Cryptantha wigginsii (Boraginaceae): A Presumed Extinct Species Rediscovered

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CRYPTANTHA WIGGINSII (BORAGINACEAE): A PRESUMED EXTINCT SPECIES REDISCOVERED

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ABSTRACT

Cryptantha wigginsii I.M. Johnston (Boraginaceae) had previously been known from a single collection made in April 1931, at a locality 18 miles south of Tijuana, Baja California, Mexico. This species is distinctive and unique in the genus in having nutlets with a surface that is smooth and glossy near the base and densely tuberculate at the apex. Because of the absence of subsequent collections, the species was presumed extinct. However, a population of *C. wigginsii* was recently discovered in Carlsbad, San Diego Co., California, constituting a new county, state, and country plant species record. Subsequent field investigations and study of (mis-identified) *Cryptantha* specimens at several California herbaria has turned up additional documented populations of this species in the USA and coastal northwestern Baja California, Mexico. In addition to the three adjacent Carlsbad populations and the type locality in Baja California, populations known to date include: 1) five from Santa Catalina Island, Los Angeles Co.; 2) one from Riverside Co.; and 3) three from northwestern Baja California. *Cryptantha wigginsii* is commonly found in, but apparently not restricted to, clay soil. Although additional populations may be found now that the taxon has been rediscovered, it is rare enough to warrant future listing as a sensitive and rare plant. Appropriate measures should be taken to preserve existing populations, some of which may be in danger of extirpation. The identification of vouchers of this species from existing herbarium collections highlights the need for depositories of plant collections and for their continued study by taxonomists and systematists.

Key Words: Baja California, Boraginaceae, clay, conservation, *Cryptantha*, *Cryptantha wigginsii*.

Cryptantha is a genus of annual and perennial herbs of the family Boraginaceae. The genus as traditionally defined (*Cryptantha s.l.*) consists of approximately 200 species, distributed in western North America and western South America (Hasenstab-Lehman and Simpson 2012; Simpson 2012). These taxa have been grouped together by a feature of their fruits (''nutlets''), which have a characteristic ventral (adaxial) groove running the length of the nutlet, corresponding to the point of attachment to the central gynobase. Species and infraspecies of *Cryptantha* have been distinguished in large part on the size, shape, sculpturing, and ventral groove morphology of these nutlets. In addition, plant duration, leaf position, leaf morphology, vestiture, calyx morphology, and corolla size, shape, and color can be important in diagnosis and taxon identification (Simpson and Hasenstab 2009; Kelley et al. 2012).

Based on a recent molecular phylogenetic study (Hasenstab-Lehman and Simpson 2012), *Cryptantha s.l.* has been split into five genera: *Eremocarya* (one species), *Greeneocharis* (two species), *Johnstonella* (13 species), *Oreocarya* (ca. 62 species), and a reduced *Cryptantha* s.s. (ca. 120 species). These five genera can be distinguished from one another morphologically (see key in Hasenstab-Lehman and Simpson 2012).

Cryptantha wigginsii I.M. Johnston 1939, a species in *Cryptantha s.s.* of Hasenstab-Lehman and Simpson (2012), was originally described from a 1931 collection made in northwestern Baja California, Mexico by Ira L. Wiggins (*Wiggins 5107*, 2 April 1931; see Table 1). Wiggins cited the

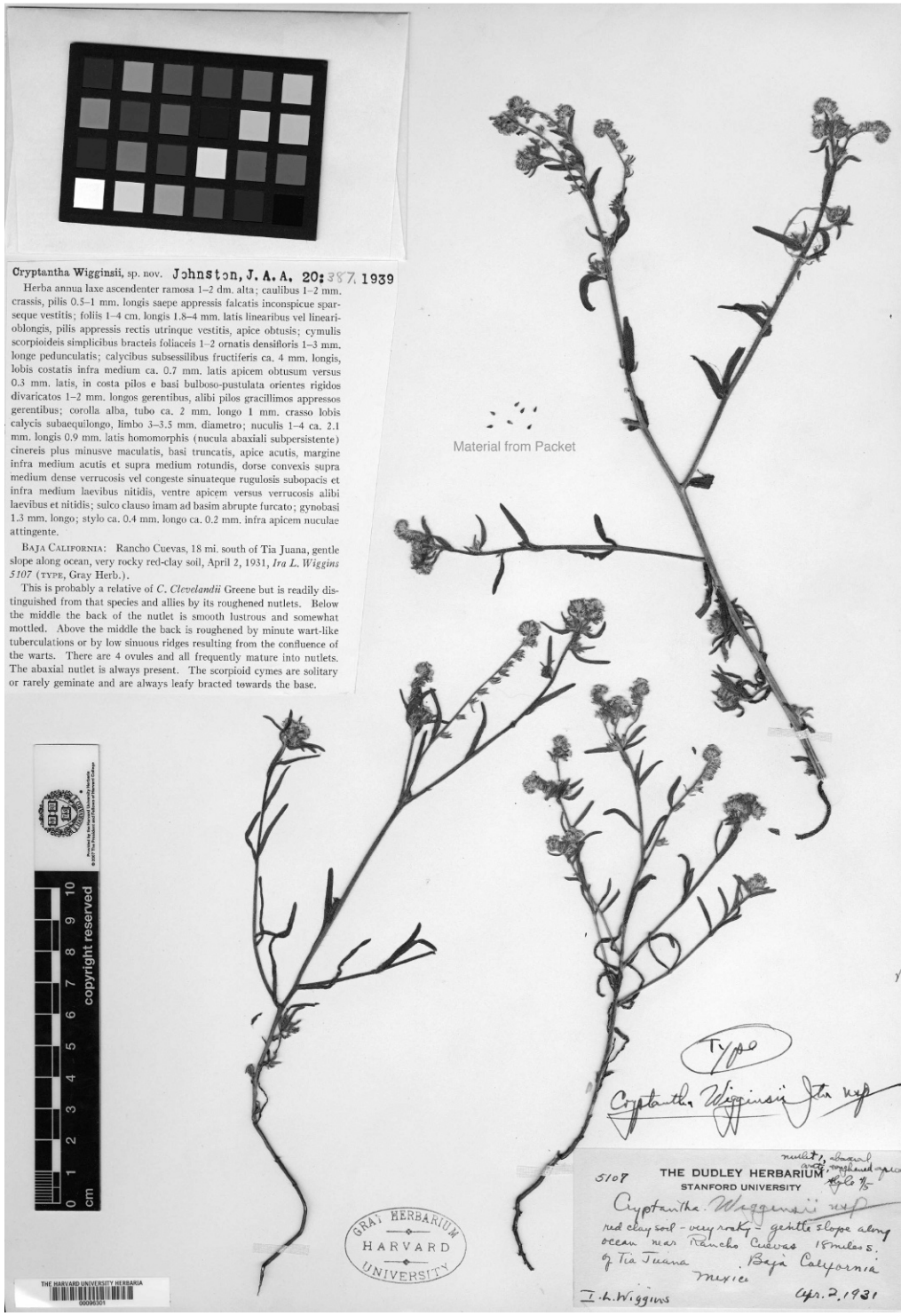

FIG. 1. Scan of holotype specimen of *Cryptantha wigginsii, Wiggins 5107* (GH 00096301).

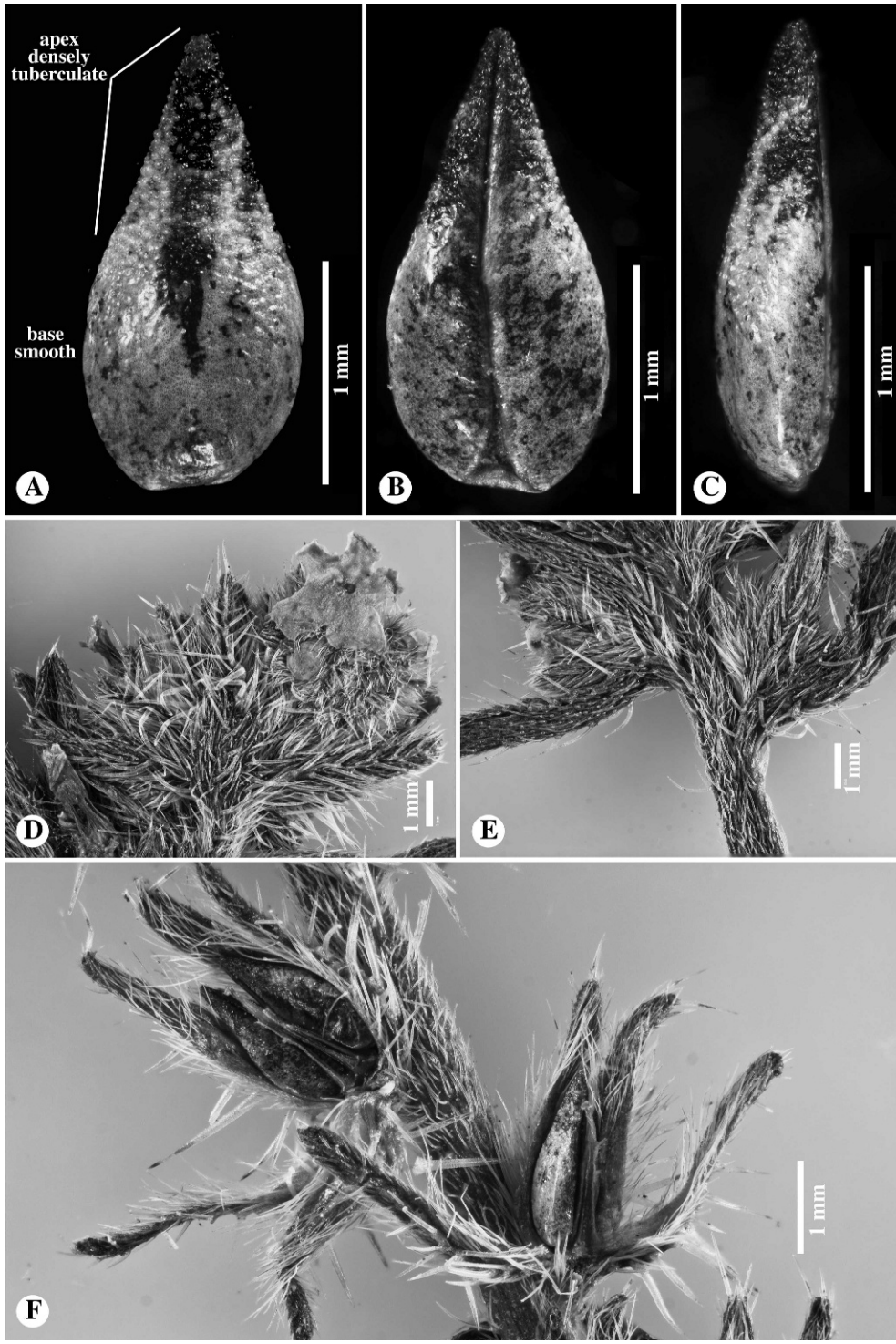

FIG. 2. Images of components of *Cryptantha wigginsii* holotype specimen (GH 00096301). A–C. Nutlets, in dorsal, ventral, and lateral views (left to right). D–E. Inflorescence units, showing open corolla (D) and stem and calyx vestiture (E). F. Fruits, showing calyx and nutlets attached to gynobase.

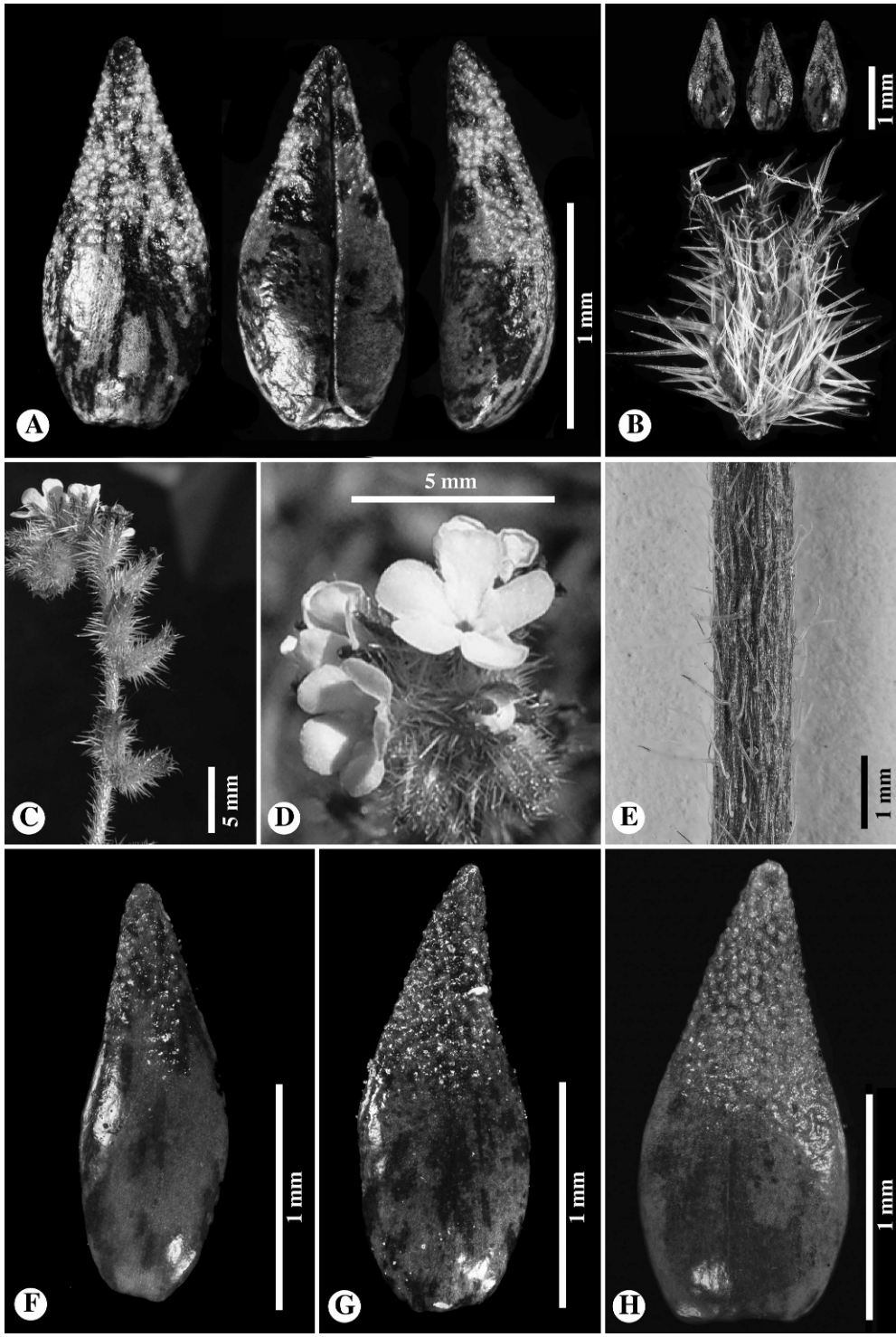

FIG. 3. *Cryptantha wigginsii* from mainland USA. A–G. Carlsbad, San Diego Co. A, B. *McConnell s.n.* (SDSU 19477) voucher. A. Nutlet, in dorsal, ventral, and lateral views (left to right). B. Fruit, with calyx (below) and three nutlets removed (above). C–F. *Simpson 3674* (SDSU 20063) voucher. C. Inflorescence unit, a circinate scorpioid cyme. D. Flowers, with showy, white corollas, the limb up to 5 mm in diameter. E. Close-up of stem below inflorescence unit, showing antrorsely appressed and spreading trichomes. F. Nutlet, dorsal view. G. *Simpson 3675* (SDSU 20019) voucher, nutlet dorsal view. H. Riverside County population. *Boyd 1979* (RSA 407732) voucher, nutlet dorsal view.

TABLE 1. LOCALITY, COLLECTOR, GEO-REFERENCE DATA, ACCESSION NUMBERS, AND COMMUNITY/SUBSTRATE FOR ALL KNOWN POPULATIONS OF *CRYPTANTHA WIGGINSII,* ARRANGED CHRONOLOGICALLY BY COLLECTION DATE. All latitude/longitude data, except that estimated from herbarium label locality information, were obtained from topographic maps or GPS devices (databases various). All specimens, except the type collections, were originally identified as other species of *Cryptantha*. Symbols: [T] = type collection; [H] = holotype; [I] = isotypes; * = latitude/longitude estimated from locality information on herbarium label; ** = *Cryptantha* aff. *wigginsii*.

Population and locality	Collector, collection date	Latitude/longitude (elevation)	Accession no(s).	Community/ substrate
Near Rancho Cuevas, 18 mi S of Tijuana, Baja California, MEXICO	*Wiggins 5107*[T], 2 Apr 1931	32.27/-117.02* (6 m)	GH 00096301[H], RSA 0008263[I], US 00118523[I]	red clay soil, very rocky, gentle slope along ocean
Santa Catalina Island: between Cherry Valley and Howland's Landing, Los Angeles Co., CA, USA	*Fosberg 4934*, 21 May 1931	33.4567/-118.5157* (20 m)	POM 368370	steep slope, facing ocean, upper Sonoran Zone
Santa Catalina Island: Cottonwood Canyon, Los Angeles Co., CA, USA	*Thorne 35850*, 5 Apr 1966	33.3884/-118.4434* (172 m)	SD 69480	rocky, dry, S-facing slope above stream
Santa Catalina Island: N of Marine Science Station at Fisherman's Cove, elev. ca. 150 ft, Los Angeles Co., CA, USA.	*Thorne 42470*, 12 Feb 1973	33.4458/-118.4822* (46 m)	RSA 353854	bare, clayey openings in coastal sage scrub
Punta Mezquite, 1 km S of Medio Camino, Baja California, MEXICO	*Moran 30019*, 13 Mar 1982	32.167/-116.9 (40 m)	SD 110406	common in grassy, cleared area in adobe soil
Southwestern Perris Basin: Hill W of Skunk Hollow, Riverside Co., CA, USA	*Boyd 1979*, 1 May 1986	33.5588/-117.1088* (274 m)	RSA 407732	gabbro substrate; Skunk Hollow vernal pool with silty clay
Ca. 0.1 mi E from Mexican Hwy 1 along dirt road to Ejido Benito Juarez, ca. 1.5 mi S of Colonet, Baja California, MEXICO	*Marsden 20III92B*, 20 Mar 1992	31.0479/-116.2025* (91 m)	SDSU 5460	closed mixed coastal succulent scrub/ open sandy soil
Carlsbad: open space between housing, just W of Hidden Canyon Community Park, ca. 0.5 mi S of Hwy 78, 0.1 mi SW of Vancouver St., San Diego Co., CA, USA	*McConnell s.n.*, 7 May 2010 *McConnell 170*, 1 Jun 2010 *McConnell s.n.*, 11 Mar 2011 *Simpson 3673,* 18 Apr 2012	33.17330/-117.31621 (58 m) 33.173/-117.316 (58 m) 33.17330/-117.31621 (58 m) 33.17329/-117.31615 (71 m)	SD 208177, SDSU 19477 SD 214896 SD 214622, SDSU 19479 SDSU 20062	opening of coastal sage scrub/heavy clay soil
Mesa N of Colonet Mesa, approx. 6 km N of main N-S trending access road at the northern end of Colonet Mesa, and 4 km N of Johnson Ranch. Along a narrow, NW-SE trending dirt road, Baja California, MEXICO	*Guilliams 1796,* 21 Mar 2012	31.14161/-116.28507 (109 m)	SDSU 20081, SD 222116, UC 1999566	plant along upper margin of clayey vernal pool in matrix of maritime succulent scrub
NE Carlsbad, Calavera Hills, Roberston Ranch Preserve, Village X parcel, accessed from dirt road running S-SW from Basin Rd., San Diego Co., CA, USA	*Simpson 3674*, 18 Apr 2012	33.15985/-117.29615 (46 m)	SDSU 20063	opening of coastal sage scrub/ brownish-red, rocky clay soil

TABLE 1. CONTINUED.

Population and locality	Collector, collection date	Latitude/longitude (elevation)	Accession no(s).	Community/ substrate
Carlsbad open space, ca. 75 m N of College Ave., nearby Crossings golf course, adjacent to undeveloped pad, San Diego Co., CA, USA	*Simpson 3675*, 18 Apr 2012	33.13006/-117.29552 (74 m)	SDSU 20019, SD 222118, UC 1999563	opening of coastal sage scrub/gray-brown, sandy/ gravelly diablo clay
Santa Catalina Island: W-facing road cut, on road between Cherry Cove and Howland's Landing, Los Angeles Co., CA, USA	*Simpson 3682***, 21 Apr 2012	33.45508/-118.51696 (51 m)	SDSU 20031, 20032, UC 1999565	coastal sage scrub/ rocky, tan, silty soil
	*Clohessy s.n.***, 27 May 2012	33.45508/-118.51696 (51 m)	SDSU 20082, SD 222117	
Santa Catalina Island: road cut on N side of St. Catherine Way Rd., ca. 0.25 mi along road S of entrance to Hamilton Cove Villa, Los Angeles Co., CA, USA	*Simpson 3684*, 22 Apr 2012	33.35123/-118.33192 (55 m)	SDSU 20033, UC 1999564	coastal sage scrub/ rocky granite rock, S-facing road cut; gravelly, brown, silty-sand soil

locality as "18 mi. south of Tia Juana, gentle slope along ocean, very rocky, red-clay soil." The holotype specimen resides at the Gray Herbarium (GH 00096301; Fig. 1), with known isotypes at the herbaria of Rancho Santa Ana Botanic Garden (RSA 0008263) and the Smithsonian Institute (US 00118523). In the protologue publication of *Cryptantha wigginsii*, Johnston (1939) noted:

> This is probably a relative of *C. clevelandii* Greene but is readily distinguished from that species and allies by its roughened nutlets. Below the middle the back of the nutlet is smooth lustrous and somewhat mottled. Above the middle the back is roughened by minute wart-like tuberculations or by low sinuous ridges resulting from the confluence of the warts. There are 4 ovules and all frequently mature into nutlets. The abaxial nutlet is always present. The scorpioid cymes are solitary or rarely geminate and are always leafy bracted towards the base.

Johnston described the nutlet number as varying from 1–4, nutlet length as "ca. 2.1 mm long." He described the stem vestiture as sparse, appressed, falcate, and inconspicuous, and corollas with a limb diameter of 3–3.5 mm. (Fig. 2 shows details of the inflorescence, flowers, and nutlets of the *C. wigginsii* holotype.) We note that *C. clevelandii* Greene (with two varieties: var. *clevelandii* and var. *florosa* I.M. Johnston), which appears to be the closest relative to *C. wigginsii*, differs in having nutlets that are smooth and glossy throughout, lacking any tuberculations. From our qualitative observations, *C. wigginsii* appears to resemble *C. clevelandii* var. *c.* in stem pubescence, having both appressed and spreading trichomes, whereas *C. clevelandii* var. *florosa* has predominantly spreading trichomes. On the other hand, *C. wigginsii* resembles *C. clevelandii* var. *florosa* in having a larger corolla limb width, a more inclined calyx, and a greater nutlet number [the last described as "1–4" in *C. wigginsii* (Johnston 1939)], "(1–2)3–4" in *C. clevelandii* var. *florosa,* and "1–2" in *C. clevelandii* var. *clevelandii* (Kelley et al. 2012).

Wiggins (1980), in his *Flora of Baja California*, lists *C. wigginsii* in the key to *Cryptantha* taxa, indicating that the species occurs on "coastal slopes between Tijuana and Ensenada; endemic to B.C." But aside from the original 1931 type collection, there were no known specimens of *Cryptantha wigginsii* (BajaFlora 2011; CCH 2011; Kartesz 2011; SEINet 2011), and this taxon had been presumed extinct. However, specimens collected at a single site in Carlsbad, San Diego Co., California (*McConnell s.n.*, 7 May 2010 (SD, SDSU); *McConnell 170,* 1 Jun 2010 (SD); *McConnell s.n.*, 11 Mar 2011 (SD, SDSU) were subsequently identified as *Cryptantha wigginsii* (Fig. 3A, B; Table 1). These constituted a new county, state, and national record for this taxon. These plants fit the holotype specimen and Johnston's (1939) description. Subsequent field surveys documented two other populations in the Carlsbad region (Fig. 3C–G; Table 1), resembling the first population in all respects. However, the corolla of these and other populations was observed to be up to 5 mm when measured in the field (e.g., Fig. 3D), larger than what Johnston reported. It should be noted that corollas of *Cryptantha* may shrink significantly upon drying, and Johnston's description was based on dried herbarium material.

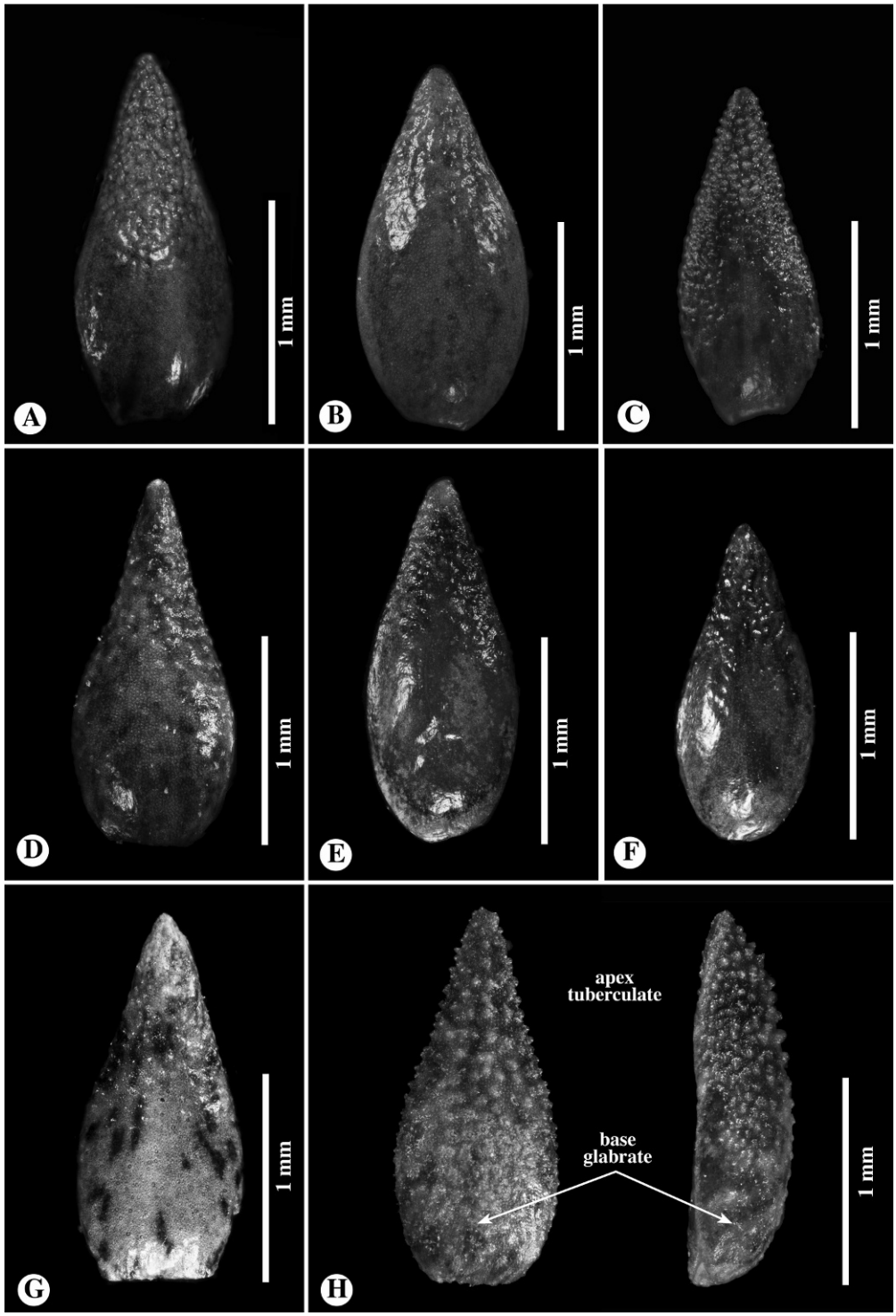

FIG. 4. A–G. *Cryptantha wigginsii.* A–C. Nutlets, dorsal view, from additional populations in Baja California, Mexico. A. *Marsden 20III92B* (SDSU 5460) voucher. B. *Moran 30019* (SD 110406) voucher. C. *Guilliams 1796* (UC 1999566) voucher. D–G. Nutlets, dorsal view, from sites on Santa Catalina Island, Los Angeles Co. D. *Fosberg 4934* (POM 368370) voucher. E. *Thorne 35850* (SD 69480) voucher. F. *Thorne 42470* (RSA 353854) voucher. G. *Simpson 3684* (SDSU 20033) voucher. H. *Cryptantha* aff. *wigginsii, Simpson 3682* (SDSU 20031) voucher, nutlet, dorsal view. Note more numerous, but less dense, tubercles extending to near nutlet base, base becoming glabrate.

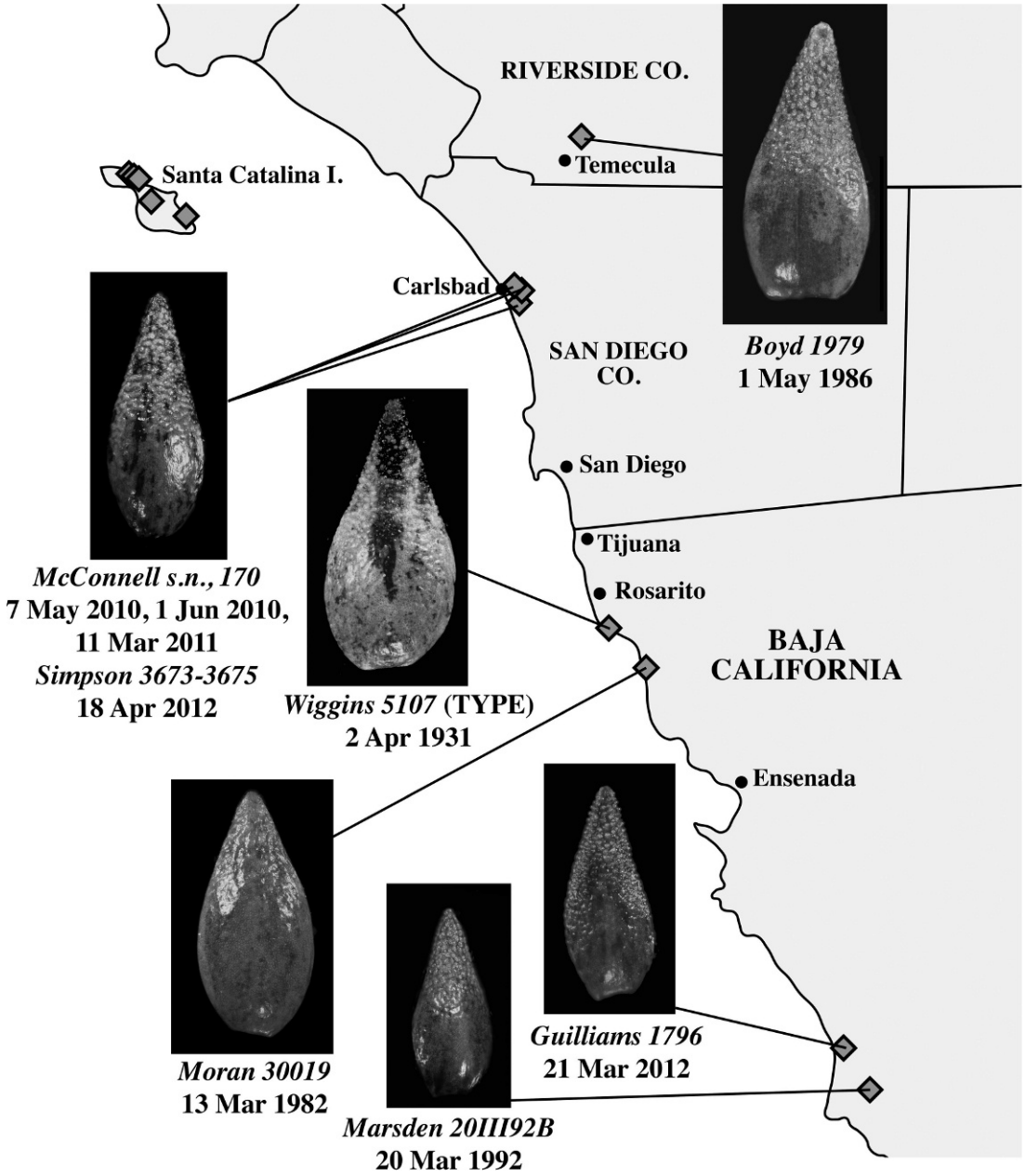

FIG. 5. Distribution map of *Cryptantha wigginsii* on mainland, with nutlet images shown to scale.

A search of specimens at RSA-POM, SD, SDSU, and UC-JEPS revealed six additional populations of this species (Figs. 3H, 4A, B, D–F; Table 1), all of which had previously been identified as other *Cryptantha* species, usually as *C. clevelandii*. In addition, recent field surveys have documented one additional population in northwestern Baja California (Fig. 4C) and two on Santa Catalina Island (Fig. 4G, H; Table 1). These additional collections have expanded the known range of *C. wigginsii* to include a total of four populations (including the type locality) in northwestern Baja California, one in Riverside Co., five on Santa Catalina Island, Los Angeles Co., and the three, adjacent populations in Carlsbad, San Diego Co.

An examination of fruit morphology of these specimens reveals some variation in nutlet size, coloration, and (most importantly) sculpturing of the known populations of *C. wigginsii.* Nutlets of the mainland San Diego Co. (Fig. 3A–G) and Riverside Co. (Fig. 3H) populations and of the two southernmost populations in northwestern

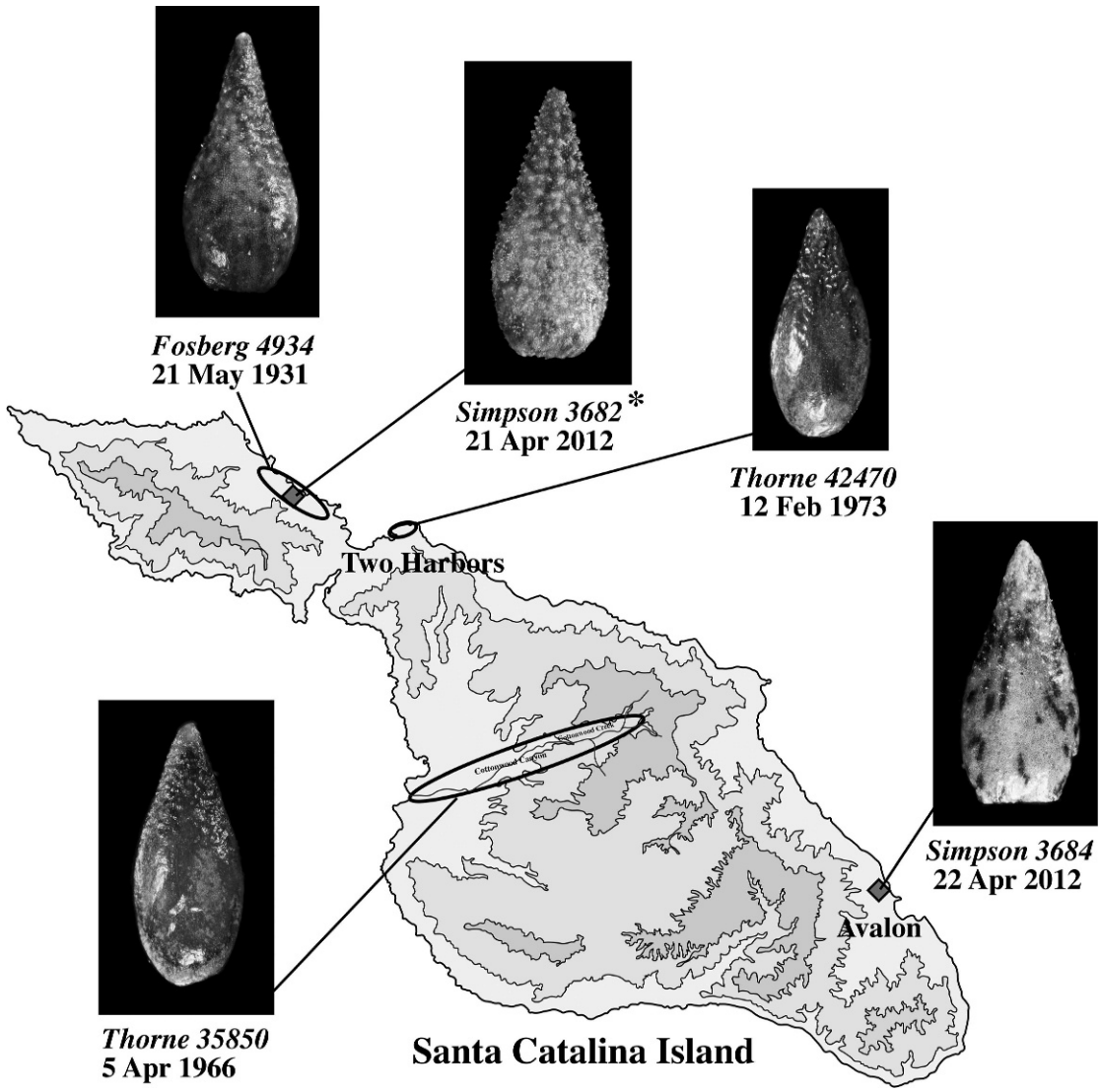

FIG. 6. Distribution map of *Cryptantha wigginsii* and *C.* aff. *wigginsii* (*) on Santa Catalina Island, with nutlet images shown to scale. Isoclines delimit elvations of 0–200 m (light gray), 200–400 m (medium gray), and 400–600 m (dark gray).

Baja California (Fig. 4A, C) have the characteristic sculpturing pattern of the type specimen (Fig. 2A–C), being smooth and glossy in the lower half and densely tuberculate in the upper half, on both dorsal (abaxial) and ventral (adaxial) surfaces. Nutlets of the other population of coastal, northwestern Baja California (Fig. 4B) are less densely tuberculate in the apical region. Those of four of the five Santa Catalina Island, Los Angeles Co. vouchers (Fig. 4D–G) are also less densely tuberculate than the type material, but otherwise appear to belong to this species. However, one recent collection (*Simpson 3682*, SDSU), found in the same general region as a 1931 collection (*Fosberg 4934*, POM), is quite different in having nutlets with numerous, but much less dense, tubercles extending to the base, with the extreme basal region glabrate (Fig. 4H). This specimen also has a slightly larger calyx, 4–5 mm long, as opposed to 3–4 mm long in typical *C. wigginsii*. This collection, which is in all other respects like typical *C. wigginsii* and fits no other known species in the genus, we refer to here as *C.* aff. *wigginsii*. Further investigations will be needed to determine if this should be treated as a separate taxon.

Distribution maps (Figs. 5, 6) show that almost all populations of *C. wigginsii* are near

the coast, with the exception of the Riverside Co. voucher. The substrate for five of the nine known populations of *C. wigginsii* is a clay soil, described as ''red clay soil, very rocky,'' ''gabbro substrate,'' ''heavy clay soil,'' ''heavy crumbly clay soil,'' ''dark gray sandy diablo clay,'' ''brownish-red rocky clay soil,'' ''gray-brown sandy/gravelly diablo clay,'' ''bare, clayey openings,'' ''upper margin of clayey vernal pool,'' or ''adobe soil.'' The substrates of other populations are described as ''rocky, dry,'' ''silt,'' ''silty sand,'' ''rocky, tan, silty soil,'' or ''gravelly, brown silty-sand soil.'' Two collections lack substrate descriptions. Thus, a common substrate appears to be clay, suggesting that *C. wigginsii* may preferentially grow on clay, but other substrate types occur. The surrounding community type for *C. wigginsii*, where documented, is a ''closed mixed coastal succulent scrub community,'' ''maritime succulent scrub,'' or ''coastal sage scrub or opening of coastal sage scrub.'' Elevation ranges from 6–274 m (20–900 ft); Table 1.

Cryptantha wigginsii can be readily distinguished from other members of the genus. In recent keys to California taxa of *Cryptantha s.l.* (e.g., Simpson and Hasenstab 2009; Kelley et al. 2012), *C. wigginsii* would correspond to the group with ebracteate flowers and nutlets (at least one) that are rough, homomorphic, and with rounded margins. *Cryptantha wigginsii* is distinctive and unique within this group in having nutlets that are basally smooth and apically tuberculate, generally densely so. The rediscovered species requires an addition to the key of the *Cryptantha s.l.* of California of Kelley et al. (2012) as follows (abbreviated with addition in bold):

1. Bracts present; generally annual, generally wider than tall, often rounded to cushion-like; root generally red-purple, staining
1′ Bracts generally 0; annual or perennial herb, generally taller than wide (rounded or cushion-like); root generally not red-purple
7. Biennial to perennial herb; leaves generally basal or tufted; nutlet wide-rounded to obtuse at tip; tip of attachment scar groove well below nutlet tip
7′ Generally annual; leaves generally cauline; nutlet narrow-acute to acuminate at tip; tip of attachment scar groove ± to nutlet tip
23. Nutlets ± smooth
23′ Nutlets, or at least 1, rough
46. At least 1 nutlet with all or part of margin a ± flat rim (occasionally seeming sharp-angled) or wing
46′ All nutlets with margin rounded or sharp-angled, not a ± flat rim or wing
55. Nutlets 2–4, dissimilar in 1 fruit, 1 more persistent, >other(s), of similar textures or not
55′ Nutlets 1–4, generally of similar persistence, size, texture
Nutlets basally smooth, apically tuberculate. . . . . ***C. wigginsii***
Nutlet sculpturing uniform at base and apex

Given that collections of *C. wigginsii* are known to date from only 13 populations (Table 1; Figs. 5, 6), despite our search in major California herbaria, we conclude that this taxon is rare. An attempt in April 2012 to find the species on Santa Catalina Island was successful in only one of the three localities known from vouchers (this population is the morphologically different *C.* aff. *wigginsii*, cited earlier), and one new population was located (Fig. 6). An attempt, also in April 2012, to re-locate the species in the area known from a voucher in Riverside Co. was unsuccessful, although it should be pointed out this was a relatively dry year. With regard to current protection, all Carlsbad populations are under management (Contract and Conservation Easement) by the Center for Natural Lands Management (CNLM) and can therefore be considered protected. However, two of the Carlsbad populations straddle developed edge, and therefore risk extirpation from fuel-clearance activities, over-irrigation/seepage, landscape dumping, and erosion, and will therefore require regular visitation in perpetuity (McConnell personal observation). The Riverside Co. population (''Southwestern Perris Basin: Hill W of Skunk Hollow,'' in an unincorporated area north of Temecula called French Valley) is on land owned and managed by CNLM and is protected in perpetuity under a Conservation Easement. Threats to the Riverside Co. population are unlikely, but can only be assessed when and if individuals of the population are relocated. The three known populations at Santa Catalina Island are most likely protected, given they are within the land holdings of the Catalina Island Conservancy (2012). The conservation status of the Baja California populations of *C. wigginsii* is unknown. However, the two known populations near Colonet are potentially in danger, given the proposal by the Mexican government for the construction of a massive port nearby (Clark et al. 2008; Harper et al. 2011).

Additional populations of *C. wigginsii* may yet be discovered in Mexico and the United States, especially given the now heightened awareness of this taxon. However, we feel that the rarity of this species justifies listing in the California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants (2012), a process underway. Subject to further field studies in the near future, *C. wigginsii* may warrant listing at the California state and/or federal level. Appropriate measures should be taken to preserve existing populations

of this species. It is hoped that future studies will also evaluate the morphological variation, phylogenetic relationships, and specificity of this taxon to a clay substrate.

Lastly, this discovery highlights the need for active collection of plant specimens, their storage and maintenance in herbaria, and their continued study by scientific experts. Half of the discovered populations of *C. wigginsii* were identified from specimens in existing herbarium collections, having been mistaken as other species. This constitutes yet another example of the "thousands of plant species undiscovered in cupboards" (Bowdler 2010).

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