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TAXONOMY OF *GENTIANELLA* (GENTIANACEAE) IN MÉXICO

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ABSTRACT

The taxonomy is detailed for the twelve Mexican species of *Gentianella* (excluding *Gentianopsis*). Among them are four new species, **Gentianella calycidon, Gentianella fimbrilinguis, Gentianella glossocarpa,** and **Gentianella tarahumarae,** as well as **Gentianella sandiana** *comb. et stat. nov.* Distribution maps are included.

KEY WORDS: *Gentianella*, Gentianaceae, México

A detailed revision of the North American species of *Gentianella* was provided by Gillett (1957), but both his generic and species concepts have been considerably restricted by later students of the Gentianaceae. Particularly, the segregation of *Gentianella* subgenus *Eublephis*, the "fringed gentians," as *Gentianopsis* (Ma 1951) has been generally recognized as justified (Iltis 1965). *Gentianella* subgenus *Comastoma* also has been segregated as a separate genus (Tokokuni 1961; other transfers by Holub 1967), but these species have generally been retained within *Gentianella* in recent floristic treatments (*e.g.*, Holmgren 1984).

Gentianella and *Gentianopsis* both differ from *Gentiana* in their epipetalous nectar glands, corollas without conspicuous folded plaits between the lobes, and calyx tubes usually without an inner membranous rim. Based on these features, both genera are perhaps more closely related to *Frasera* and *Swertia* than to *Gentiana* (Tokokuni 1963). *Gentianella* differs from *Gentianopsis* in its much smaller corollas and smooth (vs. papillose) seeds.

Gentianella is a cosmopolitan genus comprising about 100-125 species of temperate regions. The greatest number of species are found in South America, which were treated in large part by the studies of Fabris (1960) and Pringle (1981). Other centers of lower diversity are in North America, Europe, and Asia. Eleven species of *Gentianella* occur in North America north of México (Kartesz & Kartesz 1980) and twelve in México; four of these cross the international border in their distribution. A number of these represent taxa raised from subspecific rank (*sensu* Gillett 1957) to specific rank by Holub (1967).

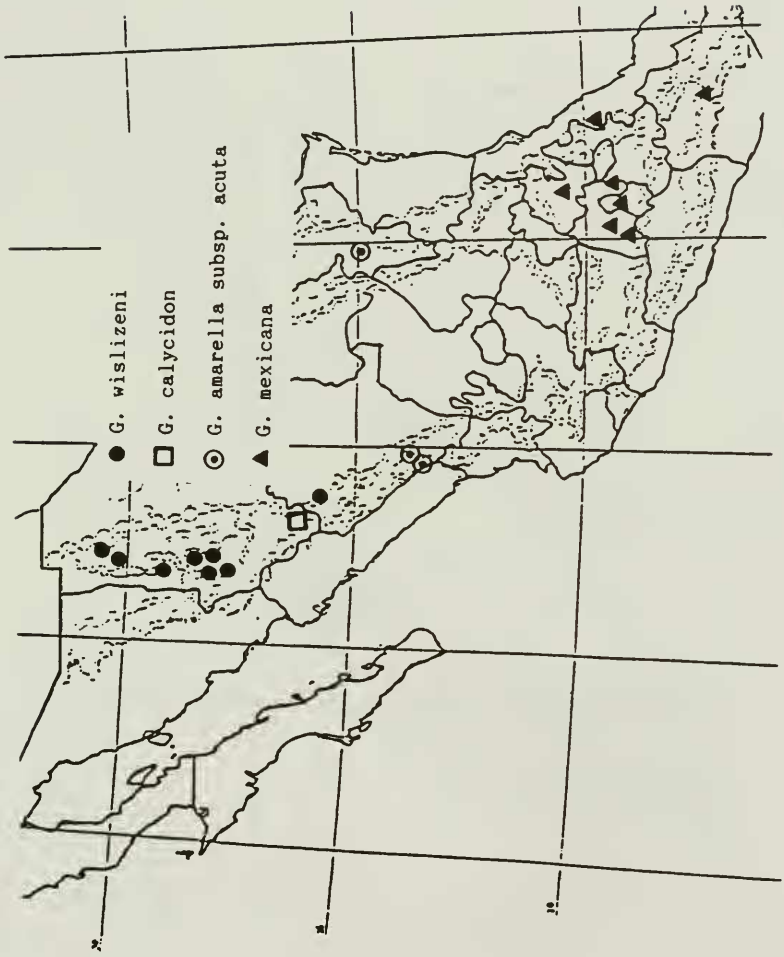
The latter worker provided only a short paper that presented many new combinations but no discussion or explanation of the taxonomic decisions. The present study evaluates and summarizes the taxonomy of the Mexican species.

In my overview, all of the Mexican taxa recognized by Gillett are accepted, but all except one are recognized at the specific rank; however, some of the collections studied by Gillett are identified differently. Four new species are recognized, in addition to another recently described in a separate paper (Nesom & Turner 1990). Several of the species appear to be somewhat variable in morphology, but all are distinct and there is no evidence of intergradation among any of the taxa. In Mexico, species of *Gentianella* that are most closely similar among themselves appear to be allopatric (Maps 1-3) and consequently have little or no opportunity to hybridize. Many of these species apparently are extremely narrow in their geographic distribution and at least three are probably in immediate danger of extinction.

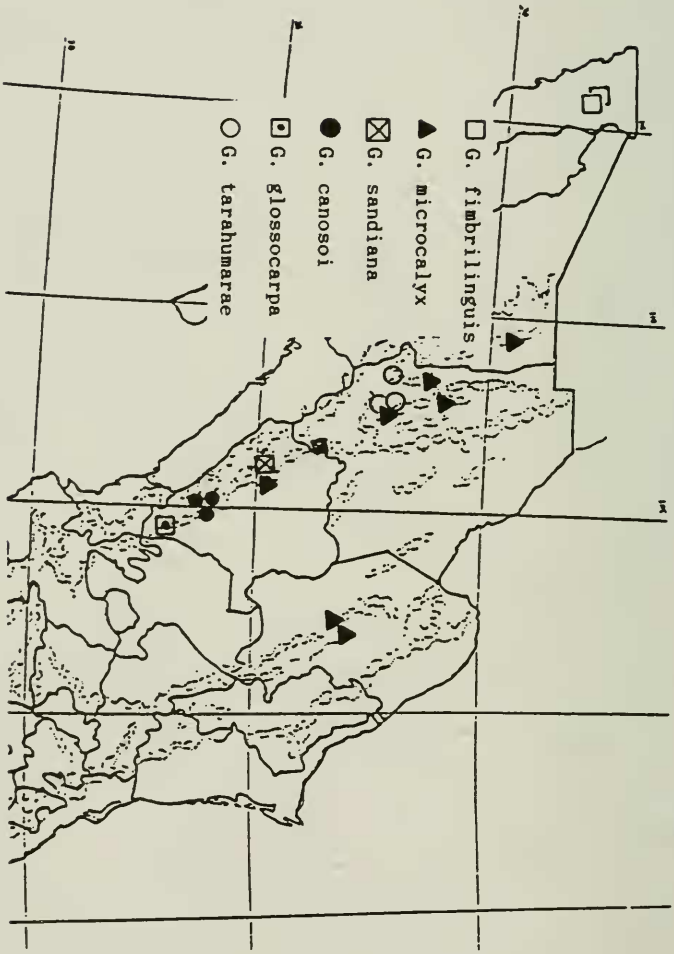
Plants of the Mexican species of *Gentianella* are notably similar in their vegetative morphology, and as seen in the key and reflected in the descriptions, features that distinguish the taxa are almost completely restricted to the flowers and fruits. Among the species included here, the color of fresh corollas appears to be either primarily yellowish or variably purplish to bluish to nearly white. The pigments, however, have a strong tendency to become yellowish when dry, and use of flower color in the identification of dried specimens is not particularly reliable.

Gentianella Moench, *Meth. Pl.* 482. 1794.

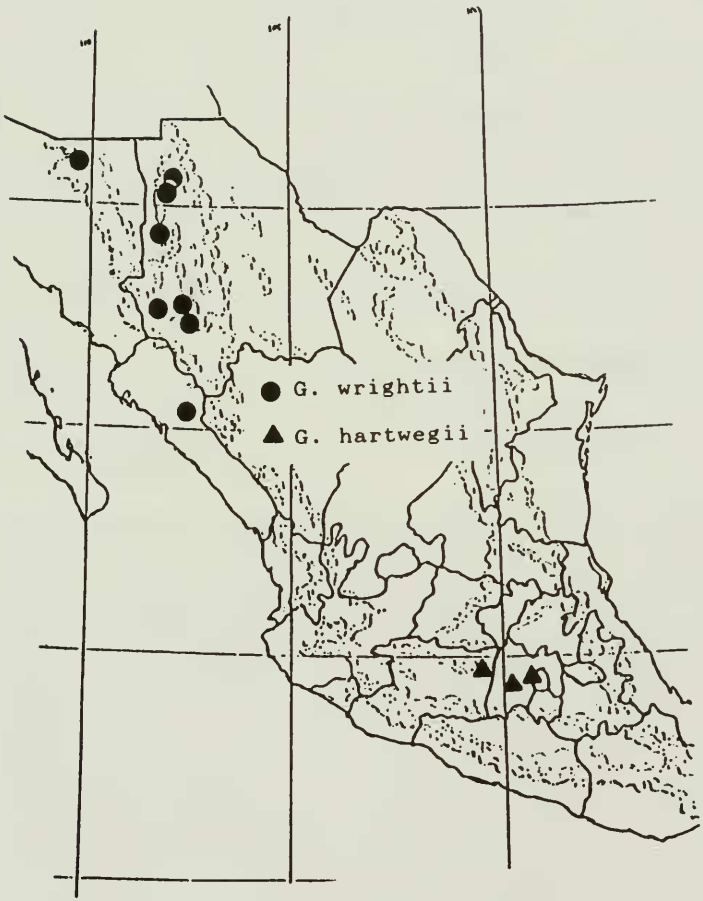
Taprooted annuals, glabrous, smooth or minutely papillate-scabrous. Stems erect, simple from the base or rarely few branched, often ridged. Leaves opposite, epetiolate, commonly subclasping, entire, 3-5 nerved, the basal usually absent by flowering [in the Mexican taxa]. Flowers (4-) 5-merous, convolute in bud, mostly in compact, axillary and terminal cymes, pedicels longest on the lower nodes; calyx usually with a short tube, lacking an inner membranous rim, with lobes equal or unequal in length; corollas yellow to purplish blue, tubular to funnelform or campanulate, 5-25 mm long, with epipetalous nectar glands at the base of the tube, the lobes spreading to erect, without plicae in the sinuses, usually with a row of fimbriae inserted at the base of the lobes. Stamens epipetalous, the filaments often narrowly winged basally, often adnate for about half the corolla tube length, the anther thecae 0.6-1.0 mm long, positioned near the apex of the throat, included within the tube or barely exserted. Ovaries unilocular, placentation parietal, the 2 stigmas persistent on the fruit apex; fruits sessile or short stipitate, usually slightly exserted from the corolla, capsular, 2 valved, septicidal, apically dehiscent. Seeds numerous, 0.6-1.0 mm long, brownish, more or less smooth, round to slightly flattened. Base chromosome number, $x = 9$ in subg. *Gentianella* (see comments by Pringle 1981), $x = 5$ in subg. *Comastoma*.



Map 1


G. fimbrilinguis
G. microcalyx
G. sandiana
G. canosoi
G. glossocarpa
G. tarahumarae

Map 2



Map 3

Type species, *Gentianella tetrandra* Moench (= *Gentianella campestris* [L.] Borner), a European species.

KEY TO THE MEXICAN SPECIES

1. Calyx lobes linear lanceolate, lanceolate, or ovate lanceolate, 2-12 mm long, the sinuses acute to sharply rounded. ..... (3)

1. Calyx lobes teethlike, 0.5-2.0 mm long, usually of a thicker texture than the tube, arising from a calyx tube with a relatively flat upper margin. ..... (2)

2. Calyx split to the base along one side to form a membranaceous sheath. ..... *G. wislizeni*

2. Calyx a continuous tube, herbaceous in texture, not membranous. ..... *G. calycidon*

3. Calyx tube (1-)2-3 mm long, with lobes 3-12 mm long; corollas 10-18 mm long. ..... (5)

3. Calyx tube 0.5-1.0 mm long, with lobes 2-4 mm long; corollas 6-11 mm long. ..... (4)

4. Corollas without fimbriae, the tube 4.0-6.5 mm long; calyx lobes thin herbaceous, narrowly triangular; fruits sessile. . *G. microcalyx*

4. Corollas with numerous fimbriae, the tube 6-8 mm long; calyx lobes fleshy, linear; fruits stipitate. ..... *G. tarahumarae*

5. Calyx tube 2.0-3.5 mm long. ..... (8)

5. Calyx tube 1-2 mm long. ..... (6)

6. Corollas 17-20 mm long; apical extensions of fruit 1.2-1.8 mm long, narrowly oblong. ..... *G. glossocarpa*

6. Corollas 8-16 mm long; apical extensions of fruit 0.3-0.5 mm long, ovate. ..... (7)

7. Calyx lobes 6-12 mm long, with minutely papillate margins; corollas 13-16 mm long, the tube 9-11 mm long, the lobes relatively even in length, with fimbriae inserted at the base of the lobes. ..... *G. amarella*

7. Calyx lobes 3-7 mm long, with smooth margins; corollas 8-14 mm long, the tube 4-8 mm long, the lobes strongly uneven in length, with fimbriae inserted at about midlength of the lobes. ..... *G. fimbrilinguis*

8. Calyx 5-11 mm long, the tube 2-3 mm long; corollas mostly bluish or purplish before drying, 10-18 mm long. .....(10)

8. Calyx (9-)12-15 mm long, the tube 3-4 mm long; corollas yellow before drying, 17-25 mm long. .....(9)

9. Corollas 20-25 mm long, the lobes 7-10 mm long, with attenuate apices, the throat densely fimbriate. ..... *G. wrightii*

9. Corollas 17-21 mm long, the lobes 5-7 mm long, with acute but not attenuate apices, the throat sparsely fimbriate. ..... *G. hartwegii*

10. Calyx lobes 4-8 mm long; corolla fimbriae inserted well above the base of the lobes. ..... *G. mexicana*

10. Calyx lobes 3-4 mm long; corolla fimbriae inserted at the base of the lobes. .....(11)

11. Pedicels and the veins, lamina, and margins of calyx lobes and tube densely scabrous with erect, prominent papillae. ..... *G. canosoi*

11. Pedicels smooth, the calyx sometimes with minutely papillate-scabrous margins, otherwise smooth. ..... *G. sandiana*

1. *Gentianella amarella* (L.) Borner subsp. *acuta* (Michx.) Gillett, Ann. Missouri Bot. Gard. 44:253. 1957. BASIONYM: *Gentiana acuta* Michx., *Fl. Bor. Amer.* 1:177. 1803. TYPE: [CANADA. Quebec.] Near "Tadoussack," *A. Michaux s.n.* (P). *Amarella acuta* (Michx.) Rafin., *Fl. Tellur.* 3:21. 1837. *Ericala acuta* (Michx.) G. Don, *Gen. Syst. Gard. Bot.* 4:190. 1837. *Gentiana amarella* L. var. *acuta* (Michx.) Herder, Trudy Imp. S-Peterburgsk. Bot. Sada 1:428. 1872. *Gentianella acuta* (Michx.) Hiit., Mem. Soc. Faun. Fl. Fenn. 25:76. 1950. *Gentiana amarella* L. subsp. *acuta* (Michx.) Hultén, Ark. Bot., ser. 2, 7:107. 1968. *Gentiana amarella* L. f. *michauxiana* Fern. (homotypic with *Gentiana acuta*), Rhodora 19:151. 1917. *Gentianella amarella* (L.) Borner f. *michauxiana* (Fern.) Scoggan, *Fl. Canada* 1:52. 1978.

Michaux's citation reads "in montibus altibus Carolinae et Canada, prope Tadoussack." The only species of *Gentianella* of the Appalachian Mountains in the "Carolina" region is *G. quinquefolia* (L.) Small. See Gillett (1957) for numerous other North American (north of México) synonyms of *Gentiana acuta.*

Leaves spreading-ascending, ovate-lanceolate, 3-5 nerved, 15-25 mm long. Pedicels 3-12 mm long. Calyx 7-13 mm long, the tube 1-2 mm long, the lobes 6-12 mm long, often strongly unequal in width, less so in length, herbaceous,

the margins distinctly papillate-thickened and commonly purplish. Corollas blue to purple, 13-16 mm long, the tube 9-11 mm long, the 5 lobes 4-5 mm long, lanceolate-ovate, erect, fimbriae numerous, inserted at the base of the corolla lobes. Staminal filaments slightly winged, adnate along the basal 1/4-1/3 of the corolla tube, anthers purplish. Fruits sessile, 12-15 mm long, not exceeding the corolla at maturity, the apices erect.

Disjunct populations in Durango and Nuevo León, widespread in the western United States, eastern to western Canada and north into Alaska, the Aleutian Islands, northeastern U.S.S.R.; in Nuevo León, meadows, openings in conifer forests, just below to above timberline, ca. 3400-3800 m, July-September; 2000-2100 m in Durango.

Additional collections examined: MÉXICO. Durango: Mpio. Pueblo Nuevo, 5 km NE of El Palmito, steep barranca wall, 19 Oct 1983, *Breedlove 58881* (MO); 21.9 mi NE of El Paraiso, Sinaloa, on road between Villa Union and El Salto, steep, moist embankment, 29 Sep 1953, *Ownbey & Ownbey 1984* (GH, US). Nuevo León: Cerro Potosí, 27 Aug 1987, *Bogler & Atkins 149* (TEX); Cerro Potosí, 21 Aug 1969, *Hinton, et al. 17244* (TEX); Cerro Potosí, 23 Aug 1984, *Lavin 4782* (TEX); Cerro Potosí, 26 Jul 1985, *McDonald 1783* (MO, TEX); Cerro Potosí, 21 Jul 1935, *Muller 2247* (GH, MO); Cerro Potosí, 1938, *Univ. Illinois Students 971* (MO, US).

Gillett (1957) treated these plants as a subspecies of *Gentianella amarella* (L.) Borner, while noting that the subsp. *amarella* is restricted to central and western Europe, completely disjunct from its North American relatives. Subsp. *amarella* and another more geographically restricted subspecies have been recognized in western Europe (Clapham, *et al.* 1987). In comparisons of the American and Eurasian populations of *G. amarella*, Fernald (1917) concluded that all were conspecific, but he did not identify the origin of the extra-American specimens he compared. Fernald (1950) and Gleason & Cronquist (1963) recognized the North American plants as *G. amarella*, but similar plants that extend into northeastern Russia were identified as *G. acuta* Michx. (Grossgeim 1952). Hultén (1968) identified the same taxon from Alaska as *Gentiana amarella* L. subsp. *acuta* (Michx.) Hultén.

Compared to the American plants of *Gentianella amarella*, the European ones tend to have larger corollas (12-22 mm long, Clapham, *et al.* 1987). In the northeastern U.S.S.R., they are 9-13 mm long (Grossgeim 1952) and 10-15 mm long in Alaska (Hultén 1968). Clearly, the taxonomy of this complex needs to be studied in detail from a worldwide perspective, where there perhaps is as much justification for treating subsp. *acuta* and subsp. *amarella* at the specific rank as combining them into a single species.

Disjunct populations of subsp. *acuta* occur in Durango and Nuevo León, apparently as southern extensions of montane population systems in California-Arizona and in New Mexico, respectively. I can find no basis for separating these Mexican plants from others in the southwestern United States. Besides

subsp. *acuta*, Gillett recognized four additional subspecies within *Gentianella amarella* in the New World. In his view, each of the other four American subspecies of *G. amarella* has a more restricted geographic range, each partially overlapping with the range of subsp. *acuta*. Marroquin & Rzedowski (1984) recognized two taxa in the Valley of México as subspecies of *G. amarella*, which are treated here as the separate species *G. mexicana* (Griseb.) Holub and *G. hartwegii* (Benth.) Holub. They noted that citations of subsp. *acuta* from the Valley of México refer to plants of *G. mexicana*; Gillett's report of subsp. *acuta* from the state of México was based on two collections of somewhat immature plants of *G. mexicana*. Previous records of subsp. *acuta* from Baja California are identified here as *G. fimbrilinguis* Nesom.

2. **Gentianella calycidon** Nesom, *sp. nov.* TYPE: MÉXICO. Chihuahua: 11 mi SW of El Vergel, 9200 ft, 7 Oct 1959, *D.S. Correll & H.S. Gentry 22895* (HOLOTYPE: GH!).

   Gentianellae sandianae (Gillett) Nesom similis sed differt lobis calycis dentoidibus multo brevioribusque marginibus rasilibus, corollis brevioribus, et antheris luteis differt.

Leaves ovate-lanceolate, 13-17 mm long, 5-9 mm wide, trinerved, spreading, with minutely papillate-scabrous margins. Pedicels 5-9 mm long, with flowers laterally oriented to slightly nodding. Calyx 4.0 mm long, the tube 2.5-3.0 mm long, the lobes 1.0-1.5 mm long, teethlike, linear-lanceolate and thickened relative to the tube, with smooth margins, the sinuses broadly rounded to nearly flat. Corollas pale lavender, drying yellowish, 15-18 mm long, the tube 10-12 mm long, the lobes ovate, not speckled, 4-5 mm long, fimbriae numerous, inserted at the very base of the corolla lobes. Staminal filaments broadly winged on the basal third, adnate to the basal 3-4 mm of the corolla tube, the anthers yellow. Fruits sessile, mature size not observed.

Known only from the type collection.

The calyx of *Gentianella calycidon* Nesom, with its flat margined tube and short, teethlike lobes with smooth margins, is very similar to that of *G. wislizeni* (Engelm.) Gillett, but the calyx is not as thin textured or cut to the base as in the latter. *Gentianella microcalyx* (Lemmon) Gillett has a calyx with short but scabrous margined lobes and much shorter tube, blue and shorter corollas, and no fimbriae in the corolla. *Gentianella calycidon* is different from *G. sandiana* (Gillett) Nesom in its fewer flowered inflorescence, shorter and differently textured calyx lobes without scabrous margins, shorter corollas, and yellow anthers.

3. *Gentianella canosoi* Nesom & Turner, Sida 14:227. 1990. TYPE: MÉXICO. Durango: Mpio. Pueblo Nuevo, vicinity of El Salto, pine woods, 4 Oct 1981, *S. González & S. Acevedo 2053* (HOLOTYPE: TEX!; Isotypes: GH!, MO!).

Stems often purple, the young portions densely papillate-scabrous, smooth below or remaining slightly scabrous along the ridges. Leaves subclasping, not basally connate, trinerved, lanceolate, 15-35 mm long, 3-6 mm wide, the margins minutely papillate-scabrous. Pedicels 1-4 mm long. Calyx prominently scabrous on the veins and lamina with long, erect papillae, most densely so on the veins, 5-6 mm long, the tube 2.0-2.5 mm long, the lobes linear-lanceolate, 3-4 mm long, equal in length or nearly so, spreading at the apices. Corollas yellow, drying yellow to purplish, 13-16 mm long, the tube 8-10 mm long, the 5 lobes spreading-erect, 5-6 mm long, with attenuate apices, fimbriae numerous, inserted at the base of the corolla lobes. Staminal filaments narrowly winged basally, adnate to the corolla tube for about half its length, anthers yellow. Fruits sessile, 14-18 mm long, distinctly exceeding the corollas.

South-central Durango; pine-oak woodlands, rich soil, ca. 2400-2650 m; September-November.

Additional specimens examined: MÉXICO. Durango: Sierra Madre W of Durango, Sep-Oct 1881, *Forrer s.n.* (US); Mpio. Pueblo Nuevo, 6 mi W of La Ciudad on Hwy 40, at Puerto de Buenos Aires, 7 Nov 1964, *Flyr 276* (TEX); Mpio. Pueblo Nuevo, 5 km SW of El Salto, 4 Oct 1981, *González & Acevedo 2033* (TEX); Mpio. Pueblo Nuevo, along Hwy 40 at the turnoff to La Campana, 3.2 mi W of Las Adjuntas and 14.7 mi W of El Salto, 26 Sep 1973, *Reveal 3458* (TEX).

4. **Gentianella fimbrilinguis** Nesom, *sp. nov.* TYPE: MÉXICO. Baja California Norte: Sierra San Pedro Martír, banks of La Sanca creek, 5 mi NW of La Grulla, 6700 ft, 17 Sep 1930, *I.L. Wiggins & D. Demaree 4845* (HOLOTYPE: GH!; Isotype: F).

Gentianellae amarellae (L.) Borner subsp. *acutae* (Michx.) Gillett similis sed differt lobis corollarum longis lanceolatisque in longitudine inaequalibus fimbriis ad ca. medio loborum insertis et filamentis antherarum ad basim tubi corollae insertis.

Plants 20-45 cm tall. Cauline leaves sharply ascending, ovate-lanceolate, not basally connate, 3-5 nerved, 15-40 mm long, the margins minutely papillate-scabrous. Pedicels 4-14 (-20) mm long. Calyx 4-8 mm long, the lobes smooth margined, 3-7 mm long, with sinuses acute to sharply rounded, the tube 1.0-1.5 mm long. Corollas purplish, 8-14 mm long, the tube 4-8 mm long, the 5 lobes lanceolate, erect, 4-6 mm long, often equaling or longer than the tube, usually very uneven in length, with one cut half the length of the corolla, each lobe bearing numerous fimbriae inserted in an arc at about midlength of the lobe. Staminal filaments not winged, inserted at the base of the corolla tube, anthers purple. Fruits short stipitate, 9-13 mm long, the apices erect to slightly divergent.

Baja California Norte, endemic to the Sierra San Pedro Martír; 2050-2350 m; September-October.

Additional collection examined: MÉXICO. Baja California Norte: Sierra San Pedro Martír, llanitos ca. 6 mi from La Encantada on trail to Vallecitos, 22 Sep 1938, *Wiggins 9075* (GH, US).

Both collections of this species were cited by Gillett (1957) as *Gentianella amarella* subsp. *acuta*, but they differ from the latter in the calyx tubes with smooth margins, anther filaments free to the base of the corolla tube, and shorter corollas with deeply cut, lanceolate corolla lobes of uneven length with fimbriae inserted at about the middle of the lobes. The fimbriae diverge from the corolla at about midpoint of the lobes and are adnate for a short distance below that. The corolla fimbriae of *G. mexicana* and *G. glossocarpa* Nesom are similarly positioned though not inserted so far distally.

5. **Gentianella glossocarpa** Nesom, *sp. nov.* TYPE: MÉXICO. Durango: Mpio. Mezquital, 48 km WNW of Huejuquilla El Alto, Jalisco, on road to Canoas, Durango; crest of ridge, forest of *Pinus*, *Arbutus*, and *Quercus*, with steep slopes to north and south, 2530 m, 21 Oct 1983, *D.E. Breedlove 59156* with F. Almeda (HOLOTYPE: MO!; Isotype: CAS).

   Gentianellae fimbrilingui Nesom similis tubis calycum brevibus, lobis calycum ad marginem laevibus, corollis caesiis, et lobis corollarum fimbriis supra basim insertis, sed foliis ad marginem laevibus, corollis longioribus, et fructibus longioribus extensionibus apicalibus linguiformibus 1.2-1.8 mm longis differt.

Plants 3-6 dm tall. Cauline leaves spreading-ascending, ovate-lanceolate, not basally connate, 3-5 nerved, 15-30 mm long, gradually reduced upwards, the margins smooth (not papillate). Pedicels 2-7 mm long. Calyx 5.5-7.0 mm long, the lobes smooth margined, 3.5-5.0 mm long, with acute to sharply rounded sinuses, the tube 2.0 mm long. Corollas "lavender," drying purplish blue, 17-20 mm long, the tube 11-12 mm long, the 5 lobes lanceolate, erect, 7-8 mm long, relatively even in length, each with numerous fimbriae inserted in an arc ca. 1 mm above the base. Staminal filaments not winged, inserted ca. 3 mm above the base of the tube; anthers purplish, not exserted from the corolla tube. Fruits 18-21 mm long, on a basal stipe ca. 2 mm long, the apices somewhat divergent, bearing persistent, narrowly oblong, tonguelike, apical extensions 1.2-1.8 mm long, these usually at least slightly recurved.

Known only from the type collection; the MO sheet bears three plants.

Gentianella glossocarpa Nesom is similar to *G. fimbrilinguis* Nesom in its short calyx tubes, calyx lobes with smooth margins, blue corollas, and corolla lobes with fimbriae inserted above the base but different in its smooth leaf margins, longer corollas, and longer fruits with long, tonguelike apical extensions. These latter structures (the persistent stigmatic portions of the ovary)

are found on *Gentianella* fruits of all species, but their shape and length on *G. glossocarpa* are distinct among the Mexican species. Further, the only other Mexican species with such long corollas and fruits are *G. hartwegii* and *G. wrightii* (A. Gray) Holub, which are closely related to each other but not especially close to *G. glossocarpa.*

6. *Gentianella hartwegii* (Benth.) Holub, Folia Geobot. Phytotax. 2:117. BASIONYM: *Gentiana hartwegii* Benth., *Pl. Hartw.* 47. 1840. TYPE: MÉXICO. Michoacán: Angangueo, [Aug-Sep 1838], *Hartweg 351* (probable HOLOTYPE: BM; Isotype: W, MO-photo!). *Gentiana mexicana* Griseb. subsp. *hartwegii* (Benth.) Wettst., Oesterr. Bot. Zeitsch. 50:291. 1900. *Amarella hartwegii* (Benth.) Arthur, Torreya 12:33. 1912. *Gentianella amarella* (L.) Borner subsp. *hartwegii* (Benth.) Gillett, Ann. Missouri Bot. Gard. 44:260. 1957.

   Gentiana mexicana subsp. *hartwegii* f. *pringlei* Wettst., Oesterr. Bot. Zeitsch. 50:291. 1900. TYPE: MÉXICO. México: Moist meadows, Nevado de Toluca, 11,000 ft, 6 Sep 1892, *C.G. Pringle 4237* (HOLOTYPE: WU; Isotypes: F, GH!, MO!, US!).

   Gentiana citrina Pollard, Proc. Biol. Soc. Washington 13:130. 1900. TYPE: MÉXICO. México: Wet meadows, valley of Toluca, 18 Aug 1892, *C.G. Pringle 4196* (HOLOTYPE: US; Isotypes: F, GH!, MEXU, MO!, NY).

Leaves ovate-lanceolate, spreading-ascending, 1.5-3.0 cm long, 7-12 mm wide, trinerved, basally rounded but not connate. Pedicels 5-25 mm long. Calyx 10-15 mm long, thin herbaceous, often with noticeable reticulate venation, the tube 3.5-5.0 mm long, the (4-) 5 lobes 5-10 mm long, slightly uneven in width. Corollas yellowish or creamy white, drying yellow, 17-21 mm long, the tube 11-16 mm long, the (4-) 5 lobes lanceolate ovate to lanceolate, 5-7 mm long, the apices acute to rounded, fimbriae relatively few though prominent, inserted at the base of the corolla lobes or slightly above. Staminal filaments narrowly winged near the base, adnate to the lower 3-4 mm of the corolla tube. Fruit sessile, 20-23 mm long, the apices erect to slightly divergent.

Michoacán, México, Distrito Federal; wet meadows, 2800-3400 m; July-October (-February).

Additional collections examined: MÉXICO. Distrito Federal: Near Dinamo de Contreras, 8 Aug 1965, *Rzedowski 20397* (TEX). México: Dist. Temascaltepec, Crucero-Agua Blanca, 8 Oct 1935, *Hinton 8320* (GH, US); Dist. Temascaltepec, Meson Viejo, 8 Feb 1932, *Hinton 1317* (GH, US); Dist. Temascaltepec, 9 mi E of Villa Victoria by Mex 15, 29 Jul 1965, *Kral 25169* (US).

Gentianella hartwegii and *G. wrightii* both produce flowers on relatively short pedicels, large and somewhat foliaceous calyx lobes, and large yellow

corollas, and they appear to be very closely related although distantly separated geographically. The latter differs chiefly in its slightly longer pedicels, smaller corollas with fewer fimbriae, and its smaller (on average) leaves.

7. *Gentianella mexicana* (Griseb.) Holub, Folia Geobot. Phytotax. 2:117. BASIONYM: *Gentiana mexicana* Griseb., *Gen. Sp. Gentian.* 243. 1839. TYPE: MÉXICO. "Patria," no other data, *Schiede s.n.* (GOET, not seen). *Gentianella amarella* subsp. *mexicana* (Griseb.) Gillett, Ann. Missouri Bot. Gard. 44:258. 1957. *Amarella mexicana* (Griseb.) Arthur, Torreya 12:34. 1912.

Leaves spreading-ascending, ovate-lanceolate, trinerved, (6-) 10-25 mm long, 5-9 mm wide. Pedicels 3-14 mm long. Calyx 6-11 mm long, the tube 2.0-3.5 mm long, the lobes narrowly lanceolate, 4-8 mm long, often strongly unequal in width, less so in length, herbaceous, the margins minutely papillate-scabrous. Corollas bluish to purple, 10-18 mm long, the tube 6-9 (-14) mm long, the lobes 3.5-5.0 mm long, ovate-lanceolate, erect, fimbriae numerous, inserted in an arc at about midlength of the corolla lobes or slightly below. Staminal filaments very slightly winged, adnate to the basal 2-4 mm of the corolla tube, anthers greenish. Fruits sessile, 8-15 mm long, shorter than the corollas, the apices erect.

Veracruz, Hidalgo, Distrito Federal, México, Oaxaca; open meadows, sometimes near timberline, areas of pine to fir woods, 2350-3200 m; September-November (-December).

Additional collections examined: MÉXICO. Without locality, *Ehrenberg 79* (GH). Distrito Federal: La Cima, 14 Oct 1908, *Barnes & Land 383* (US); Desierto Vieja, Vallee de México, 17 Oct 1865-1866, *Bourgeau 1125* (GH); Cañada Contreras, Sep 1937, *Lyonnet 1978* (US); Desierto de los Leones, Sep 1929, *Lyonnet 517* (GH, MO, US); S of Contreras, 17 Sep 1930, *Russell & Souviron 197* (US). Hidalgo: Pachuca, 28 Oct 1900, *Holway 5253* (GH); Mpio. Mineral del Chico, below national park, fir forest, 20 Oct 1946, *Moore 1607* (GH). Mexico: Toluca, Oct 1827, *Berlandier 1086* (MO-photo of G specimen); Dist. Temascaltepec, Crucero, 21 Oct 1932, *Hinton 2117* (GH, US); Dist. Temascaltepec, Crucero-Agua Blanca, 9 Oct 1935, *Hinton 8330* (GH, MO, TEX, US); Dist. Temascaltepec, Sierrita, 29 Oct 1935, *Hinton 8313* (GH, MO, TEX, US); Dist. Temascaltepec, Oro, 28 Sep 1952, *Matuda 27261* (MO); Dist. Temascaltepec, road to Nevado de Toluca, 4 Oct 1940, *Moore 89a* (GH); Dist. Temascaltepec, Sierra de las Cruces, 2 Oct 1892, *Pringle 4227* (GH, MO, US); Dist. Temascaltepec, Ixtaccihuatl, Oct 1905, *Purpus 1757* (GH, MO, US); Dist. Temascaltepec, Cerro San Miguel, Nov 1912, *Salazar s.n.* (US). Oaxaca: Sierra de Clavellinas, 26 Oct 1894, *Smith 667* (MO, US). Veracruz: Cofre de Perote, La Simiento, 9 Dec 1930, *Balls 5435* (US); Mpio. Las Vigas, Manzanares, 20 Oct 1972, *Ventura A. 7222* (LL).

These plants are different from *Gentianella amarella* subsp. *acuta* in the distinctive epilobed insertion of the corolla fimbriae, longer calyx tube, and narrower leaves. The only other species in south-central México, *G. hartwegii*, has much more foliaceous calyx lobes without scabrous margins and longer, yellow corollas with fimbriae inserted at the bases of the lobes.

8. *Gentianella microcalyx* (Lemmon) Gillett, Ann. Missouri Bot. Gard. 44:246. 1957. BASIONYM: *Gentiana microcalyx* Lemmon, Pacific Rural Press 23:129. [Feb] 1882. TYPE: UNITED STATES. Arizona: [Cochise Co.], peaks of Chiricahua Mts., 30 Sep 1881, *J.G. Lemmon 584* (HOLOTYPE: CAS?; Isotypes: GH!, MO, US). *Gentiana microcalyx* Engelm. *ex* A. Gray, Proc. Amer. Acad. Arts 17:222. 1882. Homotypic with *Gentiana microcalyx* Lemmon but published separately and slightly later, based on *Lemmon 584* (HOLOTYPE: GH!; Isotypes: MO, US).

Leaves ovate, 1.5-3.5 cm long, 6-15 mm wide, not basally connate. Pedicels 10-25 mm long. Calyx 2.5-4.5 mm long, the tube 0.5-1.0 mm long, the lobes thin herbaceous, 2.0-3.5 mm long, usually noticeably unequal, the margins smooth edged. Corollas lavender-pink to bluish, often drying yellowish, sometimes slightly speckled, completely lacking fimbriae, (6-) 7-10 mm long, the tube 4.0-6.5 mm long, the 5 lobes 2.0-3.5 mm long, ovate-lanceolate, erect. Staminal filaments slightly winged, adnate to the basal 2 mm of the corolla tube, anthers greenish to purplish, sometimes abortive. Fruits 8-9 mm long, on short (1 mm) stipes, the apices widely divergent.

Sonora, Chihuahua, Coahuila, Durango, southern Arizona; commonly on seepy ledges or cliffs, in areas of oak-pine to pine and pine-fir woodlands, 1800-2650 m; August-October.

Additional collections examined: MÉXICO. Chihuahua: N of Basiguare, a few mi off Creel-Río Urique road, 19 Oct 1977, *Bye & Weber 8334* (GH); Mpio. Temosachi, Nabogame, 3 Dec 1987, *Laferriere 1285* (TEX); Temosachic, Madera, *Muller 3465* (GH, as cited by Gillett 1957). Coahuila: Sierra de la Madera, middle and upper Cañon de la Hacienda, 21 Sep 1972, *Chiang, et al. 9451* (LL); Sierra de la Madera, above Cañon de la Hacienda, 5 Aug 1973, *Henrickson 11945* (TEX); Sierra de la Madera, Corte Blanco fork of Charretera Canyon, 12-14 Sep 1941, *Johnston 8990* (GH); Sierra de la Madera, high crest of main ridge ca. 2 km E of Picacho de Zozaya, 13 Sep 1941, *Johnston 9030* (GH, LL); Sierra de la Madera, Cañon Desiderio, 29 Sep 1976, *Wendt 1831* (TEX). Sonora: 4 mi E of El Bilito, Río Bavispe region, 12 Oct 1941, *White 4771* (US). Durango: Barranca, Sandia Station, *Pringle 13660* (GH, as cited by Gillett 1957).

Gentianella microcalyx is recognized by its very short calyx tube, consistent lack of corolla fimbriae, and fruits with widely divergent apices. It is most similar to and probably most closely related to *G. tarahumarae* Nesom,

distinguished by features noted in the key. As cited above, two specimens of *Gentianella microcalyx* (*Mueller 3465*, *Pringle 13660*) that were examined by Gillett have not been relocated in the present study.

9. **Gentianella sandiana** (Gillett) Nesom, *comb. et stat. nov.* BASIONYM: *Gentianella amarella* subsp. *sandiana* Gillett, Ann. Missouri Bot. Gard. 44:259. 1957. TYPE: MÉXICO. Durango: Mesa de Sandia, 9000 ft, 20 Oct 1905, *C.G. Pringle 10111* (HOLOTYPE: MO!; Isotypes: F, GH!, MEXU, NY, US!).

Leaves ovate-lanceolate, basally rounded, trinerved, 15-30 mm long, 6-10 mm wide, spreading-ascending. Pedicels 3-9 mm long. Calyx 5.5-7.0 mm long, the tube 2.5-3.0 mm long, with linear lobes 3.0-4.0 mm long, not fleshy, the margins and veins minutely but prominently papillate-scabrous. Corollas light bluish to lavender, drying yellowish, sometimes with red speckles, 11-16 mm long, the tube 7-10 mm long, the lobes 3.5-6.0 mm long, spreading, ovate lanceolate to obovate, fimbriae numerous, inserted at the very base of the corolla lobes. Staminal filaments very narrowly winged, adnate to the basal 3-4 mm along the corolla tube, anthers greenish. Fruits 13-18 mm long, slightly longer than the corolla tube, sessile.

Northern Durango and southern Chihuahua; 9000-9200 ft; October.

Additional collection examined: MÉXICO. Chihuahua: 11 mi SW of El Vergel, 9200 ft, 7 Oct 1959, *Correll & Gentry 22895* (GH).

Gentianella sandiana (Gillett) Nesom is similar to *G. canosoi* Nesom & Turner in the sizes and relative proportions of its calyces and corollas. The latter differs in its densely papillate-scabrous calyx and pedicels, and its yellow anthers.

The tiny red "speckles" on the corolla lobes, noted by Gillett (1957) as distinctive of this species, are found on 5 of the 7 plants mounted on the three type sheets examined. They also occur on the corollas of some, but not all, plants of both *Gentianella tarahumarae* and *G. microcalyx* but not on corollas of *G. canosoi*.

10. **Gentianella tarahumarae** Nesom, *sp. nov.* TYPE: MÉXICO. Chihuahua: Mpio. Guachochic, between Cusarare and Bahichic, open slopes of mixed pine and oak forest, 6900 ft, 10 Oct 1974, *R. Bye 7045* (HOLOTYPE: TEX!).

Differt a *Gentianella amarella* (L.) Borner subsp. *acuta* (Michx.) Gillett foliis effusis crassis anguste lanceolatis minoribusque, calycibus brevioribus lobis incrassatis linearibusque, corollis brevioribus, et ovariis stipitatis.

Leaves darkly pigmented, linear lanceolate to lanceolate, sometimes noticeably trinerved, not at all basally rounded, 1-3 cm long, 1.5-5.0 mm wide, strongly spreading to slightly deflexed. Pedicels 3-9 mm long. Calyx 2.2-5.0 mm long, 1/6-2/5 as long as the corolla, the tube 0.5-1.0 mm long, with fleshy, linear lobes 1.8-4.0 mm long, with sinuses acute to sharply rounded, the margins minutely papillate-scabrous. Corollas purple to blue, drying whitish to blue or rose, 8.5-11. mm long, the tube 6-8 mm long, the 5 lobes ovate to ovate elliptic, spreading, 2.5-3.0 mm long, sometimes speckled, with numerous fimbriae inserted at the base of the lobes. Staminal filaments inserted the middle of the corolla tube, not winged, the anthers greenish, included within the corolla tube. Fruits 10-12 mm long, with erect to somewhat divergent apices, slightly exserted from the corolla tube, on a short (0.5-0.9 mm long) but distinct stipe.

Southwestern to south-central Chihuahua; 2000-2200 m; September-November.

Additional collections examined: MÉXICO. Chihuahua: Mpio. Guachochic, Cusarare, along arroyo just NW of Cusarare church, 2200 m, 14 Oct 1977, *Bye & Weber 8095* (GH); Sierra Madre, 65 mi E of Batopilas, 7000 ft, 1-2 Oct 1898, *Goldman 188* (US); SW Chihuahua, Aug-Nov 1885, *Palmer 334* (GH-mounted on same sheet as isotype of *G. wislizeni*, US).

The collections by Goldman and Palmer were identified by Gillett as *Gentianella sandiana*, but that taxon differs from *G. tarahumarae* in its ovate-lanceolate, ascending leaves, calyces with a much longer tube and broader lobes, longer corollas, and sessile ovaries. *Gentianella tarahumarae* is distinct from *G. amarella* subsp. *acuta* in its thick, short, narrowly lanceolate, spreading leaves, shorter calyces with thickened, linear lobes, shorter corollas, and stipitate ovaries. As noted by Bye on the label of the type collection of *G. tarahumarae*, this is "one of the few plants still in flower after frost; plants mashed in water and used to wash head and clothes."

11. *Gentianella wislizeni* (Engelm.) Gillett, Ann. Missouri Bot. Gard. 44:235. 1957. BASIONYM: *Gentiana wislizeni* Engelm., Trans. Acad. Sci. St. Louis 2:215. 1862. TYPE: MÉXICO. Chihuahua: Llanos, mountains west of Chihuahua, 5 Oct 1846, *Wislizenus 206* (HOLOTYPE: MO!; Isotype: GH!).

Leaves ovate-lanceolate with rounded bases, not basally connate, trinerved, 2-4 cm long, 4-15 mm wide, spreading at right angles to somewhat ascending. Pedicels 4-18 mm long. Calyx tube thin textured, often hyaline, commonly purplish, 3.5-4.0 mm long, nearly flat across the top, with 5, greenish, linear toothlike lobes 0.5-1.5 mm long, the whole tube split to the base along one side to form a membranaceous sheath. Corollas whitish pink to violet purple, commonly drying distinctly yellowish, 8-14 mm long, the 5 lobes lanceolate

ovate to broadly elliptic, spreading to erect, 3-4 mm long, of even length, fimbriae relatively dense to very sparse, inserted at the base of the lobes, sometimes completely lacking. Staminal filaments narrowly winged, adnate to the basal half of the corolla tube, the anthers wholly included to slightly exserted from the corolla tube. Fruit 10-12 mm long, sessile, with erect apices.

Chihuahua, Durango, Arizona; rocky sites in pine-oak and pine woodlands, 2000-2550 m; September-October.

Additional collections examined: MÉXICO. Chihuahua: Mex. NW R[ail] R[oad], continental divide, ridge between Río Chico and Río Caballo, 30 Sep 1911, *Barlow s.n.* (US); Santo Domingo on Matachic-Ocampo truck road between Concheno and Pinos Altos, 21 Oct 1945, *Hewitt 78* (GH); Mesa, W of Hop Valley, 17 Sep 1903, *Jones s.n.* (US); 5.3 mi W of Madera on road to Río Papigochic, 22 Sep 1984, *Lavin 4947* (TEX); Colonia Garcia, 23 Sep 1934, *Pennell 19097* (GH, US); Colonia Garcia, near First Meadow, 23 Sep 1934, *Pennell 19136* (GH, US); Sierra Madre, cool slopes, *Pringle 1328* (GH, US); Sierra Madre, cool slopes, 9 Oct 1888, *Pringle 1662* (MO); near Colonia Garcia, 11 Sep 1899, *Townsend & Barber 322* (GH, MO, US); 8 mi S of Cd. Guerrero, ca. 2 mi W of Río Colorado, 23 Sep 1981, *Warnock 2358* (TEX). Durango: Road between San Julian and Cerro Prieto, 9 Sep 1898, *Nelson 4950* (US).

The peculiar calyx of this species is unmistakable. The closest relative of *Gentianella wislizeni* probably is *G. calycidon*, as noted in the discussion following the latter.

12. *Gentianella wrightii* (A. Gray) Holub, Folia Geobot. Phytotax. 2:118. BASIONYM: *Gentiana wrightii* A. Gray, *Syn. Fl. N. Amer.* 2(2):118. 1886. TYPE: MÉXICO. Sonora: Valley near Santa Cruz, springy ground, 24 Sep 1851, *C. Wright 1659* (HOLOTYPE: GH!; Isotype: GH!). *Amarella wrightii* (A. Gray) E. Greene, Leafl. Bot. Observ. Crit. 1:53. 1904. *Gentianella amarella* (L.) Borner subsp. *wrightii* (A. Gray) Gillett, Ann. Missouri Bot. Gard. 44:259. 1957.

Amarella cobrensis E. Greene, Leafl. Bot. Observ. Crit. 1:56. 1904. LECTOTYPE (designated here): UNITED STATES. New Mexico: Santa Rita del Cobre, 11 Oct 1880, *E.L. Greene s.n.* (ND-G!).

Apparently referring to the type, Gillett (1957) cited a collection by Greene (*s.n.*) from the "Pinos Altos Mountains" in Grant Co., New Mexico, but the specimens referred to in the original publication apparently are from a different gathering. The specimen chosen as lectotype is a sheet from Greene's herbarium, filed by Greene in his *Gentiana cobrensis* folder. The specimen has label data exactly matching those in the

publication, although it has no original identification or annotation other than "*Gentiana Amarella* L. var."

Gentiana townsendii Briq., Candollea 4:329. 1931. TYPE: MÉXICO. Chihuahua: Near Colonia Garcia, 1 Oct 1899, *C.H.T. Townsend & C.M. Barber 358* (HOLOTYPE: G; Isotypes: F, GH!, MO!, NY, US!).

Leaves ovate-lanceolate, spreading to ascending, 2-5 cm long, 8-17 mm wide, trinerved, basally rounded but not connate. Pedicels 3-5 (-15) mm long. Calyx 8-13 mm long, thin herbaceous, often with noticeable reticulate venation, the tube 3.5-5.0 mm long, the 5 lobes 6-8 mm long, slightly uneven in width. Corollas yellowish or whitish, rarely with blue streaks, drying yellow, 20-25 mm long, the tube 13-16 mm long, the lobes lanceolate, 7-10 mm long, with markedly attenuate apices, fimbriae numerous, inserted at the base of the corolla lobes or slightly above. Staminal filaments narrowly winged near the base, adnate to the lower 3-5 mm of the corolla tube. Fruit sessile, 22-26 mm long, the apices erect to slightly divergent.

Sonora, Chihuahua, Sinaloa, Arizona, New Mexico; low, wet meadows or swales, area of pine-juniper to pine woodlands, 2100-2400 m; August-November.

Additional collections examined: MÉXICO. Chihuahua: SW of Creel, Mpio. Bocoyna, 17 Oct 1977, *Bye & Weber 8262* (GH); 1-2 mi S of Creel, 25 Sep 1972, *Henrickson 8031* (TEX); Chuichupa, 26 Sep 1903, *Jones s.n.* (MO, US); SW Chihuahua, Yerba Buena, Nov 1885, *Palmer 306* (GH, MO, US); Colonia Garcia, 23 Sep 1934, *Pennell 19118* (US). Sinaloa: Cerro del Viejo, San Ignacio, 19 Nov 1917, *Montes & Salazar 83* (US).

See comments following *Gentianella hartwegii*, which is closely related.

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