

PHLOX VERMEJOENSIS (POLEMONIACEAE),
A NEW SPECIES FROM NORTHERN NEW MEXICO, U.S.A.

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ABSTRACT

Phlox vermejoensis B. Legler is described as a new species from alpine scree slopes in the Sangre de Cristo Mountains of Taos County, New Mexico. This highly distinctive and previously uncollected species is readily distinguished from other members of the genus by its rhizomatous habit, short, tufted stems, broad leaves, corolla tube equal to the calyx, and short styles. Its discovery demonstrates the importance of continued floristic work in North America.

RESUMEN

Phlox vermejoensis B. Legler se describe como una nueva especie de las laderas alpinas de las montañas Sangre de Cristo del Condado de Taos, Nuevo México. Esta especie altamente diferente y no colectada previamente se distingue fácilmente de otros miembros del género por su hábito rizomatoso, tallos cortos formando matas, hojas anchas, tubo de la corola igualando el cáliz, y estilos cortos. Su descubrimiento demuestra la importancia la continuidad del trabajo florístico en Norte América.

The genus *Phlox* L. contains 65 to 70 species, all but two of which are restricted to North America (Wilken & Porter 2005). Although the circumscription of *Phlox*, excluding *Microsteris* Greene, is not in question (Porter & Johnson 2000; Ferguson & Jansen 2002), the genus has been considered taxonomically difficult (Wherry 1955) and relationships among many of the taxa remain poorly resolved due to hybridization, introgression, and polyploidy (Ferguson et al. 1999; Ferguson & Jansen 2002; Ferguson et al. 2010). In addition, many species are narrow endemics. Some of these (e.g., *P. caryophylla* Wherry, and *P. cluteana* A. Nels.) are restricted to one or a few mountain ranges in the southwestern United States. *Phlox vermejoensis*, described here as new, is another such narrow endemic.

Phlox vermejoensis was first discovered by the author in July, 2008 during a floristic inventory of Vermejo Park Ranch (VPR) in the Sangre de Cristo Mountains of north-central New Mexico (Legler 2010). Two populations separated by about 0.5 miles were found that year. Attempts to identify these plants to any previously described species of *Phlox* were not successful, and it quickly became apparent that they represented a new, undescribed species. To the author's knowledge no prior collections of this highly distinctive taxon exist in herbaria, which is not surprising given that the land on which these populations lie has been privately owned since the mid 1800s.

Discoveries such as this contradict the common misconception that the flora of North America has been fully explored and cataloged. To the contrary, much work remains to be done. Hartman and Nelson (1998) reported that the rate of publication of novelties in North America north of Mexico has remained relatively constant since 1955, at an average of 60 per year, while Ertter (2000) estimated that as many as 1,800 more novelties may await discovery in this same area, representing a further increase in the total flora by nearly 5%. These estimates underscore the need for continued floristic inventories, even in seemingly well explored areas such as the United States.

Phlox vermejoensis B. Legler, sp. nov. (Figs. 1, 2, 3). TYPE: U.S.A. NEW MEXICO. Taos Co.: Vermejo Park Ranch, Sangre de Cristo Mountains, NW side of unnamed peak 12673, 2.3 air mi NNE of Big Costilla Peak and 3.25 air mi SSW of State Line Peak, scree slope of metamorphic rock, with *Geum rossii*, *Senecio taraxacoides*, *S. cf. soldanella*, *Claytonia megarhiza*, *Androsace septentrio-*

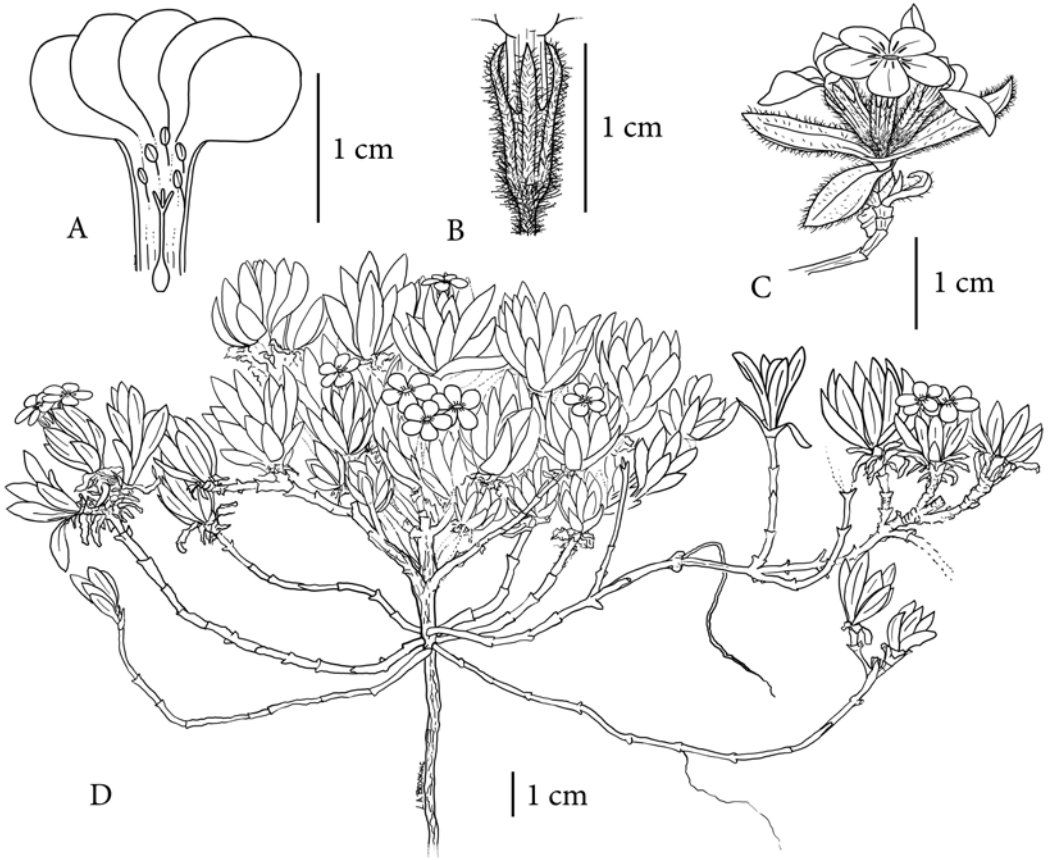


FIG. 1. Illustration of *Phlox vermejoensis*. A) Corolla, split open showing position of anthers and style. B) Calyx tube. C) Above-ground stem with inflorescence. D) Habit and rhizomes.

nalis, *Poa glauca* ssp. *rupicola*, and *Festuca* sp., 36.95209° N, 105.31537° W, elev. 12,610 ft, aspect NW, slope 30–40°, 21 Jul 2009, B. Legler 11521 (HOLOTYPE: RM; ISOTYPES: ARIZ, COLO, MO, UNM, WTU).

Herba perennis e caudice ramoso, demum rhizomatosa; caules caespites foliosos breves 1–4 cm altos facientes; folia elliptica, oblonga, vel oblanceolata, 6–25 mm longa, 3–8 mm lata, 2.5–5plo longiora quam latiora, glanduloso-pubescentia; inflorescentia 1–4(–6)-flora, glanduloso-pubescentis; pedicelli 1–4 mm longi; sepala 8–11 mm longa, membranis calycis intercostalibus planis; corolla alba, saepe purpureo notata ad bases loborum, tubo (7)–8–11 mm longo; styli 3.5–5.5(–6) mm longi, sub antheris positi; capsulae 4.5–6.5 mm longae.

Perennial herb from a much-branched caudex, the caudex and taproot often not apparent, becoming replaced by numerous, branched and tangled rhizomes, these to 15 cm long by 1–3 mm diameter, slender and herbaceous to slightly woody, with internodes 0.5–2 cm long; above-ground stems in clumps or widely scattered at upturned tips of rhizomes, forming short, leafy tufts 1–4 cm tall (including the inflorescence), glabrous or sometimes glandular-pubescent, bases clothed in curled, dead, gray leaves, internodes mostly less than 5 mm long, obscured by sheathing leaf bases; leaves opposite and sessile, spreading to ascending, not appressed, blades elliptic, oblong, or oblanceolate, 6–25 mm long, 3–8 mm wide, mostly 2.5–5 times as long as wide, green, soft and slightly fleshy, abaxial surface glabrous to sparsely pubescent with multicellular, gland-tipped hairs, adaxial surface sparsely to moderately pubescent with multicellular, gland-tipped hairs, margins likewise glandular-pubescent, not noticeably ciliate at base, slightly thickened and papillose near tip but not cartilaginous, the tip acute to obtuse, occasionally apiculate but not pungent, midvein obscure; inflorescence a

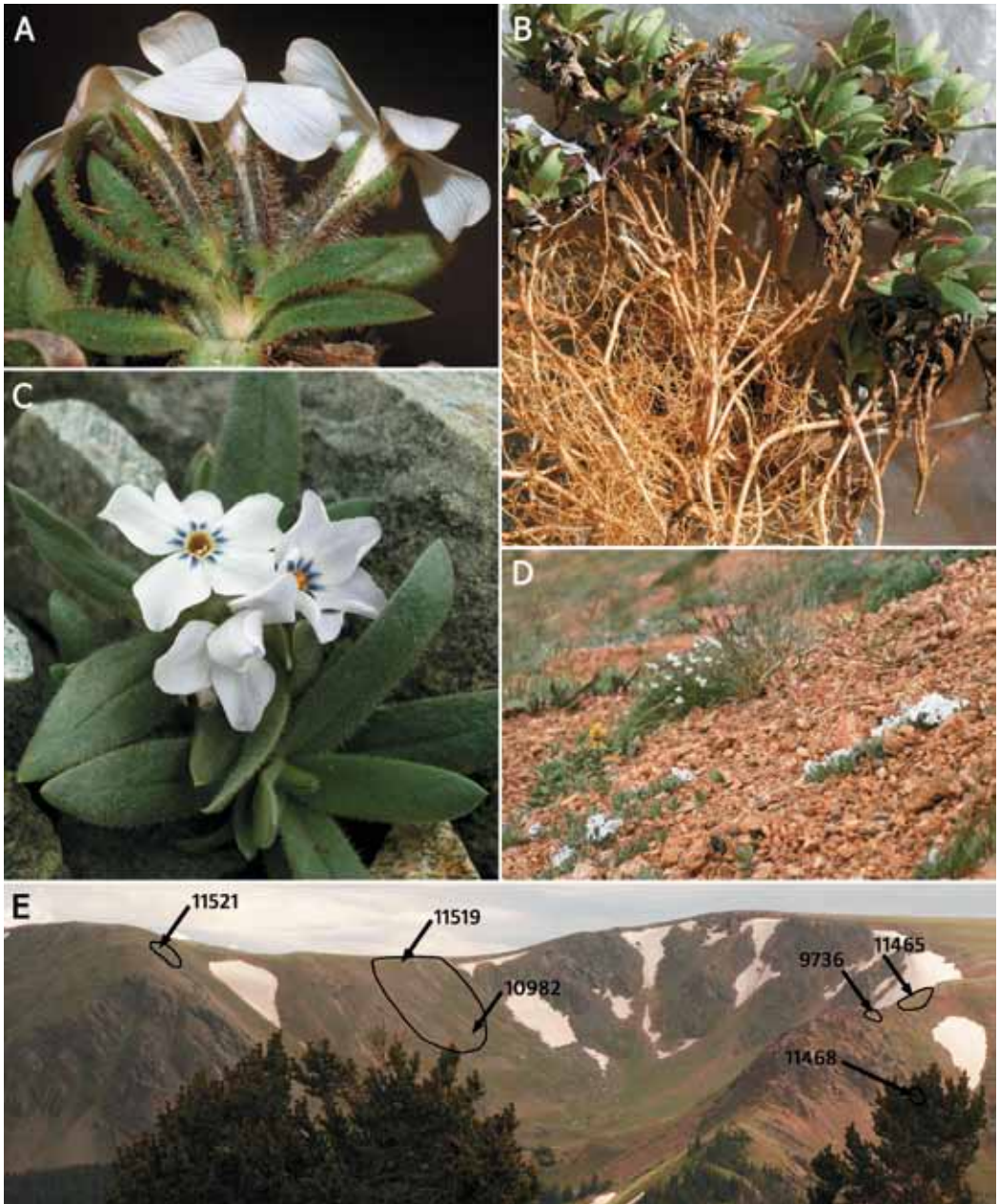


FIG. 2. *Phlox vermejoensis*. A) Inflorescence. B) Rhizomes. C) Flowers and leaves from the type locality. D) Habit in scree, with plants visible in lower half of photo. E) Habitat, encompassing all known populations, with the locations of individual collections indicated by arrows and collection numbers, and the approximate extent of each population outlined in black. Photos by the author.

terminal, reduced, leafy cyme with 1–4(–6) flowers; pedicels 1–4 mm, densely pubescent with multicellular, gland-tipped hairs to 0.3 mm long, the glands yellow; sepals 5, narrowly lanceolate to almost linear, 8–11 mm long, 0.4–0.7 mm wide, fused for 4–5 mm at base, outer surface densely glandular pubescent like the pedicels,

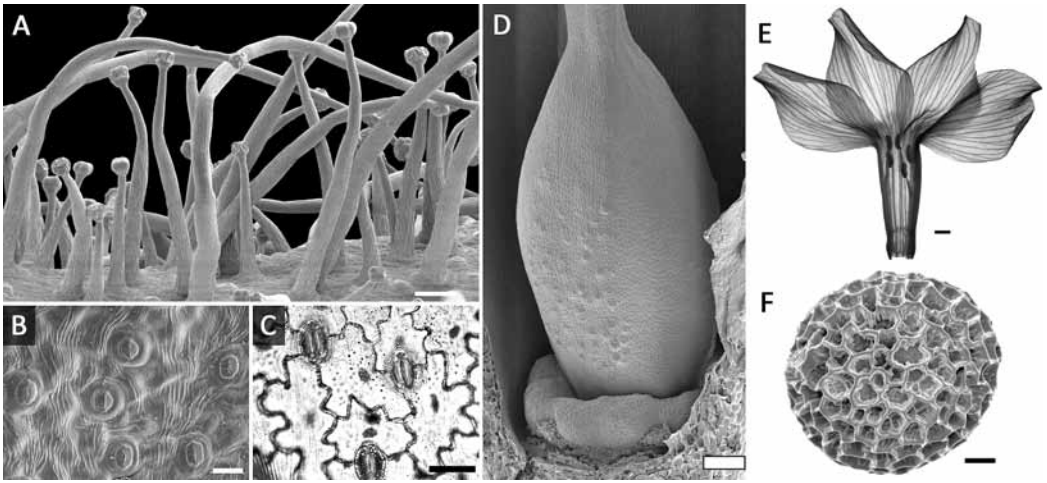


FIG. 3. Scanning electron and light microscope images of *Phlox vermejoensis*. A) SEM micrograph of leaf surface showing gland-tipped hairs; scale = 100 μm . B) SEM micrograph and C) light micrograph of the epidermis of the leaf, illustrating stomata and cell shape; scale = 25 μm . D) SEM micrograph of the ovary and nectary gland; scale = 200 μm . E) Light micrograph of dissected corolla (4 of the 5 lobes present) showing trichomes near the base of the tube; scale = 1 mm. F) SEM micrograph of pollen; scale = 5 μm .

intercostal membrane flat; corolla salverform, regular, white or rarely tinged with pink, often with purple “pin-wheel” markings at throat, tube (7–)8–11 mm long, equal in length to the calyx, glabrous except for a ring of eglandular trichomes within near the base, lobes 5, spreading, obovate, 6–9 mm long, 4.5–7.5 mm wide, entire, not notched at tip; filaments 0.8–1.5(–2) mm long, unequally attached on upper half of corolla tube; anthers 5, 0.8–1.8 mm long (mostly either 0.9 mm or 1.4 mm, and of uniform size within each flower), yellow, positioned above the style and stigmas, some slightly exerted from tube; ovary superior, glabrous, with 3 carpels and 3 locules, each locule containing a single ovule; style 3.5–5.5(–6) mm long including the stigmas, stigmas 3, 1.1–1.6(–2) mm long; capsule 4.5–6.5 mm long, 2–3 mm wide, elliptic, tan, glabrous, hardened, with 3 valves, appearing unilocular due to separation of the septa from the valves; seeds 1(2) per capsule, 3–3.6 mm long, 1–1.8 mm wide, elliptic, slightly flattened, light brown, minutely irregular-rugose, cupped on one side by the compressed, boat-shaped remnant of the septa. Chromosome number not known. All measurements are from dried herbarium specimens and dissected, separately pressed flowers.

Pollen morphology.—pollen grains pantoporate, (18–)24–48(–53) μm diameter; pores (12–)18–28, spheroidal, 0.9–3 μm diameter, with considerable variation in size, shape, and exine form; exine 2–4.9 μm , reticulate, heterobrochate; luminae 0.8–9.7(–12.3) μm , polygonal, provided with a micromesh formed by thin bridges hanging between the muri; apertural luminae (brochae) usually smaller than average, 1.8–6.8 μm ; muri 0.2–1.4 μm wide, curved to sinuate, simpli- or duplilaculate; bacula 2–2.6 μm long, 0.35–1.2 μm diameter, very densely spaced; nexine 0.5–1.1 μm , slightly thicker, 0.8–1.5 μm , at the pore margins.

Habitat and distribution.—*Phlox vermejoensis* grows on north-facing, stable, vegetated, alpine scree slopes of decomposing granite or metamorphic rock (Fig. 2, D & E). Scree texture varies from pea-gravel to a mix of gravel and angular blocks up to 20 cm diameter, with fine-textured soil immediately below the surface. At one site the granite is distinctly reddish-colored. Most plants are found just below ridge crests where wind-blown snow likely accumulates and increases soil moisture availability relative to adjacent, more exposed slopes. However, no plants were observed around cornices or late-lying snowfields. Slopes vary from 20% to 45%. Vegetation cover ranges from 15% to 60%. Common associated species include *Androsace septentrionalis* L., *Carex rupestris* All., *Claytonia megarhiza* (A. Gray) Parry ex S. Wats., *Eremogone fendleri* (A. Gray) Ikonn., *Geum rossii* (R. Br.) Ser. var. *turbinatum* (Rydb.) C. L. Hitchc., *Minuartia obtusiloba* (Rydb.) House, *Poa glauca* Vahl. var.

rupicola (Nash ex Rydb.) B. Boivin, *Potentilla concinna* Richardson var. *concinna*, *Saxifraga bronchialis* L. var. *austromontana* (Wiegand) Piper ex G.N. Jones, *Senecio taraxacoides* (A. Gray) Greene, and *Trifolium attenuatum* Greene.

Phlox vermejoensis is currently known from two metapopulations about 0.5 miles apart along the crest of the Sangre de Cristo Mountains, about 3 miles south of Colorado and wholly within the confines of Vermejo Park Ranch. The populations occur between 12,200 and 12,600 feet (3,720–3,840 meters) elevation around the perimeter of a northeast-facing glacial cirque. No additional populations were found during intensive surveys by the author in 2008 and 2009 that covered nearly all suitable habitat from the Colorado state line south to the vicinity of Big Costilla Peak, beyond which lies the Costilla Creek Valley and a disruption in alpine habitat. An examination of aerial photographs suggests suitable habitat occurs a few miles to the north in the Colorado portion of the Sangre de Cristo Mountains, particularly in the vicinity of Vermejo and Purgatoire peaks. These peaks lie on large, private ranches with limited access. Additional surveys should be conducted there.

Phenology.—Flowering specimens were collected from July 13–21. The condition of these flowers suggests the bloom period extends from early July through the end of July. Mature capsules with seeds were collected on August 20, and immature capsules are present on a collection made July 18.

Etymology.—The specific epithet *vermejoensis* refers to Vermejo Park Ranch, the boundaries of which encompass the entire known distribution of this new species. The word *vermejo*, or *bermejo*, is of Spanish origin, similar in meaning to vermilion, and describes the brick-red color of the Vermejo River when swollen with late summer rains. A suitable common name is Vermejo phlox.

Conservation status.—*Phlox vermejoensis* is estimated to be Vulnerable (VU D1+2) according to IUCN Red List criteria (IUCN 2001). It is known from two meta-populations with a total population size (number of clonal clumps) estimated at 500–1,000 individuals, and a total area of occupancy estimated at less than 5 acres (2 hectares). Trends in population size are unknown but presumed to be stable. There are no known, direct, impacts from human activities. Climate change poses a possible long-term threat since the populations lie near ridge crests where upslope migration is limited. Rocky Mountain Elk (*Cervus elaphus* L.) were frequently observed grazing on adjacent areas of flat, alpine turf; however, they usually avoid the scree slopes where *P. vermejoensis* grows.

Additional specimens examined: **U.S.A. New Mexico: Taos Co.**: Vermejo Park Ranch, crest of spur ridge extending NE from point 12827, 3.0 air mi SW of State Line Peak, 36.95704° N, 105.31961° W, elev. 12,460 ft, 13 Jul 2008, B. Legler 9736 (COLO, KSC, RM, UNM); Vermejo Park Ranch, S side of an unnamed cirque 3.3 air mi SSW of State Line Peak, 36.95208° N, 105.3193° W, elev. 12,430 ft, 20 Aug 2008, B. Legler 10982 (KSC, RM, UNM, WTU); Vermejo Park Ranch, crest of spur ridge extending NE from point 12827, 3.0 air mi SW of State Line Peak, 36.95686° N, 105.32069° W, elev. 12,520 ft, 18 Jul 2009, B. Legler 11465, with J.M. Porter & D. Hyder (RM, UNM, VPR); Vermejo Park Ranch, north slope of spur ridge extending NE from point 12827, 2.95 air mi SW of State Line Peak, 36.95782° N, 105.31901° W, elev. 12,200 ft, 18 Jul 2009, B. Legler 11468, with J.M. Porter & D. Hyder (ARIZ, MO, RM); Vermejo Park Ranch, crest of ridge on S side of an unnamed cirque 3.3 air mi SSW of State Line Peak, 36.95159° N, 105.31834° W, elev. 12,620 ft, 21 Jul 2009, B. Legler 11519 (ARIZ, COLO, MO, RM, UNM, WTU).

DISCUSSION

The distinctiveness of *Phlox vermejoensis* is such that its relationship to other members of the genus could not be ascertained based on morphology alone. It is therefore unlikely to be confused with any other species. Superficially, it resembles the more northerly species *P. alyssifolia* Greene in appearance and leaf shape, but differs in its rhizomatous growth form, lack of cartilaginous leaf margins, shorter style (styles 6–11 mm in *P. alyssifolia*), and distribution and habitat. *Phlox vermejoensis* shares a low, rhizomatous habit with *P. dispersa* Sharsmith, an apparently unrelated species found in granitic scree in the Sierra Nevada Mountains of California that has smaller, pungent, subulate leaves, smaller, solitary flowers, and styles less than 3 mm long. In the monograph by Wherry (1955) it keys most easily to the rhizomatous species in subsect. *Cluteana* of sect. *Phlox*. However, as Wherry freely admitted, this subsection is artificial. Furthermore, *P. vermejoensis* differs substantially in growth form and floral characters from the two species in subsect. *Cluteana*, both of which have corolla tubes much longer than the calyx and styles 12–20 mm long. Attempts to place *P. vermejoensis* into other

sections and subsections defined by Wherry are just as unsatisfactory and would be of limited value in determining affinities due to the highly artificial nature of Wherry's classification (Ferguson & Jansen 2002).

It is unreasonable to treat *P. vermejoensis* as a spontaneous hybrid due to the size of the populations, the presence of apparently viable seeds, and the lack of potential parent species in the vicinity. The only other species of *Phlox* recorded nearby was *P. pulvinata* (Wherry) Cronq., a densely caespitose, subulate-leaved plant found on adjacent areas of dry, alpine turf.

Preliminary, unpublished ITS and cpDNA maximum parsimony phylogenies of western species of *Phlox* by C. Ferguson (pers. comm.) place *P. vermejoensis* within a clade comprised of other southwestern species, with weak support. In the ITS phylogeny, *P. vermejoensis* is sister to a clade including *P. amabilis* Brand, *P. caryophylla* Wherry, *P. cluteana* A. Nels., *P. nana* Nutt., *P. tenuifolia* E.E. Nels., and *P. woodhousei* (A. Gray) E.E. Nels. Support for the overall clade (i.e., including *P. vermejoensis*) is weak (bootstrap <50%). In the cpDNA phylogeny, *P. vermejoensis* falls within a poorly supported polytomy (bootstrap <50%) that includes a subset of the ITS southwestern clade (*P. amabilis*, *P. caryophylla*, and *P. woodhousei*), along with some samples of *P. stansburyi* (Torr.) A. Heller, *P. longifolia* Nutt., and several caespitose to pulvinate species. Further sampling of DNA regions and phylogenetic analyses will be needed to better infer relationships of *P. vermejoensis* within the genus. Presently, no close affinity to a single taxon is apparent.

Given morphology and available DNA information, it may be useful to compare the new species with *P. cluteana*, *P. nana*, and *P. woodhousei*. From all three of these, *P. vermejoensis* differs in its short, tufted stems (1–4 cm high vs. (5–)10–30 cm), shorter leaves (6–25 mm vs. 20–50 mm), smaller inflorescences (1–4(–6) flowers vs. (3–)6–12 flowers), shorter pedicels (1–4 mm vs. 3–30 mm), and habitat (alpine scree vs. open woods and lower slopes). From *P. cluteana*, it further differs in corolla tube length (8–11 mm vs. 15–18 mm), and style length (3.5–6 mm vs. 12–18 mm). *Phlox nana* and *P. woodhousei* both have shorter styles (1.5–3.5 mm). It is further distinguished from *P. nana* by sepal length (8–11 mm vs. 10–16 mm), corolla tube length (8–11 mm vs. 12–18 mm), and smaller corolla lobes. Flower color in *P. cluteana* is purple, while *P. nana* varies from purple to lilac, pink, white, or yellow, and in *P. woodhousei* the color is purple to pink.

Regardless of relationships, *P. vermejoensis* can readily be separated from other members of the genus by the combination of rhizomatous habit, short, tufted stems, broad, non-pungent leaves mostly 2.5–5 times as long as wide, glandular-pubescent inflorescences, corolla tube equal in length to the calyx, styles 3.5–6 mm long and positioned below the anthers, and, usually, a single seed per capsule.

Although capsules with mature, apparently viable seeds were found, several characteristics suggest that *P. vermejoensis* may rely primarily on vegetative dispersal. First, the rhizomatous habit allows it to readily spread through scree and could facilitate downslope dispersal via rhizome fragments. Second, pollen viability appears to be low, with 60.4% (± 6.4 std. dev.) of pollen grains failing to stain with cotton blue. Some pollen grains have very irregular, non-reticulate exine sculpting, while, in others the reticulum is tight and dense, with very small lumina and very thick muri. These irregular forms often have thinner walls and tend to collapse. The irregular size, development, and high infertility of the pollen suggest chromosomal pairing irregularities (J. Mark Porter, pers. comm.). Third, the presence of only a single mature seed per capsule may indicate low seed set. Lastly, its narrow distribution and absence from other, nearby scree slopes is unusual since there is no indication that the species is restricted to a particular rock type.

Despite a separation of only 0.5 miles, plants from the southern metapopulation tend to have larger leaves, larger inflorescences, and a later phenology. This difference may be environmentally influenced since the northern sites are slightly drier and more exposed. The type collection, taken from the southern metapopulation, displays the largest observed leaf and inflorescence sizes and illustrates the expected potential of the species.

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