



Cryptantha nevadensis var. *rigida* elevated to species with a new name, *C. juniperensis*

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Abstract

A replacement name, *Cryptantha juniperensis*, *nomen et status novum*, is proposed for *Cryptantha nevadensis* A.Nelson & P.B.Kennedy var. *rigida* I.M.Johnston. A new name was necessary because the name *C. rigida* was unavailable, due to its previous use for the South American *Cryptantha rigida* (Phil.) Reiche. *Cryptantha juniperensis* is similar to what has been treated as *Cryptantha nevadensis* var. *nevadensis*, with which it shares appressed upper stem trichomes and a relatively long fruiting calyx, often with erect to reflexed apices. However, *Cryptantha juniperensis* differs significantly from *Cryptantha nevadensis* var. *nevadensis* by the nutlet shape, which is narrowly ovate to widely lance-ovate, narrowly acute, and tuberculate in the former but lance-ovate, strongly acuminate, and elongate-tuberculate to muricate in the latter. In addition, *Cryptantha juniperensis* is erect (vs. lax and sprawling in *Cryptantha nevadensis* var. *nevadensis*), has fruiting calyces between 4.5–7.5 mm (vs. 6–11 mm long), and has a corolla limb that ranges between 2–5 mm in diameter (vs. 1–2 mm in diameter). *Cryptantha juniperensis*, which has also been classified as *Cryptantha intermedia* (A.Gray) Greene var. *rigida* Brand, is similar to recognized varieties of *C. intermedia* in nutlet morphology and in growth habit but differs in having upper stems with trichomes mostly appressed (vs. mostly spreading), a smaller corolla size (ca. 2–5 mm vs. 3–11 mm), and cymules that are mostly paired (vs. cymules that are arranged in threes). Preliminary molecular studies also support the recognition of *C. juniperensis* as a taxon separate from both *C. nevadensis* and *C. intermedia*.

Key words: Boraginaceae, nomenclature, taxonomy, systematics

Cryptantha Lehmann ex G.Don (1837: 373) is one of the largest genera of the family Boraginaceae s.str. (*sensu* Luebert *et al.* 2016), including 102 recognized species to date (Simpson 2008 onwards). The genus is classified in subfamily Cynoglossoideae Weigend (2016: 538), tribe Cynoglosseae W.D.J.Koch (1837: 496), and subtribe Amsinckiinae Brand (1931: 20) (Chacón *et al.* 2016) and has traditionally been characterized by having nutlet attachment scars within a distinct ventral groove (Johnston 1925, Simpson & Hasenstab 2009). Four genera – *Eremocarya* Greene (1887: 58), *Greeneocharis* Gürke & Harms (1899: 460), *Johnstonella* Brand (1925: 249), and *Oreocarya* Greene (1887: 57) – have been separated from *Cryptantha* s.l. based on molecular phylogenetic data (Hasenstab-Lehman & Simpson 2012). The different species and infraspecific taxa of *Cryptantha* s.str. are distinguished by a number of features, but the number, shape, size, sculpturing, and heteromorphism of the fruit segments (nutlets) are perhaps the most fundamental characters in delimiting taxa within the genus (Simpson & Hasenstab 2009).

One of the many species of this genus, *Cryptantha nevadensis* A.Nelson & P.B.Kennedy (1906: 157), is readily distinguished in having lax stems with appressed (strigose) trichomes, clustered flowers and fruits in later stages of inflorescence development, an elongate fruiting calyx with reflexed apices, relatively small corollas, and four typically homomorphic, lance-ovate, acuminate nutlets that are coarsely elongate-tuberculate to muricate (see Kelley *et al.* 2012). Surprisingly, few of these diagnostic characters were mentioned in the original description of the species (Nelson & Kennedy 1906: 157):

“*Cryptanthe nevadensis* sp. nov.

Plant about 2 dm. high, branched from the base; leaves few, linear-lanceolate, pilose-hispid, from 1–2 mm. long, usually one at the base of each branchlet; fruiting calyx open, segments with a strong central vein, linear, 5 mm. long, about twice the length of the nutlets, pilose, also beset with stiff bristles; these about 2 mm. long and swollen at the base; corolla white, 2 mm. long; corolla-lobes 1 mm. long with minute brown veins; nutlets 4, and all alike, ovate-acuminate, 2 mm. long, minutely-scabrous.

Allied to *C. geminata* and *C. affinis*. Type (accession No. 55,039) collected in a dry gulch at Reno, Washoe County, Nevada, June 16, 1893. *F. H. Hillman s.n.*”

The holotype of *Cryptantha nevadensis* is reported as RM0001565. Reported isotypes are RSA0001790 and UC444412 (herbarium codes according to Index Herbariorum; Thiers, continuously updated). Three taxa subsequently described were considered by Johnston (1925) to be synonyms of *Cryptantha nevadensis*, and we concur:

Krynitzkia barbiger A.Gray var. *inops* Brandegee (1906: 228)

≡ *Cryptantha barbiger* (A.Gray) Greene var. *inops* (Brandegee) J.F.Macbride (1916: 548)

Cryptantha arenicola A.A.Heller (1906: 242)

Cryptantha leptophylla Rydberg (1909: 678)

Johnston (1925: 68), in his seminal treatment of the North American species of *Cryptantha*, stated:

“*Cryptantha nevadensis*, var. *genuina* [= *C. nevadensis* var. *nevadensis*] is a striking plant on account of its wiry, strigose, usually flexuous stems, very elongate calyces and lanceolate attenuate nutlets. Its habit is suggestive of *C. dumetorum*, since it grows in shelter of shrubs and frequently scrambles up through them. The stems are also very brittle.”

Johnston, however, did not indicate that he had examined the type specimen for *C. nevadensis*. In this treatment, Johnston described a new variety of *Cryptantha nevadensis*, which he named *C. nevadensis* var. *rigida* I.M.Johnston (1925: 68), presumably after its more rigid, as opposed to lax and brittle, stems:

“Var. **rigida**, var. nov., erecta non rariter plus minusve hirsuta; calycibus 5–10 mm. longis; nuculis oblongo-ovatis acutis verrucosis ca. 2 mm. longis. Western portion of Mohave Desert and neighboring coastal slopes; also in western Arizona.”

Johnston (1925: 68–69) further stated:

“The variety *rigida*, with which the var. *genuina* is confluent, has the habit and nutlets of some forms of *C. intermedia*. From that species it differs in its small corollas and in invariably having strigose pubescence. The variety intergrades with *C. intermedia* and through it *C. nevadensis*, var. *genuina* is related to *C. intermedia* and eventually to *C. barbiger*. The axial nutlet of *C. nevadensis*, var. *genuina* is frequently somewhat smoother than the others and usually has a closed groove.”

A single homotypic synonym has been named for *C. nevadensis* var. *rigida*: *Cryptantha intermedia* (A.Gray) Greene var. *rigida* (I.M.Johnston) Brand (1931: 70). The recognition of two varieties for *C. nevadensis* has subsequently been accepted by the authors of some floras that encompass regions where the two varieties occur (e.g., Abrams 1951, Kearney & Peebles 1960, Kelley *et al.* 2012) but treated as a synonym or not mentioned in others (e.g., Cronquist 1984, Kelley & Wilken 1993).

We believe that what has been previously treated as *Cryptantha nevadensis* var. *rigida* is distinct enough from *C. nevadensis* var. *nevadensis* in stem habit, calyx and corolla size, nutlet morphology, geographic separation, and habitat preference to warrant a rank at the species level. *Cryptantha n.* var. *rigida* has ascending to erect, stiff stem branches (Fig. 1), as opposed to the sprawling, flexuous stems of *C. n.* var. *nevadensis*. Stem trichomes in *C. n.* var. *rigida* are often both appressed and sparsely spreading (especially above), but those of *C. n.* var. *nevadensis* are only appressed. The inflorescence cymule units of *C. n.* var. *rigida* all lengthen in fruit, but the later-formed cymules of *C. n.* var. *nevadensis* generally remain condensed (glomerate). The fruiting calyx of *C. n.* var. *rigida* is shorter but with some overlap, being 4.5–7.5 mm long (Fig. 2A) as opposed to 6–11 mm long in *C. n.* var. *nevadensis* (Fig. 2B). We do note that *C. n.* var. *rigida* can be more variable in corolla size than indicated by some earlier workers, the corolla limb ranging from 2–5 mm in diameter. At the onset of anthesis, the corolla limb diameter of *C. n.* var. *rigida* starts at 4–5 mm wide, generally diminishing to 2–2.5 mm wide by the end of anthesis, while *C. n.* var. *nevadensis* is initially 1.5–2 mm wide, diminishing to 1 mm wide. But, perhaps most significantly, the nutlets of *C. n.* var. *rigida* are narrowly ovate to broadly lance-ovate (average length:width ratio 2.0), the apex generally narrowly acute to slightly acuminate, with surfaces more or less uniformly tuberculate (Figs. 1B, 2C). In contrast, nutlets of *C. n.* var. *nevadensis* are lance-ovate (average length:width ratio 2.6), the apex strongly acuminate, with surfaces ranging from elongate-tuberculate to muricate, tubercles near apex often upturned (Fig. 2D). A comparison of the vegetative and reproductive features of the two taxa is presented in Table 1 (data from Kelley and Simpson, in prep.).



FIGURE 1. Holotype specimen of *Cryptantha nevadensis* var. *rigida* [= *C. juniperensis*], C. G. Pringle s.n., 16 May 1882 (GH 00096065). Note paired cymules.

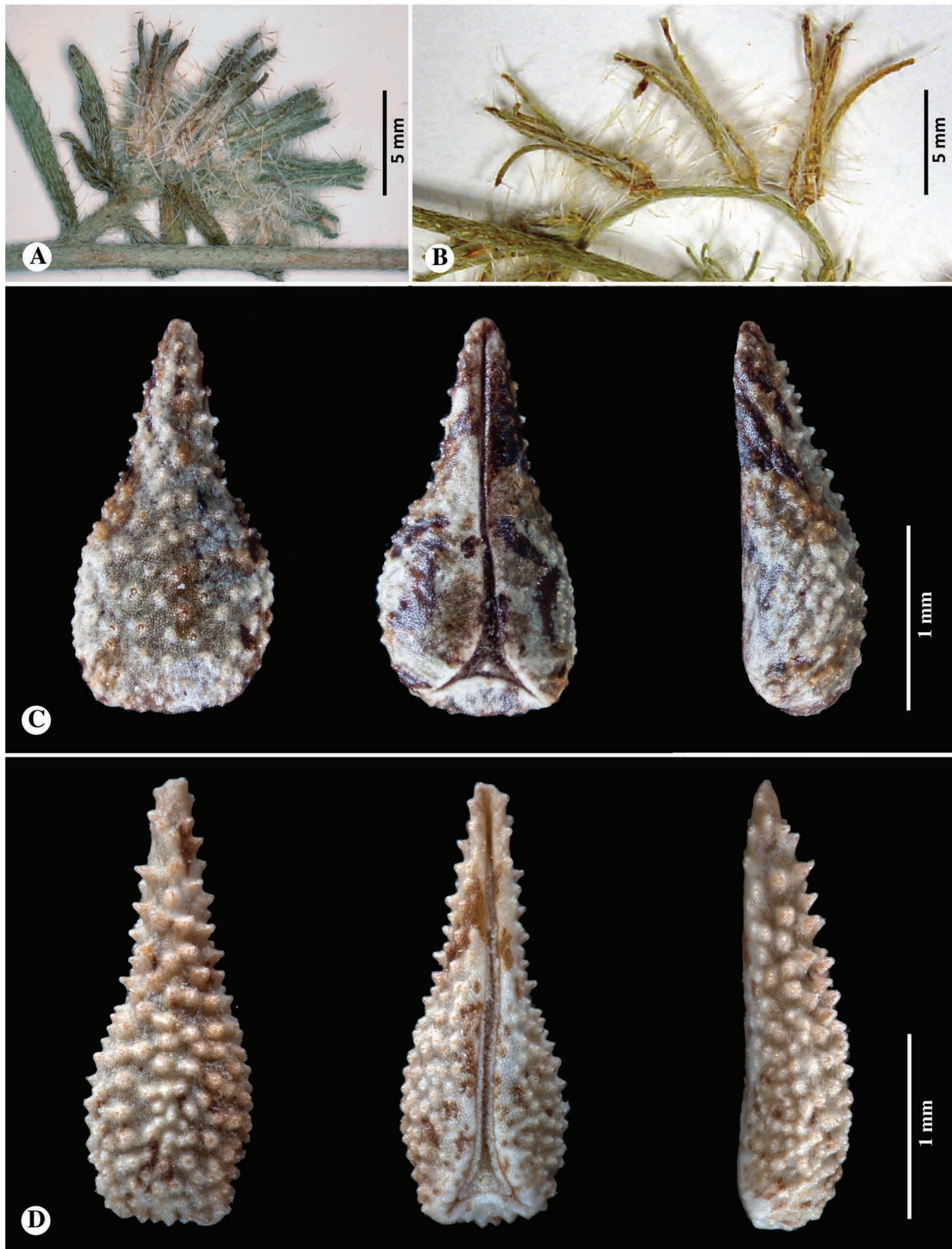


FIGURE 2. Comparison of features of *Cryptantha nevadensis* var. *rigida* [= *C. juniperensis*] with *C. nevadensis* var. *nevadensis*. A. Fruiting calyces of *Cryptantha nevadensis* var. *rigida*. B. Fruiting calyces of *Cryptantha nevadensis* var. *nevadensis*, which are longer and more reflexed apically (shown to same scale as “A”). C. Nutlets of *Cryptantha nevadensis* var. *rigida*, in dorsal (left), ventral (middle), and lateral (right) views. D. Nutlets of *Cryptantha nevadensis* var. *nevadensis* (shown to same scale as “C”), which are longer, relatively narrower, and more coarsely elongate-tuberculate to muriculate, tubercles near the apex often upturned. Specimens illustrated: A, C: RSA 580318; B, D: SDSU 13032.

TABLE 1. Comparison of diagnostic features of *C. juniperensis* and *C. nevadensis*.

Attribute	<i>C. juniperensis</i>	<i>C. nevadensis</i>
Plant habit	Ascending to generally strictly erect	Generally sprawling
Stem and branch habit	Stiff	Flexuous, especially in age
Upper stem vestiture	Trichomes both appressed and sparsely spreading	Trichomes only appressed
Inflorescence development pattern	All cymules lengthening in fruit	First-formed cymules lengthening in fruit, more numerous later-formed cymules generally remaining glomerate
Calyx length	4.5–7.5 mm in fruit	6–11 mm in fruit
Corolla limb diameter	2–5 mm	1–2 mm
Nutlet shape and sculpturing	Narrowly ovate to broadly lance-ovate (length:width ratio ca. 2.0), apex generally narrowly acute, both surfaces +/- uniformly tuberculate	Lance-ovate (length:width ratio ca. 2.6), apex strongly acuminate, both surfaces irregularly elongate-tuberculate to muricate, tubercles near apex upturned

In plant habit and nutlet morphology *Cryptantha nevadensis* var. *rigida* is similar to and can be confused with *Cryptantha intermedia*. This similarity was undoubtedly the basis for Brand's (1931) transfer of the taxon as a variety of *C. intermedia*. However, *C. intermedia* always has spreading stem trichomes, a larger corolla limb diameter range starting at 8–11 mm wide diminishing to 3–4 mm, and generally has at least some inflorescence cymules in groups of three, as opposed to groups of two for *C. n.* var. *rigida* (Fig. 1).

Cryptantha nevadensis var. *rigida* also displays an allopatric distribution over most of its range with *C. n.* var. *nevadensis* (Fig. 3; see Appendix 1 for vouchers used to generate map). In California, *C. n.* var. *rigida* discretely occurs along the inner Coast Ranges, Stanislaus County, and eastern slopes of the Santa Lucia Range, Monterey County, east to the western San Joaquin Valley and south to the southern slopes of the Tehachapi Range and the northern slopes of the Transverse Ranges bordering the western Mojave desert (Fig. 3). It is also well documented from the Greenhorn Range of the Southern Sierra Nevada. It then sporadically occurs southward in localized populations along the eastern slopes of the Peninsular Ranges bordering the Colorado Desert. It is absent from the lower elevations of the central desert regions in California, but again occurs as an apparently disjunct population on the eastern slope of the New York Mountains, San Bernardino County, eastward to western and southeastern Arizona, and possibly extreme western New Mexico, though notably absent from southern Nevada, and southward into northern Baja California and Sonora, Mexico (Fig. 3). In contrast, *C. n.* var. *nevadensis* is a common and widespread component of the *Larrea* dominated shrub communities of both the Mojave and Colorado Deserts of southeastern California, southern Nevada, and central to northern Arizona, seldom venturing outside those bioregions (Fig. 3).

The distribution of *C. n.* var. *rigida* throughout its entire range is tightly associated with the distribution of California juniper woodland communities. Extensive populations of the taxon can also be found in low density grassland associations where the junipers have been historically removed. The disjunct eastern populations in Arizona are also well correlated with the distribution of more diverse juniper dominated woodland communities. In contrast, *C. n.* var. *nevadensis* is typically found in *Larrea* based desert shrub associations. In the vicinity of the Cajon Pass type locality of *C. n.* var. *rigida* where these two contrasting habitats meet, the woodland taxon can abundantly be found spilling down to the Mojave Desert floor where California juniper is able to encroach into typical desert shrub communities.

All of these factors support the elevation of *Cryptantha nevadensis* var. *rigida* to the rank of species. However, the epithet *rigida* is not available for use at the species level for this taxon, having been used previously for the South American *Cryptantha rigida* (Philippi) Reiche, *Anales Univ. Chile* 121: 819. 1907. We propose the following name:

Cryptantha juniperensis R.B.Kelley & M.G.Simpson, *nomen et status novum*.

Replaced name: *Cryptantha nevadensis* A.Nelson & P.B.Kennedy var. *rigida* I.M.Johnston, *Contr. Gray Herb.* 74: 68. 1925. ≡ *Cryptantha intermedia* (A.Gray) Greene var. *rigida* (I.M.Johnston) Brand, *Pflanzenr. (Engler) IV, Fam.* 252 (Heft 97): 70. 1931. [non *C. rigida* (Philippi) Reiche 1907] TYPE—U.S.A. California, hills bordering the Mojave Desert “about hills of Cajon Pass,” 16 May 1882, *C. G. Pringle s.n.* (holotype GH00096065!; isotype MO2246528! [Note: “*C. G. Pringle 14769*” on isotype specimen]).

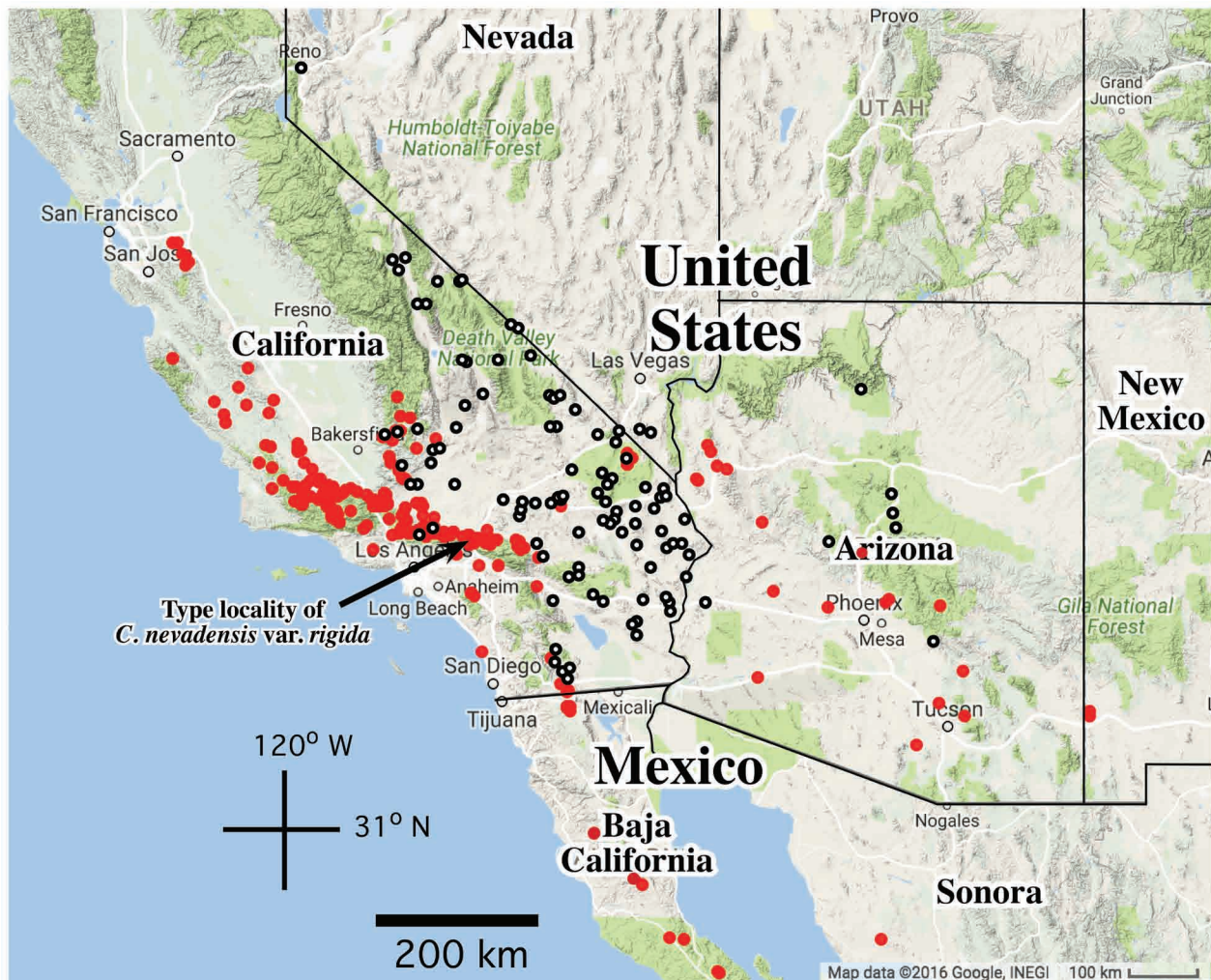


FIGURE 3. Distribution map of *Cryptantha nevadensis* var. *rigida* [= *C. juniperensis*] (solid red dots), and of *C. nevadensis* var. *nevadensis* (black bordered dots). Data from georeferenced records at Baja Flora (2016), Consortium of California Herbaria (2016), and SEINet (2016). Map data from ©Google 2016, INEGI Data.

Etymology. The specific epithet refers to “in the habitat of juniper,” as populations of *Cryptantha juniperensis* are very frequently found in juniper woodlands.

Habitat and distribution. *Cryptantha juniperensis* occurs in southwestern, south-central, and southern California, disjunctly eastward to Arizona, extreme western New Mexico, and northern Baja California and Sonora, Mexico. It is found in sandy, silty, loamy, to gravelly soils, generally on open slopes, often in California or occasionally other juniper woodland, less commonly in pinyon/juniper woodland or other woodland associations, open chaparral, or sparse grassland associations. Little morphological variation is demonstrated by *C. juniperensis* throughout much of its range in California; however, the disjunct populations in Arizona that barely encroach into southeastern California consistently exhibit most noticeably larger nutlet dimensions, 2.3–2.5 mm versus 1.6–2.1 mm long, and longer, coarser, spreading calyx trichomes.

Discussion. Future molecular phylogenetic studies are needed to elucidate the interrelationships of species and infraspecific taxa of *Cryptantha*. A recent molecular analysis (Mabry 2015) places what is now *Cryptantha juniperensis* [*C. nevadensis* var. *rigida*] in a clade distant both from *Cryptantha nevadensis* var. *nevadensis* and *C. intermedia*. Although these data may not be sufficient to resolve interrelationships of these taxa at this level, they are supportive of recognition of this taxon as a separate species.

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Appendix 1. Voucher specimens used to generate distribution maps in this study. Data from georeferenced records at Baja Flora (2016), Consortium of California Herbaria (2016), and SEINet (2016). The authenticity of all listed specimens has not been verified.

Cryptantha nevadensis var. *nevadensis*: *Andre 18979* (SDSU 21770); *Andre 22280* (RSA 798062); *Andre 23486* (RSA 798892); *Andre 23858* (UCR 267893); *Andre 24322* (RSA 814031); *Andre 24357* (RSA 810029); *Andre 24438* (RSA 831779); *Andre 24594* (RSA 810354); *Andre 24617* (UCR 251556); *Andre 24759* (RSA 817947); *Andre 25001* (RSA 836734); *Andre 25068* (RSA 828155); *Andre 25236* (RSA 809508); *Andre 25274* (RSA 807501); *Andre 25945* (RSA 826345); *Andre 26137* (SD248148, SDSU 20915); *Andre 26175* (SD248147, SDSU 20920); *Andre 27109* (RSA 825101); *Andre 27726* (RSA 834309, 834310); *Andre 27803* (RSA 834179); *Andre 27899* (RSA 822502); *Andre 27979* (SD 248149); *Andre 27984* (RSA 823802, SD 248146); *Andre 28036* (RSA 823919); *Andre 29148* (RSA 826945); *Andre 29226* (RSA 837836); *Andre 29862* (UCR 267496); *Andre 30008* (UCR 267593); *Andre 30370* (UCR 267971); *Andre 31198* (UCR 269072); *Andre 7550* (UCR 183296); *Annable 511* (SBBG 85742); *Annable 512* (SBBG 85740); *Barth 1276* (SD 226397); *Barth 913* (SDSU 20393); *Beare 31V92A* (SDSU5481); *Bell 6121* (RSA 828689); *Bell 6457* (RSA 828749); *Bell 6609* (RSA 823679); *Bell 886* (RSA 781904); *Bostick 4045* (DES 00024109); *Boyd 2016* (SBBG 87686); *Butterwick 6518* (ASU 115860); *Dearing s.n.*, 22 April 1935 (SBBG 14706, 14707); *DeDecker 2776* (SBBG 42797); *DeDecker 3382* (SBBG 49133); *DeGroot 6590* (RSA 779504); *Dellavalle 10IV95J-2* (SDSU 12028); *Forbes 451* (RSA 786420); *Gander 41*, 176 (SD11208); *Gardner 1127* (CAS1202360); *Green s.n.*, 11 April 2011 (UCR 229309); *Harvey 1216* (SDSU 5471); *Hasenstab 50* (SDSU 18685); *Hasenstab 59* (SDSU 18698); *Hodgson 13265* (DES 00045652); *Hoffmann s.n.*, 10 May 1929 (SBBG 63836); *Hoffmann s.n.*, 17 May 1930 (SBBG 63833); *Hoffmann s.n.*, 23 June 1931 (SBBG 63832); *Hoffmann s.n.*, 27 April 1929 (SBBG 63979); *Hoffmann s.n.*, 4 April 1929 (SBBG 63835); *Hoffmann s.n.*, 7 May 1929 (SBBG 63830); *Hoffmann s.n.*, 8 May 1929 (SBBG 63831); *Hoffmann s.n.*, 9 February 1928 (SBBG 63983); *Howald 3053* (UCR 254964); *Junak 1269* (SBBG 81015); *La Doux 2724* (JOTR 33723); *La Doux 2981* (JOTR 34086); *Mabry 23* (SDSU20361); *McLellan 1190* (UCR 246608); *McMullen s.n.*, 7 February 1982 (SDSU 18140); *Muller 9501* (SBBG 6270); *Nelson 63771* (RM); *Nelson 64233* (ASC 96363, RM); *Nelson 64628* (RM); *Nelson 64631* (RM); *Parikh 3237* (SBBG 125847, UCR 239012); *Philbrick s.n.*, 26 April 1969 (SBBG 36749); *Piehl 63322* (SBBG 20313); *Prigge 2887* (UCR 32428); *Ross 2788* (RSA 584877); *Salvato 8303* (UCR 269798); *Sanders 36323* (DES 00068259, SEINET 3099420, UCR 203523); *Sanders 36403* (UCR 204155); *Sanders 36474* (UCR 203630); *Sanders 36492* (UCR 249913B); *Sanders 36588* (UCR 211048); *Sanders 36709* (DES 00068342, UCR 210551); *Sanders 37461* (DES 00068307); *Sanders 37461* (RSA 781251); *Sanders 37461* (SEINET 3195133); *Sanders 37461* (UCR 213400); *Sanders 37530* (UCR 214897); *Sanders 38188* (UCR 213584); *Sanders 40680* (UCR 241574); *Sanders 42130* (UCR 269627); *Sanders 42337* (UCR 269778); *Simpson 21III98J* (SDSU 13032); *Simpson 2944* (SDSU 18652); *Stoughton 1048* (RSA 777842); *Stoughton 1344* (RSA 775734); *Stoughton 901* (RSA 777541); *Sweet 908* (SD 241303); *Swinney 10564* (UCR 222753); *Theroux 1335a* (ARIZ 201922); *Thomas 5933* (VVC 2474); *Thorne 55634* (RSA 810045); *Thorne 55673* (RSA 760093); *Thorne 55704* (RSA 758849); *Twisselmann 10945* (SBBG 23586); *Twisselmann 11867* (SBBG 26228); *Twisselmann 12264* (SBBG 26247); *Twisselmann 6835* (SBBG 14998); *Twisselmann 9279* (SBBG 21074); *Wood 3442* (RSA 799629); *Zabriskie s.n.*, 26 March 1975 (SBBG 53354).

Cryptantha nevadensis var. *rigida* [= *C. juniperensis*]: *Abrams s.n.*, 1 May 1927 (POM 145905); *Andre 11202* (UCR 218688); *Andre 15605* (UCR 236687); *Andre 27068* (GMDRC 6021, RSA 824107); *Andre 28619* (GMDRC 6218); *Andre 32654* (GMDRC 7524); *Andre 32670* (GMDRC 7526); *Andre 33031* (GMDRC 7632); *Bell 4949* (RSA 806164); *Bell 6567* (RSA 829012); *Benson 4350* (POM 287894); *Blakley 3444* (SBBG 11991); *Blakley 6928* (SBBG 33309); *Boyd 10190* (RSA 612099); *Boyd 10609* (RSA 725664); *Boyd 11480A* (RSA 736016); *Boyd 1673* (RSA 572995); *Boyd 8306* (RSA 571541); *Boyd 8654* (RSA 593893); *Boyd 8739* (RSA 593009); *Boyd 9527* (RSA 599545, UCR 99357); *Boyd 9557* (RSA 599533, UCR 99470); *Breedlove 2750* (SBBG 16490); *Chandler 1151* (SBBG 15706); *Chandler 1251* (SBBG 15672); *Chandler 1282* (SBBG 15673); *Chandler 1864* (SBBG 24567); *Chandler 1864* (SBBG 24569); *Chandler 1880* (SBBG 24521); *Chandler 1932* (SBBG 24564); *Chandler 2160* (SBBG 24568); *Chandler 2174* (SBBG 24547); *Chandler 2198a* (SBBG 24519); *Chandler 2210* (SBBG 24550); *Chandler 2295* (SBBG 24553); *Chandler 2327f* (SBBG 24565); *Chandler 2351* (SBBG 40666); *Chandler 2503* (SBBG 22916); *Chandler 2868* (SBBG 24531); *Chandler 2965a* (SBBG 24775); *Chandler 3000* (SBBG 24522); *Chandler 3468* (SBBG 45321); *Chandler 3469* (SBBG 45322); *Chandler 3476* (OBI 37225, SBBG 45325); *Chandler 3481* (SBBG 40530); *Chandler 3485* (SBBG 40528); *Chandler 3493* (SBBG 40529); *Chandler 3503* (SBBG 45323); *Chandler 3506* (SBBG 27079); *Chandler 3652* (SBBG 97602); *Chandler 3657b* (SBBG 97622); *Chandler 3684* (SBBG 97624, UCR 73086); *Chandler*

3685 (SBBG 97676); *Chandler 3717* (OBI 77606, RSA 615363, SBBG 97623, UCR 107650); *Chandler 3844* (SBBG 97625, UCR 73090); *Chandler 3847* (SBBG 97626); *Chandler 3852* (SBBG 97627, UCR 73091); *Chandler 552* (SBBG 16454); *Chandler 812* (SBBG 18913); *Clarke s.n.*, 7 June 1971 (UCR 178021); *Clokey 5823* (MO 1559727, UCR 66486); *Clokey 5832* (RSA 499748); *De Vries 7304* (RSA 747016); *De Vries 7309* (RSA 747081); *De Vries 7355* (RSA 746945); *De Vries 7396* (RSA 748003, UCR 219890); *De Vries 7418* (RSA 747998); *Dearing s.n.*, 13 April 1935 (SBBG 14702); *Edge 337* (SBBG 48016); *Elmer 4362* (POM 63745); *Elster CARR-928A* (UCD 163534); *Felger 6930* (ARIZ 426602); *Ferris 9054* (RSA 14190); *Fischer 5899* (ASU 206935); *Fosberg 10689* (RSA 337999, UCR 66487); *Fosberg 10691* (RSA 499747); *Fosberg S-01182* (UCR 50369); *Gander 8081* (SD 26729); *Griesel s.n.*, 1 April 1961 (RSA 149750); *Gross 2121* (UCR 177780); *Gross 2677* (RSA 723127); *Gross 3300* (RSA 735602); *Gross 3333* (RSA 737675); *Gross 3812* (RSA 745261); *Gross 3833* (RSA 745046); *Gross 3873* (RSA 750077); *Gross 3939* (RSA 749394, UCR 245902); *Gross 3951* (RSA 749406); *Gross 4444* (RSA 761669); *Gross 4459* (RSA 761924); *Gross 4518* (RSA 761731); *Gross 4597* (RSA 761496); *Gross 4652* (RSA 761579, UCR 242967); *Gross 5451* (RSA 772440); *Gross 582* (RSA 669523); *Gross 6798* (RSA 833709); *Gross 6998* (RSA 836226); *Gross s.n.*, 12 May 2009 (RSA 749451); *Gustafson 417* (RSA 499745); *Hardham 10248* (SBBG 22469); *Hardham 10487* (SBBG 36157); *Hardham 1878* (SBBG 20687); *Hardham 3140* (SBBG 107160); *Hardham 647* (SBBG 18119); *Helmkamp 9409* (UCR 190655); *Hendrickson 117* (SD 161801); *Hill 33344* (ILLS 211919, UCR 120573); *Hoffmann 46* (RSA 499742); *Hoffmann s.n.*, 27 April 1930 (POM 171598); *Hoover 10313* (OBI 20764); *Hoover 10411* (OBI 20758); *Hoover 11054* (OBI 20748); *Hoover 3026* (RSA 128431); *Hoover 3041* (RSA 128430); *Hoover 3363* (RSA 128432); *Hoover 6874* (OBI 20762); *Hoover 7633* (OBI 20757); *Hoover 7805* (OBI 77741); *Hoover 7819* (OBI 20760); *Hoover 8053* (OBI 20763); *Hoover 8311* (OBI 20756); *Hoover 8321* (OBI 20761); *Howell 30238* (RSA 118017); *Howell 37292* (UCR 95793); *Howell 47779* (UCR 95794); *Hrusa 11049* (CDA 11015); *Hrusa 18392* (CDA 35433); *Johnston s.n.*, 17 May 1920 (POM 7860); *Jones 7012* (POM 73071); *Jones s.n.*, 20 May 1903 (POM 72815); *Jones s.n.*, 20 May 1903 (POM 73075); *Jones s.n.*, 22 May 1903 (POM 71357); *Jones s.n.*, 22 May 1903 (POM 73260); *Keil 28312* (OBI 59530); *Keil 4381* (DES 00003334); *Keil 6212* (ASU 25668); *Kelley 1077* (SDSU 20700); *Kelley 1084* (SDSU 20699); *Kelley 1099* (SDSU 20701); *Kelley 1636* (SDSU 21365); *Kelley 1659* (SDSU 21878); *Kelley 1681* (SDSU 21366); *Kelley 1771* (SDSU 21367); *Kelley 1784* (SDSU 21368); *Kelley 774* (SDSU 21801); *Kelley 782* (SDSU 20698); *Lane 785* (ASU 87000); *Lane 959* (ASU 86999); *Lindley 770* (ARIZ 423710); *Mabry 75* (SDSU 20766); *Mabry 75* (SDSU 20767); *Mabry 78* (SDSU 20770); *Milauskas 9* (UCD 119980); *Mistretta 1227* (RSA 588146); *Mistretta 2355* (RSA 757199); *Mistretta 5180* (UCR 227716); *Mistretta 5683* (RSA 804184); *Mistretta 948* (RSA 589969); *Moe 2372* (RSA 708850); *Moran 19554* (SD 84338); *Moran 20546* (SD 87112); *Moran 20702* (SD 88925); *Moran 27345* (SD 103399); *Moran 27366* (SD 103655); *Moran 30601* (SD 110938); *Moran 30658* (SD 111116); *Morgan s.n.*, 16 June 1991 (UCR 76375); *Muller 1007* (SBBG 45996, UCR 24511); *Munz 9986* (UCR 142733); *Parfitt 4189-B* (UCR 188989); *Peirson 1022* (RSA 80759); *Philbrick s.n.*, 22 June 1967 (SBBG 40830); *Phillips 82-4* (SEINet); *Preston 2728* (UCD 146983); *Preston 2751* (UCD 146984); *Preston 2761* (UCD 146985); *Provance 6532* (SDSU 21781); *Provance 723* (UCR 115894); *Rebman 16908* (SD 195788, SDSU 19367); *Rebman 9929* (SD 157381); *Rodin 4940* (POM 313421); *Ross 2512* (RSA 597456, UCR 98824); *Ross 2856* (UCR 132655); *Ross 4855* (UCR 89476); *Ross 4980* (UCR 89457); *Ross 5036* (RSA 570198); *Ross 7950* (UCR 84560); *Ross 8520* (RSA 596912); *Salazar 635* (SD 175886); *Sanders 13754* (ARIZ 394162, RSA 733365, SD 234335, SEINET 1004955, UCR 176979); *Sanders 13953* (IRVC 28521, UCR 127959); *Sanders 14714* (UCR 81618); *Sanders 16993* (UCR 176736); *Sanders 17158* (UCR 162784); *Sanders 17184* (UCR 162725); *Sanders 17196* (UCR 127705); *Sanders 17250* (UCR 86219); *Sanders 20364* (RSA 653110, UCR 112810); *Sanders 20462* (UCR 98319); *Sanders 21763* (RSA 660935, UCR 112609); *Sanders 21773* (RSA 660937, SEINET 238910, UCR 112601, UTC 00230872); *Sanders 21800* (RSA 653040, SEINET 238933, UCR 112343, UTC 00230895); *Sanders 21836* (UCR 112908); *Sanders 22000* (RSA 653131); *Sanders 22046* (UCR 119432); *Sanders 22776* (IRVC 28522, UCR 127963); *Sanders 27714* (UCR 136149); *Sanders 27723* (UCR 134622); *Sanders 28192* (UCR 137323); *Sanders 29418* (RSA 713737, UCR 152895); *Sanders 29505* (SDSU 21786); *Sanders 29725* (UCR 153561); *Sanders 31996* (UCR 186944); *Sanders 32068* (UCR 186663); *Sanders 32133* (UCR 187212); *Sanders 32723* (SDSU 21782); *Sanders 33448* (UCR 184201); *Sanders 33572* (UCR 185567); *Sanders 34813* (UCR 192564); *Sanders 34857* (UCR 191702); *Sanders 34931* (UCR 192172); *Sanders 34947* (UCR 191997); *Sanders 35084* (UCR 191732); *Sanders 37951* (UCR 214385); *Sanders 37978* (UCR 214022); *Sanders 38031* (UCR 214588); *Sanders 38061* (UCR 214745); *Sanders 38087* (UCR 213653); *Sanders 40006* (SDSU 21778); *Sanders 40027* (SDSU 21023); *Sanders 40087* (SDSU 21863); *Sanders 40169* (UCR 235071); *Sanders 40751* (SDSU 21777); *Sanders 40990* (SDSU 21016); *Sanders 6452* (ARIZ 394490, IRVC 28519, RSA 709098, SEINET 1007998, UCR 157736); *Sanders 6512* (RSA 371701); *Sanders 6603* (ARIZ 394491, RSA 709097, SD 167188, SEINET 1007997, UCR 157737); *Silverman 8015* (SD 240923, UCR 228572); *Silverman 8039* (SD 240922, UCR 228576); *Silverman 8044* (UCR 228575);

Simpson 3734 (SDSU 20781); *Simpson 3814* (SD 245300); *Simpson 3816* (SD 245301); *Simpson 3821* (SD 245302); *Simpson 3826* (SDSU 20744); *Simpson 3848* (SDSU 21206); *Sivinski 5963* (UNM 111689); *Sivinski 5985* (UNM 111691); *Smith 10464* (SBBG 85606); *Smith 10496* (SBBG 85607); *Smith 10518* (SBBG 85614); *Smith 10527* (SBBG 85604); *Smith 10528* (SBBG 85605); *Smith 10561* (SBBG 85603); *Smith 3514* (SBBG 82410); *Smith 4238* (SBBG 82354); *Smith 8300* (SBBG 82353); *Smith 9296* (SBBG 82360); *Smith 9664* (SBBG 82372); *Smith 9782* (SBBG 82768); *Smith s.n.*, 4 June 1965 (SBBG 82361); *Swinney 10454* (UCR 220044); *Swinney 10557* (RSA 773280); *Swinney 10579* (UCR 222818); *Swinney 10662* (RSA 771581, UCR 223043); *Swinney 10726* (RSA 772399); *Swinney 10782* (RSA 777521, RSA 780995); *Swinney 12659* (RSA 823743); *Swinney 12739* (RSA 826628); *Swinney 3556* (UCR 181533); *Swinney 3911* (UCR 150059); *Swinney 4281* (RSA 719155); *Swinney 6078* (UCR 189268); *Swinney 7384* (RSA 729476, UCR 150540); *Swinney 8246* (UCR 203205); *Swinney 8311* (RSA 750205, UCR 203180); *Swinney 8866* (RSA 748898, UCR 205587); *Taylor 14815* (RSA 696029); *Thorne 31714A* (RSA 773009); *Thorne 41587* (RSA 250588); *Thorne 52298* (RSA 336379); *Thorne 52894* (RSA 309666); *Thorne 53120* (POM 339366); *Thorne 54262* (RSA 338397); *Twisselmann 11976* (RSA 187068); *Twisselmann 13291* (SBBG 28691); *Twisselmann 8439* (SBBG 19010); *Vanderplank 120325 6* (SD 240030); *Vanderplank 50506-50* (RSA 725108); *Wetherwax 474* (SBBG 118513); *Wheeler 9337* (UCR 95507); *Wheeler 9376* (RSA 594674, UCR 176961); *Wheeler 9421* (UCR 95525); *Wheeler 9429* (RSA 592354); *Wheeler s.n.*, 17 April 1968 (RSA 617199); *Wheeler s.n.*, 20 April 1973 (RSA 632137, UCR 138899); *White 10286* (RSA 702539); *White 10294* (RSA 702543); *White 12741* (RSA 750567, UCR 213818); *White 12826* (RSA 750759); *White 13056* (RSA 750691, UCR 213996); *White 7877* (RSA 674849); *White 8671* (RSA 675792); *Wilvert 119* (RSA 807660); *Wilvert 29* (RSA 813508); *Woglum 2283* (RSA 611558); *Wood 1644* (RSA 763246); *Wood 1952* (RSA 800226); *Wood 3953* (RSA 792940); *Wood 744* (RSA 763374); *Wright 1790* (ASU 205320).