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A NEW SPECIES OF *CRYPTANTHA* RESTRICTED TO DUNES IN NORTHWESTERN BAJA CALIFORNIA, MEXICO

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ABSTRACT

Cryptantha arenophila Rebman & M.G.Simpson (Boraginaceae) is described as new. This species is restricted to sandy dunes near San Quintín, Baja California, Mexico and adjacent coastal regions. It is similar to the more common *Cryptantha patula* Greene in stem vestiture, calyx morphology, and inflorescence morphology. *Cryptantha arenophila* differs from that species in having significantly larger corolla limbs and narrowly oblong to narrowly elliptic leaves with obtuse-rounded leaf apices, as opposed to linear to narrowly lanceolate leaves with acute to obtuse leaf apices in *C. patula*. In addition, nutlets of *C. arenophila* tend to have more numerous and shorter tubercles, while those of *C. patula* have tubercles that are less dense and larger, although variation in this species needs further investigation. The dune habitats where the type locality of *C. arenophila* occurs are currently under severe impacts from animal grazing and off-road traffic, necessitating the conservation of these regions.

Key Words: Baja California, Boraginaceae, conservation, *Cryptantha arenophila*, *Cryptantha patula*, dunes, taxonomy.

Cryptantha is a genus of annual or (only in South America) perennial herbs of the family Boraginaceae. Based on molecular phylogenetic studies (Hasenstab-Lehman and Simpson 2012; Simpson et al. 2017; Mabry and Simpson 2018), *Cryptantha* is currently recognized with about 103 species and 118 minimum-ranked taxa, having been split from the genera *Eremocarya, Greeneocharis*, *Johnstonella,* and *Oreocarya* (see Hasenstab-Lehman and Simpson 2012 for a key to genera and Amsinckiinae Working Group 2021 for updated taxonomy). These five genera were previously grouped together within *Cryptantha* s. l., by a feature of their fruits ("nutlets"), all having a characteristic ventral (adaxial) groove running the length of the nutlet, corresponding largely to the scar of attachment to the central gynobase. Species and infraspecies of *Cryptantha* have been distinguished in large part by the size, shape, number per fruit, sculpturing, and ventral groove morphology of the nutlets, but also by plant duration, leaf position, leaf morphology, vestiture, calyx morphology, and corolla size, shape, and color (see Simpson and Hasenstab 2009; Kelley et al. 2012).

In reviewing the *Cryptantha* species of Baja California and Baja California Sur, Mexico, we discovered specimens with unusually wide leaves and large flowers, these confined to sandy dune habitats in northwestern Baja California. A subsequent collecting trip in April 2017 confirmed this. Members of these populations are similar to *Cryptantha patula* Greene (Greene 1889), resembling that species in having decumbent to ascending branches with long cymule units and an elongate peduncle subtended by leaf-like bracts, with some bracts subtending the lowermost flowers. However, *C. patula* has much narrower leaves, smaller flowers, and a different nutlet morphology (see Results, Discussion). We believe this new entity is different enough to warrant naming it as a new species. Here we name and describe the species and provide results of a quantitative analysis corroborating its distinctiveness, utilizing a taxonomic (morphologic) concept (Cronquist 1978, 1988). We cite information on vital conservation needs for this new species, review some taxonomic challenges for future work in this complex, and provide a taxonomic key for its identification.

TAXONOMIC TREATMENT

Cryptantha arenophila Rebman & M.G.Simpson, *sp. nov*.—Type: MEXICO. **Baja California**. *J. Rebman 33048*, with M. G. Simpson, M. Mulligan, and S. Vanderplank, 19 April 2017 (holotype: **SD**278625; isotypes: **BCMEX**, **MEXU**, **RSA**, **SBBG**, **SDSU**, **UC**), Mpio. Ensenada, El Socorro Dunes: south of San Quintín and just north of Arroyo Socorro, dune fields above the ocean, prostrate annual, flowers white, common, note heteromorphic sepals, dune vegetation, with *Acmispon distichus* (Greene) Brouillet, *Nemacaulis denudata* Nutt., *Brassica tournefortii* Gouan, *Eulobus crassifolius* (Greene) W.L.Wagner & Hoch, and *Cryptantha* sp., 30.32735°N, 115.82779°W, 30 m elevation.

Paratypes. (Note: georeference coordinates and elevations indicated with an asterisk were estimated

from label data.) MEXICO, **Baja California**. *F. Casillas 214* (**SD**267039), 30 March 2010, Mpio. San Quintín, La Chorera, coastal sand dunes, 30.4542°N, 116.033°W, 6 meters elevation*; *P. Flanagan s.n.* (**SD**132560), 23 April 1989, San Quintín, 30.55775°N, 115.93919°W*, 28 meters elevation*; *J. Henrickson 4460* (**SD**80913), 25 March 1970, 2 miles W of Colonia Guerrero in sand dunes near Colonia Mormona, fls white, with *Oenothera, Astragalus*, *Ephedra, Abronia, Carpobrotus*, etc., 30.71896°N, 116.03322°W*, 3 meters elevation; *N. Jensen 691* (**SD**253407), 18 March 2014, San Quintin region, El Socorro Dunes, WGS 1984: 30.327185°N, 115.82766°W, 35.9 meters elevation, coastal dunes, stable back side of sand dunes dominated by *Helianthus niveus* (Benth.) Brandegee, slope=slight, aspect=east, associates: *Schismus* sp., *Abronia umbellata* Lam., *Oenothera wigginsii* W.M.Klein, *Helianthus niveus, Ephedra* sp., *Euphorbia* sp., herb, annual, flowering, flower color white, infrequent; *A. Johnson 128* (**SD**116684), 25 March 1973, Laguna Mormona, lee slope of dunes, atypical in broad leaves, large corollas, 30.66067°N, 116.0333°W*, 5 meters elevation; *P. W. Rundel 2106* (**IRVC**18157, **SDSU**22355), 15 March 1973, San Quintin, Colina del Sudoeste, sand dunes, 30.44237°N, 116.029821°W*, 28 meters elevation*.

Description (Figs. 1–3). [Note: Leaf measurements are ranges of averages from examined specimens, with minimum and maximum values in parentheses.] **Plants** annual with single taproot, aerial stems to 45 cm long. **Stems** ascending to decumbent, branched, especially near base (Fig. 1A,B), aerial stem vestiture antrorse-strigose (Fig. 1D), interspersed with minutely pustulate, spreading hirsute to hispid trichomes; older stems with more pronounced, pustulate spreading hirsute trichomes. **Leaves** (13)16–23(30.5) mm long x (2.5)2.9–4.9(5.2) mm wide, length:width ratio (3.6)3.9–7.2(8.2), narrowly oblong to narrowly elliptic, apically obtuse-rounded (Fig. 1A–C), both surfaces with whitish, appressed to inclined hirsute, trichomes, these pustulate, with basal ring of cells, midrib sunken adaxially, raised abaxially, leaves reduced distally. **Inflorescence** cymules mostly solitary (Fig. 1A), arising from lower axes, peduncles 5–27 cm long, cymules circinate, with deciduous, basal inflorescence bracts, 15-25-flowered, elongate in fruit, up to 10 cm long from lowermost to uppermost flowers, lowest fruits not touching one another, 3–5(9) mm apart, isolated flowers often found at junction of inflorescence axes, flower bracts mostly absent, occasionally present near base of cymule (Fig. 1A), bracts similar to but smaller than vegetative leaves. **Flowers** subsessile, pedicel $\leq$0.5 mm. **Calyx** horizontal to inclined, lance-ovoid at maturity, 2.5–3.5 mm at anthesis, (4)5–7 mm in fruit; sepals distinct, heteromorphic by size, with 1–2 typically longer, linear to narrowly lanceolate, apically rounded, erect with tip slightly recurved when dry, midrib thickened adaxially and abaxially, margins densely ascending fine-hirsute, adaxial surface glabrous below, appressed short hirsute near apex, abaxial surface appressed to spreading hirsute marginally, with ascending to horizontal, pustulate, inflated, hispid trichomes along thickened midrib, white throughout or white with yellowish tip (Fig. 2A,B). **Corolla** white, rotate, tube about equal to calyx, limb 5–6 mm in diameter, fornices yellow, rarely white (Fig. 1C). **Gynobase** ca. 1/2–2/3 height of nutlet; style tip/stigma extending to or very slightly beyond mature nutlets (Fig. 2B). **Ovules** 4, sometimes abortive. **Nutlets** (1)2–4 (Fig. 2A), 1.8–2.0 mm long, homomorphic, brownish to grayish, often dark mottled, lance-ovate, base truncate to slightly rounded, margins rounded, apex acuminate, dorsal surface convex, spinal ridge absent, ventral surface flat at base, both surfaces finely and densely papillate and low-rounded tuberculate with ca. 14–20 tubercles within a 0.1 mm high transverse band of the dorsal face at the widest region (Fig. 3A–D), attachment scar edges abutted or slightly separated entire length, not raised, gapped at base forming a small, triangular areole, bi-forked below (Fig. 3A).

Diagnosis. *Cryptantha arenophila* is similar to *C. patula* in having both appressed and spreading stem trichomes and mostly solitary, often basally bracteate cymules, differing from the latter in having relatively wide (ca. 3–5 mm) leaves with a length:width ratio $<$8, relatively wide (5–6 mm) corolla limbs, and nutlets with smaller, more numerous tubercles.

Distribution, Habitat, and Endemism. *Cryptantha arenophila* is endemic to a limited region of northwest Baja California, Mexico (Fig. 4A,B), distributed on coastal sand dunes in the vicinity of San Quintín and adjacent coastal regions, from the mouth of the Santo Domingo River near Colonia Vicente Guerrero in the north, south to the El Socorro dune field; $<$40 meters elevation.

Phenology. Based on data from available specimens, *Cryptantha arenophila* appears to flower and fruit from March to May, the fruits likely persisting into the early summer.

Etymology. Latin *arenos*, sand, + *phila*, from *phileo*, to love, in reference to its typical occurrence on sand dunes (pronounced *a-re-nó-phi-la*). Note that *Cryptantha arenophila* should not be confused with the similar-sounding *Cryptantha arenicola* A.Heller, which is currently recognized as a heterotypic synonym of *Cryptantha nevadensis* A.Nelson & P.B.Kennedy.

Suggested Common Name. San Quintín Dune Cryptantha.

Rejected Paratypes. We examined two herbarium specimens that had relatively wide, short leaves that were within or close to dimensions of *Cryptantha arenophila*, both of which we rejected. These are

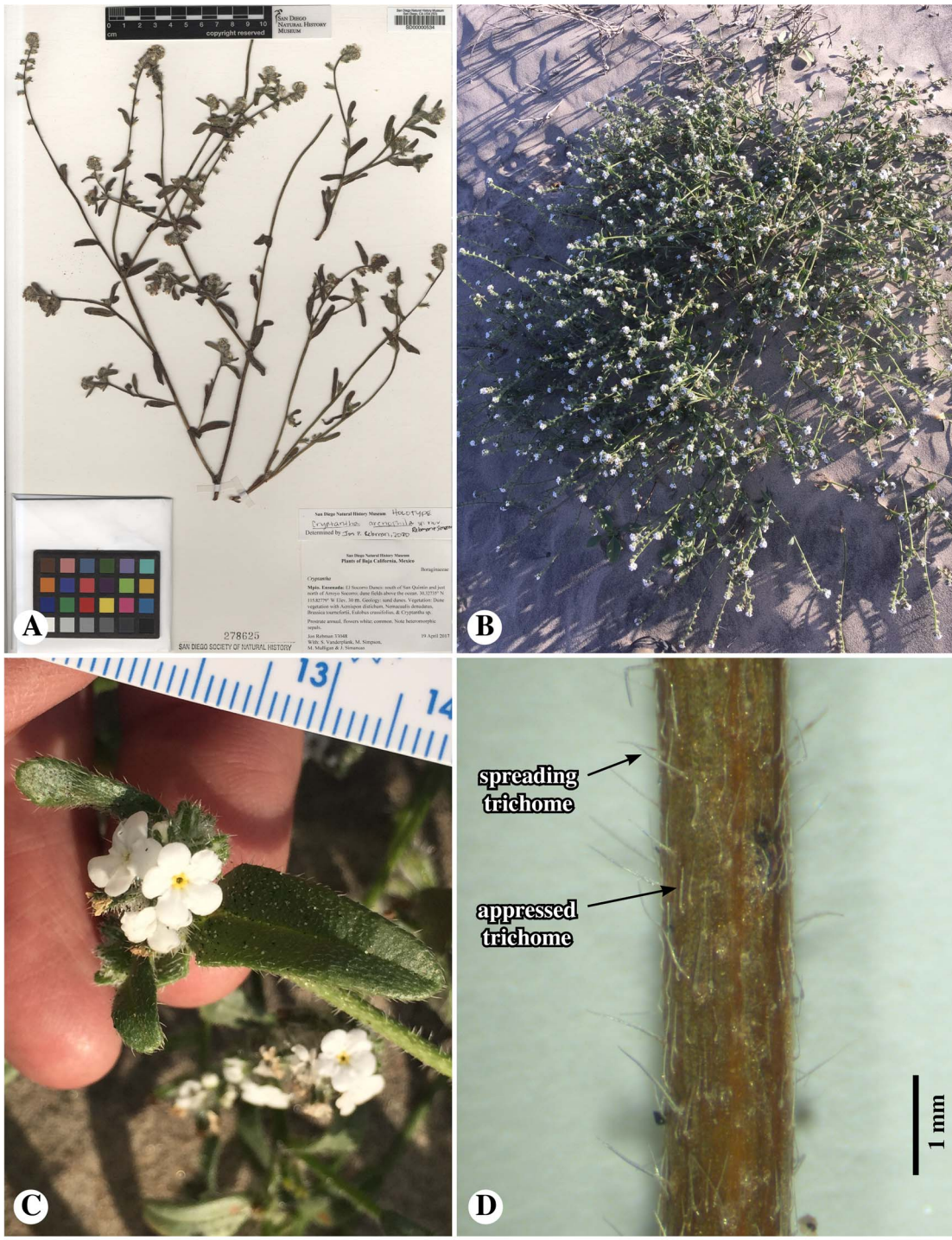

FIG. 1. *Cryptantha arenophila*. A. Holotype specimen (*Rebman 33048*, **SD**278625), showing elongate cyme units and wide leaves. B,C. Habit photographs, type population. Note typical sand dune habitat and relatively large leaves and corollas. D. Stem close-up, just below cymule, showing both antrorse-appressed and spreading-hirsute trichomes.

FIG. 2. Fruits of *Cryptantha arenophila*, from type material (*Rebman 33048*). A. Fruit with 4 nutlets removed. Note sepals with coarse, hispid trichomes along adaxial midrib and ascending hirsute trichomes along margin and outer surface, typical of many *Cryptantha* species. B. Fruit close-up, showing mature nutlet attached to gynobase, one nutlet (at left) abortive, one removed (not shown). Note style tip/stigma extending just beyond nutlet apex.

listed below with the reasons for not considering them representatives of this new species.

R. Moran 21837, 21 April 1975 (**SD**91282), Mexico, Baja California, ca. 5 miles northwest of San Quintín, common on dunes atop low beach bluffs, 30°33′N, 116°02′W, 20 meters. This specimen resembles *C. arenophila* in having wider leaves, elongate, basally bracted cymes, and relatively large corollas. It also occurs on dunes within the range of *C. arenophila*. We reject it because the nutlets have relatively large tubercles and a longer style length (extending ca. 0.5 mm above the nutlets), similar to that of mainland *C. patula* s. l.

J. Henrickson 19346, 19 March 1983 (**RSA**660863), Mexico, Baja California, ca. 55 air miles SE of Bajia [sic] San Luis Gonzaga at ruins of Mina Desengaño, in granite area with ocotillo [*Fouquieria splendens* Engelm. subsp. *splendens*], Boojum tree [*Fouquieria columnaris* (Kellogg) Curran], *Ambrosia dumosa* (A.Gray) W.W.Payne, *Yucca valida* Brandegee, *Ephedra, Lycium, Atriplex, Agave, Viscainoa*, etc., near 29°07′N, 114°05′W, 300 ft. Although this specimen has relatively wide leaves, the nutlets are coarsely tuberculate, the tubercles somewhat conical and sharp-pointed, quite different from those of *C. arenophila* and a typical *C. patula*. Also, although this specimen does have some apparent elongate "solitary" cyme units as in *C. arenophila* and forms of *C. patula*, it also has some that are trifurcate, resembling *C. intermedia* (A.Gray) Greene. The corolla limb width (maximum 3 mm) of this specimen is more typical of *C. patula*. Finally, this specimen is well out of range of *C. arenophila*, at about 280 km (175 miles) southeast of the nearest *C. arenophila* population and in the middle of the peninsula, not in coastal habitats.

MATERIALS AND METHODS

Field collections and photographic documentation of this large-leaved *Cryptantha* were made in April 2017, the collections serving as type material. Herbarium specimens of these and of *C. patula* were obtained and studied from the following herbaria: University of California Irvine (**IRVC**), San Diego Natural History Museum (**SD**), San Diego State University (**SDSU**), Santa Barbara Botanic Garden (**SBBG**), and the Smithsonian Institution (**US**). Additional online specimen images of related taxa were also examined from the Harvard University Herbarium (**GH**) and the California Botanic Garden (**RSA**) (acronyms after Thiers, continuously updated). A total of six specimens of *C. arenophila* (all but one known) and 16 collections of *C. patula* were measured (Appendix 1). Photomicrographs of selected parts of *C. arenophila* and of *C. patula* were taken with a Visionary Digital Imaging System using a Canon EOS 5D Mk II DSLR with an Infinity model K2 tube lens fitted with a CF-4 adapter. Three to five of the lowermost, largest leaves were measured for length and width, and the mean length, width, and length:width ratio per specimen were calculated. The corolla limb width was measured, the maximum value used because of corolla shrinkage in dried specimens. For a limited number of specimens having high resolution photomicrographs, quantification of tubercle density on the nutlet dorsal face was approximated by tabulating the number of tubercles occurring within a 0.1 mm band (whole tubercles or those >50% within the band) at the widest transverse axis of the nutlet. Nutlet tubercle size was not quantified because this feature could not be accurately measured from the images available. The software ImageJ (Scheinder et al. 2012) was used to quantify these metrics. Box plots showing the median and four quartiles of distribution were prepared of the two taxa for: 1) median leaf width (mm); 2) median leaf length:width ratio; 3) maximum (within a specimen) corolla limb diameter (mm); and 4) nutlet tubercle density. T-tests were performed to evaluate statistical differences ($\alpha = 0.05$ and $\alpha = 0.01$), using Microsoft Excel, version 16.44. A distribution map, using the mapping function of the Berkeley multi-

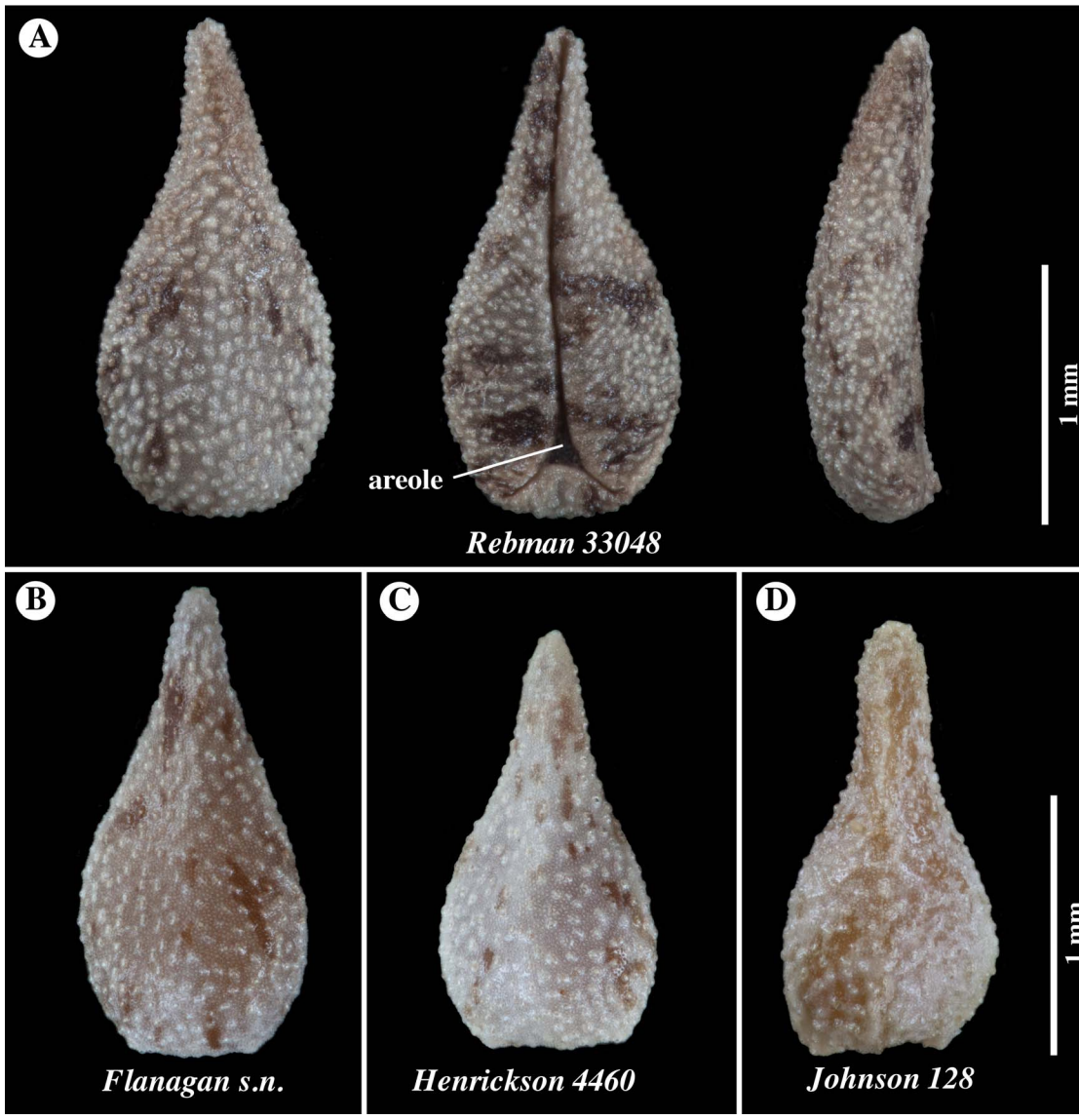

FIG. 3. Nutlet images of *Cryptantha arenophila*, showing densely papillate and low-tuberculate sculpturing. A. Type material (*Rebman 33048*) showing dorsal (left), ventral (middle), and lateral (right) views. B–D. Nutlet images of additional paratype specimens, all dorsal view: B. *Flanagan s.n.* (**SD**132560). C. *Henrickson 4460* (**SD**80913). D. *Johnson 128* (**SD**116684).

mapper tool (CCH1 2020), was prepared of all known specimens of *Cryptantha arenophila* plus specimens identified as *C. patula* from Baja Flora (2020), CCH2 (2020), and SEINet (2020).

RESULTS

The box plots and t-tests of *C. arenophila* and examined specimens identified as *C. patula* showed differences between the two taxa in median leaf width (Fig. 5A), median leaf length:width ratio (Fig. 5B), maximum corolla limb diameter (Fig. 5C), and nutlet tubercle density (Fig. 5D), all significant at $P < 0.01$. However, leaf length (boxplot not illustrated) showed considerable overlap between the two taxa, with $P > 0.05$. Measurements of type specimens ("**t**" in Fig. 5) fall within the two 25% quartiles above and below the mean in all of these features with the exception of nutlet tubercle density, in which the value of the type specimen of *C. arenophila* is in the upper quartile; this feature was unobtainable for the type of *C. patula* (Fig. 5D) because of unavailability and probable immaturity of the type material.

Qualitative observations of specimens showed that the two forms are similar in having mostly "single",

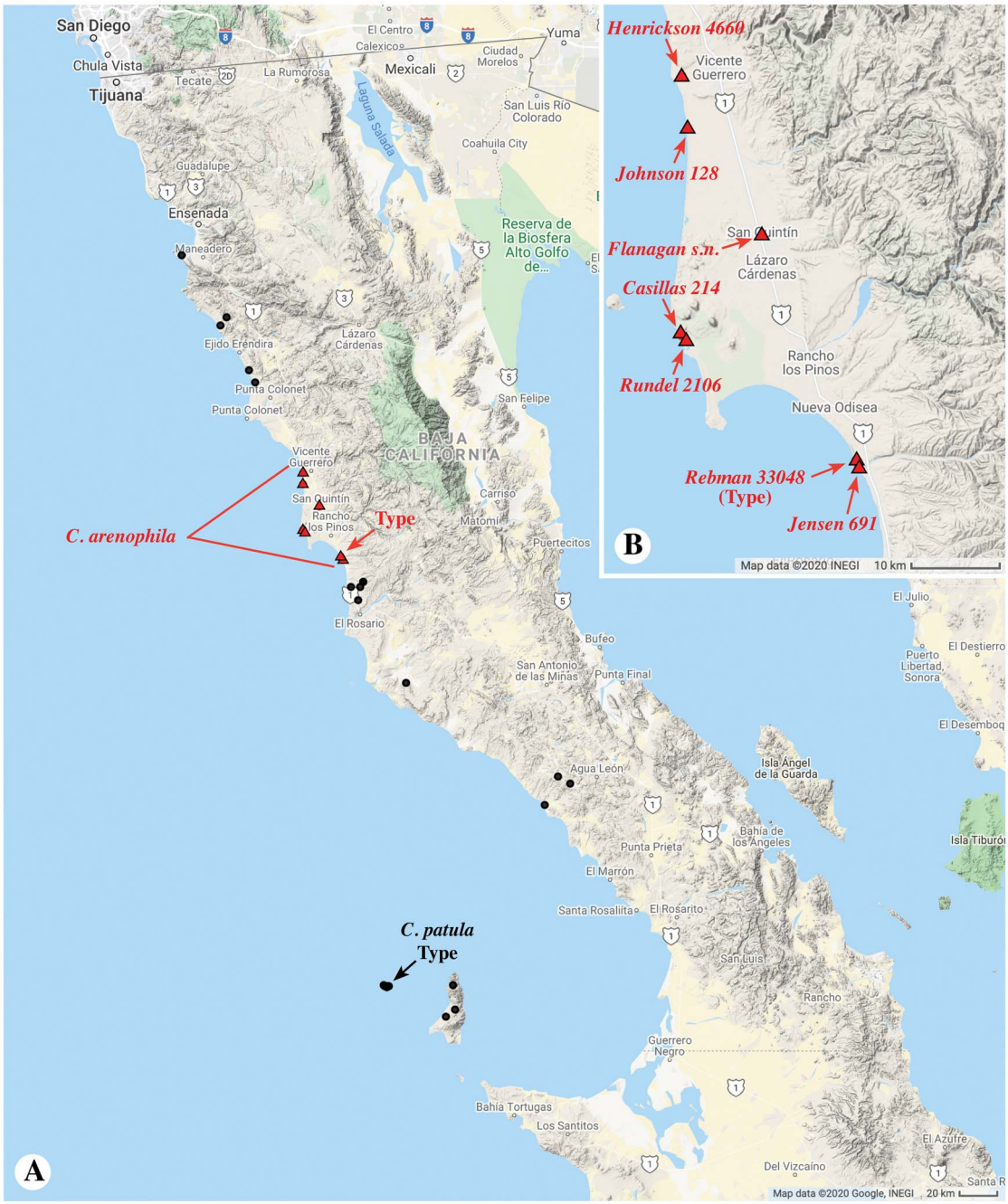

FIG. 4. Distribution of *Cryptantha arenophila* (red triangles) and specimens identified as *C. patula* s. l. (black dots), from examined and measured herbarium specimens, type localities of both species indicated; data from SEINet (2020), CCH2 (2020), and Bajaflora (2020). Inset: Magnified image of San Quintín region, showing localities of all currently known specimens of *C. arenophila*. Maps from ©Google 2020, INEGI Data.

elongate cymules, meaning that the cymules do not branch after the occurrence of basal inflorescence bracts (Figs. 1A, 6C). Our measurements of corolla limb width show that *Cryptantha arenophila* has a consistently wider maximum corolla limb width (ca. 5–6 mm limb diameter; see Fig. 1C) than *Cryptantha patula* (ca. 2.5–4 mm), quantified in Figure 5C. Nutlets of both forms were similar in being lance-ovate with a narrowly acute to acuminate apex, rounded margins, and a papillate-turberculate sculpturing (Figs. 3, 6F). However, as illustrated in Fig. 5D, nutlets of *C. arenophila* have more numerous,

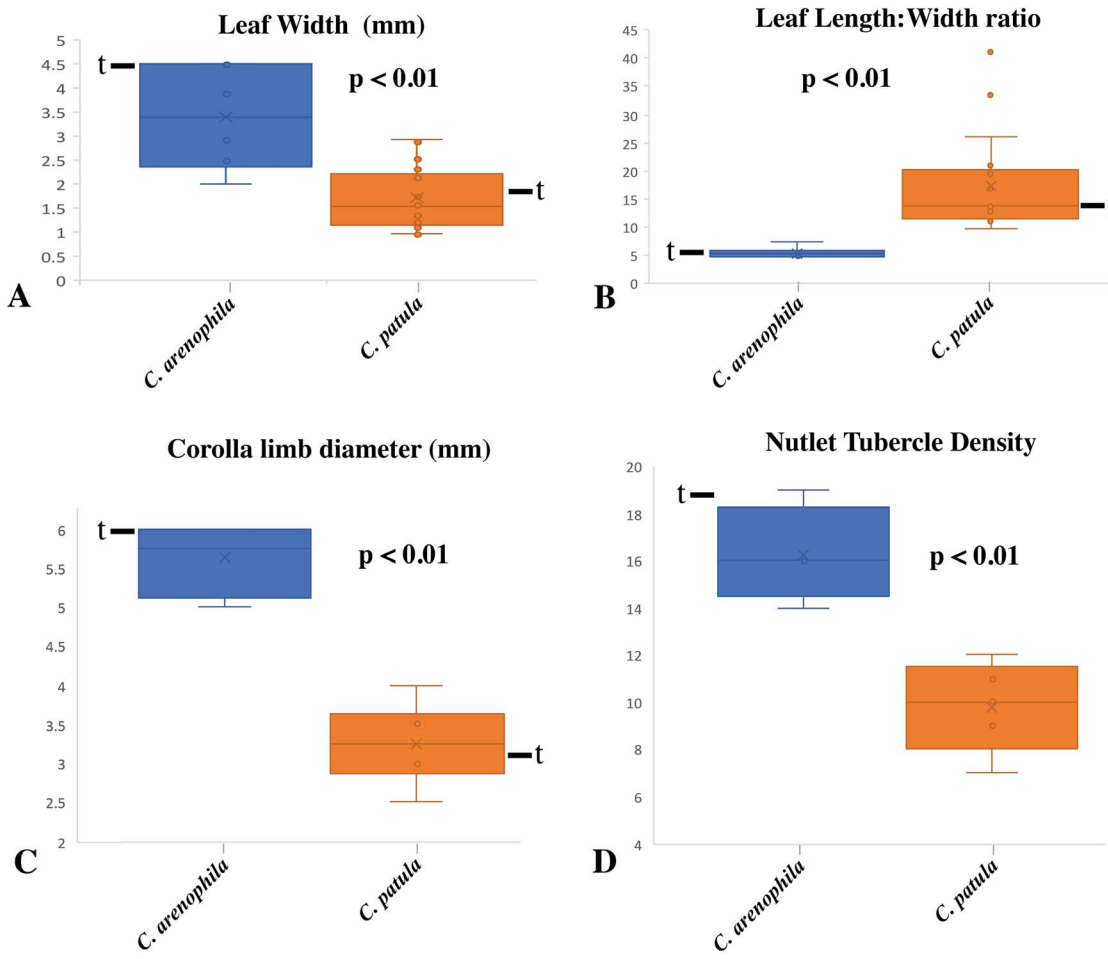

FIG. 5. Box plots comparing quantified leaf measurements of *Cryptantha arenophila* and *C. patula*. A. Leaf width (mm). B. Leaf length:width ratio. C. Maximum corolla limb diameter. D. Nutlet dorsal surface tubercle density (tubercle number within a 0.1 mm transverse band at widest point). In all cases, the two taxa are different at $P < 0.01$. Box plots show median (horizontal line), first and third quartiles (boxes above and below median), and second and fourth quartiles (vertical lines); outliers indicated by small dots. Abbreviation: **t** = values of the type specimens of the corresponding two species. Note that nutlet tubercle density was unobtainable for the type specimen of *Crypantha patula* (Fig. 5D).

smaller (shorter) tubercles (Fig. 3) than *C. patula*, which have fewer, longer, and stouter tubercles (Fig. 6F), the latter resembling those of a typical *Cryptantha intermedia* (see Amsinckiinae Working Group 2020). The relative style length of the two species was not quantified because of scarcity of specimens. However, observed specimens of *C. arenophila* have a relatively shorter style, extending to or just beyond (ca. 0.1 mm) the nutlet apices of mature fruits (Fig. 2B). Styles of *C. patula* were observed to be longer, extending to about 0.5 mm above the nutlet apices (Fig. 6D).

DISCUSSION

We chose to recognize this new entity at the species level because of its discrete leaf morphology, relatively large corolla size, distinctive nutlet sculpturing, habitat specificity, and limited geographic range. We did not consider an infraspecific rank to other *Cryptantha* taxa because its relationship to other taxa is unclear. *Cryptantha arenophila* is similar to *C. patula* in stem vestiture (both species having both appressed and spreading trichomes; Figs. 1D, 6E), calyx morphology (both species having distinct, linear, apically rounded, and heteromorphic sepals), and inflorescence morphology (both species with what are described as "solitary" cymules [also termed "spikelets" in the literature]) (Figs. 1A, 6C). As seen from quantitative leaf measurements, *Cryptantha patula* differs in having considerably narrower leaves, being linear to narrowly lanceolate (see Fig. 6A, B for image of holotype specimen of *C. patula*; note that the holotype is a rather immature specimen). In addition to leaf morphological differences, *Cryptantha arenophila* has a consistently wider corolla limb

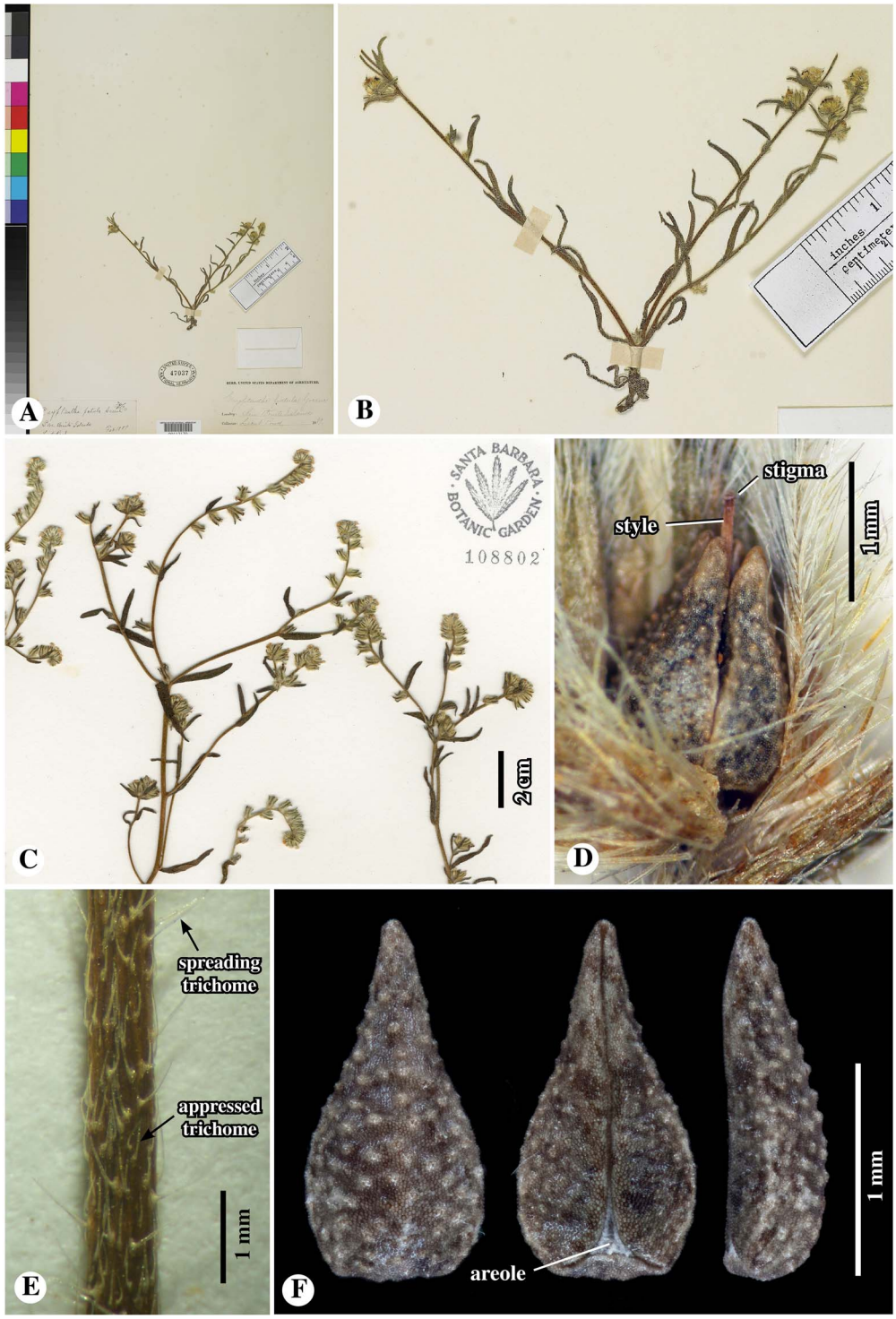

FIG. 6. *Cryptantha patula* images. A,B. Holotype specimen, *C.F. Pond 21*, Feb. 1889, Mexico: Baja California, San Benito Islands (**US**47037). Note narrow leaves, the type material somewhat immature. C–F. Exemplar of *C. patula* from San Benito Island, the type locality: *S. A. Junak 5308*, 15 March 1993 (**SBBG**108802). C. Herbarium sheet, showing elongate, linear to lanceolate leaves and bracts at base of cymules or lower flowers. D. Fruit close-up, showing relatively elongate style. E. Stem, just below cymule, showing antrorse-appressed and spreading-hirsute trichomes, similar to *C. arenophila*. F. Nutlet in dorsal, ventral, and lateral views, showing papillate-tuberculate sculpturing, with tubercles longer and less dense than *C. arenophila*.

width (5–6 mm limb diameter; Fig. 1C, 5C). In the Protologue for *Cryptantha patula* (Greene 1889), the corolla is cited as "rather large" (p. 266), with Johnston (1925) describing the corolla limb width of this species as "1.5–3 mm long" (p. 62). Our examination of several specimens of *Cryptantha patula* yielded a maximum corolla limb width range of 2.5–4 mm, confirming that it is smaller than *C. arenophila*. Finally, the differences in nutlet sculpturing, in terms of density and size of tubercles, of the two species is diagnostic.

The relatively wide leaves of *Cryptantha arenophila* may possibly be an adaptation to its occurrence in sandy dunes, the larger leaves able to withstand or resist being covered by shifting sands. However, we note the occurrence of a narrow-leaved specimen tentatively identified by us as *Cryptantha* cf. *patula* in sands at the base of the dune near the type specimen of *C. arenophila*, which indicates that the larger leaves of *C. arenophila* are not the result of environmental plasticity.

Cryptantha arenophila is much more limited in distribution than *C. patula* s. l., the latter known to occur from near Santo Tomás to the vicinity of Punta Canoas and on San Benito and Cedros Islands in Baja California (Fig. 4). *Cryptantha arenophila* is restricted to the Coastal Succulent Scrub (maritime succulent scrub) ecoregion, whereas *C. patula* occurs in that region plus the western Central Desert, Vizcaino Desert, and Pacific Islands regions (Rebman et al. 2016).

Cryptantha patula

Cryptantha patula was named and described by Greene (1889). The type specimen was not indicated by Greene. Johnston (1925) indicated one collection in his description of the species: "San Benito Island, 1897, Brandegee (**G**, **UC**)." Thus, the type of *C. patula* is thought to be (Lieut.) *C. F. Pond 21* (or *C. F. Pond, s.n.*), Feb. 1889, Mexico, Baja California, San Benito Island, holotype: **US**47037; isotypes: **GH**00096299, **GH**00273561, **NDG**01388.

What has in the past been identified as *Cryptantha patula* occurs on the mainland and on Cedros, San Benito, and San Martin islands of Baja California, Mexico (Baja Flora 2020; Fig. 4). Specimens consistently have stems with both appressed and spreading trichomes, leaves linear to lanceolate in shape, and solitary inflorescence cymules. Most specimens observed also have generally four nutlets that are lance-ovate, narrowly acute to acuminate, and have a papillate, long-tuberculate sculpturing. However, in our study of *Cryptantha patula* specimens, we note some variation in that species, as treated in the broad sense. A thorough investigation of *Cryptantha patula* is beyond the scope of this study, but we point out that this species (or complex) is worthy of a future study, both morphological and molecular.

Cryptantha quentinensis

A taxon worth mentioning is *Cryptantha quentinensis* J.F.Macbride (1918). This named species was collected at San Quintín (spelled "quentin" in the epithet), Baja California in 1889 (*Palmer 695*, holotype **GH**00096300), the general region of *C. arenophila*. Our examination of the imaged holotype specimen of this taxon confirms what others have said (e.g., Johnston 1925), that *C. quentinensis* should be treated as a synonym of *Cryptantha intermedia,* and we believe of *C. intermedia* var. *intermedia,* given its stem pubescence. Like the latter, *C. quentinensis* has mostly trifurcate cymules. Interestingly, *C. quentinensis* appears to have stem trichomes that are (from the online image) predominantly appressed-strigose in orientation, with few spreading hirsute trichomes, a vestiture that we have found in a limited number of *Cryptantha intermedia*. In any case, despite its name and type locality, we are convinced that *C. quentinensis* is neither *C. arenophila* nor *C. patula*.

Endemism and Conservation Needs

Cryptantha arenophila is endemic to sandy dune habitats in a small, mostly coastal region of northwestern Baja California and quite restricted in range (Fig. 4). We are aware of two other localized endemic species that are also concentrated in this region, *Astragalus anemophilus* Greene and *Oenothera wigginsii* W.M.Klein, with the latter also occurring sporadically in a couple of populations further south. Given their similar distribution and microhabitat selection, it is possible that these three species had a common geological origin.

The type locality of *Cryptantha arenophila* (exemplified by *Jensen 691* and *Rebman 33048*) in the high sandy dunes of Socorro just south of San Quintín, Baja California, Mexico (Fig. 4B), is currently under severe habitat degradation (Clark et al. 2008; Harper et al. 2011). The San Quintin region has extensive and continuing agricultural and urban development. The dune habitats where *C. arenophila* occurs specifically are being degraded due to unrestricted livestock (cattle and goat) grazing and off-road vehicular activity and recreation. Plus, the introduction and spread of various invasive non-native plant species, such as *Brassica tournefortii* Gouan, *Carpobrotus edulis* (L.) N.E.Br., *Mesembryanthemum crystallinum* L., and *Schismus barbatus* (L.) Thell. are negatively impacting the dune vegetation.

The *Flanagan s .n.* paratype, cited as occurring in "San Quintín", is likely extirpated. Although the other, coastal populations of *C. arenophila* may be less impacted than these, we believe the protection status of the species should be high, equivalent to that of the California Native Plant Society (CNPS 2020) Inventory ranking of 1B.1 (locally rare, threatened, or endangered).

Future Taxonomic Work

The phylogenetic placements of *Cryptantha arenophila* and *C. patula* are currently unknown, as no specimens of either have been included in molecular analyses to date (Hasenstab-Lehman and Simpson 2012; Simpson et al. 2017; Mabry and Simpson 2018). We believe that this complex of species is in need of detailed morphometric and phylogenetic studies, the latter using molecular markers showing variation at the population level. The relationships of *C. arenophila* both to *C. patula* s. l. and to the varieties of *C. intermedia* will be quite interesting to elucidate. And, as pointed out, *C. patula* shows more variation in some features (e.g., calyx pubescence and nutlet morphology) than previously realized. In fact, *Cryptantha* specimens from San Martin Island, just to the west of San Quintin, somewhat resemble *C. patula*, but exhibit a nutlet morphology closer to *C. arenophila* and are rather distinct in having linear to thread-like leaves and an erect growth habit, and may represent yet another undescribed taxon. We suspect there may be cryptic taxa (Bowdler 2010) lurking in the populations that have been lumped as *C. patula*.

Key to *Cryptantha*, including *C. arenophila*

The following key, modified from Kelley et al. (2012) and Kelley and Simpson (in press) can be used to identify *Cryptantha arenophila*, and to distinguish that species from *C. patula* s.l. and *C. intermedia* var. *intermedia*, also in Baja California. Pertinent leads are in **bold**; non-applicable leads and taxa are removed.

1. Nutlet(s) all smooth or obscurely roughened
1′ Nutlets, or at least 1, variously roughened (papillate and/or tubercled)
2. At least one nutlet with margins winged or narrow, knife-like lineate-rimmed
2′ All nutlets with margins entirely rounded or angled, not winged or lineate-rimmed
3. Nutlets of 1 fruit dissimilar in size and/or sculpturing
3′ Nutlets of 1 fruit similar in size and sculpturing
4. Pedicels 2–3 mm in fruit, long-villous; calyx with single hair type, densely white, long-villous, without coarse bristly hairs
4′ Pedicels 0–1.5(–2) mm in fruit, not villous; calyx with at least 2 hair types, at least some coarse, bristly hairs present
5. Nutlets 1(–2 or 3).
5′ Nutlets generally 4
6. Corolla inconspicuous, limb 1–2 mm
6′ Corolla conspicuous, limb 2–8 mm
7. Nutlets ovate to widely ovate/deltate (length:width ratio <2)
7′ Nutlets lance-ovate to lanceolate (length:width ratio >2)
8. Nutlet dorsal and ventral surfaces glabrous to glabrate lower half, densely tuberculate to warty upper half
8′ Nutlet dorsal surfaces tuberculate over entire surfaces
9. Stem vestiture mostly appressed, sometimes sparsely spreading soft-bristly
9′ Stem vestiture both appressed and spreading hirsute or only spreading hirsute
10. Calyx 4.5–9 mm in fruit, lobe margins tufted-spreading hairy below middle; inflorescence paired, rarely solitary or 3-numerous
10′ Calyx 4–5.5 mm in fruit, lobe margins appressed fine-hairy below middle; inflorescence solitary to 5-numerous
11′ Upper stem hairs spreading only, few to none appressed; fruiting calyx spreading to inclined relative to rachis axis
11. Upper stem hairs both appressed and spreading; fruiting calyx +/- ascending relative to rachis axis
12. At least some cymules trifurcate; nutlet tubercles relatively large, sparse; widespread in mainland of California and northwestern Baja California, Mexico ... *C. intermedia* var. *intermedia*
12′ Inflorescence cymules mostly solitary, occasionally paired or 3-merous, 1–few bracteate at base
13. Corolla limb width 2.5–4 mm; leaves linear to narrowly lanceolate, average largest, basal leaf width 1–4.2 mm, average length:width ratio 9–41; nutlet tubercles relatively large, moderately dense; northwestern and central-western Baja California, San Benito and Cedros Islands ... *Cryptantha patula* s. l.
13′ Corolla limb width 5–6 mm; leaves narrowly oblong to oblanceolate, average largest, basal leaf width 2.9–4.9 mm, average length:width ratio 4–7; nutlet tubercles small, dense; mostly sandy dunes, restricted to dunes of San Quintín and adjacent coastal areas, Baja California ... *Cryptantha arenophila*

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Appendix 1

Specimens examined for leaf width, leaf length:width ratio, and corolla limb width measurements. Specimens used for nutlet tubercle density are indicated with an asterisk. Cited are collection/collection number (italics), collection date, and herbarium accession number.

Cryptantha arenophila: *F. Casillas 214,* 30 March 2010 (**SD**267039); *P. Flanagan s.n.**, 23 April 1989 (**SD**132560); *J. Henrickson 4460**, 25 March 1970 (**SD**80913); *N. Jensen 691*, 18 March 2014 (**SD**253407); *A. Johnson 128**, 25 March 1973 (**SD**116684); *J. Rebman 33048** (**Type**), 19 April 2017 (**SD**).

Cryptantha patula: *Junak 5308**, 15 March 1993 (**SBBG**108802); *Junak 5321**, 15 March 1993 (**SBBG**108801); *Moran 17143*, 31 March 1970 (**SD**76970); *Moran 20316**, 26 March 1973 (**SD**86999); *Philbrick B73-200*, 7 March 1973 (**SBBG**46951); *Philbrick B73-200*, 7 Mar-1973 (**SD**171992); *Pond 21* (**Type**), Feb 1889 (**US**00112170); *Rebman 22664*, 19 March 2012 (**SDSU**20155); *Rebman 22736*, 20 March 2012 (**SDSU**20158); *Rebman 22889**, 21 March 2012 (**SD**222881); *Rebman 22931*, 22 March 2012 (**SDSU**20161, **SD**222885); *Rebman 22926*, 22 March 2012 (**SD**222886); *Rebman 22998*, 23 March 2012 (**SD**222887); *Rebman 25916*, 16 April 2013 (**SDSU**20438); *Rebman 25944*, 18 April 2013 (**SDSU**20398); *Riley 22*, 28 February 2012 (**SD**227956).

Not measured (rejected paratypes; taxonomy uncertain): *Henrickson 19346*, 19 March 1983 (**RSA**660863); *Moran 21837*, 21 April 1975 (**SD**91282).

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