Dalea cylindriceps* was adopted in *Flora of the Great Plains* (GPFA 1986) and has since been used in most treatments of the flora of the region (Dorn 2001; Kaul et al. 2011; Turner et al. 2003; Van Bruggen 1985; Weber & Wittmann 2012). Correct nomenclature and synonymy for this species is provided below.

Dalea cylindriceps Barneby, Mem. New York Bot. Gard. 27:227. 1977. TYPE: UNITED STATES: "Long's 1st Expedition. Dr. James" [as on label], E. James s.n. (HOLOTYPE: NY [26677], internet image!). Collection locality and date not stated but along or near South Platte River in Lincoln County, Nebraska, 22–23 Jun 1820.

Petalostemon macrostachyus Torr. [originally published as *Petalostemum macrostachyum* Torr.], Ann. Lyceum Nat. Hist. New York 2:176–177. 1827. Not *Dalea macrostachya* Moric., Pl. Nouv. Amer. 6. t. 5. 1833. Not *Petalostemon macrostachyum* sensu Torr. & A. Gray, Fl. N. Amer. [Torr. & A. Gray] 1:309. 1838.

Petalostemon compactus sensu Swezey, Neb. Fl. Pl. (Doane Coll. Nat. Hist. Soc.) 1:6, 1891. Not *Dalea compacta* Spreng., Syst. Veg. (ed. 16) [Sprengel] 3:327. 1826. Not *Kuhnistera compacta* (Spreng.) Kuntze, Rev. Gen. Pl. 192. 1891.

Discovery and Type Locality

The type specimen of what would eventually be recognized as *D. cylindriceps* was collected by Edwin James while traveling with the Stephen H. Long Expedition of 1820. In his enumeration of the botany of the expedition, Torrey (1827) stated the locality of James' collection of *Petalostemum macrostachyum* as "About the forks of the Platte." No date or locality information is provided on the holotype (the only known specimen) at NY (Fig. 3), only the statement, "Long's 1st Expedition. Dr. James." James did not mention this species in either his published account of the expedition (James 1823) or in his personal diary (Goodman & Lawson 1995).

The North and South Platte rivers ("the forks of the Platte") join to form the Platte River in Lincoln County, Nebraska, just east of the city of North Platte. From here westward to Ogallala, Nebraska (a distance of ca. 70 km), the main channels of the North and South Platte rivers run within a few (5–6) kilometers of each other until they begin to diverge about 18 km east of Ogallala, the North Platte to the northwest and the South Platte to the southwest. Thus, "About the forks of the Platte" could be a general description of the area between North Platte and Ogallala, which the expedition traversed 22–25 June 1820 (Goodman & Lawson 1995).

But this phrase appears to refer to a more limited geographic area. After reaching the junction of the North Platte and South Platte on 22 June 1820, the expedition continued west along the north side of the North Platte River for a few miles then crossed the river heading southwest, making camp on the north side of the South Platte River. In their reconstruction of the route and itinerary of the Long Expedition, Goodman and Lawson (1995, p. 15) place the location of the camp of June 22 at 6–7 miles (10–12 km) west of the city of North Platte, which would be just to the east of the present-day community of Hershey, Nebraska.

On the morning of June 23, the party traveled about two miles (3.3 km) upstream then crossed to the south side of the South Platte. The crossing would have been in the vicinity of Hershey. James (1823, p. 468) states that the party "had no sooner crossed the [South] Platte when our attention was arrested by the beautiful white primrose (*Oenothera pinnatifida*. N.)" (= *O. coronopifolia* Torr. & A. Gray). In a footnote to his discussion of the *Oenothera*, James lists several other species that were collected "about the forks of the Platte."

Thus, it appears that the area referred to by James as "about the forks of the Platte" is tied to the locality of this crossing of the South Platte River in present-day Lincoln County, Nebraska on 23 June 1820. The type of *D. cylindriceps* was likely collected along the river somewhere between the towns of Hershey and Sutherland (ca. 12 km to the west), the latter being the vicinity of the expedition's camp of June 23 (Goodman & Lawson 1995, p. 16). This conclusion is supported by a collection of *D. cylindriceps* made on 05 August 1989 (*D. Sutherland* 6802 with S. Rolfsmeier at NEB, NY) along the South Platte River just south of Hershey.

Historical Accounts

Armed with knowledge of the nomenclatural history of *D. cylindriceps*, the early floristic and ecological literature of the Great Plains was searched for references to this species. The following is a summary of notable findings.

Dalea cylindriceps was encountered by many of the early botanical collectors traveling across the central Great Plains in the 1800s. The list includes Edwin James in 1820 (Torrey 1827), Augustus Fendler in 1846 (Gray 1848), Ferdinand Hayden in 1857 (Engelmann 1862), and Elihu Hall and J.P. Harbour (with Charles C. Parry) in 1862 (Gray 1863).

Where relative abundance is indicated, *D. cylindriceps* was typically classified as rare, infrequent, localized, etc. (Hitchcock 1896; Pound & Clements 1900; Ramaley 1939; Rogers 1953). This is in spite of fact that the species is a noticeable object in the landscape when present, as reflected in the comments of Pound and Clements (1900) in *The Phytogeography of Nebraska*, where they described *D. cylindriceps* (as *K. compacta*) as

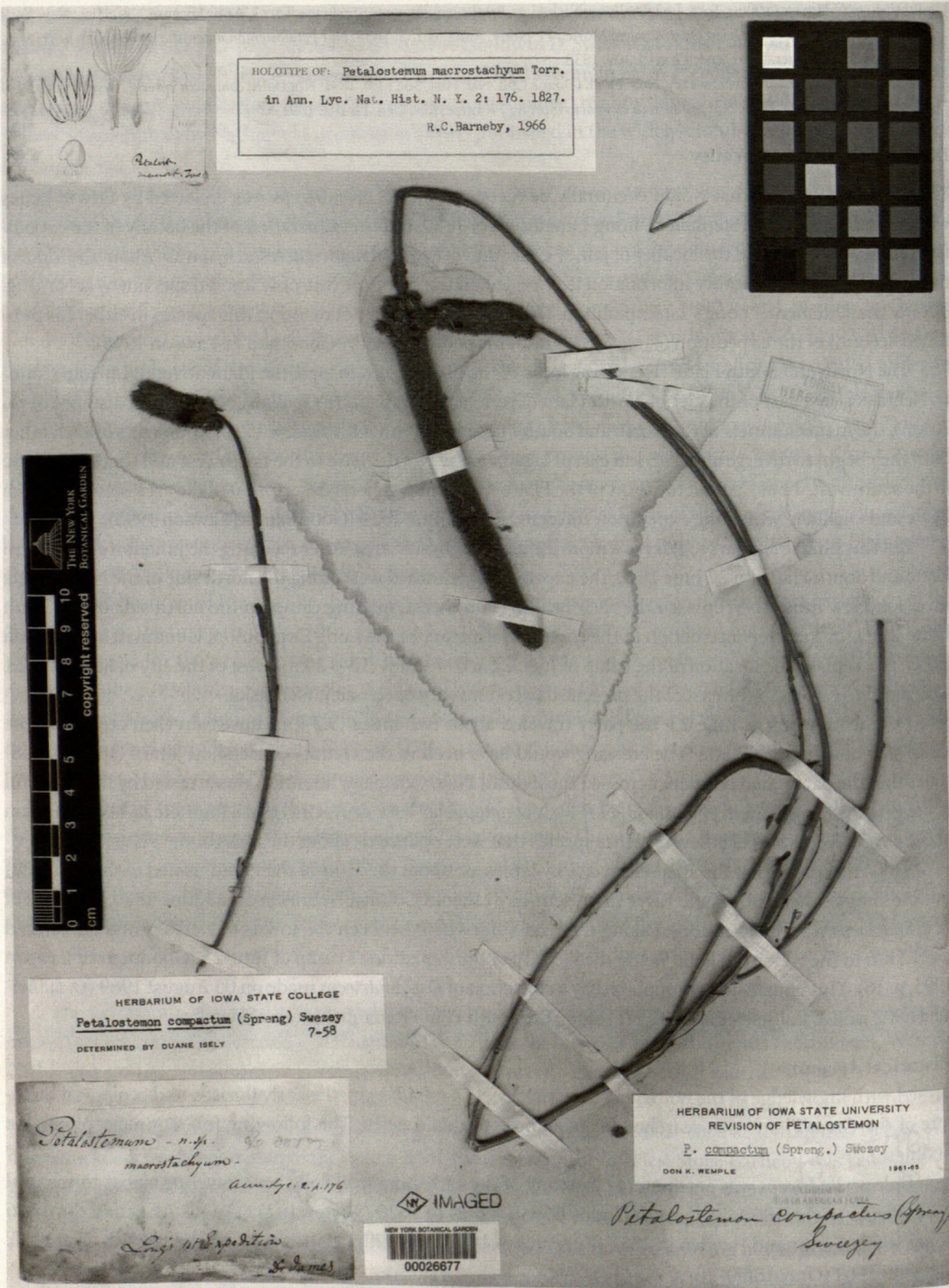


FIG. 3. Holotype of *Dalea cylindriceps* Barneby; *E. James* s.n. (holotype, NY). Digital image courtesy of the C.V. Starr Virtual Herbarium of the New York Botanical Garden.

"the most remarkable species of this genus in our flora. Its stems, which are densely leafy, are often a meter high and are very conspicuous on account of the long (a decimeter) nodding spikes of white or yellowish flowers."

Dalea cylindriceps may have been more abundant prior to settlement and agricultural development within its range. Eastwood (1893) included "*Petalostemon macrostachyus* Torr." in *A Popular Flora of Denver, Colorado*, her book aimed at "students" and "beginners" and therefore focused on the showier or more common elements of the flora. Eastwood stated the species occurred in "North Denver." There are a number of *D. cylindriceps* herbarium specimens collected in the late 1800s from what is today the Denver metropolitan area northward toward Fort Collins, but the native vegetation of this area has been largely displaced by suburban and ex-urban development.

The following references provide early accounts of the ecological associations of *D. cylindriceps*:

Colorado: "Sand Prairie" (Ramaley 1939, p. 14 as *P. compactus*). In his ecological study of the sandhill vegetation of northeastern Colorado, Ramaley recognized four plant communities occurring in upland sandy soils (Loose Sand and Blow-out; Sand-hills-Mixed; Sand-Sage; Sand Prairie); he listed *P. compactus* only under Sand Prairie, where he placed it on the list of "Other species," indicating relative infrequency.

Kansas: "Prairie" (Gray 1848, p. 33 as *P. macrostachyum*). Gray enumerated plants collected by Augustus Fendler in the vicinity of Santa Fe, New Mexico, which he reached in 1846 after traveling from St. Louis along the Santa Fe Trail. Gray reported the locality of the collection as "18 miles west of Lower Springs, Cimarron [River]." Lower Spring (also called Wagon Bed Spring) was a site along the Cimarron Cutoff of the Santa Fe Trail located on the Cimarron River in what is today Grant County, Kansas. A location along the trail 18 miles west of Lower Spring would be in present-day Morton County, Kansas in the vicinity of the Cimarron National Grasslands, where a number of recent collections of *D. cylindriceps* have been made in sandhill habitat.

Kansas: "Ulysses, Grant County...on sandy knolls along the South Fork of the Cimarron [River]. Rare." (Hitchcock 1896, p. 543 as *K. compacta*). Hitchcock reported on the plants collected by C.H. Thompson in southwestern Kansas in 1893.

Nebraska: "Sand hills along the Loup fork and Niobrara [rivers]" (Engelmann 1862, p. 189 as *P. macrostachyum* [sic]). Engelmann enumerated plants collected by Ferdinand Hayden in the Elkhorn, Loup, Platte, and Niobrara river valleys of present-day Nebraska during an expedition led by Lieutenant G.K. Warren of the U.S. Topographical Engineers in 1857.

Nebraska: "Localized in the sand-hills of Scotts Bluff county (sic)" (Pound & Clements 1900, p. 250 as *K. compacta*). Pound and Clements likely based their account of this species on herbarium material collected by P.A. Rydberg (Rydberg 61; NEB 177085, 177088; NY 1259216, 1259217) on 04 August 1891. Rydberg identified his number 61 as "*Petalostemon macrostachyus* Torr." in his journal (manuscript at NEB), noting the locality as "On the sandhills north of the Platte River, Scotts Bluff Co."

Such early references, as well as those found in more recent literature (Hazlett 2004; Kaul et al. 2011; Kuhn et al. 2011; Neid et al. 2007; Reif et al. 2009; Rolfsmeier & Steinauer 2010; Sutherland & Rolfsmeier 1989), indicate a strong association of *D. cylindriceps* with sandy habitat. Eolian sand sheets and sand dunes are common landforms in the western Great Plains, notably in Nebraska, Colorado, Kansas, Oklahoma, New Mexico, and Texas (Muhs & Holliday 1995). At present, these dune fields are mostly stabilized by vegetation.

Review of Great Plains floristic and ecological literature coupled with examination of herbarium specimens and the author's initial field survey, indicate that *D. cylindriceps* is frequently associated with plant communities in which the shrub sand sagebrush (*Artemisia filifolia*) is a dominant or distinctive element. Occurrences of *D. cylindriceps* in southwest Nebraska, eastern Colorado (Fig. 4), and southwest Kansas are associated with steppe communities comprised of a sparse to moderately dense layer of *A. filifolia* interspersed with tall or mid-height grasses, the component grass species varying with geography, precipitation, soil texture, etc. (Kuchler 1974, Lauver et al. 1999; Neid et al. 2007; Ramaley 1939; Rolfsmeier & Steinauer 2010). Frequently referred to as "sandsage prairie," these sometimes extensive communities occur on sands and loamy sands associated with eolian dune systems.



FIG. 4. *Dalea cylindriceps* in *Artemisia filifolia* community, Cheyenne County, Colorado. Photo James Locklear.

Dalea cylindriceps has been collected (to a lesser extent) in other sandy-gravelly habitat, notably the alluvial deposits of streams and colluvium derived from sandstone outcrops and escarpments. The mostly herbaceous plant communities that develop in such habitat occur as small patches or bands of vegetation in the landscape.

The association of *D. cylindriceps* with sandsage prairie could be a factor in the apparent decline of this species. Throughout the Great Plains, extensive tracts of sandsage prairie have either been converted to irrigated cropland, degraded by intensive grazing, or subject to extensive alteration to enhance grazing potential, primarily through the use of herbicides to decrease the density of *A. filifolia* in favor of grasses (Farrar 1993a; Sexson 1983).

Future Research

University of Kansas botanist Ronald L. McGregor (1986) asserted nearly 30 years ago that *D. cylindriceps* "needs more careful study," and his statement holds true yet today. Additional research is needed to more fully assess the conservation status of *D. cylindriceps*. Survey of historical occurrences throughout the range of the species is needed to determine the number of existing occurrences and to develop a more detailed ecological profile that includes habitat requirements, edaphic factors, disturbance factors, associated species, etc. As a more precise understanding of the ecology of *D. cylindriceps* is gained, field workers can be more strategic in identifying potential habitat to search for additional occurrences.

Research into the life history traits (phenology, reproductive ecology, etc.) of *D. cylindriceps* is needed to determine how these shape demography and population trends. This species appears to be a short-lived or even

monocarpic herbaceous perennial (Barneby 1977; Kaul et al. 2011). McGregor (1986) noted that on dunes and areas of loose sand, *D. cylindriceps* “sometimes flowers the first year and frequently expires at the end of the second or third season,” yet is often a longer-lived perennial in more stable sandy areas.

Many plant species associated with sandy habitat are specialized to a particular ecological niche or stage of recovery related to natural disturbance, and research is needed to determine if such is the case for *D. cylindriceps*. Sandsage prairie is a naturally dynamic plant community, with species composition, patterns of vegetation, and percent canopy cover changing over time in response to fluctuations in precipitation (Collins et al. 1987; Farrar 1993b; Kelso et al. 2007; Ramaley 1939; Rondeau 2003, 2013). Such recurring natural disturbance could result in fluctuations in the presence and abundance of *D. cylindriceps* over time.

Monitoring studies of existing populations of *D. cylindriceps* are needed to answer these and other questions of life history, demography, and population trends. Further study of *D. cylindriceps* would be of value not only for the conservation and management of this species, but also holds promise for a better understanding of the ecology and dynamics of sandsage prairie, a plant community that is of conservation concern throughout most of its distribution in the western Great Plains (NatureServe 2013). Given its close association, *D. cylindriceps* could serve as an indicator species of high quality occurrences of sandsage prairie and of habitat integrity and health.

A Common Name for *Dalea cylindriceps* Barneby

The misleading common name “Andean prairie-clover” has been applied to *D. cylindriceps* and is currently in use by NatureServe (2013) and other databases listing plants of conservation concern. *Dalea cylindriceps* is not a plant of the Andes, and this common name may have had its origin in the binomial *D. macrostachya* Moric., which is similar to *P. macrostachyum* Torr., the first validly published name for what is now recognized as *D. cylindriceps*. *Dalea macrostachya* is a replaced synonym for *D. coerulea* (L.f.) Shinz & Thell. var. *longispicata* (Ulbr.) Barneby, which occurs in the Andean region of South America (Barneby 1977).

Several other common names have been adopted for *D. cylindriceps* that point to the dense, elongate spike-like inflorescence which is a distinctive morphological feature of this species. These include “dense-flowered prairie clover” (Britton & Brown 1897; Saunders 1899), “massive spike prairie-clover” (GPFA 1986), and “large-spike prairie-clover” (Kaul et al. 2011; Stubbendieck & Conard 1989). The latter two names reflect Barneby’s (1977) etymology of *cylindriceps*: “of the massive spike.”

The common name “sandsage prairie-clover” is proposed here based on the close association of *D. cylindriceps* with sandsage prairie and similar plant communities in which sand sagebrush (*A. filifolia*) is a dominant or distinctive element.

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