

TWO NEW SPECIES OF *NOLANA* (NOLANEAE–SOLANACEAE) FROM SOUTHERN PERU

MICHAEL O. DILLON^{1,3} AND VICTOR QUIPUSCOA-SILVESTRE²

Abstract. In preparation for the publication of a monograph of *Nolana* L.f. (Nolaneae–Solanaceae), two new species, *Nolana hoxeyi* and *Nolana samaensis*, are described from the southern Peruvian Department of Tacna. These two share relationships and occur in the same geographic area, although not strictly sympatrically. Series of diagnostic morphological characteristics allow for discrimination of these two from all other species of *Nolana* with narrow leaves recorded from the Department of Tacna. Descriptions, illustrations, and a distribution map are provided for the new species. Typifications are provided for several taxa of *Nolana*.

Keywords: Solanaceae, *Nolana*, flora of Peru, coastal lomas, new species

Resumen. En preparación de la monografía de *Nolana* L.f. (Nolaneae–Solanaceae) para su publicación, se describen dos nuevas especies del departamento de Tacna en el Sur de Perú, *Nolana hoxeyi* y *Nolana samaensis*. Estas dos especies están relacionadas y se distribuyen en la misma área geográfica, aunque no son estrictamente simpátricas. Muchos caracteres morfológicos diagnósticos permiten diferenciar a estas dos, de las demás especies de *Nolana* con hojas angostas registradas en el departamento de Tacna. Se describen, ilustran y se proporciona un mapa de distribución para las dos nuevas especies. Se dan a conocer además, tipificaciones para varios taxones de *Nolana*.

Palabras clave: Solanaceae, *Nolana*, flora del Perú, lomas costeras, nuevas especies

Nolana L.f. (Nolaneae–Solanaceae) is an easily recognized genus possessing a unique, mericarp fruit type within the family. With the addition of the two new species described here, the genus comprises 92 species confined to Peru and Chile and one endemic species in the Galapagos Islands, Ecuador (Dillon, 2005; Dillon, 2016). *Nolana* is among the five or six largest genera in the family and has its greatest species diversity in coastal southern Peru and northern Chile (Dillon, 1997; Dillon and Hoffmann, 1997). These regions are dominated by vegetation termed *lomas* formations, which exist as virtual islands of highly endemic communities all utilizing available moisture from fog (*camanchaca* or *garua*) (Rundel et al., 1991; 2007). While most species of *Nolana*

have their distributions in near-shore habitats, a few occur in habitats far removed from oceanic influence at elevations over 2000 m.a.s.l., *Nolana* stands out as the most wide-ranging and conspicuous floristic element of these formations. In many modern classifications, members of *Nolana* have been recognized at familial (Nolanaceae) or subfamilial (Nolanoideae) rank due to their unusual carpel morphology, but data from molecular studies have provided unequivocal evidence that *Nolana* is nested within the Solanaceae (Dillon et al., 2007b; 2009). We have described several new species from Peru (Dillon et al., 2007a; Quipuscoa and Dillon, 2018) and the species described here do not conform to any previously encountered within *Nolana* (Dillon, 2016).

MATERIALS AND METHODS

During studies of *Nolana* throughout Peru and Chile, we have encountered taxa that were obviously *Nolana* (Solanaceae) but could not be associated with any of the previously described species. The first new *Nolana* described here was represented by two herbarium sheets housed at USM, one identified as *Nolana lycioides* I. M. Johnst. (Mueller & Chávez 3591, USM-81298) and the other as *N. coelestis* (Lindl.) Miers ex Dunal (Mueller et al. 12236, USM-64133), a Chilean species quite unrelated and differing in many fundamental morphological features. The images of the herbarium specimens at USM exhibited a growth habit and inflorescence different from any species of Chilean or Peruvian *Nolana* known to us. What led to the recent discovery of this taxon were photographs by Paul Hoxey that contained geographic coordinates. In late

November 2021, a field trip to the Department of Tacna was undertaken to locate and document this putative new species. Now, with ample, well-documented material available, it is possible to describe it here.

Examination of populations in the field allowed us to observe salient characteristics that are easily seen in the living state but are generally lost with drying. After studying the populations of *Nolana* and their ecological parameters, the species we describe here are based on diagnostic morphological characteristics supported by a geographic fidelity. We have also examined more than 2,600 herbarium collections and undertaken field work that has encompassed the entire geographic range of the genus. This background has given us a sound basis for describing this and the following species as new.

We thank the collection managers of F and USM for allowing us to consult their collections. We thank Maricruz Bedoya Cuno for preparing the illustrations and Margarita Esther Balvin Aguilar for preparation of the distribution map. We thank Paul Hoxey for providing photographs and geographic data of these species. We thank our field companions Cristian Tejada Pérez and Jhon Muñico Mamani for their friendship and collaboration while collecting these new species and for making our botanical excursion a success. David Boufford is acknowledged for his useful comments in an early version of this paper.

¹ Herbario Sur Peruano, Arequipa, Perú

² Departamento Académico de Biología, Universidad Nacional de San Agustín de Arequipa, Arequipa, Perú

³ Corresponding author: dillon@sacha.org

TABLE 1. Comparison of diagnostic morphological characteristics of narrow-leaved species of *Nolana* L.f. recorded from Department of Tacna, Peru.

CHARACTERS	<i>N. HOXEYI</i>	<i>N. SAMAENSIS</i>	<i>N. CONFINIS</i>	<i>N. LYCIOIDES</i>	<i>N. GRACILLIMA</i>
Habit	shrubs	subshrubs	perennial herbs to suffrutescent	suffrutescent	herb
Inflorescence	racemose	solitary flowers	solitary flowers	solitary flowers	solitary flowers
Calyces Size	3–4.5 (–5) mm long × 2–3.5 mm at anthesis; tube 1.5–2 mm long × 2–2.5 mm diam., lobes 2.5–3 mm long × 1–1.5 mm wide	5–6.5 mm long × 4–5 (–6) mm at anthesis; tube 1–1.5 mm long × 1–1.5 mm diam., lobes 4–5 mm long × 1–1.2 mm wide	3–3.5 (–4) mm long × 2.5–3.5 mm at anthesis; tube 0.5–1 mm long × 1.8–2 mm diam., lobes 2.5–3 mm long × 1 mm wide	4–5.5 mm long × 3–4 (–5) mm at anthesis; tube 0.5–1 mm long × 1.5–2.5 mm diam., lobes 2.5–3 mm long × 1–1.2 mm wide	5–5.5 (–6) mm long × 3–4 mm at anthesis; tube 2–2.5 mm long × 1.8–2 mm diam., lobes 3–3.5 mm long × 1–1.3 mm wide
Surface	densely strigose	densely pilose	lanuginous	scabrous-glandular	glabrous to glabrescent
Corolla Size	10–13 (–15) mm long × 15–20 mm at anthesis	9–11 (–13) mm long × 10–15 mm at anthesis	10–13 mm long × 7–9 (–10.2) mm at anthesis	13–22 (–27) mm long × 11–13 (–15) mm at anthesis	9–12 mm long × 7–9 (–12) mm at anthesis
No. of Mericarps	7–10 (–12)	6–8 (or 9)	4 or 5 (or 6)	5–9	4 or 5
Mericaarp Size	2–2.5 mm long	1–2.5 mm long	1.5–2.5 mm long	1.6–2.5 mm long	(1–)1.5–2 mm long
Mericaarp Surfaces	rugose-punctate	rugose-punctate	rugose-punctate	punctate	rugose

TAXONOMY

Nolana hoxeyi M. O. Dillon & Quip. *sp. nov.* TYPE. PERU. Tacna: Prov. Tacna, Dist. Sama, ca. 2 km Sur de Puerto Grau, carratera costanera, 18°00'35"S, 70°52'43"W, 112 m.a.s.l., 19 Noviembre 2021, V. *Quipuscoa S.*, M. O. Dillon, C. Tejada P. & J. Muñuico M. 8027 (Holotype: HSP [12376]; Isotypes: HSP [12377], F [2330851], HUT, USM). Fig. 1–6.

Nolana hoxeyi can be distinguished from all other species in the genus by the following combination of characteristics: shrubs to 1 m tall; leaves elliptic to linear-oblongate, strigose; inflorescences compact, densely racemose, 30–40 cm long; mericarps 7–10 (–12).

Shrubs, 50–100 cm tall. *Stems* intricately branched, erect, 50 cm long, young branches densely velutinous to villous, occasionally capitate-glandular. *Leaves* alternate, fasciculate, sessile to subsessile; petiole canaliculate, blade elliptic, linear-oblongate, 7–11 mm long, 1–1.5 (–2) mm wide, densely strigose, succulent, entire, base attenuate, apex rounded to obtuse. *Inflorescences* compact or densely racemose, 30–40 cm long; flowers subtended by leaf-like bracts, 4–5 mm long, ca. 1 mm wide, strigose; pedicels cylindrical, densely pubescent, strigose, 1–5 mm long. *Flowers* 5-merous; calyx narrowly campanulate, 2–2.5 mm wide at anthesis, densely strigose, 5-lobed, the tube 1–1.5 (–2) mm long, 1–1.5 mm in diam., lobes lanceolate,

unequal, 2–3 mm long, 1–1.5 mm wide, apex acute; corolla zygomorphic, infundibuliform, 15–20 mm wide at anthesis, 10–13 (–15) mm long, light lavender or lilac, throat clear, externally and internally glabrous; stamens 5, included, filaments inserted on lower third of corolla, unequal, 2 filaments 9–10 mm long, 3 filaments 6–8 mm long, glabrous; anthers dithecal, light purple, thecae ca. 1 mm long, ca. 1 mm wide, glabrous; ovary glabrous, ca. 1 mm long, 0.5–1 (–1.5) mm wide, nectary basal, carpels 7–9, style included, 7–9 mm long, stigma bilobed, light green, ca. 0.5 mm long. *Mericarps* 7–10 (–12), 2-seriate, round, black, rugose-punctate, (1–)2–2.5 mm long, 3 or 4 large, 7 or 8 smaller, included within expanding calyx; seeds 1–5. Chromosome number: unknown.

Etymology: The epithet of *Nolana hoxeyi* commemorates Paul D. Hoxey, a prolific collector and author of publications on the Cactaceae, especially those of Central and South American genera. His photographs and documentation were critical in locating populations of this new species. He splits his residency between Cambridge, England, and Arequipa, Peru.

Distribution and Ecology: Peru, Department of Tacna; 100–600 m; restricted to sandy soils, most commonly from near-ocean localities near sea level, and to ca. 10 kms inland reaching 600 m.a.s.l.

FIGURE 1. Holotype of *Nolana hoxeyi* M. O. Dillon & Quip. from HSP, Arequipa, Peru [HSP-12376].

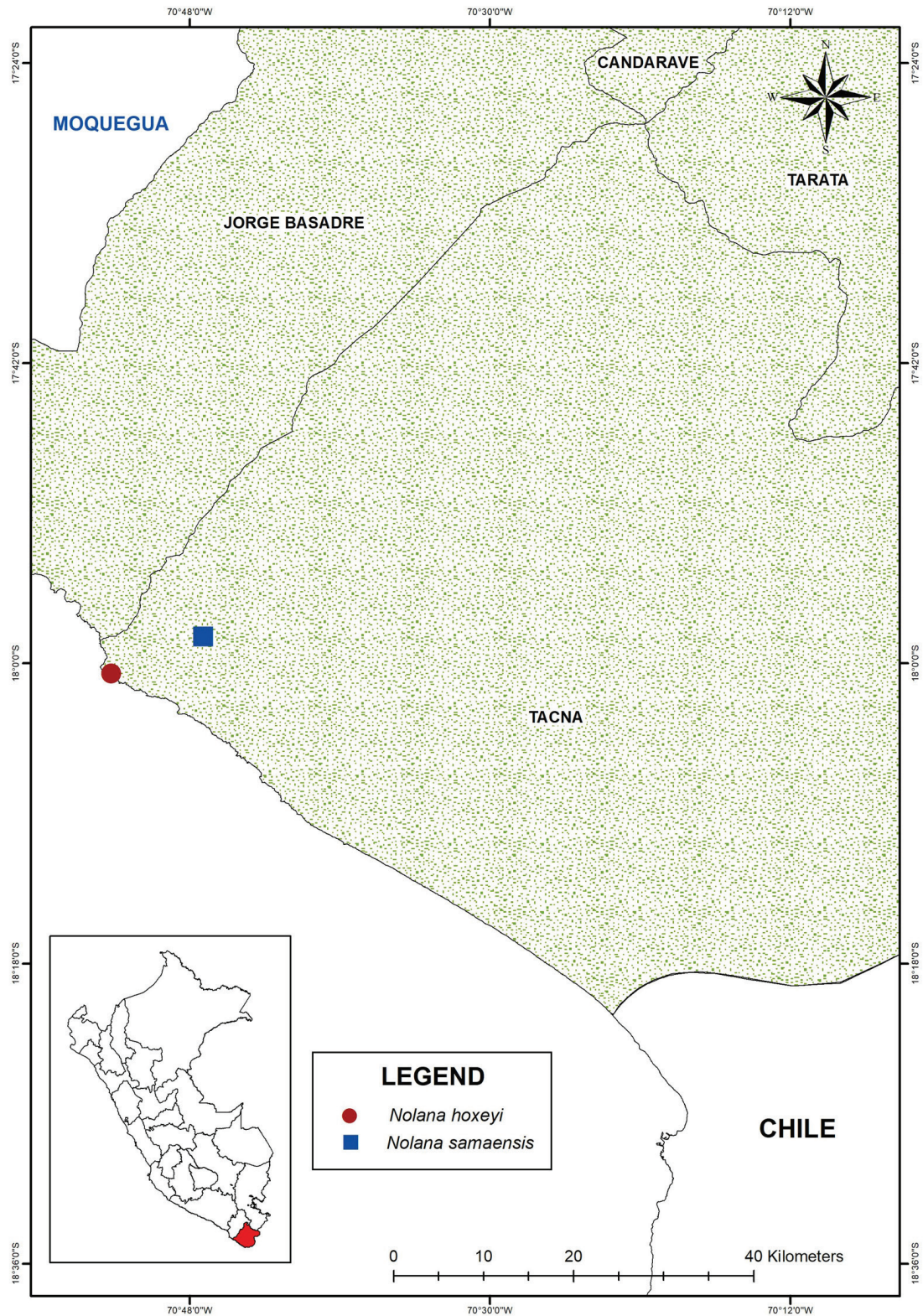


FIGURE 2. Map of known distribution of *Nolana hoxeyi* M. O. Dillon & Quip. and *N. samaensis* M. O. Dillon & Quip. in Department of Tacna, Peru. (Prepared by Margarita Balvin Aguilar).

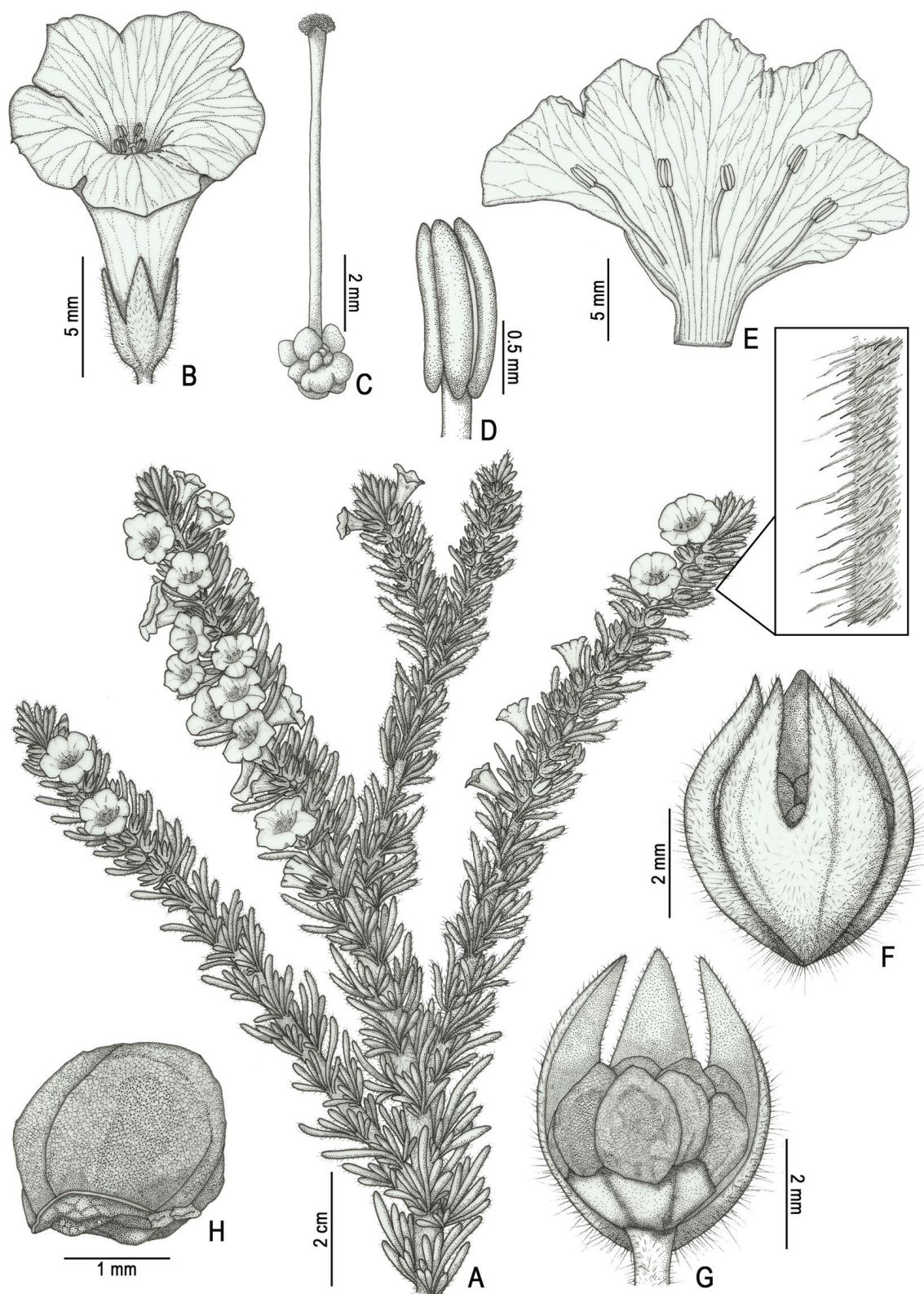


FIGURE 3. Illustration of *Nolana hoxeyi* M. O. Dillon & Quip. **A**, habit with enlargement of surface pubescence; **B**, flower; **C**, ovary and style. **D**, anther; **E**, dissected corolla; **F**, calyx; **G**, dissected calyx with mericarps; **H**, mericarp. Line drawing by Maricruz Bedoya Cuno based on the holotype.



FIGURE 4. Photograph of type locality for *Nolana hoxeyi* M. O. Dillon & Quip., ca. 2 km Sur de Puerto Grau on carratera costanera, Tacna, Peru.

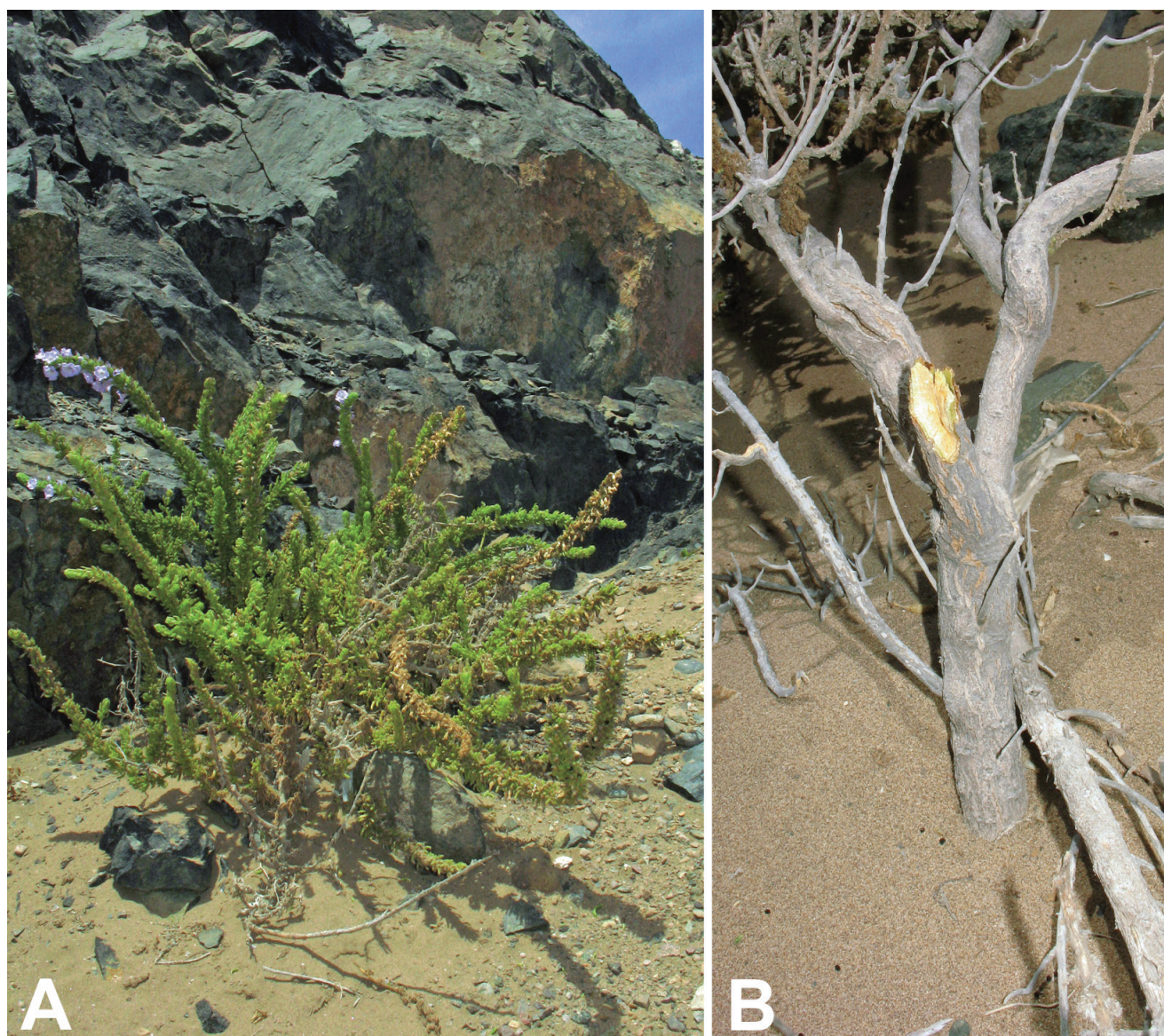


FIGURE 5. *Nolana hoxeyi* M. O. Dillon & Quip. **A**, habit; **B**, woody trunk.

Nolana hoxeyi is endemic to a small area in the Province of Sama, Department of Tacna. It is recorded from near-ocean habitats from 100 to 600 m.a.s.l. and within a few kilometers of the ocean. It is decidedly different with its non-branching, sinuate stems and densely set fasciculate leaves. There are no evident internodes; only stems covered with dense leaves on all surfaces. The apical portion of the stems are obviously racemose inflorescences that appear spicate with many flowers over the apical 20–50 cm (Fig. 6).

Nolana hoxeyi was first recognized as a potentially new species while we examined photographs of the two G. K. Muller collections identified as *Nolana lycioides* I. M. Johnst. (Mueller & Chávez 3591, USM-81298) and another identified as *N. coelestis* (Lindl.) Miers ex Dunal (Mueller et al. 12236, USM-64133), a Chilean species quite unrelated and differing in many fundamental morphological characteristics. Both sheets were collected in the Morro

Sama region. MOD did not have an opportunity to examine the herbarium collections at USM, but the photographs were intriguing. When living plants were encountered on 19 November 2021 it was obvious that they represented a species new to science.

Nolana hoxeyi does not closely resemble any other species of the genus, but it does share some characteristics with the following taxon described here, *N. samaensis*. These two species share similar mericarp shape and size but differ in mericarp number. The densely leafy stems and distinct, densely racemose inflorescences are unique. The most common inflorescences in *Nolana* are solitary flowers borne in leaf axels, but sometimes, as in *N. inflata* Ruiz & Pav. and *N. weissiana* Ferreyra, they display weakly cymose inflorescences; in *N. scaposa* Ferreyra, the inflorescence is easily recognized and well-developed. The only other species of *Nolana* with such densely set leaves are *N. galapagensis*

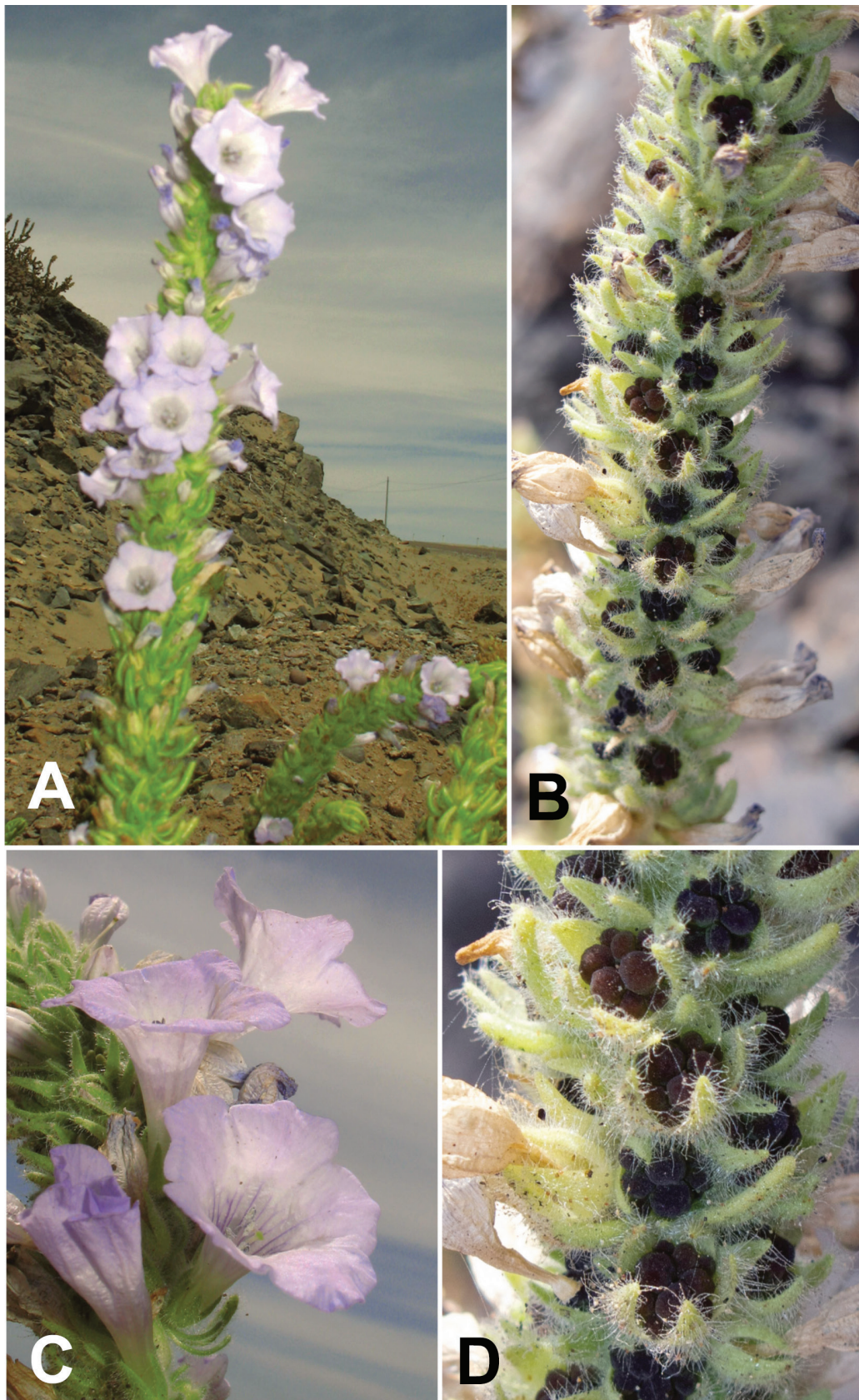


FIGURE 6. *Nolana hoxeyi* M. O. Dillon & Quip. A, inflorescence; B, closeup of fruiting inflorescence; C, flower; D, mericarps.

(Christoph.) I. M. Johnst., *N. onoana* M. O. Dillon & M. Nakaz. of northern Chile, and *N. tricotiflora* Quip. & M. O. Dillon of southern Peru. They all have very different flowers, different mericarp number and different mericarp shape.

Associated species recorded at the type locality included *Ephedra americana* Humb. & Bonpl. ex Willd. (Ephedraceae), *Cristaria multifida* (Dombey ex Cav.) Cav., *Palaua dissecta* Benth. (both Malvaceae), *Perityle emoryi* Torrey in W. H. Emory, *Trixis cacalioides* (Kunth) D. Don (both Asteraceae), *Suaeda foliosa* Moq., *Chenopodium murale* L. (both Amaranthaceae), *Spergularia collina* I. M. Johnst. (Caryophyllaceae), *Nolana adansonii* (Roem. & Schult.) I. M. Johnst., *Solanum multifidum* Lam. (both Solanaceae) and at upper reaches associated with *Neoraimondia arequipensis* (Meyen) Backeb. and other cacti.

Additional specimens examined: PERU. Tacna: Morro Sama, September 1980, 250 m.a.s.l., G.K. Muller & R. Chávez 3591 (USM-64133); Morro de Sama, 6 August 1985, G.K. Muller, G. Krebs & R. Chávez 12236 (USM-81298).

Nolana samaensis M. O. Dillon & Quip., *sp. nov.* TYPE. PERU. Tacna: Prov. Tacna, Dist. Sama, Lomas de Sama, 17°58'23"S, 70°46'12"W, 503 m.a.s.l., 19 Noviembre 2021, V. Quipuscoa S., M. O. Dillon, C. Tejada P. & J. Muñuico M. 8029 (Holotype: HSP [12378]; Isotypes: HSP [12379], F [F-2330852], HUT, USM). Fig. 2, 7–9.

Nolana samaensis can be distinguished from all other species in the genus by the following combination of characteristics: subshrubs to ca. 30 cm tall; leaves linear to obovate, 4–7 mm long, densely pilose; inflorescences of solitary flowers; mericarps 6–9.

Subshrubs to ca. 30 cm tall. **Stems** intricately branched, erect to decumbent, to ca. 20 cm long, densely villous with capitate-glandular trichomes. **Leaves** alternate, fasciculate, sessile or subsessile, internodes to 1 cm long; blade linear, oblanceolate or obovate, 4–7 mm long, 1–1.5 mm wide, pilose, succulent, entire, base attenuate, margins entire, apex rounded to obtuse. **Inflorescences** of solitary flowers in leaf

axils; pedicel cylindrical, densely pubescent, 1–2 mm long. **Flowers** 5-merous; calyx narrowly campanulate, 4–5(–6) mm wide at anthesis, densely pilose, 5-lobed, tube 1–1.5 mm long, 1.5–2 mm in diam., lobes oblong-lanceolate, unequal, 4–5 mm long, ca. 1.2 mm wide, apex acute; corolla zygomorphic, infundibuliform, 10–15 mm wide at anthesis, 9–11(–13) mm long, light lavender or lilac, throat with dark purple ring, externally pilose, trichomes uniseriate, internally glabrous; stamens 5, included, filaments inserted on lower third of corolla, unequal, (5–)7–8 mm long, glabrous at bases; anthers dithecal, purple, thecae ca. 0.5 mm long, ca. 0.5 mm wide, glabrous; ovary glabrous, ca. 1 mm long, 1–1.2 mm wide, basal nectary ca. 1 mm wide, carpels 5, style included, 6–7 mm long, stigma bilobate, purple, ca. 0.3 mm long. **Mericarps** 6–8(or 9), 2-seriate, polyhedrons, black, rugose-punctate, 1–2.5 mm long, 2–4 large, 4 or 5 small, included within expanding calyx; seeds 1–5. Chromosome number: unknown.

Etymology: The specific epithet is from the latinisation of the geographic locality of the type collection, Sama in Department of Tacna.

Distribution and Ecology: Peru, Department of Tacna; 100–600(–810) m.a.s.l.; restricted to sandy soils and inland localities within 10 km of the ocean.

Nolana samaensis is distinguished by a combination of characters not met in other species. It is a subshrub with small, densely pubescent leaves less than 10 mm long and 1.5 mm wide. The shape, size and pubescence of the calyx lobes in *N. samaensis* are distinctive amongst other southern Peruvian congeners. Two species recorded from Department of Tacna, *N. confinis* and *N. lycioides*, are shrubby and have similar sized leaves but very different pubescence. Their calyx lobes are longer, long-attenuate, and densely lanuginous or with short-stipitate glandular trichomes. *Nolana hoxeyi* and *N. gracillima* both have much longer leaves to 25 mm long; *N. gracillima* lacks leaf pubescence while *N. hoxeyi* leaves are densely strigose.

The flora at the type locality was depauperate, with only *Palaua dissecta* and *Nolana pallidula* I. M. Johnst. recorded.

TYPIFICATIONS

Nolana aenigma M. O. Dillon, S. Leiva & Quip., Arnaldoa 14: 172. 2007.

TYPE. PERU. La Libertad: Prov. Trujillo, Dist. Trujillo, Km 580, Cerro Cabezón, 10 February 1998, S. Leiva G., M. O. Dillon, A. Sagástegui A., & V. Quipuscoa S. 2165 (Holotype: HAO, destroyed; Lectotype, designated here: HUT [031950]; Isolectotype: F [F-2329912]).

Nolana coronata Ruiz & Pav., Fl. Peruv. [Ruiz & Pavón] 2: 7, tab. 112b. 1799.

TYPE. PERU. Arequipa: Prov. Camaná, entre Pongo y Atiquipa, 30 November 1777, J. Tafalla s.n. [Hb. Pavón 434] (Lectotype, designated here: MA [815123]; Isolectotypes: B-W [03451-010], F [F-712543, F-843660, F-845176, F-845335, F-341432, F-341434, F-341435, F-341436], G [G-23240, G00383540, G00383541], HAL [HAL0115088], K [K000532272], MA [MA815121, MA815122, MA817983], MPU [MPU012108]).

Nolana crassulifolia Poepp., Not. Natur- Heilk. 23: 276. 1829.

TYPE. CHILE. Valparaíso: “in rupibus marit. ubique prope Concón,” E.F. Poeppig 67 (Lectotype, designated here, W [1889-0301807]; Isolectotypes: BM [BM000021201], HAL [HAL115090], P [P00605847], W [W0075445]).

Nolana gayana (Gaudich.) Koch, Ind. Sem. Berol. 12. 1855.

Basionym: *Alibrexia gayana* Gaudich., Voy. Bonite, pl. 105. 1851; p. 81. 1866. **TYPE.** PERU. Lima, based upon material collected at Callao or Lurín, 11–21 July 1836, C. Gaudichaud s.n. [Johnston (1936) accepted the illustration as the type until the type collection could be located. Neotype, designated here: PERU, Lima, “Tablada de Lurín,” A. Mathews 837 (E00793138); Isoneotypes: BM [BM000941268], E [E00793139], K).



FIGURE 7. Holotype of *Nolana samaensis* M. O. Dillon & Quip. from HSP, Arequipa, Peru [HSP-12378].

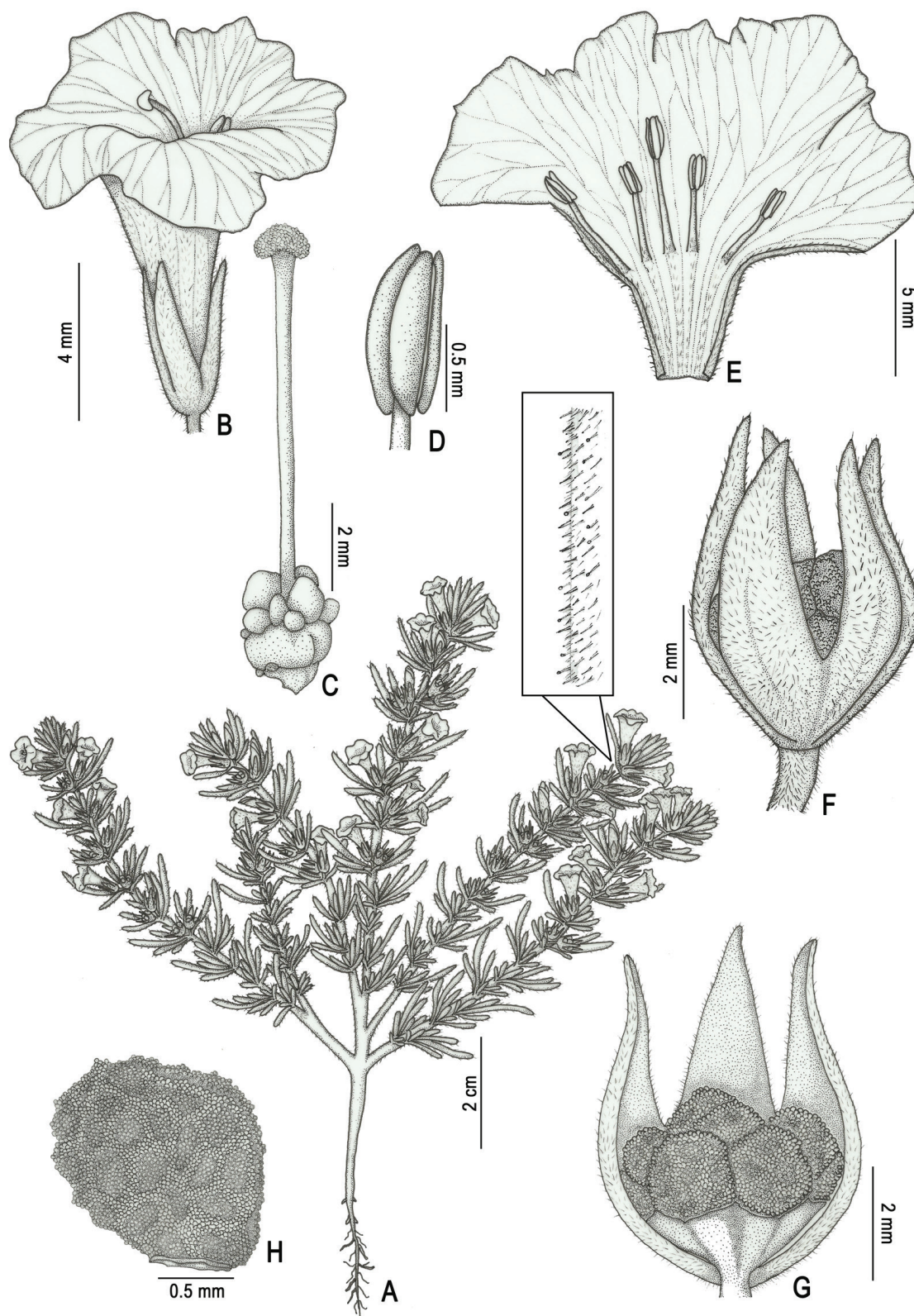


FIGURE 8. Illustration of *Nolana samaensis* M. O. Dillon & Quip. **A**, habit with enlargement of surface pubescence; **B**, flower; **C**, ovary and style; **D**, anther; **E**, dissected corolla; **F**, calyx; **G**, dissected calyx with mericarps; **H**, mericarp. Line drawing by Maricruz Bedoya Cuno based on the holotype.

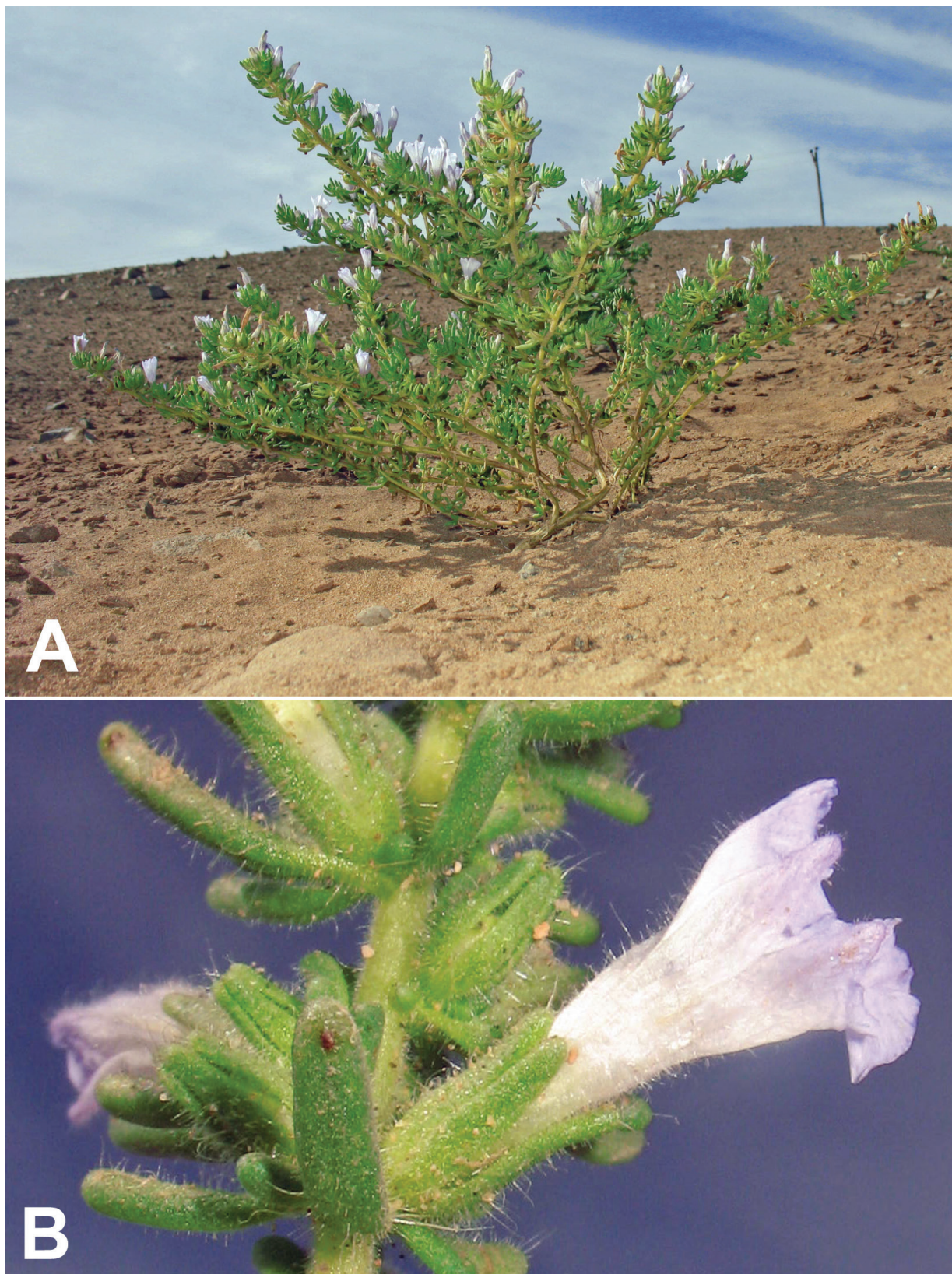


FIGURE 9. *Nolana samaensis* M. O. Dillon & Quip. **A**, habit; **B**, closeup of flowering branch.

Nolana inflata Ruiz & Pav., Fl. Peruv. [Ruiz & Pavón] 2: 7, tab. 112a. 1799.

TYPE. PERU. Arequipa: Prov. Camaná, *J. Tafalla s.n.* (Lectotype, designated here: MA [815130]; Isolectotypes: B [B-W03450-010], F [F-712544, F-843609, F-845149], FI-Webb [FI009586], G [G00383940, G00303942, G00383943], HAL [HAL115089], K [K000532269], MA [MA815125, MA815126, MA815127, MA815129, MA815131, MA817979, MA817682, MA817683], MPU [MPU0012109], P [P00605856]).

Nolana lezamae M. O. Dillon, S. Leiva & Quip., Araldoa 14: 184. 2007.

TYPE. PERU. Ancash: Prov. Corongo, Dist. Corongo. Tres Cruces (entre La Pampa-Yuramarca), 8°41'S, 77°55'W, 2144 m.a.s.l., 30 June 1998, *S. Leiva G., V. Quipuscoa, P. Lezama A. & E. López 2212* (Holotype: HAO, destroyed; Lectotype, designated here: HUT [032058], Isolectotypes: E, F [F-2329913], G, GH, HSP).

Nolana sedifolia Poepp., Not. Natur- Heilk. 23: 276. 1829.

TYPE. CHILE. Valparaíso: “in rupibus maritus ubique prope Concón,” *E. F. Poeppig 68* (Lectotype, designated here: W [1889-0301807]; Isolectotypes: BM [BM000941358], F [F-870466], GH [GH00282361], HAL [HAL-115091], K [K000532209], W [W0075450]).

Heterotypic synonym: *Fabiana lanuginosa* Hook. & Arn., Bot. Beechey Voy. 1: 35. 1830. **TYPE.** CHILE. Coquimbo: Coquimbo, Capt. F. W. Beechey Voyage, *A. Collie & G. T. Lay s.n.* (Lectotype, designated here: E [00369176]).

Nolana spathulata Ruiz & Pav., Fl. Peruv. [Ruiz & Pavón] 2: 7, tab. 113a. 1799.

TYPE. PERU. Arequipa: Prov. Camaná, “Pongo et Atiquipa,” *J. Tafalla s.n.* [435] (Lectotype, designated here: MA [815133]; Isolectotypes: B [B-W03449], BC, F [F-843636, F-845155], FI [FI132659], G [G00383935, G00383937, FM neg 23244], MA [MA815132, MA815134, MA815135, MA817982], MPU [MPU012112]).

DISCUSSION

Several taxa of *Nolana* require nomenclatorial changes that are best addressed here. In Mesa (1981), the last monograph for the genus, lectotype designations were provided for nearly 50 taxa. Now, for a variety of reasons, additional lectotypifications and neotypifications are required. For *Nolana aenigma* and *N. lezamae*, the holotypes were destroyed in a catastrophic fire in the Herbario Antenor Orrego (HAO) on 6 June 2010. Material deposited in Herbario

Universidad de Trujillo (HUT) has been chosen as lectotypes for those two species.

In the instance of *Nolana coronata*, *N. inflata* and *N. spathulata*, Mesa (1981) designated an institution (MA) from the duplicates distributed to various herbaria, but there were several duplicates. Because no single specimen was designated as the lectotype, following the *Shenzhen Code* (Turland et al., 2018), the names are here lectotypified with one of them.

LITERATURE CITED

- DILLON, M. O. 1997. *Lomas Formations-Peru*. Pages 519–527, in S. D. DAVIS, V. H. HEYWOOD, O. HERRERA-McBRYDE, J. VILLA-LOBOS, AND A. C. HAMILTON, EDS., *Centres of Plant Diversity, A Guide and Strategy for their Conservation*. WWF, Information Press, Oxford, U.K.
- . 2005. Solanaceae of the *Lomas* formations of Coastal Peru and Chile. Pages 131–155, in V. HOLLOWELL, T. KEATING, W. LEWIS, AND T. CROAT, EDS., *A Festschrift for William G. D'Arcy: The Legacy of a Taxonomist*. Monographs in Systematic Botany from the Missouri Botanical Garden 104.
- . 2016. 71. *Nolana* (Solanaceae). Pages 343–344 in G. E. BARBOZA, A. T. HUNZIKER, G. BERNARDELLO, A. A. COCUCCI, A. E. MOSCONE, C. CARRIZO GARCIA, V. FUENTES, M. O. DILLON, V. BITTRICH, M. T. COSA, R. SUBILS, A. ROMANUTTI, A. ARROYO, AND A. ANTON, EDS., *The Families and Genera of Vascular Plants, Asterales*. Vol. 8. Springer-Verlag, Berlin.
- , AND A. E. HOFFMANN-J. 1997. *Lomas Formations of the Atacama Desert, Northern Chile*. Pages 528–535 in S. D. DAVIS, V. H. HEYWOOD, O. HERRERA-McBRYDE, J. VILLA-LOBOS AND A. C. HAMILTON, EDS., *Centres of Plant Diversity, A Guide and Strategy for their Conservation*. WWF, Information Press, Oxford, UK.
- , S. LEIVA-G., AND V. QUIPUSCOA-S. 2007a. Five new species of *Nolana* (Solanaceae-Nolaneae) from Peru and notes on the classification of additional taxa. *Araldoa* 14: 171–190.
- , T. TU, A. SOEJIMA, T. YI, Z. NIE, A. TYE, AND J. WEN. 2007b. Phylogeny of *Nolana* (Nolaneae, Solanoideae, Solanaceae) as inferred from granule-bound starch synthase I (GBSSI) sequences. *Taxon* 54: 1000–1011. DOI: 10.2307/25065900 <http://www.jstor.org/stable/25065900>
- , T. TU, L. XIE, V. QUIPUSCOA S., AND J. WEN. 2009. Biogeographic diversification in *Nolana* (Solanaceae), a ubiquitous member of the Atacama and Peruvian Deserts along the western coast of South America. *J. Syst. Evol.* 47: 457–476. DOI: [10.1111/j.1759-6831.2009.00040.x](https://doi.org/10.1111/j.1759-6831.2009.00040.x)
- MESA-M, A. 1981. *Nolaneae*. *Flora neotropica* 26: 1–197. <http://www.jstor.org/stable/4393742>.
- QUIPUSCOA-S., V., AND M. O. DILLON. 2018. Four new endemic species of *Nolana* (Solanaceae-Nolaneae) from Arequipa, Peru. *Araldoa* 25(2): 295–322.
- RUNDEL, P. W., M. O. DILLON, B. PALMA, A. H. MOONEY, S. L. GULMON, AND J. R. EHRLINGER. 1991. The phytogeography and ecology of the coastal Atacama and Peruvian Deserts. *Aliso* 13: 1–50. DOI: 10.5642/aliso.19911301.02
- RUNDEL, P. W., P. E. VILLAGRA, M. O. DILLON, S. ROIG-JUÑENT, AND G. DEBANDI. 2007. Arid and semi-arid ecosystems. Pages 158–183 in T. T. VELEN, K. R. YOUNG, AND A. R. ORME, EDS., *The Physical Geography of South America*. Oxford University Press, Oxford, UK.
- TURLAND, N. J., J. H. WIERSEMA, F. R. BARRIE, W. GREUTER, D. L. HAWKSWORTH, P. S. HERENDEEN, S. KNAPP, W.-H. KUSBER, D.-Z. LI, K. MARHOLD, T. W. MAY, J. MCNEILL, A. M. MONRO, J. PRADO, M. J. PRICE, AND G. F. SMITH. 2018. International Code of Nomenclature for Algae, Fungi, and Plants (Shenzhen Code) Adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. *Regnum Vegetabile* 159. Koeltz Botanical Books, Glashütten. DOI <https://doi.org/10.12705/Code2018>