A New Cryptic Species of *Nemophila* (Hydrophyllaceae) from Texas and the Leptotypification of *N. phacelioides* Nuttall

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Abstract: Nemophila sayersensis, a cryptic species restricted to sandy, nutrient poor soils and sister to *N. phacelioides,* is described and illustrated. While examining type material of *N. phacelioides* and that of its synonyms, it became obvious that the species had never been typified despite its widespread distribution and treatment in numerous revisions. We here typify all named entities associated with the two species.

Keywords: Cryptic species, edaphic species, flora of Texas, Hydrophyllaceae, *Nemophila.*

As part of a phylogenetic study of *Nemophila* Nutt. and the evolutionary relationship of *Nemophila* to other members of the Hydrophylleae (Hydrophyllaceae), a pair of possible edaphic races of the south-central U. S. species *N. phacelioides* Nutt. were studied (Helfgott, 2000). The first of these (typical *N. phacelioides*) occurs in comparatively shaded areas, usually along watercourses, on relatively nutrient-rich, sandy loam soils. The second, originally called the Sayers form, for the Texas locale where it was first noted, occurs in drier, more open habitats on very sandy, comparatively nutrient-poor soils. While the distribution of the Sayers form is entirely within the distribution of typical *N. phacelioides,* we have never found populations of the two forms to be sympatric. Chemical analyses indicated consistent, statistically significant differences between the soils occupied by the two forms (Helfgott, 2000). Crossing studies found an average seed set per fruit of only 0.17 (of a possible four seeds per fruit) for crosses between the two forms while crosses between populations of typical *N. phacelioides* averaged 2.29 seeds per fruit and crosses between populations of the Sayers form averaged 2.06 seeds per fruit (Helfgott, 2000). In addition, parsimony analysis of DNA sequence data including individuals from several populations of each form yielded two clades, one of the typical form, the other of the Sayers form. Details of this study can be found in Helfgott (2000).

We also found that the two entities display distinctive morphological features (i.e., significantly shorter stature and more darkly colored corollas [Fig. 1, Table 1] in the Sayers form relative to typical *N. phacelioides*) that were retained in greenhouse experiments (Helfgott, 2000). In addition to the obvious color differences visible to the human eye, the two forms differ in their ultraviolet reflection patterns. The inner surfaces of the corolla lobes of typical *N. phacelioides* are strongly UV absorbent while those of the Sayers forms are distinctly, albeit weakly, UV reflective (Fig. 2). In both forms, the outer corolla lobes surfaces are weakly UV reflective. The basal corolla spots are seen as distinct UV absorbant spots in typical *N. phacelioides* but form a dark, coalesced, basal UV absorbant ring in the Sayers form. The combination of morphological, habitat, and DNA differences coupled with the strong crossing barriers indicate

FIG. 1. Ventral views of corollas of *N. sayerensis* and *Nemophila phacelioides.* A. *N. Nemophila sayerensis*, B. *N. phacelioides.*

these are biologically distinct entities, each worthy of species status.

Unfortunately there is overlap in the ranges of sizes between the two species and flower color is usually lost during drying for herbarium specimens, obscuring the fact until now that two very similar but distinct species are involved. Consequently, without precise ecological data or geographical information it is difficult to identify herbarium specimens correctly.

We have examined the type material of *Nemophila phacelioides* and its synonyms to determine to which of the species the name was originally applied. We found that all validly published names refer to the species found in wetter sites on sandy loam with *N. phacelioides* the correct name. Despite the fact that *Nemophila* was treated extensively in several early revisions and in a comprehensive monograph by Constance (1941), *N. phacelioides* was never typified. We therefore here typify *N. phacelioides* and provide complete synonymy. We also provide a description for the species on sandy soils and list specimens we have collected that can be placed with certainty in this species.

Nemophila sayersensis B. B. Simpson, Neff, and Helfgott, sp. nov.—(Figs. 1, 2)

TYPE: UNITED STATES. TEXAS: Bastrop Co: Sayersville, Sayers Road off hwy. 95 along Little Sandy Creek growing with willow, post oak, pecans, and elms in very sandy soil, 30° 13.945′N, 97° 19.80′ W, 8 Apr 2001, *B. B. Simpson 8-IV-01-5.* (HOLOTYPE: TEX; ISOTYPES: BM, GH, JEPS, K, PH).

A *Nemophila phacelioides* statura minore, indumento pilis longissimis, corolla intensius violaceis, et habitat in locis arenosis differt.

ANNUALS forming a rosette early in the spring and then bolting to become weak, diffusely branched plants to 27 cm tall. Basal leaves 3–17 cm long including the short petiole, 1.7–4.0 cm wide, oblong in outline, pinnately divided into 3–5 entire or 2–3 lobate segments, light green, cordate basally,

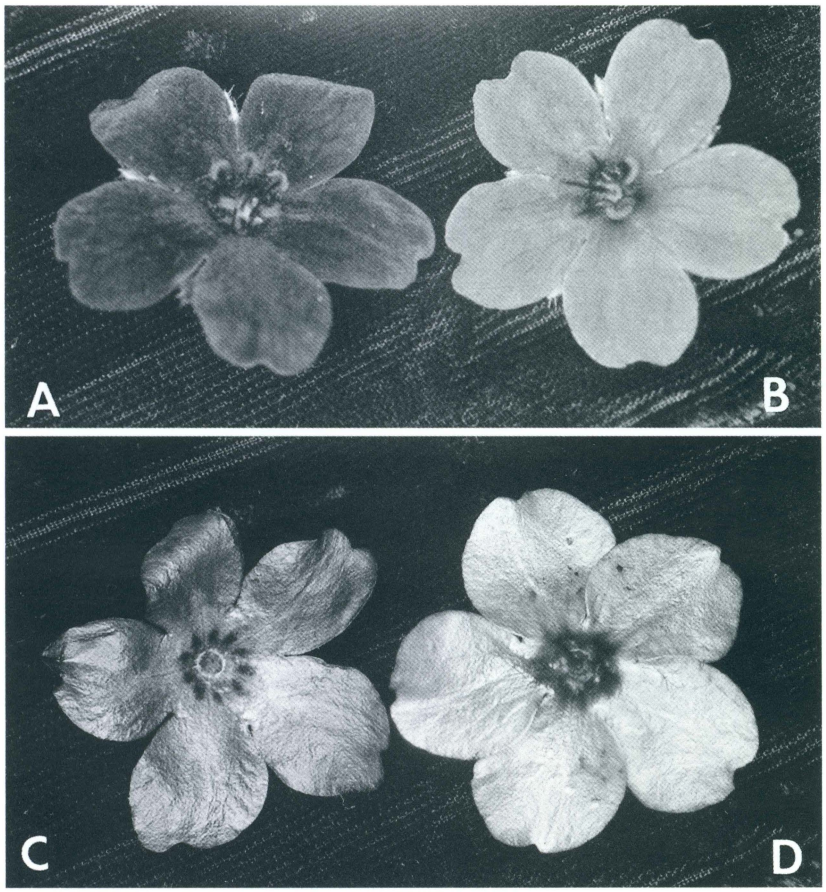

FIG. 2. Corollas of *Nemophila phacelioides* and *N. sayersensis* photographed using a UV filter. A. Ventral view of *N. phacelioides* showing the UV absorptive character of the petals. B. Ventral view of *N. sayersensis* showing the UV reflective surface of the petals. C. Dorsal view of the corolla of *N. phacelioides* with the sepals removed showing the pattern of absorptive dots at the base. D. Dorsal view of *N. sayersensis* showing the absorptive ring at the base of the corolla.

obtuse at the apex, hirsute on both surfaces; cauline leaves similar but decreasing in size up the stem. FLOWERS 21–34 mm in diameter, opposite a leaf or in terminal helicoid cymes; calyx broadly campanulate, lobes oblong to ovate, auricles erect or spreading, corolla shallowly cupped to almost flat, deep blue-purple with a lighter center and with two faint purple triangles or dots on each petal segment at the base of tube; lobes twice the length of the tube, somewhat irregularly toothed; corolla scales broad, often partly free and fimbriate; filaments equaling the tube, anthers oblong; ovary globose, surmounted by a style 5–6 mm long cleft for about one fourth its length. FRUIT a capsule 7–8 mm at the widest part, 7–9 mm tall, equal to, or exceeded by, the accrescent calyx; seeds usually 4, nearly globose, brown, with regular rows of deep pits, 3–4 mm in diameter; cucullus consisting of a patch of hyaline concave scales that sometimes form stripes on the sides of the seed, persistent.

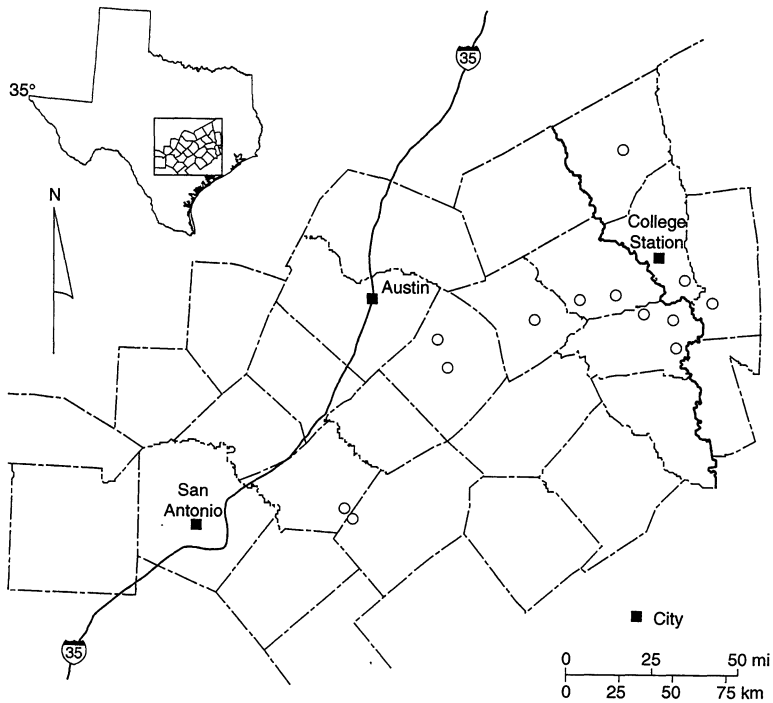

FIG. 3. Distribution of known populations of *Nemophila sayersensis* (open circles). Populations from which a representative specimen is not cited are sight records.

OTHER SPECIMENS EXAMINED: TEXAS. Bastrop Co.: Fairview, Fairview Cemetery off rt. 95 on the E side of Bastrop, 1 Mar 1997, *D. M. Helfgott 17Feb97-1* (TEX); Local in deep loose sand, partially shaded roadside, NW side of Co. road 179, 0.5 mi SW of Co. road 49, just SW of Sayersville, Lake Bastrop Quadrangle 301315N, 972010W, 29 Apr 1990, *W. R. Carr 10508* (TEX). Burleson Co.: rt. 1361, 4 mi NE of Somerville, 30° 22.671′ N, 96° 28.765′ W, 8 Apr 2001, *B. B. Simpson 8-IV-01-4* (TEX); SE of Somerville, moist shady bank, 24 Apr 1970, *D. S. Correll & H. B. Correll 38491* (TEX). Gonzales Co.: Capote Hills ca 100 yards from the Guadalupe Co. line on rt. 466, 29° 28.5′ N, 97° 44.3′ W, 7 May 1995, *B. B. Simpson 07-V-95-3* (TEX). Grimes Co.: 4 mi N of Navasota on rt. 6, 8 Apr 2001, *B. B. Simpson 8-IV-01-2* (TEX). Lee Co.: In sandy field 6 mi E of Lincoln, 26 Apr 1947, *C. M. Rowell & F. A. Barkley 17T109* (TEX). Robertson Co.: on rt. 1644, 2.9 mi S of Calvert. 30° 56.751′ N, 96° 41.150 W, 8 Apr 2001, *B. B. Simpson 8-IV-01-1* (TEX). Washington Co.: Pickens rd. off rt. 105 from Navasota to Brenham, along the road in tall grass, 8 Apr 2001, *B. B. Simpson 8-IV-01-3* (TEX); rt. 96, N side of rd., 0.6 mi W of rt. 105, 30° 20′ 385″ N, 96° 10′ 5.37″ W, 12 Mar 2000, *D. M. Helfgott 12Mar00-1* (TEX); Washington-on-the-Brazos State park ca. 300–450 yds N of Star of the Republic Museum, 21 Mar 1997, *A. Harry 15* (TEX).

Nemophila sayersensis is restricted to fossil beach sand areas in central Texas. *Nemophila phacelioides,* in contrast, is a widespread species growing from northern Oklahoma and Arkansas to central and eastern Texas and Louisiana on sandy-loam soils in areas moist and shady in the spring. The most obvious feature distinguishing *N.*

TABLE 1. Differences between *Nemophila sayersensis* and *N. phacelioides.*

Character	*N. sayersensis*	*N. phacelioides*
Corolla lobe color	Violet to deep violet	Light violet
Markings at base of each corolla lobe	Two pronounced purple triangular spots (sometimes lacking)	Two light purple or brown spots
UV pattern of upper corolla lobes	Inner petals UV reflective	Inner petals UV absorptive
UV pattern of dorsal corolla base	Basal spots appear as a UV absorbant ring	Basal spots distinct
Stem vestiture	Densely hirsute	Moderately hirsute
Trichomes	Retrorse, many ca. 2 mm long	Irregularly oriented, most shorter than 2 mm
Habitat	Sunny, open habitats, sterile sands	Shady, riparian alluvial sandy loam

sayersensis and *N. phacelioides* is the corolla color: dark blue-purple in the former and light blue in the latter (Fig. 1). In addition, plants of *N. sayersensis* are generally smaller (to 27 cm) than those of *N. phacelioides* (to 60 cm), but the flowers of *N. sayersensis* are larger on average (29.9 mm across) than those of *N. phacelioides* (24.8 mm in diameter). However, there is substantial overlap cross the range of plant and flower size. *Nemophila sayersensis* can be distinguished from *N. phacelioides* by the features listed in Table 1.

In his original description of *Nemophila phacelioides,* Nuttall listed the type locality as "In the shady woods of Cedar prairie, ten miles from Fort Smith, and from thence in similar situations to the sources of the Pottoe." When Constance monographed *Nemophila* in 1941, he listed the type locality verbatim but did not designate a specimen as type. In his list of specimens examined, he included specimens of Nuttall's with uncertain localities at G, NY, and PH as well as a specimen at PH with the locality of "Red River" and one from K with a locality "Arkansas near Fort Smith or Belle Point." This last specimen he labeled as "?isotype." We have reviewed the Nuttall specimens from BM, GH, K, and PH. Kew has three specimens with Nuttall collections. One specimen indeed says "Arkansas Belle Point (Fort Smith)" but is annotated (apparently in Nuttall's hand) with the name **Nemophila coerulea* (as well as *N. phacelioides*). A second sheet has two plants and is labeled simply "Arkansas." On the third sheet there are three sprigs (or plants), one a Nuttall specimen labeled only with "Arkansas" but with a pinned note with the locality as cited in the description and the place of publication. The British Museum also has a specimen with the notation in the same handwriting of **Nemophila coerulea* with the locality of "Arkansas, Belle Point (Fort Smith)." PH has two Nuttall sheets. On one sheet with two plants, no locality is given, on the other, only "Red River" is noted. None of the specimens from GH qualify as a potential type of the species, but on one sheet there are sprigs of the plants described by Buckley that Gray reduced to synonymy (see below).

The notes on the K and on the BM specimens indicate that Nuttall probably was going to name the species *Nemophila coerulea* originally but later changed his mind. The BM and K "Fort Smith" sheets are the only specimens with sufficient label data to assure that they are type material.

Since Nuttall's personal herbarium is now at BM (Stafleu & Cowan, 1981), we designate the specimen at BM with the Fort Smith locality as lectotype and the K specimen as isolectotype.

NEMOPHILA PHACELIOIDES Nuttall in Barton, Fl. N. Amer. 2: 71. 1822 [Nutt., in J. Acad. Nat. Sci. Philadelphia 2: 179. 1822]. TYPE: UNITED STATES. Arkansas. [Sebastian Co.]: "In the shady woods of Cedar prairie, ten miles from Fort Smith, and from thence in similar situations to the sources of the Pottoe [= Poteau]" [9 May 1819], *Nuttall s.n.* (LECTOTYPE: BM! here designated; ISOLECTOTYPE: K!).

N. nuttalli Colla, Hort. Rip. App. 1: 116, t. 5. 1824 (nom. illeg.)

Colla described this taxon from plants he grew in the garden in Turino. The seeds for the plants were sent to Colla by the Philadelphia Academy of Sciences under the name of *N. nemorosa.* Colla clearly states in his protologue that his species is the same as *N. phacelioides* of Nuttall. Hence this is an illegitimate name.

N. nemorosa Ruben-Heynes ex Steud., Nom. Bot. Ed. 2. 2: 189. 1841 (as a synonym). A *nomen nudum.*

N. hirsuta Buckley, Proc. Acad. Nat. Sci. Philadelphia 13: 462. 1862. TYPE: UNITED STATES. TEXAS. Western Texas, May [1861], *S. B. Buckley s.n.* (HOLOTYPE: PH!; ISOTYPE: fragment at GH!).

Buckley described both this species and the next in the same publication. Gray (1862) subsequently considered both as synonyms of *N. phacelioides,* saying that he was "surprised at the large number of new species which he [Buckley] had gleaned in such a well-harvested field." The type of this species is mounted on the same sheet at PH as that of *N. pilosa.* According to Dr. Laurence Dorr [in litt.], who has studied Buckley's travels in Texas, the trip to "western Texas" (which is north-central Texas today) was in 1861. *Nemophila sayersensis* does not occur in this region. Examination of the type of *N. hirsuta* showed that its morphological characters fall within the range of *N. phacelioides.*

N. pilosa Buckley, Proc. Acad. Nat. Sci. Philadelphia 13: 463. 1862. TYPE: UNITED STATES. TEXAS. Travis Co.: Austin, Apr 1860, *S. B. Buckley s.n.* (HOLOTYPE: PH!).

The type of this specimen mounted with that of *Nemophila hirsuta* is most similar in morphology to *N. sayersensis* and, if it had been collected in the right habitat could arguably have been our new species. The plant is small and the trichomes dense and sometimes up to 2 mm long. However, the locality is clearly stated as Austin and the date 1860. According to L. Dorr [in litt.] Buckley did not collect east of Austin in April of 1860. Only *N. phacelioides* occurs in Austin proper.

Viticella phacelioides (Nutt.) MacBride, Contr. Gray Herb. 59: 30. 1919.

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