



An addition to genus *Hechtia* (Hechtioideae; Bromeliaceae) from Jalisco, Mexico

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Abstract

A new species of *Hechtia* (Bromeliaceae, Hechtioideae) from the Mexican State of Jalisco and the physiogeographical province of the Pacific Lowlands, *H. santanae*, is proposed as new herein. A description is provided, based on male and female plants, including fruits. Specimens of the new species had been identified previously as *H. laevis* L. B. Smith, a species native of the neighboring state of Colima. Photographs showing diagnostic characters and details of the habitat, and an assessment of the conservation status of the new taxon, based upon the B criteria of the IUCN, are also included.

Key words: Endemic, gypsum, *Hechtia*, IUCN

Introduction

Espejo *et al.* (2004) reported 10 genera and 72 species of Bromeliaceae from the Mexican State of Jalisco, with only 11 species (15%) wholly restricted to the state, based on herbarium records representing 60% of the state municipalities (76/124). These figures placed Jalisco as the fifth most diverse Mexican State for Bromeliaceae after Oaxaca, Chiapas, Veracruz, and Guerrero. The most recent list of vascular flora of Jalisco (Ramírez-Delgado *et al.*, 2010), includes 98 species of Bromeliaceae (including one hybrid). However, our current estimate of the actual number of species after eliminating cultivated species and synonyms from that list, come to a total number of 89 species, including *Hechtia santanae* I. Ramírez & P. Carrillo, *sp. nov.*, described herein. This number places Jalisco and Guerrero together in a fourth position as far as bromeliad diversity of Mexico is concerned (*sensu* Espejo *et al.*, 2004).

Ramírez Morillo *et al.* (2014) stated that *Hechtia* Klotzsch (1835: 401) includes ca. 70 accepted species out of 89 published binomials. In the same publication, three more species were described: *Hechtia flexilifolia* I. Ramírez & Carnevali (2014: 116), *H. huamelulaensis* I. Ramírez & Carnevali (2014: 119), and *H. nivea* I. Ramírez & Carnevali (2014: 122). Four more species were described thereafter: *Hechtia purhepecha* I. García, Espejo & López-Ferr. (2014:10), *Hechtia montis-frigidi* Gonz.-Rocha, Espejo, López-Ferr. & Cerros (2014:46), *H. rubicunda* López-Ferr. & Espejo (2014:154), and *H. deceptrix* I. Ramírez & Hornung (2015: 158), for a total of 78 accepted species in the genus, again, considering the one described herein. Of these 78 species, five are endemic to Jalisco: *H. iltisii* Burt-Utley & Utley (1993: 222) from vicinity of La Huerta; *H. jaliscana* Smith (1964: 482) from the vicinity of Tequila, *H. pedicellata* S. Watson (1891: 155) from the surroundings of the city of Guadalajara, and *Hechtia santanae* I. Ramírez & P. Carrillo, *sp. nov.*, described herein. A fourth species, *Hechtia reticulata* Smith (1937: 17) described from Colima, has also been reported for Jalisco and the neighboring states of Guerrero and Michoacán (Espejo *et al.* 2004).

McVaugh (1989) reported two additional species of *Hechtia* for the state of Jalisco. One was *H. subalata* Smith (1937: 15), the holotype of which (*J. N. Rose 3467*, US [302444]!), previously known only from the state of Durango, consists solely of an infructescence bearing young, non-dehiscent fruits; the other was *H. podantha* Mez (1896: 549), native of the states of Aguascalientes, Guanajuato, Hidalgo, and Queretaro, for which Espejo *et al.* (2010) proposed a neotype (*C. G. Pringle 6932*, ENCB; isoneotypes at 15 different herbaria, some with more than one replicate). We examined several collections of the neotype cited in Espejo *et al.* (2010), and additional ones reported herein (B

100202857!, GH!, MEXU 8673!, MEXU 154994!, NY!, P!, PH 01085633!, S 1430452!, UC117173!, US334787!, US934713!, US958296!), all consisting of a leaf and pistillate and staminate inflorescences.

McVaugh (1989) based his report of *H. subalata* on *C. Chávez Reyes # D.I.6.9.(A)* (IBUG!), which L. Smith had identified in 1987. When comparing Chávez Reyes's specimen, bearing a leaf (without sheath) and a fragment of an infructescence bearing dehiscent fruits, with the holotype of *H. subalata*, it is evident that the former has a much laxer inflorescence. It should be emphasized that the infructescence branches of *Hechtia* become denser as fruits develop and mature, strongly suggesting that the specimen collected by Chávez Reyes is not referable to *H. subalata* and that the report of this species in Jalisco presently is untenable.

McVaugh's report of *Hechtia podantha* (1989) was based on *J. B. Zabaleta 7*, which consists of four sheets, two of them [US2521051 and US2521052] bearing leaves (a few with sheaths), and the remaining two [US2521050 and US 2521049] each with an infructescence bearing young fruits. A comparison of Zabaleta's specimen to replicates of *Pringle 6932* shows that inflorescence branches in Pringle's collection are shorter, denser, and subtended by a primary bract that is wide and long, longer than the apical branches of the inflorescence, whereas in Zabaleta's the inflorescence branches are long and lax, subtended by a primary bract that although conspicuous, is narrower and shorter than the apical branches.

Regarding these two reports of *Hechtia* species for the state of Jalisco (*i.e.*, *Chávez Reyes # D.I.6.9 (A)* and *Zabaleta 7*), we hypothesize that the cited collections actually represent new species, but more field work and/or more specimens of both sexes are needed to definitively ascertain their identity.

Materials and methods

Complete material of the new species (live plants as well as herbarium specimens) were cross-examined against 16 species described or reported from Jalisco and relevant neighboring states (Aguascalientes, Colima, Guanajuato, Michoacán, Nayarit, and Zacatecas), these are: *Hechtia elliptica* Smith (1937: 20), *H. glauca* Burt-Utley & Utley (1993: 220), *H. hintoniana* Burt-Utley, Utley & García-Mend. (2011: 2), *H. iltisii*, *H. jaliscana*, *H. laevis* Smith (1964: 482), *H. laxissima* Smith (1954: 521), *H. mapimiana* López-Ferr. & Espejo (2013: 90), *H. michoacana* Burt-Utley, Utley & García-Mend. (2011: 5), *H. pedicellata*, *H. podantha*, *H. pretiosa* Espejo & López-Ferr. (2008: 50), *H. purhepecha*, *H. reflexa* Smith (1937:18), *H. reticulata*, and *H. subalata*. A careful revision of protologues, type material (whenever available) or high resolution images thereof were analyzed during the course of this study to assess the status of the novelty proposed herein. The type locality of the new species was visited in order to document and understand the population variation in several taxonomically informative features. In particular, quantitative characters (size of rosettes, number of rosettes per colony, growth pattern, inflorescence length, and branch number) were carefully examined. Photographs of flowering plants *in situ* are included here to facilitate the identification of the new species. A complete morphological description is also provided; it was compiled using information from herbarium material, live rosettes, as well as fresh flowers and fruits.

An assessment of conservation based on IUCN criteria (2012) is also presented herein. The conservation status of *Hechtia santanae* was assessed using the IUCN Red List Criteria (IUCN 2012). Because population data of the species are restricted to few localities, we relied mostly on the B criteria, geographical distribution assessed both as B1 (extent of occurrence) or B2 (area of occupancy), both as implemented in GeoCAT (Bachman *et al.*, 2011).

Taxonomy

Hechtia santanae I. Ramírez & P. Carrillo, *sp. nov.* (Figs. 1–4, Table 1)

The new species is similar to *H. laevis* L. B. Smith, a species native of the neighboring state of Colima, from which it differs in its rhizomatose habit (*vs.* no discernable rhizomes), shorter leaves (leaves 12–34 *vs.* 60 cm long), sparsely white lepidote on both surfaces (*vs.* glabrous above and lepidote below), staminate and pistillate branches with several basal bracts *vs.* without basal bracts, when in fruit, shorter pistillate branches (ca. 4–9.5 *vs.* 15 cm long), pistillate flowers with non-articulate pedicels (*vs.* articulate), sepals triangular, acute, 2.4–2.9 mm long (*vs.* widely ovate, apiculate, 1.5 mm long), and petals oblong, 4.7–5 mm long (*vs.* triangular, 3.5 mm long).

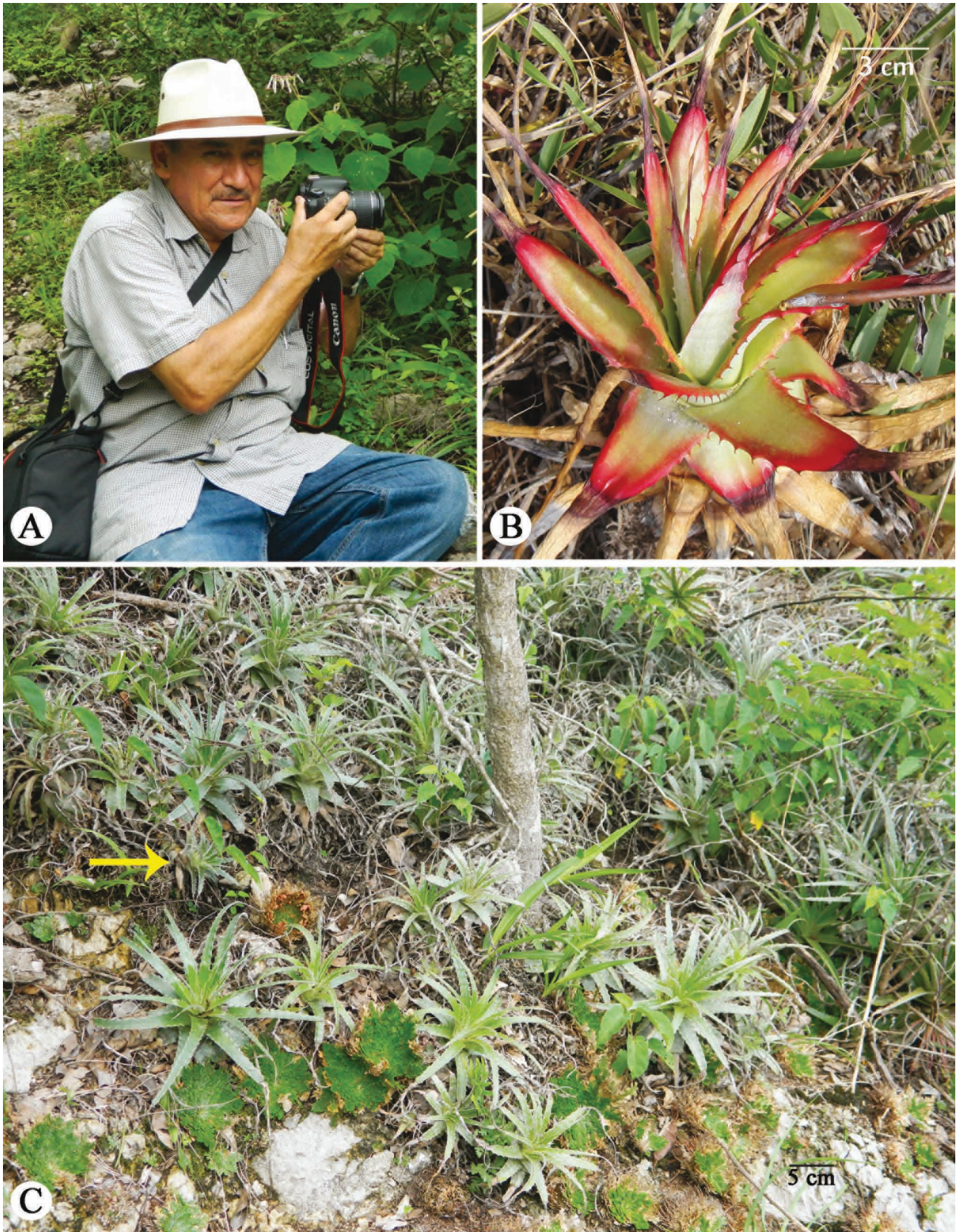


FIGURE 1. A, *C. Hechtia santanae* I. Ramírez & P. Carrillo. A. Francisco Santana Michel at the type locality. B. *Hechtia laevis* L. B. Sm. in habitat. C. Rosettes in habitat, showing (arrow) rhizomes. (Photographs A, C by Pablo Carrillo-Reyes; B by Ivón M. Ramírez-Morillo).

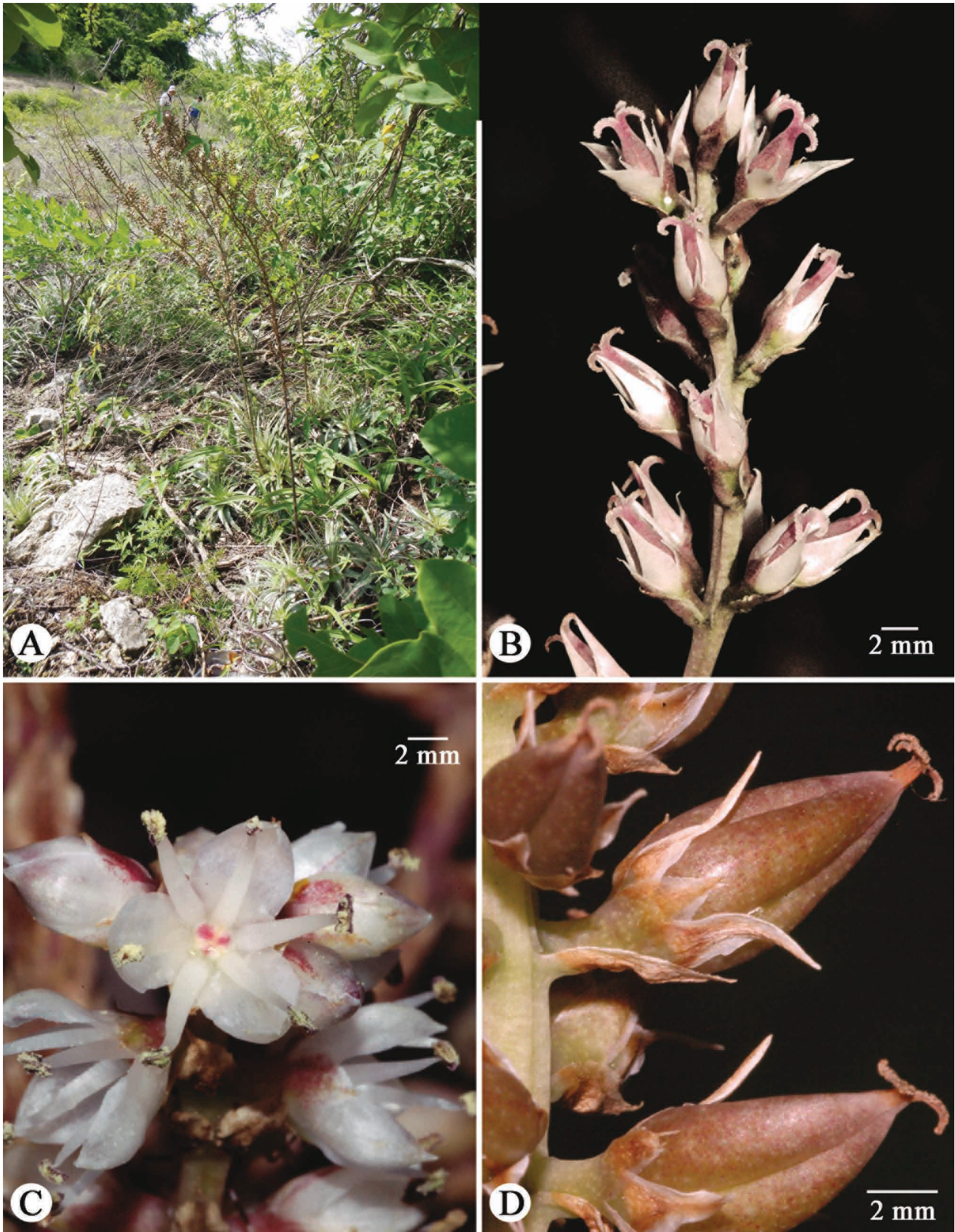


FIGURE 2. A–D. *Hechtia santanae* I. Ramírez & P. Carrillo. A. Flowering plant in habitat. B. Pistillate flower. C. Staminate flower. D. Fruits (Photographs A by Ivón M. Ramírez-Morillo; B–D by Pablo Carrillo-Reyes).

Type.—MEXICO. Jalisco: Municipio Tuxcacuesco, desvío de la carretera 429 tomando la brecha a El Agua Dulce, ca. 1 km SO de San Buenaventura, 19°45'32.9"N, 104°02'49"W, 840 m, 2 July 2014, Ramírez, Carrillo-Reyes, Santana-Michel, Tapia & Cetzal 1940 ♂ (Holotype CICY; isotypes IBUG, MEXU, US, ZEA).

Epitype (designated here):—MEXICO. Jalisco: Municipio Tuxcacuesco, desvío de la carretera 429 tomando la brecha a El Agua Dulce, ca. 1 km SO de San Buenaventura, 19°45'32.9"N, 104°02'49"W, 840 m, 2 July 2014, *Ramírez, Carrillo-Reyes, Santana-Michel, Tapia & Cetzal 1941b*♀ (Epitype, CICY).

Plants lithophytic, rosettes caespitose, globose, 20–30 cm height, 20–40 cm in diameter, producing basal rhizomes and forming colonies of 3–7 or more rosettes. *Rhizomes* medium size, 6–10 cm long, 3–4 cm diameter. *Leaves* (20–)30–40 in number, central ones erect, basal ones slightly reflexed; *sheaths* widely ovate to widely oblong, 3–4 × 3.5–4.8 cm, pale yellow with light brown spots when dry, glabrous in the middle area but featuring white lepidote margins and at distal end, margins finely spiny; *blades* narrowly triangular, attenuate, 12–34 × (1.2–)1.7–2.8 cm, succulent, green, occasionally with reddish margins, densely to sparsely silvery lepidote adaxially, densely white lepidote abaxially, margins spiny; spines antrorse, triangular, 1–3 mm long, 4–17 mm apart, brownish, with a short tuft of white trichomes at the axil of basal spines. *Inflorescence* central, emerging from the center of a newly-forming rosette (growth pattern SPFP *sensu* Ramírez *et al.*, 2014), sometimes tips of branches brown, without flowers (probably abortive floral buds).



FIGURE 3. A–B. Type specimens *Hechtia santanae* I. Ramírez & P. Carrillo. A. Pistillate plant (Based on Ramírez *et al.* 1941b♀, epitype CICY). B. Staminate plant (Based on Ramírez *et al.* 1940♂, holotype CICY).

Staminate inflorescence a 1-divided panicle, cylindrical, erect, 0.8–1.10 m long; *peduncle* terete, 24–34 cm long, 0.5–1 cm diameter at the base, reddish, surface waxy, twice to almost three times longer than rosette height but shorter than main axis of the inflorescence, internodes 1–2.5 cm long; *peduncle bracts* triangular, long attenuate, acute, 2–9 × 0.7–0.9 cm, brownish, erose at base, sparsely spiny to the apex, multinerved, glabrous at base and densely white toward apex on both surfaces, usually longer than internodes but occasionally as long as the internodes; *main axis* 54–73 cm long, 5–6 mm in diameter at the base, terete, reddish, surface waxy, internodes 0.5–2 cm long; *primary bracts* ovate-triangular, attenuate, acute, 1–1.8(–2.5) × 0.4–0.7 cm, papiraceous, usually shorter than the stipe of the branch, entire to rarely erose, sometimes spinulose, brownish, multinerved, sparsely lepidote on both surfaces; *branches* (35–)40–45 in number, forming an angle of 45°–75° or smaller relative to the main axis, (3.5–)5.5–13.5 cm long, 1.5–2 cm diameter, each with 60–100 flowers; stipe of the branch 1–6 cm long, covered by bracts similar to the floral bracts;

rachis 1–2 mm diameter, dorsiventrally flattened; *floral bracts* oblong-triangular, acuminate, 3.4–3.9(–5) × 2.2–2.4 mm, purple with a brown apex, margins erose and hyaline, glabrous, 3–5 nerved, shorter than sepals at anthesis. *Flowers* subsessile, erect, 5–5.5 mm long, 3.8–4.2 mm diameter, actinomorphic; *pedicels* obconic, 1 mm long, ca. 1.5 mm diameter; *sepals* ovate, acute, purple with a brown apex, 2.3–2.7 × 1.8–2.3 mm, entire, glabrous, 3-nerved, shorter than petals; *petals* elliptic, rounded, 4.3–4.8 × 3–3.2 mm, white, 7–9 nerved; *filaments* triangular, flattened, 3.8–4.4 mm long, white; anthers oblong, ca. 2–2.2 mm long, dorsifixed, reddish; *pistillode* reduced, pale purple to reddish, ca. 1 mm long.

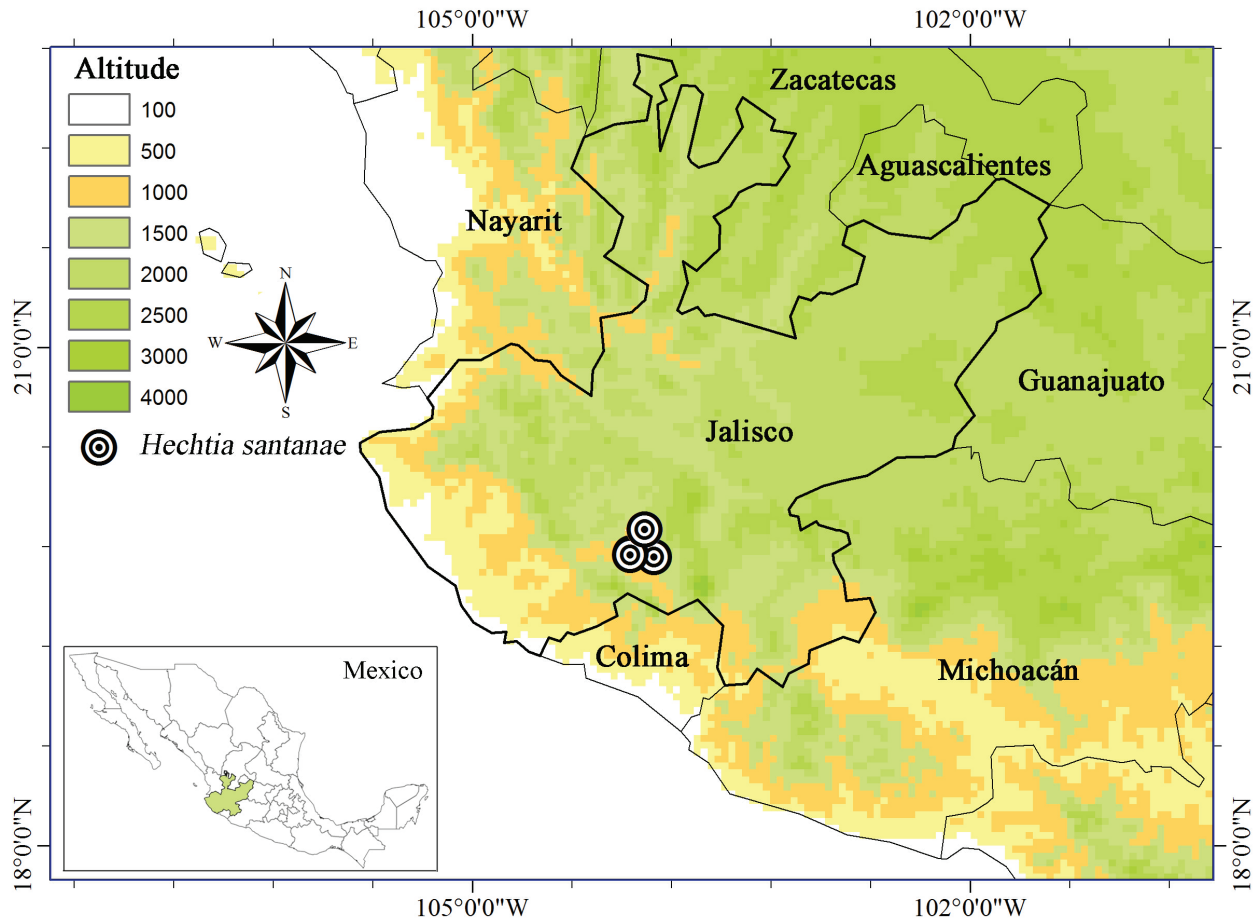


FIGURE 4. Geographical distribution of *Hechtia santanae* I. Ramírez & P. Carrillo.

Pistillate inflorescences a 1-divided panicle, cylindrical, erect, 1.10–1.40 m long; *peduncle* terete, 58–72 cm long, 0.6–1 cm diameter at the base, much longer than rosette height and as long as the main axis, green with purple hues, waxy surface, internodes 0.8–3.5 cm long; *peduncle bracts* triangular, acute, long-attenuate, 1.4–10.5 cm long, 0.4–1.4 cm wide, brownish, margins entire to erose at base, sparsely spinulose toward apex, multinerved, glabrous at base to densely white lepidote towards the apex on both surfaces, usually longer to rarely equaling the internode length; *main axis* 51–66 cm long, 4–5 mm in diameter at the base, terete, green, some sections are reddish, provided with a waxy cover, internodes 0.5–2 cm long; *primary bracts* ovate-triangular, attenuate, acute, 0.8–1.6 × 0.4–0.8 cm, entire to erose to sometimes spinulose, brownish, multinerved, sparsely white-lepidote on both surfaces, usually shorter than the stipe of the branches; *branches* 30–37 in number, forming an angle of ca. 45° with the main axis, 4–9.5 cm long, 10–50 flowered, stipe of the branch 0.8–2.5 cm long, rarely completely absent and sessile; *rachis* 1–2 mm diameter, dorsiventrally flattened, green, some sections are reddish, stipe of the branch absent or 1–1.5(–2) cm long; *floral bracts* oblong, acuminate, 4–4.2 × 3–3.2 mm, margin erose, hyaline, purple, apex brownish, 3-nerved, longer than sepals at anthesis, adnate to the pedicel for more than half of its length. *Flowers* 5.7–6 mm long, 3–4 mm diameter, pedicellate, actinomorphic, erect; *pedicel* terete, 2.8–3.2 mm long, ca. 1 mm diameter; *sepals* triangular, acute, 2.4–2.9 × 2–2.2 mm, purple with a brownish apex, entire, glabrous, 1-nerved, shorter than petals; *petals* oblong, acute, 4.7–5 × 2–2.2 mm, entire, white-purplish; *staminodes* six in number, triangular, laminar, 2.5–3 mm long, white; *ovary* superior, oblong to ellipsoid, 3–3.2 mm long, 1.7–2 mm in diameter, purple to reddish, glabrous; stigmatic lobes recurved, 1.2–1.7 mm

long, adnate at their bases, white, equaling the petals at anthesis; placentation central. *Fruits* ovoid to narrowly ovoid, 6–11 mm long, (2–) 3–4 mm in diameter, scattered lepidote, brown when mature; *seeds* fusiform, brown to reddish brown, reticulate, 5–6.8 mm long, ca. 1 mm diameter, with a lateral wing ending in two hyaline caudae.

Distribution and habitat:—*Hechtia santanae* is known from four localities in the Municipalities of Tuxcacuesco, San Gabriel, and Tolimán, in the floodplain and contiguous foothills of the Ayuquila river basin, in Southern Jalisco (Figure 4). This area is a valley system which represents a dry enclave influenced by the rain shadow produced by the Sierra de Manantlán, Nevado de Colima and Volcán de Fuego. Some other endemic species of succulent plants has been described from this area (Jimeno-Sevilla *et al.*, 2015: 72). The Ayuquila river basin belongs to the Pacific Lowland biogeographic region (Morrone, 2014) and to the ecoregion Bosques Secos de Jalisco (WWF 2001). The new species forms large colonies on gypsum and limestone outcrops at 780–920 m elevation. The vegetation of all localities corresponds to tropical deciduous forest (Rzedowski, 1978), along with *Bursera fagaroides* (Kunth 1824: 27) Engler (1880: 44), *B. schlechtendalii* Engler (1883: 41), *Cyrtocarpa procera* Kunth (in Humboldt *et al.* 1825: 20), *Hintonia latiflora* (Sessé & Mociño ex De Candolle 1830: 350) Bullock (1935: 4), *Mimosa rosei* Robinson (1898: 317), *Stenocereus queretaroensis* (Weber 1891: 27) Buxbaum (1961: 101), *Wimmeria lanceolata* Rose (1909: 283), and *Ziziphus amole* (Sessé & Mociño 1888:38) Johnston (1963: 1021). Locally it grows in association with *Bletia* sp., *Polianthes howardii* Verhoek (1976: 365), *Selaginella lepidophylla* (Hooker & Greville 1830: 162) Spring (1840: 126), and *Tradescantia orchidophylla* Rose & Hemsley (in Hooker 1897: pl. 2522).

Etymology:—The specific Latin epithet, *santanae*, honors Francisco Javier Santana Michel (1958–2015) (Figure 1A), who, based on his profound knowledge of the flora of Jalisco took us to the type locality since he suspected that this species was new to science. Sadly, Francisco passed away recently while preparing the first draft of this article.

Additional specimens examined (paratypes):—MEXICO. Jalisco: Municipio Tuxcacuesco [originally assigned to El Limón], 4–5 km al SW de San Buenaventura, por la brecha a El Agua Dulce, 19°45'02"N, 104°03'07"W, 950 m, 24 April 1999, *Santana-Michel & Cervantes* 9355 fruits (ZEA!). Same locality; 9 September 2000, *Santana-Michel* 10407♀ (CICY, IBUG, ZEA). Same locality, 2 July 2014, *Ramírez et al.* 1941, fruits (CICY, IBUG, MEXU, SEL, UAMIZ, US, WU, ZEA). A 3 km al W de Tuxcacuesco, camino a El Camichán, pendientes fuertes que dan al pueblo, 7 October 1982, *Lott & Hernández M.* 1370 fruits (MEXU!). Municipio San Gabriel, 0.5 km O de Apulco, 19°44'15"N, 103°54'20"W, 920 m, 2 July 2014, *Carrillo-Reyes et al.* 7405 ♂ (IBUG); 11 March 2016, *Carrillo-Reyes et al.* 8246 ♀ (IBUG); Municipio Tolimán, Arroyo La Ciénega, ca. 1 km al N de Tolimán, 19°36'33.4"N, 103°54'33"W, 783 m, 13 January 2015, *Carrillo-Reyes et al.* 7627 ♂ (IBUG!); *Carrillo-Reyes et al.* 7632, fruits (CICY!, IBUG!).

Discussion:—The species has been collected in the biogeographical region of Pacific Lowlands (Tierras Bajas del Pacífico, TBP, Morrone 2014), a narrow strip that extends from Mexico (Sinaloa) to Costa Rica. This region is one of the thirteen biogeographical provinces within the Megamexico III region (*sensu* Rzedowski, 1991) and houses the largest number of *Hechtia* species (Pech-Cárdenas, 2015). *Hechtia santanae* is characterized by its relative small rosette, size not exceeding 40 cm in diameter and 30 cm in height, with succulent, rigid, light green leaves, covered by a silvery, shiny layer of trichomes. Rosettes produce basal rhizomes as well as basal new rosettes, thus mature individuals consist of small colonies of 3 to 7 (rarely more) rosettes (Figure 1C). Inflorescences emerge from the center of a newly-formed, still undeveloped rosette denominated SPFP pattern (Ramírez Morillo *et al.*, 2014) (Figure 1C) and rarely from mature rosettes, suggesting that both patterns are variations of a central inflorescence. All taxa with SPFP growth pattern comprise a group whose monophyletic origin has been tested with molecular and morphological evidence (Ramírez-Morillo unpubl.). Two remarkable characters distinguish *H. santanae* from other *Hechtia* species: female and male inflorescences have the same architecture (simple panicles) (Figures 3A, B), an uncommon feature in this group of dioecious species where male plants tend to have more branched inflorescences and more flowers than their female counterpart. The second key character is the presence of sterile bracts enclosing the base of the branches, giving the entire structure a scaly aspect (Figures 3A, B); these bracts are very similar to the floral bracts but sterile. This last feature has also been observed in *Hechtia iltisii* with the difference that the stipe of the branch is located at the tip of the branches not at the base (Burt-Utley & Utley 1993: 225).

As mentioned above, specimens of *Hechtia santanae* were previously referred to *H. laevis*, particularly in fruiting stage (*Lott & Hernández* 1370, MEXU!). *Hechtia laevis* (Fig. 1B) is a species that grows on gypsum-rich soils in xerophytic scrubland or low forests in the state of Colima along the Colima-Manzanillo road; the two species can be distinguished easily using the character summarized in table 1.

TABLE 1. Comparison of several vegetative and reproductive of *Hechtia santanae* I. Ramírez & P. Carrillo and *H. laevis* L. B. Smith.

Characters	<i>Hechtia laevis</i>	<i>Hechtia santanae</i>
Rhizomes	Inconspicuous	Conspicuous
Leaf length (cm)	60	12–34
Leaf width (cm)	3	(1.2)1.7–2.8
Main axis diameter (cm)	1	0.5–1
Pistillate branch length when in fruit (cm)	15	4–9.5
Primary bracts length (cm)	17	8–16
Pedicel length (mm) on pistillate flower	3.5	2.8–3.2
Sepals (pistillate flower)	Widely ovate, apiculate, 1.5 mm long	Triangular, acute, 2.4–2.9 mm long
Petals (pistillate flower)	Triangular, 3.5 mm long	Oblong, 4.7–5 mm long

IUCN Conservation assessment:—*Hechtia santanae* is currently known from few collections from four localities that are separated by no more than 23 km among them. All populations were found outside protected areas. At San Buenaventura, the population is located over a gypsum outcrop. Although the site is apparently not suitable for agriculture, low levels of perturbation by cattle have been observed. Neighboring areas to this population are heavily disturbed by agricultural activities. At Apulco (Municipio San Gabriel) and at Arroyo La Ciénaga (Municipio Tolimán), plants grow on vertical limestone cliffs that are inappropriate neither for agriculture nor for raising cattle. No threats were detected there. Using GeoCAT (Bachman *et al.*, 2011) and based on the limited number of localities, the Extent of Occurrence (EOO) is 130.064 km² meanwhile the size of the Area of Occupancy is 16 km², based on cells of 2 km. A preliminary category of Endangered (EN (B2 bii)) is proposed following the IUCN (2012) criteria.

Acknowledgments

We are indebted to curators of the following herbaria B, CICY, ENCB, GH, GUADA, IBUG, MEXU, MO, NY, P, PH, S, UC, US, and ZEA, for allowing the study of the material deposited in these herbaria and for sending material on loan to CICY. The senior author thanks the Missouri Botanical Garden for granting an Elizabeth Bascom Fellowship, as well as the DAAD-ANUIES and the Klarff foundation whose support (to IMRM) enabled the study of the Bromeliaceae collection in European and American herbaria. We would like to acknowledge CONACyT's support of the project “Phylogeny, evolution and biogeography of *Hechtia* Klotzsch (Hechtioideae: Bromeliaceae)” [number 183281] granted to the first author. We are indebted to Carlos Jiménez who helped with the morphological description of the species. Silvia Hernández-Aguilar (CICY) handled herbarium material and loans. Paola Marfil from CICY, edited images of the close-ups of the flowers. Gerardo Salazar provided images of herbarium specimens deposited at Herbarium MEXU. Germán Carnevali and Gustavo A. Romero's editorial assistance is greatly acknowledged. Claudia J. Ramírez-Díaz, Alejandro Zabalgoitia, and Raúl M. Ramírez-Ulloa helped during the field work, the former is also acknowledged for maintaining the species in cultivation, and, finally, to Eric Gouda for editorial comments and to two anonymous reviewers for observations and comments that helped to improve the quality of this paper.

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