
Sclerocactus dawsoniae (Cactaceae), a New Species from Western Colorado, U.S.A.

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ABSTRACT. *Sclerocactus dawsoniae* McGlaughlin & Naibauer (Cactaceae), a new species from western Colorado, is described. *Sclerocactus dawsoniae* is segregated from *S. glaucus* (K. Schum.) L. D. Benson, differing by having a smaller overall size, fewer spines per areole, an allopatric distribution, and substantial genetic differentiation.

Key words: Cactaceae, cactus, Colorado, new species, *Sclerocactus dawsoniae*.

Sclerocactus Britton & Rose (Cactaceae) is a diverse group of ca. 19 cacti endemic to western North America (Heil & Porter, 2003; NatureServe, 2023) that have been the focus of substantial taxonomic study. Species within *Sclerocactus* have commonly been distinguished based on spine characteristics (size, shape, and number), flower color and size, geography, and seed micromorphology. *Sclerocactus glaucus* (K. Schum.) L. D. Benson has a complicated taxonomic history, having been treated as a widespread species with populations in western Colorado and northeastern Utah (Heil & Porter, 1994) or a species endemic solely to western Colorado (Hochstätter, 1996). The current treatment in the Flora of North America (Heil & Porter, 2003) has become widely accepted, recognizing northeastern Utah occurrences as two distinct species, *S. brevispinus* K. D. Heil & J. M. Porter (Heil & Porter, 1994) and *S. wetlandicus* Hochstätter (Hochstätter, 1989), which are distinctive from western Colorado occurrences of *S. glaucus*. The Flora of North America treatment of *S. glaucus* has been supported by phylogenetic (Porter et al., 2000), morphometric, and population genetic studies (Porter et al., 2012).

Sclerocactus glaucus within Colorado has been the focus of continued study due to its status as threatened under the Endangered Species Act (USFWS, 1979). Schwabe et al. (2015) conducted a population genetic study investigating the frequency of hybridization between *S. glaucus* and *S. parviflorus* Clover & Jotter due to the documentation of many plants with hooked cen-

tral spines within the range of *S. glaucus*, a trait generally associated with *S. parviflorus*. Schwabe et al. (2015) concluded that although hybridization between *S. glaucus* and *S. parviflorus* can occur, it tends to be rare, and the presence of hooked central spines is a poor indicator of species assignment.

The updated treatment presented here is based on more extensive genetic studies of *Sclerocactus glaucus*, the examination of morphological features, and the distinction of a new species, which is separate from *S. glaucus*. Schwabe et al. (2015) previously identified plants in the northern range of *S. glaucus* as being genetically distinct, which we have segregated as the newly recognized species *S. dawsoniae* McGlaughlin & Naibauer. Genetic data from restriction site associated DNA sequencing (RADseq) genetic markers show that *S. dawsoniae* is substantially genetically differentiated from *S. glaucus* (Fig. 1; McGlaughlin & Naibauer, 2023). The RADseq methodology has an advantage over previous genetic analyses by including thousands of variable genetic sites, leading to strong confidence in the distinction between *S. dawsoniae* and *S. glaucus*. Sequence data used to create the phylogenetic tree in Figure 1 are available from the National Center for Biotechnology Information (NCBI) Sequence Read Archive (BioProject: PRJNA1023954, submission ID: SUB13880669).

Data were collected from herbarium specimens of *Sclerocactus dawsoniae* and *S. glaucus* to examine morphological differences (Table 1). *Sclerocactus dawsoniae* is shown to have a smaller size and fewer spines per areole than *S. glaucus* (Fig. 2). Finally, *S. dawsoniae* occupies an allopatric distribution relative to all other known populations of *Sclerocactus* (Fig. 3). It is likely that geographic isolation north of De Beque Canyon is the cause of speciation for *S. dawsoniae*. Applying the cohesion species concept (Templeton, 1989), *S. dawsoniae* is supported by geographic, morphological, and genetic cohesion mechanisms, warranting recognition as a distinct species within the Colorado flora.

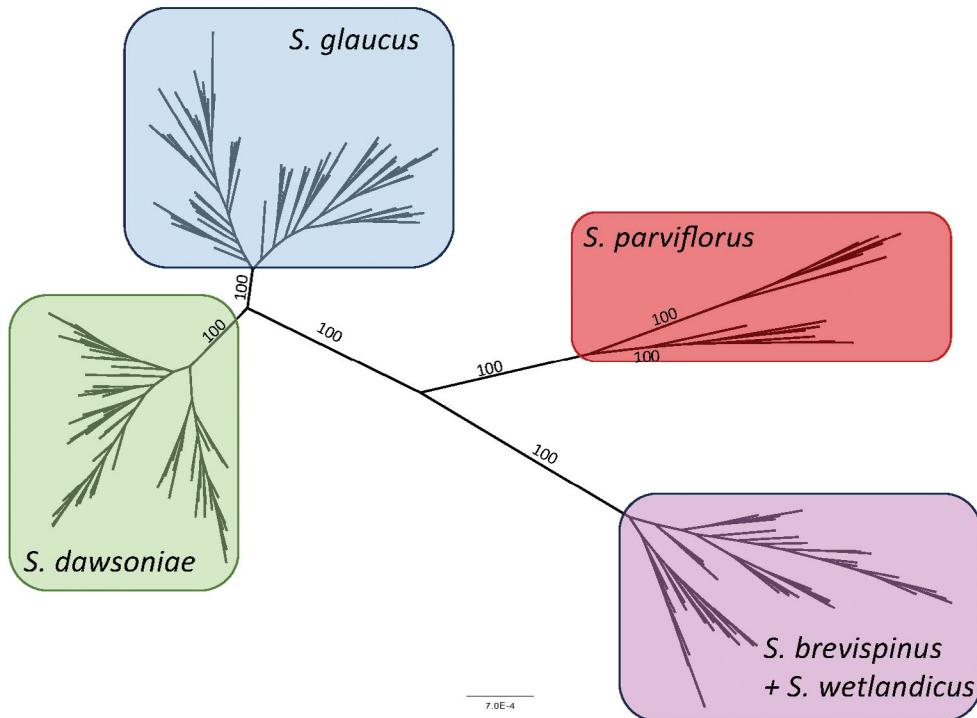


Figure 1. Unrooted phylogenetic tree showing the relationships of *Sclerocactus dawsoniae* McGlaughlin & Naibauer, *S. glaucus* (K. Schum.) L. D. Benson, *S. parviflorus* Clover & Jotter, *S. brevispinus* K. D. Heil & J. M. Porter, and *S. wetlandicus* Hochstätter. Bootstrap values of major branches are shown. See McGlaughlin and Naibauer (2023) for more comprehensive details on the genetic data and analyses.

Table 1. Morphological characteristics distinguishing *S. dawsoniae* McGlaughlin & Naibauer and *S. glaucus* (K. Schum.) L. D. Benson.

	<i>S. dawsoniae</i>	<i>S. glaucus</i>
Number of specimens examined	13	26
Range of plant height	2.8–13.6 cm	5.2–17.3 cm
Average stem height	7.4 ± 3 cm	10.8 ± 3.9 cm
Range of stem width	2.3–8.6 cm	4–12.3 cm
Average stem width	5.1 ± 2.1 cm	7.7 ± 2.3 cm
Range of number of spines per areole	7 to 9	8 to 15
Average number of spines per areole	7.9	10.6

TAXONOMIC TREATMENT

***Sclerocactus dawsoniae* McGlaughlin & Naibauer, sp. nov.** TYPE: U.S.A. Colorado: Mesa Co. [detailed locality information protected], 19 May 2010, Clark 3137 (holotype, KHD00027126!).

Diagnosis. *Sclerocactus dawsoniae* McGlaughlin & Naibauer differs from *S. glaucus* (K. Schum.) L. D. Benson by its smaller size (3–14 × 2–9 cm vs. 5–17 × 4–12 cm), fewer spines per areole (seven to nine vs. eight to 15), and a RADseq F_{ST} genetic distance greater than 0.25 between species (BioProject: PRJNA1023954; McGlaughlin & Naibauer, 2023).

Stems 1(to 2), cylindrical, bluish-green, 3–10(–14) × 2–9 cm; ribs (8 to)11 to 12(to 15); tubercles 0.2–1 × 0.4–1.2 cm; spines 7 to 9 per areole, white-brown, up to 3.3 cm, generally not hooked at tip. Flowers 2–5 × 0.5–1.5 cm; outer tepals with greenish-brown mid-stripe and pink to white margins; inner tepals pink to magenta; filaments green or white; anthers yellow; style green. Fruit cylindrical, 9–22 × 8–12 mm; seeds black, 1.5 × 2.5 mm.

Habitat, ecology, and distribution. *Sclerocactus dawsoniae* is endemic to Mesa and Garfield Counties, Colorado. The distribution is centered around the town



Figure 2. —A. *Sclerocactus dawsoniae* McGlaughlin & Naibauer. Photo taken from South Shale Ridge in Mesa County, Colorado. —B. *Sclerocactus glaucus* (K. Schum.) L. D. Benson. Photo taken from Whitewater in Mesa County, Colorado.

of De Beque, Colorado (Fig. 3). The southernmost populations are found in Winter Flats on the west end of the distribution, and north of Plateau Creek and Colorado State Highway 65 on the east end of the distribution. This cactus is distributed in alluvial terraces along the drainages of the Colorado River and generally occurs on rocky, volcanic cobble, or gravelly soils. Plants are mostly inconspicuous in desert scrub habitats, where they may be hard to see unless they are flowering. Individuals may sink below the soil during the driest portions of the year. The total estimated range of *S. dawsoniae* is roughly 456 km² (USFWS, 2022). This landscape is heavily dotted with oil and gas wells. There is a minimum population estimate of 17,362 individuals in Mesa and Garfield Counties (Bureau of Land Management [BLM], in press) with an unequal distribution of plants throughout the northern section of the range.

Phenology. Members of this species flower from April to May.

Etymology. This species is named in honor of Carol Dawson, Ph.D., a botanist for the Colorado BLM. Daw-

son has made substantial contributions to the conservation of rare and endangered plant species in Colorado, including *Sclerocactus dawsoniae*. She has also enthusiastically supported the education of many students at colleges and universities throughout Colorado.

Conservation status. *Sclerocactus glaucus* was listed as threatened under the Endangered Species Act in 1979 when resource exploration, urbanization, and cattle grazing were the primary threats leading to habitat fragmentation and loss in this region (USFWS, 1979). Today, there is an abundance of oil and gas operations where *S. dawsoniae* exists. In 2023, the USFWS formally proposed removing *S. glaucus* from the Endangered Species List, including *S. dawsoniae* (USFWS, 2023). The most recent scientific data indicate that *S. glaucus* is represented by a large number of plants (minimum population estimate $103,086 \pm 34,966$ individual plants; Krening et al., 2021), populations are stable, and many protected areas encompass its distribution, all supporting delisting of this taxon. In contrast, *S. dawsoniae* is represented by a small number of plants (minimum population estimate 17,362 individual plants; BLM, in press) and has a narrow range, low al-

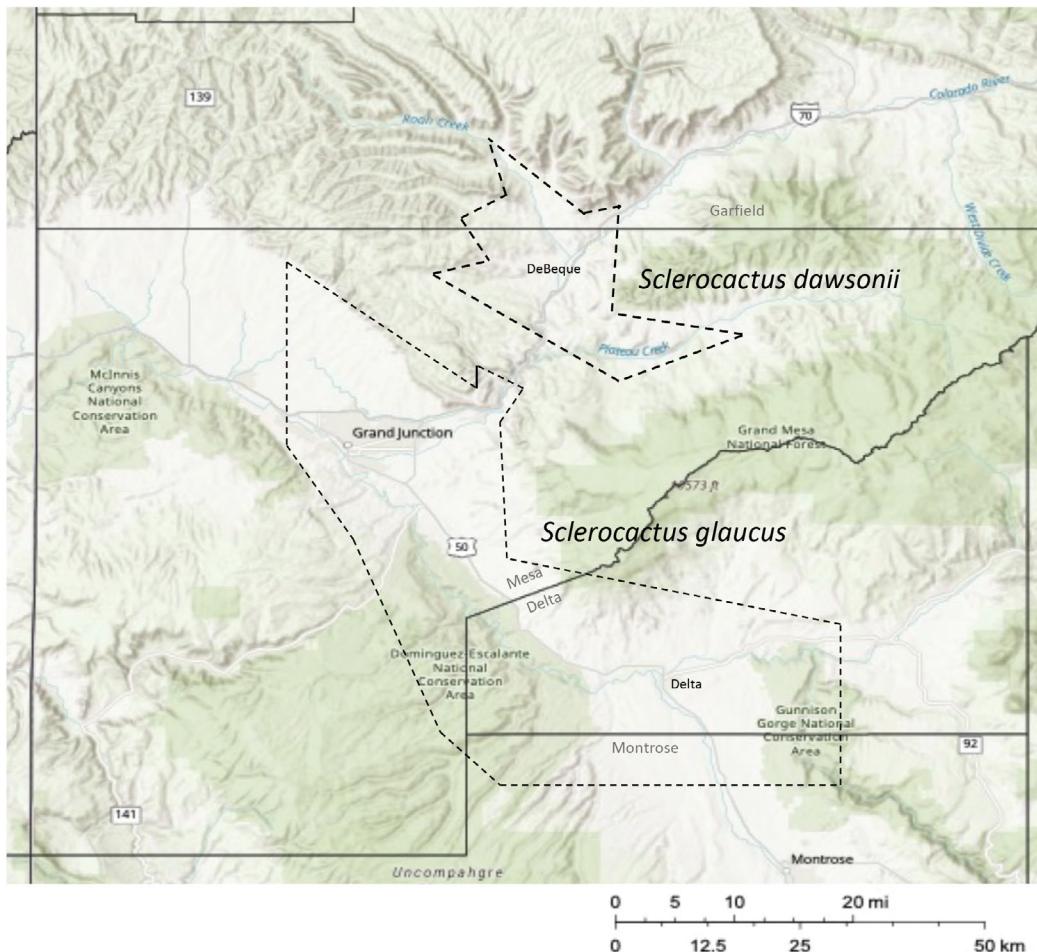


Figure 3. Map showing the ranges of *Sclerocactus dawsoniae* McGlaughlin & Naibauer and *S. glaucus* (K. Schum.) L. D. Benson. Formerly, *S. glaucus* encompassed the range of *S. dawsoniae* despite the geographic separation between the two taxa. Due to the conservation status of both taxa, specific occurrences have not been shown.

lelic diversity (McGlaughlin & Naibauer, 2023), and an unequal abundance across the species range with an estimated 86% of plants located in a single management area, all indicating that this species warrants continued conservation priority. It is our opinion that *S. dawsoniae* does not have the resiliency, representation, or redundancy necessary to persist in the future without further conservation and should be protected under the Endangered Species Act.

Paratypes. Due to the conservation status of this species, all specific locality information has been obscured. U.S.A. **Colorado:** Mesa Co., 20 June 1970, *Arp 1006* (KHD00013013); 20 June 1970, *Arp 1017* (COLO00213173); 20 June 1970, *Arp 1006* (COLO00213207); 26 Apr. 2012, *Goshorn 12-023A* and *12-023B* (KHD00024597, KHD00024589); 9 May 2012, *Goshorn 12-024* (KHD00024598); 10 May 2012, *Goshorn 12-025* (KHD00024596); 10 May 2012, *Goshorn 12-026*

(KHD00024590); [label incorrectly lists Delta Co.], 24 Apr. 1986, *Heil & Porter 2335* (ASU0023560, BRYV0051969); 23 May 1985, *Phelan & Collins s.n.* (CS108944). Garfield Co., 18 May 1983, *Kelley 83-6* (CS120297).

Examined *Sclerocactus glaucus* specimens. Due to the conservation status of this species, all specific locality information has been obscured. U.S.A. **Colorado:** Delta Co., 24 Apr. 1986, *Heil 2332* (SJNVM0024594, BRYV0051971); 24 Apr. 1986, *Heil & Porter 2333* (BRYV0051968, ASU0023562); 9 May 1983, *Neese 13206* (BRYV0051618); 2 May 2018, *Seglias AS31* (KHD00067800); *Welch et al. 22781* (BRYV0051972); Mesa Co., 7 July 1971, *Arp 1670* (COLO00213348); 8 July 1971, *Arp 1671B* (COLO00213256); 8 July 1971, *Arp 1672* (COLO00213264); 18 May 1881, *Eastwood* (COLO00213421); 24 Apr. 1986, *Heil & Porter 2331a* and *2331b* (GSW00003434, ASU0023565, BRYV0051973); 24 Apr. 1986, *Heil 2333* (FLD0003918); 27 May 1983, *Neese 13435* (BRYV0051621); 27 May 1983, *Neese 13438* (BRYV0051683, CSU100993); 27 May 1983, *Neese 13440* (BRYV0051622); 15 June 1983,

Neese & Abbott 13580 (BRYV0051620, CSU108946); 15 May 1984, Neese & Chatterley 15541 (BRYV0051686); 17 May 1984, Neese & Chatterley 15592 (BRYV0051684); 17 May

1984, Neese & Chatterley 15593 (BRYV0051970); 15 June 1973, Sedlacek 4267 (UNM0116860); 1 May 2018, Seglias AS29 (KHD00067945).

KEY TO *SCLEROCACTUS* SPECIES IN WESTERN COLORADO

1. Central spine nearly always absent, if present then hooked, 0.7–1.5 cm; flowers yellow or cream; southwest Colorado (Montezuma and La Plata Counties) and northwest New Mexico (San Juan County) *S. mesae-verdae* (Boissev. & C. Davidson) L. D. Benson
- 1'. Central spines nearly always present, hooked or straight, 1–10 cm; flowers pink; west Colorado (Garfield, Mesa, Delta, Montrose, San Miguel, Dolores, and Montezuma Counties).
 2. Central spines 4 to 9, usually with a hooked tip *S. parviflorus* Clover & Jotter
 - 2'. Central spines 1 to 3, usually straight, occasionally with a hooked tip.
 3. Stems 3–14 cm; radial spines 7 to 9 per areole; north and east of Highway 65 near De Beque, Colorado (Garfield and Mesa Counties), absent from Grand Valley *S. dawsoniae* McGlaughlin & Naibauer
 - 3'. Stems 5–18 cm; radial spines 8 to 15 per areole; south and west of Highway 65 in the Grand Valley and along Gunnison River (Mesa, Delta, and Montrose Counties) *S. glaucus* (K. Schum.) L. D. Benson

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