

THE PLANT FAMILY GENTIANACEAE IN UTAH

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ABSTRACT.—The family Gentianaceae in Utah includes the genera *Gentiana*, *Gentianella*, *Centaurium*, *Frasera*, and *Swertia* and is composed of 15 species. *Centaurium nuttallii* S. Watson is placed in synonymy under *C. exaltatum* (Griseb.) Wight, because there is no clear-cut basis for its segregation at the species level. Similarly, *Gentiana forwoodii* Gray and *G. parryi* Engelm. are extremes of clinal variation in *G. affinis* and are synonymized there. Keys to the genera, species, and subspecies are provided, as well as distribution maps, descriptions, and synonymies.

The family Gentianaceae has been subjected to repeated “splitting” and “lumping” for many years. This use of botanical license has left the taxonomy and nomenclature confused, even though some of the groups are comparatively clear-cut. The most popular and recent treatments have concentrated on reducing many of the genera to subgeneric rank. While this may be the most convenient treatment, it does not necessarily reflect the evolutionary status of the plants themselves. *Swertia perennis* and *Frasera* (*Swertia*) *albomarginata* are clearly not doing the same thing evolutionarily—hence, their segregation in this paper.

Specimens examined in this study came from the herbaria of the University of Utah (UT), Utah State University (UTC), and Brigham Young University (BRY). Acknowledgment is given to the curators of these herbaria for the use of

their material. Measurements greater than 10 mm were made with a standard metric rule, while those less than 10 mm were made with an ocular micrometer with accuracy to 0.1 mm. The descriptions of genera and species are meant to include only Utah entities. Distribution data were gathered entirely from herbarium material. It is recognized that many of the species have not been well collected throughout all Utah counties; consequently, the range maps may not be complete for all taxa. To conserve space, lists of synonymies and specimens examined have been condensed to include only those applicable to and representative of Utah. Appreciation is extended to Dr. Stanley L. Welsh of Brigham Young University for his suggestions and criticisms throughout the study, and to the BYU Department of Botany and Range Science for financial assistance.

Key to the Genera

- 1a. Corolla rotate, the lobes with foveae (glands) on upper surface 2
- 1b. Corolla campanulate to funnelform, the lobes lacking foveae 3
- 2a. Stems arising from slender rhizomes, 0.1-0.5 m tall; flowers mostly blue or bluish purple, 4- or 5-merous; leaves opposite or alternate, never whorled, not white-margined; foveae 2 per lobe. 5. *Swertia*
- 2b. Stems arising from taproots or sometimes a branching caudex, never from a rhizome, 0.2-2 m tall; flowers mostly greenish white to greenish yellow with purple splotches, 4-merous only; leaves opposite or whorled, never alternate, white-margined or not; foveae 1 or 2 per lobe. 2. *Frasera*
- 3a. Anthers coiled after anthesis; corolla reddish to pink. 1. *Centaurium*
- 3b. Anthers not coiled after anthesis; corolla blue, purplish, yellowish, or whitish, not reddish to pink. 4
- 4a. Corolla plicate, the plaits rounded, acute, lobed, or fimbriate between the true corolla lobes; nectary glands at base of ovary; calyx with mem-

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brane or rim extending around interior of tube; mostly perennial or biennial (annual or biennial in *Gentiana prostrata*). 3. *Gentiana*

- 4b. Corolla not plicate, without sinus lobes or fimbriae between the true corolla lobes; nectary glands at base of corolla tube; calyx lacking inner membrane or rim; mostly annual (perennial in *Gentianella barbellata*). 4. *Gentianella*

1. *Centaurium* Hill

Centaurium Hill, Brit. Herb. 62. 1756.

Plants glabrous annuals (or biennials?) from very slender to stout taproots; stems simple or branched, erect; basal leaves mostly well spaced and opposite but sometimes rosettelike, 5-40 mm long; cauline leaves sessile to clasping, 5-42 mm long; flowers single to several, axillary to corymbosely arranged, 4-5-merous; calyx deeply parted into narrow seg-

ments; corolla salverform or funnelform, red, pink, light salmon, or whitish; stamens inserted on corolla throat, alternate with the lobes, the anthers spirally coiled after dehiscence; ovary 1-loculed; style filiform, deciduous; stigma flattened; capsule slender, 2-valved; seeds minute, reticulate.

About 30 species in North America, Europe, and Africa. Named after Centaur (Latin: *Centaurus*) who supposedly discovered medicinal qualities in the plants.

- 1a. Corolla lobes longer than 6.5 mm, mostly greater than $\frac{2}{3}$ the length of the corolla tube. *C. calycosum*
 1b. Corolla lobes shorter than 5.5 mm, mostly less than $\frac{2}{3}$ the length of the tube. *C. exaltatum*

Centaurium calycosum (Buckl.) Fern.

Centaurium calycosum (Buckl.) Fern. Rhodora 10: 54. 1908.

Erythraea calycosa Buckley, Proc. Aca. Sc. Phil. 1862. 1863.

Erythraea calycosa Buckl. var. *arizonica* Gray, Syn. Fl. N. Amer. 2(1): 113. 1878.

Centaurodes calycosum (Buckl.) O. Ktze. Rev. Gen. 2:426. 1891.

Erythraea arizonica (Gray) Rydb. Bull. Torr. Bot. Club 33:148. 1906.

Centaurium arizonicum (Gray) Heller. Muhl. 4: 86. 1908.

Centaurium calycosum (Buckl.) Fern. var. *arizonicum* (Gray) Tidestrom. Proc. Biol. Soc. Wash. 48:42. 1935.

Plants annual (biennial?); stems simple to profusely branched at base, (5)7-45 (52) cm tall; basal leaves well-spaced or sometimes rosette-like, generally oblanceolate, 5-40 mm long; cauline leaves mostly narrower, 5-47 mm long; corolla reddish to pink, the tube 9.5-13 mm long; corolla lobes 7.5-10(12) mm long and mostly more than $\frac{2}{3}$ the length of the tube, broadly lanceolate to nearly rhombic.

Flowering April-May; wet places, stream banks and river bottoms. Colorado River drainage, to Texas and Mexico.

Representative specimens: Garfield Co.: Lindsay 22 (UT). Grand Co.: Welsh 12650 (BRY). Kane Co.: Beck s.n. (BRY). Washington Co.: Cottam 7841 (UT).

Centaurium exaltatum (Griseb.) Wight ex Piper

Centaurium exaltatum (Griseb.) Wight ex Piper. Cont. U.S. Nat. Herb. 11:449. 1906.

Cicendia exaltata Griseb. in Hook. Fl. Bor. Amer. 2:69. 1838.

Erythraea nuttallii S. Wats. in King, Geol. Expl. 40th Par. 5:276. 1871.

Erythraea douglasii Gray in Brews & Wats. Bot. Calif. 1:480. 1876.

Centaurodes douglasii (Gray) O. Ktze. Rev. Gen. 2:426. 1891.

Centaurodes nuttallii (S. Wats.) O. Ktze. Rev. Gen. 2:426. 1891.

Erythraea exaltata (Griseb.) Covill. Cont. U.S. Nat. Herb. 1:150. 1893.

Centaurium nuttallii (S. Wats.) Heller. Muhl. 4:86. 1908.

Centaurium douglasii (Gray) Druce, Rep. Bot. Exch. Club Brit. Isles 1916: 613. 1917.

Plants strictly annual; stems erect, simple to branched, 5-30(50) cm tall; basal leaves not rosette-forming, elliptic-lanceolate to oblanceolate, 5-25 mm long; cauline leaves sessile to somewhat clasping, lanceolate or oblanceolate to narrower, 5-40 mm long; corolla pink to light salmon or whitish, the tube 5.5-11.5(14) mm long; corolla lobes 3-5.5(6) mm long and mostly less than $\frac{2}{3}$ the length of the tube, lanceolate to elliptic.

Flowering May-August; moist places around streams, seeps, alkaline lakes.

Eastern Washington, Oregon, California, Utah, Idaho.

The taxa *exaltatum* and *nuttallii* have formerly been separated as species on the basis of length of corolla lobes, those of *nuttallii* supposedly longer. I have found no clear boundary between the two using this character (nor any other). The correlation of lobe length and this expressed as a percentage of tube length is shown in Fig. 1. Two distinct groupings are evident: *C. calycosum* and the combination of *C. nuttallii* and *C. exaltatum*. Consequently, *nuttallii* and *exaltatum* have been synonymized under the older epithet, *exaltatum*.

Representative specimens: Cache Co.: Garrett 5379 (UT). Duchesne Co.: Hutchings s.n. (BRY). Grand Co.: Rydberg & Garrett 8485 (UT). Kane Co.: Welsh, Murdock, & Doherty 12593 (BRY). Millard Co.: Maguire 21222 (UTC); Cottam 8151 (UT). San Juan Co.: Anderson A-5 (BRY); Welsh & Toft 11866 (BRY). Utah Co.: Larsen 7203 (BRY); Cottam 148 (UT).

2. *Frasera* Walt.

Frasera Walt. Fl. Carol. 87. 1788.

Perennials from a well-developed taproot or caudex, 0.2-2 m tall; stems single or few, branched or not, erect; leaves opposite or whorled, sheathing to petiolate, entire, prominently nerved, white-

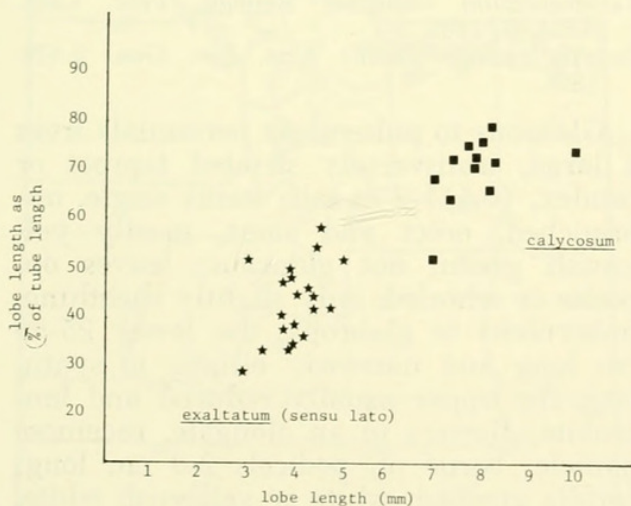


Fig. 1. Correlation of corolla lobe length expressed as a percentage of corolla tube length for all Utah taxa of *Centaurium*.

margined or not; flowers 4-merous, in compact to loose panicles; calyx 4-cleft nearly to base, the lobes lanceolate to linear; corolla greenish-white to yellowish with dark bluish blotches, the lobes deeply cleft and usually spreading; foveae one or two per lobe, fringed with hairs or laciniate scales; corona absent or sparse to very conspicuous; stamens inserted at base of corolla, alternate with corolla lobes and with corona scales if present; ovary 1-loculed, 2-carpelled, attenuate to a short or elongate style; stigma 2-cleft; placentae parietal, many ovuled; capsule ovoid, compressed, septicidal from apex; seeds compressed, often wing-margined.

About 12-15 North American species are known, mostly in western United States. This genus was named in honor of John Fraser, 1750-1811, an English nurseryman who collected plants in North America.

The differences between *Swertia* (represented in Utah by only *S. perennis*) and *Frasera* (three species in Utah) at first appear slight. Both can have tetramerous flowers, can have opposite leaves, and can have two foveae or glands per corolla lobe—hence, the reduction of *Frasera* by many authors, most notably St. John (1941). However, one look at the plants will reveal two groups: 1) the taller and more robust *Frasera*, with a taproot or caudex, whorled leaves, the flowers tending to be inconspicuously colored, generally found in drier, more open sites in rocky, sandy, or gravelly soil; and 2) the more delicate and more herbaceous *Swertia*, arising from a rhizome, with alternate leaves, the flowers much more evident, usually growing in moist meadows and woods, stream banks, and other moist places. Cytological evidence further supports the division. The trend in *Swertia* is to haploid chromosome numbers of 9, 12, and 14, while *Frasera* maintains a basic chromosome number of 13, similar to *Gentiana*. Admittedly, the segregation is perhaps tenuous, but the gross visual differences and ecological preferences exhibited within the two groups warrants separation.

- 1a. Leaves conspicuously white-margined; foveae 1 per lobe; stems branched, at least above. 2
- 1b. Leaves not white-margined; foveae 2 per lobe; stems unbranched, except in inflorescence. *F. speciosa*

- 2a. Fovae lobed at tip, long and slender; stems 20-60 cm tall. *F. albomarginata*
 2b. Fovae lobed at base, not slender but nearly as broad as corolla lobe;
 stems 40-100 cm tall. *F. paniculata*

Frasera albomarginata S. Wats. in King

Frasera albomarginata S. Wats. in King, Expl. 40th Par. 280. 1871.

Swertia albomarginata (S. Wats.) O. Ktze. Rev. Gen. 2:431. 1891.

Leucocraspedum albomarginatum (S. Wats.) Rydb. Fl. Rocky Mts. 665. 1917.

Glabrous perennials from a well-developed taproot; stems single or few, normally much branched, somewhat greenish-glaucous, ca. 20-60 cm tall; leaves opposite or whorled, the lower petiolate, the upper sessile and smaller, linear to oblanceolate, 2-10 cm long, conspicuously white-margined; flowers in broad, corymbose panicles, on slender pedicels 1-8 cm long; corolla greenish white or greenish yellow, with dark dots; corolla lobes deeply cleft and spreading, 7-10 mm long; fovae 1 per lobe, long and slender, lobed at tip, fringed with short, soft, flat, white hairs; corona absent or very sparse; capsule conic, attenuate, 10-15 mm long, often dark brown; seeds brown, ca. 4 mm long.

Flowering May-July; dry, rocky or gravelly sites at low elevations. Colorado to Arizona, west through southern Utah to southern California.

Representative specimens: Garfield Co.: Cottam 4403 (BRY). Kane Co.: Atwood, Welsh, Murdock, & Allen 02728 (UT); Atwood 4070 (BRY). Millard Co.: Woodruff 1884 (UT); Welsh & Moore s.n. (BRY). San Juan Co.: Twiss s.n. (UT); Higgins 3557 (BRY). Washington Co.: Weight 450 (UT); Higgins 3397 (BRY).

Frasera paniculata Torr.

Frasera paniculata Torr. Rept. Bot. Pacif. R.R. Repts. 4:126. 1856.

NOT *Swertia paniculata* Wallich. Pl. As. Rar. 3:3. 1832.

Frasera utahensis M. E. Jones, Zoe 2:13-14. 1891.

Swertia bigelowii O. Ktze. Rev. Gen. 2:431. 1891.

Leucocraspedum utahense (M. E. Jones) Rydb., Fl. Rocky Mts. 665. 1917.

Swertia utahensis (M. E. Jones) St. John, Am. Mid. Nat. 26:12. 1941.

Glabrous perennials from a strong, slender, and often yellow taproot; stems single, branched above, typically greenish or yellowish, glaucous, ca. 40-100 cm tall; leaves opposite (or whorled?), sheathing lance-linear to oblanceolate, the lower

clustered in a basal clump and up to 20 cm long, the upper commonly reduced to mere bracts and not exceeding 1 cm long, conspicuously white-margined; flowers in pyramidal panicles, on pedicels 0.5-6 cm long; corolla green to greenish yellow with dark dots; corolla lobes deeply cleft and spreading, 6-8 mm long; fovae 1 per lobe, broad, oblong, lobed at base, fringed with long, flexuous hairs; corona sparse and very inconspicuous; capsule conic, attenuate, 10-15 mm long, light brown to darker.

Flowering May-August; mostly dry, rocky, or sandy places at low elevations.

Southern Utah and Nevada, south to New Mexico and Arizona.

Representative specimens: Grand Co.: Welsh & Atwood 9955 (BRY); Welsh, Harrison, & Moore 2343 (BRY). Kane Co.: Atwood & Allen 02687 (BRY). San Juan Co.: Harvey s.n. (UT); Moore 237 (BRY). Wayne Co.: Welsh, Atwood, & Moore 10880 (BRY).

Frasera speciosa Dougl. ex Griseb.
in Hook.

Frasera speciosa Dougl. ex Griseb. in Hook. Fl. Bor. Am. 2:66. 1838.

Tessaranthium radiatum Kellogg, Proc. Calif. Acad. ii. 1862.

Swertia radiata (Kell.) Ktze. Rev. Gen. 2:430. 1891.

Glabrous to puberulent perennials from a large, transversely striated taproot or caudex, (0.5)1-2 m tall; stems single, unbranched, erect and stout, mostly yellowish green, not glaucous; leaves opposite or whorled, only slightly sheathing, puberulent to glabrous, the lower 25-30 cm long and narrowly elliptic to spatulate, the upper usually reduced and lanceolate; flowers in an elongate, racemose panicle, borne on pedicels 2-8 cm long; corolla greenish white or yellowish white, purple-dotted, rotate-campanulate, the lobes 10-25 mm long; fovae 2 per lobe, elliptic, 3.5-9 mm long, fimbriate around edge; corona conspicuous with lacinate scales 7-9 mm long; capsule conic, attenuate, 16-26 mm long, light brown to darker.

Flowering June-August; open (sometimes wooded) hills and valleys, general-

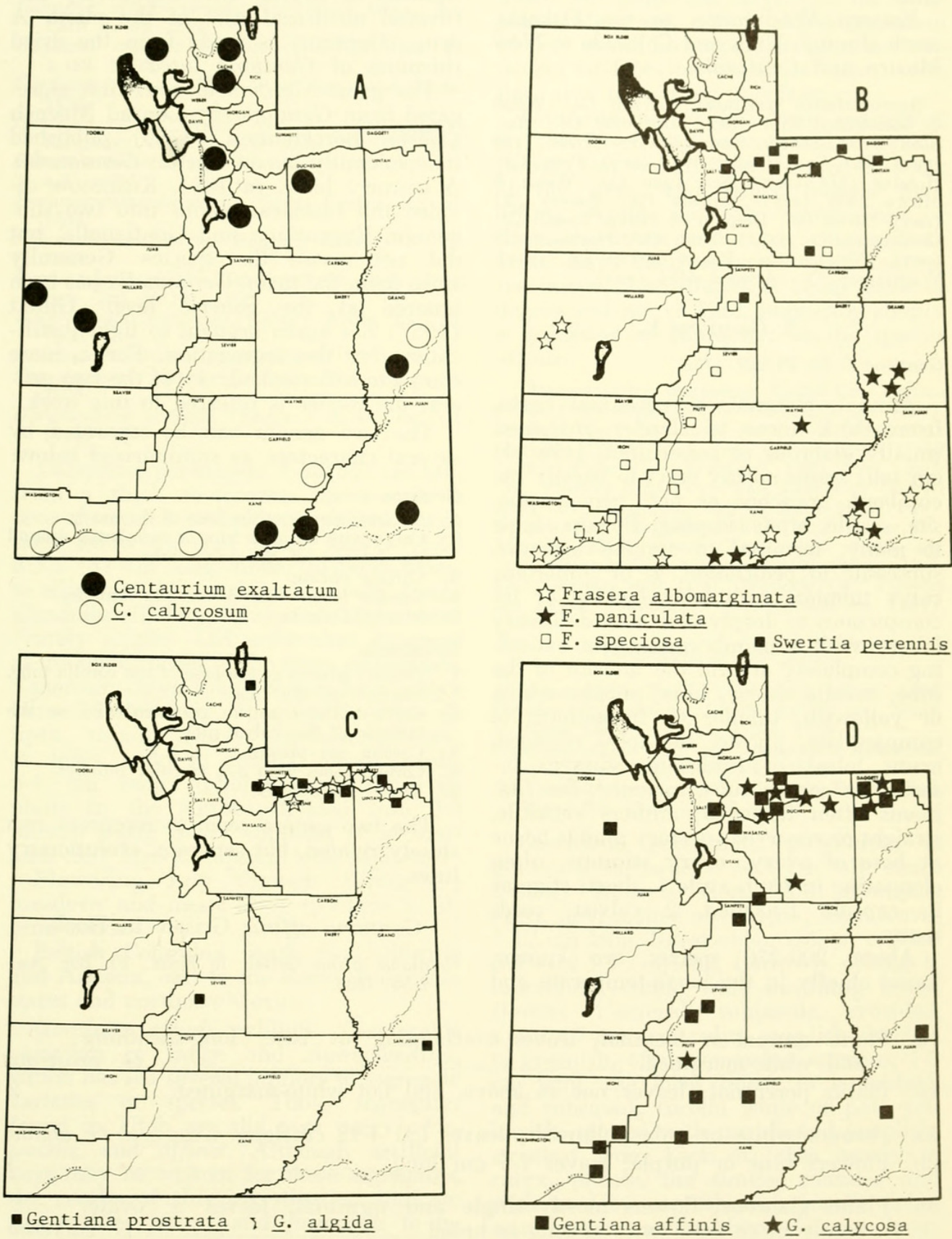


Fig. 2. Distributions of (A) *Centaurium exaltatum* and *C. calycosum*; (B) *Frasera albomarginata*, *F. paniculata*, *F. speciosa*, and *Swertia perennis*; (C) *Gentiana prostrata* and *G. alvida*; (D) *Gentiana affinis* and *G. calycosa*.

ly rocky soil, to montane slopes in mountains.

Eastern Washington to the Dakotas, south through Utah and Colorado to New Mexico and California.

Representative specimens: Carbon Co.: Welsh & Christensen 6531 (BRY). Duchesne Co.: Harrison 7732 (BRY). Garfield Co.: Boyle 1134 (BRY). Iron Co.: Higgins 4647 (BRY). Piute Co.: Higgins 1174 (BRY). San Juan Co.: Welsh & Moore 2408 (BRY). Sanpete Co.: Rooney 221 (BRY). Sevier Co.: Despain 74 (BRY). Tooele Co.: Christensen s.n. (BRY). Utah Co.: Hartman 179 (BRY). Wasatch Co.: Forest Service s.n. (BRY). Washington Co.: Atwood 5474 (BRY).

3. *Gentiana* L.

Gentiana L. Sp. Pl. 227. 1753.

Annual, biennial, or perennial herbs, from thick roots to slender rhizomes, usually glabrous or puberulent, 1-50(80) cm tall; stems mostly erect to basally decumbent, branched or not; leaves opposite, sessile, often clasping; flowers single to many, terminal to cymose-racemose, subsessile to pedicellate, 4- or 5-merous; calyx tubular, with lobes lacking or inconspicuous to deeply cleft and definitely lobate, with a membrane or rim extending completely around the interior of the tube; corolla showy, blue, purple, white, or yellowish, tubular or funnelform to campanulate, plicate, the folds rounded, acute, lobed, or fimbriate; stamens inserted on corolla tube, included, the filaments often flattened; anthers versatile, straight or recurved; nectary glands borne at base of ovary; ovary stipitate, often elongating in fruit; style 1, short; stigmas 2; capsule 1-loculed, 2 valved; seeds many.

About 200-250 species are known, found chiefly in the north-temperate and

arctic zones in moist soil. Named for King Gentius of Illyria, who supposedly discovered medicinal uses of the plant. A drug (*Gentian*) is made from the dried rhizomes of *Gentiana lutea* L.

The genus *Gentianella* was first segregated from *Gentiana* by Conrad Moench (1794). Borckhausen (1796) published independently his own genus *Gentianella*. A century later, in 1894, Kusnezow divided the Linnaean genus into two subgenera, *Eugentiana* and *Gentianella*, but did not revise the species. Generally since then, the taxon *Gentianella* has been ignored at the generic level. Gillett (1957) has again brought to light justification for the segregation. For a more complete historical survey of the two genera, the reader is referred to this work.

The two genera can be separated by several characters, as summarized below:

Gentiana

- 1. Nectary glands at the base of the ovary
- 2. Calyx with an inner rim or membrane around the interior of the calyx tube
- 3. Corolla plicate
- 4. Corolla lobes with 3 vascular bundles
- 5. Mostly diploids

Gentianella

- 1. Nectary glands at the base of the corolla tube, inserted on the tube
- 2. Calyx without a rim or membrane on the interior of the calyx tube
- 3. Corolla not plicate
- 4. Corolla lobes with 5-9 vascular bundles
- 5. Mostly tetraploids

The two genera seem to represent two closely related, but separate, evolutionary lines.

Gentiana affinis Griseb. in Hook.

Gentiana affinis Griseb. in Hook., Fl. Bor. Am. 2:56. 1838.

- 1a. Plants annual or biennial; leaves overlapping at base, long-sheathing and white-margined. *G. prostrata*
- 1b. Plants perennial; leaves not as above, and not white-margined. 2
- 2a. Flowers white or pale yellowish; leaves (3) 4-12 cm long. *G. algida*
- 2b. Flowers blue or purple; leaves 1-5 cm long. 3
- 3a. Plants glabrous; flowers mostly single and terminal; leaves ± ovate, rarely more than twice as long as broad. *G. calycosa*
- 3b. Plants not glabrous, the stems puberulent in lines below the leaf bases, and the leaves and/or calyx lobes finely but distinctly scabrous-ciliate; flowers mostly several; leaves usually more than twice as long as broad. *G. affinis*

- Gentiana parryi* Englm., Trans. Acad. Sci. St. Louis 2:218. 1863.
Gentiana affinis Griseb. var. *ovata* Gray, Bot. Calif. 1:483. 1863.
Gentiana oregana Englm. ex Gray, Syn. Fl. 2:122. 1878.
Gentiana forwoodii Gray, Proc. Am. Acad. 19:83. 1883.
Gentiana affinis Griseb. var. *forwoodii* (Gray) Kusnezow, Acta Hort. Petrop. 15: 202. 1898.
Pneumonanthe affinis (Griseb.) Greene, Leaflet. 1:71. 1904.
Pneumonanthe forwoodii (Gray) Greene, loc. cit. 1904.
Pneumonanthe parryi (Englm.) Greene, loc. cit. 1904.
Dasystephana affinis (Griseb.) Rydb., Bull. Torr. Bot. Club 33:149. 1906.
Dasystephana forwoodii (Gray) Rydb., loc. cit. 1906.
Gentiana interrupta Green, Pitt. 4:182. 1900.
Dasystephana parryi (Englm.) Rydb., loc. cit. 1906.
Dasystephana oregana (Englm.) Rydb., loc. cit. 1906.

Caespitose perennials, 1-50(80) cm tall, from a thick rootcrown; stems one to several, erect to decumbent, puberulent in lines below the leaf bases; leaves (1.5) 2-3.5 (5) cm long, linear to lance-ovate, to elliptic, 4-20 mm broad, usually finely glandular-ciliate; flowers usually several (rarely single) and somewhat clustered at the upper nodes of the stem, pedicellate, 5-merous; calyx tube 3-9 mm long; calyx lobes 3-7 mm long, unequal, linear to elliptic, usually finely glandular-ciliate, or lobes lacking; corolla bluish-purple, 2-4 cm long, tubular-funnelform, the plaits in the sinuses divided into 2-5 narrow teeth; ovary stipitate; style short and cleft above; capsule long-stipitate.

Flowering July through September; meadows and mesic soils, montane to alpine zones.

British Columbia south to California and Arizona, east to the Rocky Mountain states and northern Mexico.

Gentiana affinis exhibits considerable variation in range and characteristics, which has led several authors to segregate varieties or species. Those segregates found in Utah are the taxa *parryi*, *forwoodii*, and *affinis*. Although artificial keys may be written for these segregates, the results of this investigation indicate the entities *parryi* and *forwoodii* to be extremes of a continuum of variation in *affinis*, with intermediate forms common.

Gentiana forwoodii has been segregated from *affinis* by the absence of calyx lobes, and a 2-cleft calyx tube. However,

specimens have been examined with both lobate and nonlobate calyces on the same plant. Moreover, *affinis* shows gradation of very small, inconspicuous lobes to well-developed lobes on the same calyx, with the calyx tube being 2-cleft or not.

Gentiana parryi has been segregated on the bases of foliaceous floral bracts, flowers few and clustered toward the apex of the stem, and larger flowers than *affinis*. Again, varying combinations of these characters and many intermediate forms have been observed on numerous specimens, the differences being those of degree and not of kind, indicating simply a gradation of characters in the species *affinis*.

Representative specimens: Cache Co.: Cottam 15939 (UT). Daggett Co.: Hutchings 201 (BRY). Garfield Co.: Buchanan 83 (UT). Grand Co.: Harrison 12458 (BRY). Iron Co.: Maguire 17560 (UTC). Piute Co.: Woodruff 1369 (UT). Rich Co.: Flowers 2284 (UT). Salt Lake Co.: Garrett 2823 (UT). San Juan Co.: Rydberg 9738 (UTC). Sanpete Co.: Frischknecht 212 (BRY). Sevier Co.: Maguire 16161 (UTC). Tooele Co.: Smith s.n. (UT). Uintah Co.: Maguire 17703 (UTC). Utah Co.: Garrett 5430 (UT). Wasatch Co.: Flowers s.n. (BRY). Washington Co.: Cottam s.n. (BRY).

Gentiana algida Pall.

- Gentiana algida* Pall., Fl. Ross. 1:2. pl. 95. 1798.
Gentiana romanzovii Ledeb. ex Bunge, Nouv. Mem. Soc. Nat. Mosc. 1:215. 1829.
Gentiana algida Pall. var. *romanzovii* Kusnezow, Acta Hort. Petrop. 15: 252. 1898.
Dasystephana romanzovii (Bunge) Rydb., Bull. Torr. Bot. Club 33:148. 1906.

Caespitose perennials, puberulent to glabrous, herbaceous, 5-25 cm tall; stems 1-many from a short, stout rootstock, erect, unbranched above base; basal leaves 3-12 cm long, linear-oblongate; cauline leaves 2.5-5 cm long, narrowly oblong to lanceolate, sessile with sheathing bases; flowers 1-several, subsessile, crowded, mostly 5-merous; calyx purplish-blotched to greenish, often somewhat scarious, 1-2 cm long, the lobes linear to lanceolate, and subequal; corolla white or pale yellowish, spotted with purple and purplish-streaked from back of lobes nearly to calyx, plicate, the sinuses rounded and without lobes or fibriate; corolla lobes acuminate to acute, short, 3-5 mm long; ovary long-stipitate; style 2-branched.

Flowering in July and August; wet, alpine meadows.

Rocky Mountains from Colorado to Alaska.

Representative specimens: Daggett Co.: Hutchings 198 (BRY). Duchesne Co.: Ludwig 1026 (UT). Murdock 45 (BRY). Summit Co.: Spear 17 (BRY); Maguire 14419 (UTC). Uintah Co.: Waite 318 (BRY).

Gentiana calycosa Griseb. in Hook.

- Gentiana calycosa* Griseb. in Hook., Fl. Bor. Amer. 2:58. 1838.
Gentiana calycosa Griseb. var. *stricta* Griseb. ex Hook., Fl. Bor. Amer. 2:58. 1838.
Gentiana calycosa Griseb. var. *monticola* Rydb., Bull. Torr. Bot. Club 24: 252. 1897.
Pneumonanthe calycosa (Griseb.) Greene, Leaf. 1:71. 1904.
Dasystephana calycosa (Griseb.) Rydb., Bull. Torr. Bot. Club 40:464. 1913.
Dasystephana monticola Rydb., Bull. Torr. Bot. Club 40:464. 1913.
Dasystephana obtusiloba Rydb., Bull. Torr. Bot. Club 40:464. 1913.
Dasystephana calycosa (Griseb.) Rydb. var. *xantha* (A. Nels.) Rydb., Fl. Rocky Mts. 663. 1917.
Gentiana calycosa Griseb. var. *asepala* Maguire, Madrono 6:151. 1942.

Caespitose, glabrous perennials, 5-30 cm tall, from a stout taproot, rhizomes lacking; stems erect or basally decumbent, branching rare; leaves 1-2.5(3) cm long, ovate to broadly lanceolate, glabrous, sessile with sheathing bases; flowers mostly solitary and terminal, 5-merous; calyx tube greenish to purplish, sometimes scarious, campanulate, often 2-cleft and unequal, the membrane at base of lobes; calyx lobes reduced, linear to oblong; corolla deep blue, funnelform-campanulate, (2)2.5-3.5 cm long; corolla lobes erect to spreading, ovate to oblong, acute; plaits cleft into 2-4 narrow teeth; ovary long-stipitate; style 2-cleft at tip, short; seeds brown.

Flowering July-September; alpine to montane zones, wet meadows and stream banks.

British Columbia to California, east to Rocky Mountains.

Representative specimens: Daggett Co.: McNulty 213 (UT). Duchesne Co.: Ludwig 1051 (UT); Moore 270 (BRY). Summit Co.: Welsh 9376 (BRY); Maguire 4224 (UTC). Uintah Co.: Weight 176 (BRY). Wasatch Co.: Walsh 483 (UT).

Gentiana prostrata Haenke

- Gentiana prostrata* Haenke, Jacq. Coll. Bot. 2:66. 1788.
Gentiana fremontii Torr., Frem. Rep. 94. 1843.
Gentiana prostrata Haenke var. *americana* Engelm., Trans. Acad. Sci. St. Louis 2:217. 1863.

Gentiana humilis sensu Gray, Syn. Fl. 21:120. 1878.

Chondrophylla americana (Englm.) A. Nels., Bull. Torr. Bot. Club 31:245. 1904.

Chondrophylla fremontii (Torr.) A. Nels., loc. cit. 1904.

Chondrophylla prostrata (Haenke) Anderson, Proc. Iowa Acad. Sci. 25:445. 1918.

Glabrous, annual or biennial herbs, 2-20 cm tall; roots slender; stems erect, branched basally; leaves small, 3-10 mm long, prominently white-margined, the basal overlapping, the cauline more distant with sheathing bases; leaf blades orbicular or ovate to obovate; flowers solitary and terminal, 4(5)-merous; calyx green or bluish-tinged, 4-14 mm long; calyx lobes broadly lanceolate, subequal, and white-margined, $\frac{1}{3}$ the length of the tube; corolla blue to purplish, 8-22 mm long, funnelform, plicate, with lobes in the sinuses; corolla lobes spreading to ascending, acute, ovate-lanceolate, convolute in bud; ovary stipitate, the stipe elongate in fruit; style with flattened stigmatic lobes; capsule papery, narrowly cylindrical, either included in the coiled corolla or exserted; seeds brown.

Flowering July-August; wet, alpine meadows.

Rocky Mountains, Colorado to Alaska, west to Utah, Nevada, central Idaho, and northern California.

Several authors have separated *G. fremontii* from *G. prostrata* on the basis that in *fremontii* the capsule is exserted from the corolla, but in *prostrata* the capsule remains enclosed within the corolla. Hitchcock (Hitchcock et al. 1959) states that both conditions have been found on the same specimen, demonstrating that two separate species do not exist.

Representative specimens: Daggett Co.: Holmgren 7172 (UTC). Duchesne Co.: Smith s.n. (UTC). Rich Co.: Flowers 2257 (UT). San Juan Co.: Maguire 12946 (UTC). Sevier Co.: Cottam 4521 (BRY). Summit Co.: Welsh 9186 (BRY). Uintah Co.: Maguire 18681 (UTC).

4. *Gentianella* Moench

Gentianella Moench, Meth. Pl. 482. 1794.

Annual, biennial, or perennial herbs from taproots or rhizomes, glabrous to subglabrous, 1-70 cm tall; stems basally decumbent to erect, simple or branched; leaves glabrous, opposite, sessile, often clasping; flowers solitary to numerous,

terminal to axillary, sessile or pedicellate, 4- or 5-merous; calyx mostly tubular or funnelform, lobed, lacking a membrane or rim extending completely around the interior of the tube; corolla mostly showy, commonly blue, or white, purple, or yellowish, tubular, funnelform, or campanulate, not plicate, lobed, with or without a corona; stamens 4-5, included, the filaments slender or somewhat flattened, the anthers versatile; nectary glands borne at base of corolla tube; ovary sessile or stipitate, 2-carpelled; style 1, mostly absent, or present and short; stigmas 2, sessile or short-stipitate; capsule 1-loculed, cylindrical or ovoid, septicidally dehiscent from apex; seeds many.

Gentianella is not as large a genus as *Gentiana* and is found mostly in temperate to alpine and arctic regions, in mesic conditions. It is of little or no economic importance.

- 1a. Flowers 4-merous; calyx lobes with broad, distinctly hyaline margins; corolla lobes fimbriate to toothed. 2
- 1b. Flowers 4- or 5-merous; calyx lobes with green margins, or if inconspicuously and narrowly hyaline then the corolla 5-9 mm long and the plants from southern Utah; corolla lobes entire. 3
- 2a. Plants perennial, from slender rhizomes; flowers sessile or shortly pedicellate. *G. barbellata*
- 2b. Plants annual or biennial, from taproots; terminal flowers borne on slender, elongate pedicels *G. detonsa*
- 3a. Pedicels conspicuously longer than the subtending internode; flowers terminal and single on very elongate pedicels. *G. tenella*
- 3b. Pedicels conspicuously shorter than or equaling the subtending internode. 4
- 4a. Mature corolla 5-8(9) mm long, the lobes often as long as the tube; plants from very long, slender taproots (usually ca. 6 cm long); southern Utah. *G. tortuosa*
- 4b. Mature corolla 10-25 mm long, the lobes shorter than the tube; taproots not excessively long (usually ca. 3.5 mm long); widely distributed. *G. amarella*

Gentianella amarella (L.) Borner

Gentianella amarella (L.) Borner, Fl. deut. Volk. 543. 1912.
Gentiana amarella L. Sp. Pl. 230. 1753.

Annuals 5-70 cm. tall, simple or branched; stems erect; basal leaves 3-40 mm long, elliptic to spatulate; cauline leaves 8-60 mm long, oblanceolate, elliptic, ovate, to ovate-lanceolate, somewhat clasping; flowers few to very numerous, axillary or terminal, in cymes, sessile or pedicellate; calyx 4- or 5-lobed, 5-25 mm

long; calyx lobes subequal to decidedly unequal with one or more lobes foliaceous and enveloping the others; corolla mostly blue, or white, purple, or yellow, sometimes with a greenish tube, 10-25 mm long, tubular to funnelform; corolla lobes erect to spreading, mostly half the length of the tube; stamens included; ovary sessile or shortly stipitate; stigmas sessile; capsule equaling the corolla or slightly exceeding it.
North-temperate and arctic regions throughout most of North America.

- 1a. Calyx lobes equal or nearly so, not enveloping the others; corona fimbriae free below. *G. amarella* ssp. *acuta*
- 1b. Calyx lobes unequal, one or more broadly foliaceous and enveloping the others; corona fimbriae united below. *G. amarella* ssp. *heterosepala*

Gentianella amarella ssp. *acuta*

Gentianella amarella (L.) Borner ssp. *acuta* (Michx.) J. M. Gillett, Ann. Miss. Bot. Gard. 44:253. 1957.

Gentiana acuta Michx., Fl. Bot. Amer. 1:77. 1803.
Gentiana plebeia Cham. Linnaea 1:81. 1826.
Amarella acuta (Michx.) Raf., Fl. Tellur. 3:21. 1837.

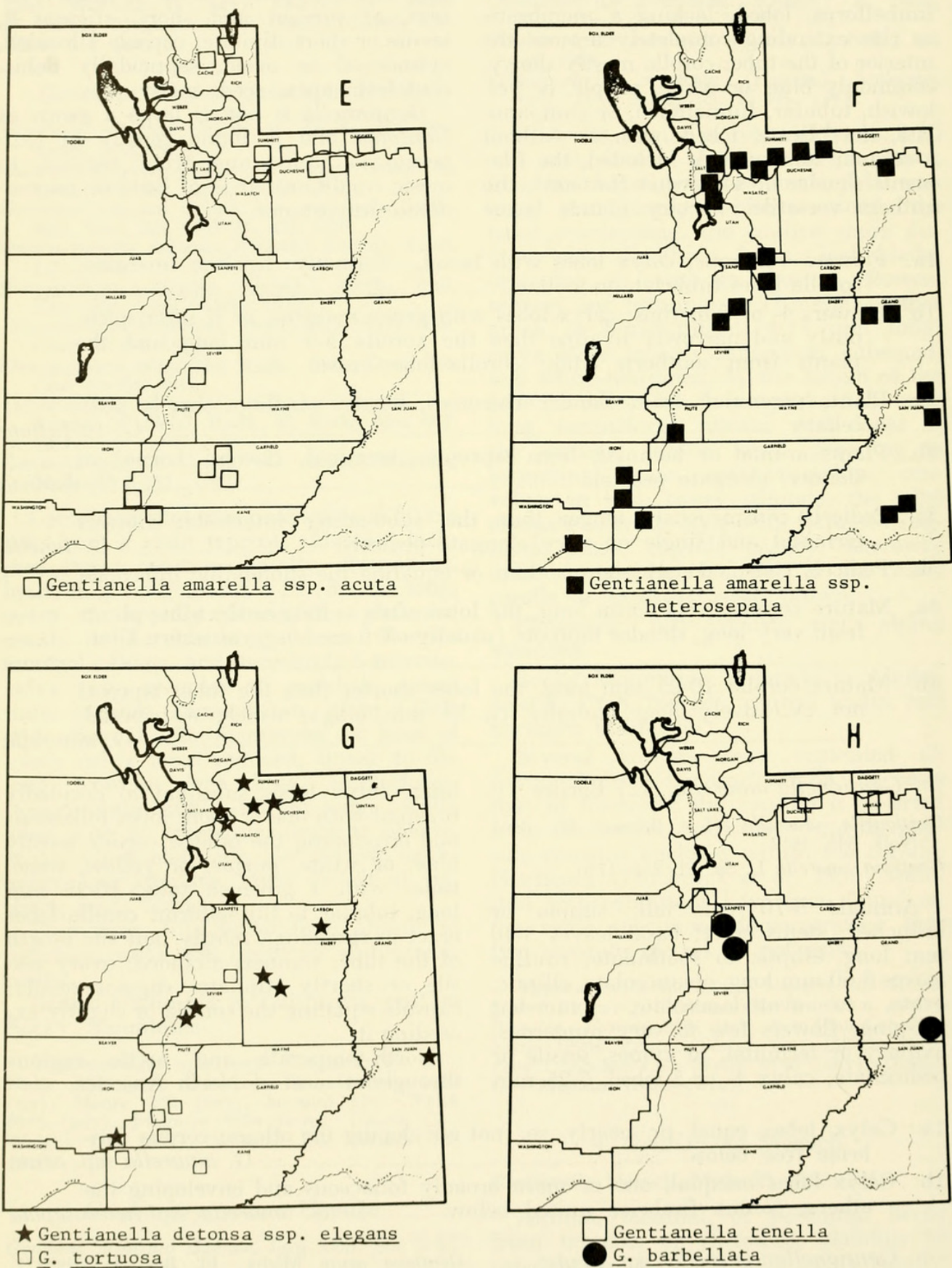


Fig. 3. Distributions of (E) *Gentianella amarella* ssp. *acuta*; (F) *G. amarella* ssp. *heterosepala*; (G) *G. detonsa* ssp. *elegans* and *G. tortuosa*; (H) *G. tenella* and *G. barbellata*.

- Gentiana acuta* Michx. var. *stricta* Griseb., Gen. & Sp. Gent. 242. 1839.
Gentiana tenuis Griseb., Gen. & Sp. Gent. 242. 1839.
Gentiana amarella L. var. *acuta* (Michx.) Herder, Acta Hort. Petrop. 1:428. 1872.
Gentiana amarella L. var. *tenuis* (Griseb.) Gray, Syn Fl. N. Amer. ed. 2. 2:118. 1886.
Gentiana anisosepala Greene, Pitt. 3:309. 1898.
Gentiana acuta Michx. var. *strictiflora* Rydb., Mem. N.Y. Bot. Gard. 1:309. 1900.
Gentiana stricta (Griseb.) Howell, Fl. N.W. Amer. 1:445. 1901.
Amarella anisosepala (Greene) Greene, Leaf. Bot. Obs. & Crit. 1:53. 1904.
Amarella strictiflora (Rydb.) Greene, loc. cit. 1904.
Amarella tenuis (Griseb.) Greene, loc. cit. 1904.
Amarella amarella (L.) Cockerell, Am. Nat. 40: 871. 1906.
Amarella plebia (Cham.) Green, loc. cit. 53. 1904.
Gentianella acuta (Michx.) Hitt., Mem. Soc. Faun. Fl. Fenn. Nl. 25:76. 1950.

Flowering from late July through August; moist meadows, open aspen forests, alpine woods.

Common in Utah, also Newfoundland, Maine and Vermont, westward to Alaska, southward in the western mountains to Baja California and central Mexico.

Representative specimens: Cache Co.: Cottam, Anderson, Rowland, & Ream 15969 (UT). Daggett Co.: Spear 202 (BRY). Duchesne Co.: Ludwig 1060 (UT). Garfield Co.: N. Holmgren 2430 (BRY). Iron Co.: Eastwood 7272 (UTC). Kane Co.: Buchanan 31 (UT). Rich Co.: Cottam, Anderson, Rowland, & Ream 16006 (UT). Salt Lake Co.: Arnow 769 (UT). Sevier Co.: Maguire 20323 (UTC). Summit Co.: Cottam 3866 (BRY). Uintah Co.: Welsh 6745 (BRY). Wasatch Co.: Walsh 448 (UT).

Gentianella amarella (L.) Borner ssp. *heterosepala* (Engelm.) J. M. Gillett

- Gentianella amarella* (L.) Borner ssp. *heterosepala* (Engelm.) J. M. Gillett, Ann. Miss. Bot. Gard. 44:251. 1957.
Gentiana heterosepala Engelm., Trans. Acad. Sci. St. Louis 2:215. 1862.
Gentiana distegia Greene, Pitt. 4:182. 1900.
Amarella heterosepala (Engelm.) Greene, Leaf. Bot. Obs. & Crit. 1:53. 1904.
Amarella scopulorum Greene, loc. cit. 1904.
Gentiana scopulorum (Greene) Tidestrom, Contr. U. S. Nat. Herb. 25:415-416. 1925.

Flowering from mid-July through August; moist meadows and aspen forests.

Common in Utah, extending into Colorado, Wyoming, New Mexico, Arizona, and Idaho.

Representative specimens: Carbon Co.: Welsh 6544 (BRY). Grand Co.: Maguire 20325 (UTC). Iron Co.: Hitchcock 4554 (UTC). Kane Co.: Maguire 19587 (UTC). Piute Co.: Coles 95 (BRY).

Salt Lake Co.: Garrett 1538 (UT). San Juan Co.: Harrison 12493 (BRY). Sanpete Co.: Shafer 47 (UTC). Summit Co.: Vickery 1395 (UT). Uintah Co.: Maguire 17705 (UTC). Utah Co.: Welsh 3500 (BRY). Wasatch Co.: Garrett 2844 (UT). Washington Co.: Giersch 527 (UTC).

Gentianella barbellata (Engelm.) J. M. Gillett

- Gentianella barbellata* (Engelm.) J. M. Gillett, Ann. Miss. Bot. Gard. 44:230. 1957.
Gentiana barbellata Engelm., Trans. Acad. Sci. St. Louis 2:216. 1862.
Gentiana moseleyi A. Nelson, Bot. Gaz. 31:396. 1901.
Anthopogon barbellatus (Engelm.) Rydb., Bull. Torr. Bot. Club 33:148. 1906.

Acaulescent or caulescent perennials, 5-15 cm tall, from a slender, branched rhizome, the branches erect; basal leaves oblanceolate, clasping at base, 2-6 cm long; flowers solitary and terminal, sessile to shortly pedicellate, 4-merous; calyx tube bluish green, 11-25 mm long, funnelform; calyx lobes triangular to lanceolate, equal; corolla deep blue to lighter at base, 2.4-4.5 cm long, funnelform; corolla lobes spreading at anthesis, oblong and obtuse to acute, as long as, or longer than the tube; stamens included to slightly exserted; ovary short-stipitate; stigmas sessile; mature capsule as long as the corolla tube.

Flowering mid-August through September; coniferous forests, montane to alpine slopes, wet meadows.

Central Colorado and southern Wyoming, south to Utah, northern Arizona and northern New Mexico.

G. barbellata is the only perennial species of the genus in North America.

Representative specimens: Grand Co.: Harrison 12457 (BRY). Sanpete Co.: Walker s.n. (BRY); Maguire 20059 (UTC).

Gentianella detonsa (Rottb.) G. Don

- Gentianella detonsa* (Rottb.) G. Don, Gen. Syst. 4:179. 1838.
Gentiana detonsa Rottb., Kiob. Selsk. Skr. (Acta Hafn.) 10:435. 1770.

Caulescent annuals or biennials, glabrous to subglabrous, 0.5-9 dm tall, from a slender taproot; stems erect to basally decumbent, branched or simple; basal leaves forming a rosette or reduced to a single pair, elliptic to spatulate, 0.5-3.5 (6) cm long; cauline leaves 1.5-6.5 cm long, linear to elliptic or spatulate, mostly clasping the stem; flowers solitary and terminal, long-pedicellate, 4-merous;

calyx tube 9-14 mm long, narrowly to broadly funnelform, the lobes triangular, acute; corolla pale to dark blue, 2-5(6) cm long, funnelform; corolla lobes erect to spreading, 9-25 mm long, oblong to somewhat obovate, the margins ciliate to fimbriate to toothed; stamens included; ovary short-stipitate; stigmas sessile to short-stipitate; capsule as long as or slightly longer than the corolla tube.

Ssp. *elegans* is the only representative of the *G. detonsa* complex found in Utah.

Gentianella detonsa ssp. *elegans*

(A. Nels.) J. M. Gillett

Gentianella detonsa (Rottb.) G. Don ssp. *elegans* (A. Nels.) J. M. Gillett, Ann. Miss. Bot. Gard. 44:217. 1957.

Gentiana thermalis O. Kuntze, Rev. Gen. 2:427. 1891.

Gentiana elegans A. Nels., Bull. Torr. Bot. Club 25:276. 1898.

Gentiana elegans A. Nels. var. *unicaulis* A. Nels., Bull. Torr. Bot. Club 25:277. 1898.

Gentiana elegans A. Nels. var. *brevicalycina* Wettst. ex Th. Holm., Ottawa Nat. 15:182. 1901.

Anthopogon elegans (A. Nels.) Rydb., Bull. Torr. Bot. Club 33:148. 1906.

Flowering throughout July and August; usually high mountain meadows and along streams, moist areas.

Rocky Mountains from southern Montana to Wyoming, Utah, and Idaho, east to eastern Nevada, south to New Mexico.

In assigning the epithet *elegans* for this subspecies, I have followed Gillett's treatment of the species (Gillett 1957). Even though *thermalis* is the older name, Kuntze's type has not been found and evidently was in very poor condition (Rydberg 1917). Nelson's specimens, however, are distributed in at least three herbaria and are of more acceptable quality.

Representative specimens: Carbon Co.: Walker s.n. (BRY). Emery Co.: Maguire 15931 (UTC). Iron Co.: Boyle 764 (UTC). San Juan Co.: Maguire 20324 (UTC). Sevier Co.: Stoddart s.n. (UTC). Summit Co.: Maguire 14769 (UTC). Utah Co.: Standing 202 (UT). Wasatch Co.: Cottam 1384 (BRY).

Gentianella tenella (Rottb.) Borner

Gentianella tenella (Rottb.) Borner, Fl. deut. Volk, 542. 1912.

Gentiana tenella Rottb., Kiob. Selsk. Skrift. (Acta Hafn.) 10:436. 1770.

Lomatogonium tenellum (Rottb.) Love & Love, Acta Hort. Gotoburg 20:117. 1956.

Herbaceous, glabrous annuals, (1)3-15 (20) cm tall, from a weak taproot; stems decumbent at base then erect, caespitose; basal leaves in rosettes or only 2, 3-10 mm long, elliptic; cauline leaves 4-9 mm long, ovate to elliptic, somewhat clasping; flowers terminal or axillary, single, on elongate pedicels 2-10 cm long; calyx 4- or 5-lobed, 5-10 mm long, the lobes commonly unequal; corolla white to blue, 8-12 mm long, tubular; corolla lobes 4 or 5, $\frac{1}{3}$ to $\frac{1}{2}$ as long as corolla tube; corona fimbriae united at base; stamens included; ovary sessile; stigmas sessile; capsule projecting beyond corolla, up to 12 mm long.

Ssp. *tenella* is the identity of all specimens in Utah. The only other subspecies is *pribilofii*, found on the Pribilof Islands, Alaska.

Gentianella tenella ssp. *tenella*

Gentianella tenella (Rottb.) Borner ssp. *tenella* *Cicendia tenella* (Rottb.) Raf. ex Jacks., Ind. Kew. 1:533. 1893.

Gentiana monantha A. Nelson, Bull. Torr. Bot. Club 31:244. 1904.

Amarella monantha (A. Nels.) Rydb., Bull. Torr. Bot. Club 33:148. 1906.

Amarella tenella (Rottb.) Cockerell, Amer. Nat. 40:871. 1906.

Gentiana borealis Bunge, Nouv. Mem. Soc. Nat. Mosc. 1:251. 1929.

Gentianella tenella Rottb. var. *monantha* (A. Nels.) Rouss & Raym., Nat. Canad. 79:77. 1952.

Flowering from late July until early September; variable habitats, moist or dry soil, sandy beaches, wet meadows, montane or alpine zones.

Northern Canada and Alaska, Rocky Mountains south to Arizona and New Mexico, west to eastern California.

Much of the Utah material has been identified as *Gentiana monantha*, originally described by Aven Nelson because he mistakenly thought *tenella* to be strictly 5-merous. It is, however, either 4- or 5-merous.

Representative specimens: Duchesne Co.: Ludwig 1062 (UT). Juab Co.: McMillan 1259 (UTC). Summit Co.: Maguire 14451 (UTC). Uintah Co.: Cottam 108 (BRY); Maguire 17686 (UTC).

Gentianella tortuosa (M. E. Jones)

J. M. Gillett

Gentianella tortuosa (M. E. Jones) J. M. Gillett, Ann. Miss. Bot. Gard. 44:248. 1957.

Gentiana tortuosa M. E. Jones, Pro. Calif. Acad. II, 5:707. 1895.

Amarella tortuosa (M. E. Jones) Rydb., Bull. Torr. Bot. Club 40:463. 1913.

Gentiana helleri Briq., Candollea 4:331. 1931.

Caespitose, glabrous annuals, 2-16 cm tall, from a very long taproot; basal leaves 5-25 mm long, elliptic to ligulate, clasping; cauline leaves 5-35 mm long, 1-5 mm wide, narrowly oblong to lanceolate; flowers solitary in the axils, or on short axillary branches, borne on short pedicels to 15 mm long, 5-merous; calyx tube short, 1-2 mm long; calyx lobes 2-7 mm long, green, the margins obscurely hyaline, linear, unequal; corolla white to pale blue, 5-8(9) mm long, broadly funnelform to campanulate, the lobes usually equaling the length of the tube and ovate; corona fimbriae free; stamens included; ovary exserted slightly in fruit.

Flowering mid-July through late August; among yellow pine, along damp stream banks, open hillsides, and bare, gravelly slopes.

Restricted to the southern half of Utah and southern Nevada.

The long, slender taproot is a unique characteristic of this species.

Representative specimens: Garfield Co.: Maguire 19074 (UTC); Atwood 1886 (BRY); Cottam 2765 (BRY). Iron Co.: Maguire 19473 (UTC); Welsh 2660 (BRY); Maguire 17569 (UTC). Kane Co.: Maguire 19646 (UTC). Sanpete Co.: Humphrey 104 (BRY).

5. *Swertia* L.

Swertia L. Sp. Pl. 1:226. 1753.

Glabrous perennials from somewhat slender rhizomes; stems usually single, (9)10-50 cm tall, erect, unbranched, slender, generally green to dark blue; leaves mostly basal, alternate or opposite, the lower petiolate, obovate to elliptic, 4-12 cm long, the cauline reduced and sessile;

flowers in a racemose panicle or somewhat cymose, on pedicels 1-4(5) cm long, 4- or 5-merous; corolla blue to bluish purple, white blotched, rotate-campanulate, the lobes 6-11 mm long; foveae 2 per lobe, oval to orbicular, 0.6-0.9 mm long, fringed around edge; corona inconspicuous and only sparsely puberulent; capsule ellipsoid, compressed, 7-12 mm long.

A single species in Utah:

Swertia perennis L.

Swertia perennis L., Sp. Pl. 1:226. 1753.

Swertia fritillaria Rydb., Bull. Torr. Bot. Club 40:465. 1913.

Flowering July through August; montane to subalpine forests, meadows, streamsides, moist and often shaded places.

Alaska to California, east through the Rocky Mountains, Eurasia.

Representative specimens: Duchesne Co.: Ludwig 1019 (UT); Harrison 10031 (BRY). Salt Lake Co.: Garrett 1566 (UT). Sevier Co.: Spear 5390 (BRY). Summit Co.: Cottam 5403 (UT); Welsh 1636 (BRY). Uintah Co.: Garrett 4006 (UT).

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