
Transfer of the Cupulate-flowered *Arabis microsperma* and *A. tricornuta* to *Pennellia* (Brassicaceae)

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ABSTRACT. The new combinations *Pennellia microsperma* and *P. tricornuta* are proposed for *Arabis microsperma* and *A. tricornuta*, which are narrowly endemic species from Chihuahua, Mexico, and southern Arizona. The distinguishing features and geographic distribution of the genus *Pennellia* are discussed, and a synopsis and key to the 11 currently recognized species are presented.

Key words: *Arabis*, Brassicaceae, *Pennellia*.

The generic name *Pennellia* was proposed by Nieuwland (1918) as a new name to replace *Heterothrix* (Robinson) Rydberg, a later homonym of *Heterothrix* Mueller in the Apocynaceae. Schulz (1924) overlooked the name *Pennellia* and recognized three North American and three South American species in *Heterothrix*, but in his subsequent account of the genus (now as *Pennellia*), Schulz (1936) maintained five species and placed one of the South American ones in *Werdermannia* O. E. Schulz. Al-Shehbaz (1990) indicated that the two South American species recognized by Schulz (1936) belong to *Sisymbrium* L. s.l., but we believe that the generic placement of those needs further study.

As presently delimited, *Pennellia* includes 11 species, including the two transferred herein (*P. microsperma* and *P. tricornuta*), the eight species recognized by Rollins (1980, 1993) from Guatemala, Mexico, and the United States (Texas, New Mexico, Arizona, and Colorado), and the disjunct South American *P. boliviensis* (Muschler) Al-Shehbaz, a species distributed in southern Bolivia and northern Argentina (Al-Shehbaz, 1990). The North-South American disjunction of *Pennellia* is exhibited by several other genera of the Brassicaceae, including *Lesquerella* S. Watson, *Mancoa* Weddell,

Thlaspi L., and *Tropidocarpum* Hooker (Al-Shehbaz & Price, 2001).

Recent molecular systematic studies (Price, 1997; Koch et al., 1999) have suggested that the widespread cruciferous genus *Arabis* L. is a heterogeneous assemblage of several morphologically relatively similar but phylogenetically unrelated lineages. This has served to focus attention on morphologically unusual taxa currently placed within *Arabis* in order to elucidate their evolutionary relationships. In the following paper we reassess the taxonomic position of two species, *A. microsperma* Rollins and *A. tricornuta* Rollins from the southern periphery of the range of *Arabis* sensu lato in North America.

Arabis microsperma was described by Rollins (1993) from oak woodlands in the area of Nabogame in west-central Chihuahua, Mexico, and is currently known only from recent collections in the area of the type locality. *Arabis tricornuta* is a narrow endemic from southeastern Arizona (Rollins in Kearney & Peebles, 1939; Rollins, 1993). Both of these species have been previously noted as being morphologically anomalous within the genus *Arabis* in having a cupulate calyx, a feature typical of several species of the genus *Pennellia* (Rollins, 1993). They were placed in the genus *Arabis* by Rollins on the basis of having silique fruits compressed parallel to the septum and compressed narrowly winged seeds with accumbent cotyledons, in contrast to the terete or slightly compressed siliques with plump, unwinged seeds and incumbent cotyledons typical of *Pennellia*. In fact, Rollins (in Kearney & Peebles, 1939: 478) stated, "*Arabis tricornuta*...is very difficult to distinguish from *Thelypodium micranthum* [now *Pennellia micrantha*]. In habit, inflorescence, flower, and type of pubescence they are almost identical."

Recent phylogenetic analyses of both chloroplast (*ndhF*) and nuclear-encoded (ITS) genes (Price, 1997; Bailey et al., 1999; Bailey, 2001; Bailey et al., in prep.) have allowed an independent assessment of the phylogenetic position of *A. tricornuta*, whereas *A. microsperma* has not yet been available for molecular comparisons. These studies have in-

dicated that *A. tricornuta* forms a well-supported monophyletic group with other representative species of *Pennellia* examined to date (*P. longifolia* (Bentham) Rollins and *P. micrantha* (A. Gray) Nieuwland) and is not closely associated with any of the other known groups examined for *Arabis* sensu lato.

KEY TO THE SPECIES OF *PENNELLIA*

- 1a. Fruits strongly flattened parallel to the septum; seeds compressed, narrowly to broadly winged; cotyledons accumbent.
- 2a. Fruits ca. 1 mm wide; valves obscurely veined; seeds ca. 1 mm long, narrowly winged 10. *P. microsperma*
- 2b. Fruits 2–3 mm wide; valves with a prominent midvein; seeds ca. 2 mm long, broadly winged 11. *P. tricornuta*
- 1b. Fruits terete or slightly flattened parallel to the septum; seeds usually plump, wingless; cotyledons incumbent.
- 3a. Racemes secund in fruit; fruiting pedicels arcuate downward to reflexed; fruits pendent, slightly flattened.
- 4a. Petals 9–12 mm long; sepals 7–9 mm long; stamens exerted 9. *P. mcvaughii*
- 4b. Petals 4–6 mm long; sepals 3–5 mm long; stamens included.
- 5a. Lower leaves and stems hirsute with simple and coarsely forked, stalked trichomes; sepals 4–5 mm long 8. *P. longifolia*
- 5b. Lower leaves and stems tomentose or pubescent with finely dendritic trichomes; sepals 3–4 mm long 7. *P. hunnewellii*
- 3b. Racemes not secund in fruit; fruiting pedicels divaricate to erect, often straight; fruits erect to divaricate, terete.
- 6a. Fruiting pedicels divaricate to horizontal; fruits distinctly not appressed to rachis; raceme lax in fruit.
- 7a. Plants glabrous basally; petals 5–6 mm long; seeds uniseriate 6. *P. juncea*
- 7b. Plants sparsely to densely pubescent basally; petals 3–4 mm long; seeds usually somewhat biseriate.
- 8a. Fruiting pedicels (3–)5–9(–10) mm long; sepals 3–4 mm long; petals oblong 5. *P. patens*
- 8b. Fruiting pedicels 11–17(–21) mm long; sepals 2–3 mm long; petals spatulate 4. *P. boliviensis*
- 6b. Fruiting pedicels erect to divaricate-ascending; fruit appressed or nearly so to rachis; raceme congested in fruit.
- 9a. Fruits 4–6 cm long; fruiting pedicels 10–15 mm long; flower buds and sepals sparsely to densely pubescent 3. *P. lasiocalycina*
- 9b. Fruits 1.5–3.5(–4.5) cm long; fruiting pedicels (3–)4–7(–8) mm long; flower buds and sepals glabrous.
- 10a. Style obsolete; fruits (2–)2.5–3.5(–4.5) cm long; seeds biseriate; sepals purple; petals purplish 2. *P. robinsonii*
- 10b. Style distinct, ca. 0.5 mm long; fruits 1.5–2 cm long; seeds uniseriate or somewhat biseriate; sepals green; petals white 1. *P. micrantha*

1. *Pennellia micrantha* (A. Gray) Nieuwland, Amer. Midl. Naturalist 5: 224. 1918. Basionym: *Streptanthus micranthus* A. Gray, Mem. Amer. Acad. Arts Sci. 4: 7. 1849. TYPE: U.S.A. [New Mexico]: near Santa Fe Creek, July 1847, A. Fendler 23 (holotype, GH; isotypes, GH, MO).

Pennellia micrantha is distributed in Colorado (Mineral, Park, and Teller Counties), Arizona (Apache, Cochise, Gila, Graham, Greenlee, Mohave, Pima, and Santa Cruz Counties), New Mexico (Dona Ana, Grant, Lincoln, McKinley, San Miguel, Santa Fe, Sierra, and Socorro Counties), Texas

(Brewster, Culberston, Hudspeth, Jeff Davis, and Presidio Counties), and Mexico (Chihuahua, Coahuila, San Luis Potosí, and Sonora). For the geographic distributions of this and the following species, see Rollins (1941, 1980, 1993) and Al-Shehbaz (1990).

2. *Pennellia robinsonii* Rollins, Contr. Gray Herb. 210: 13. 1980. TYPE: Mexico. Chihuahua: 21 mi. S of Chihuahua City, 15 Oct. 1974, R. C. Rollins & K. W. Roby 74182 (holotype, GH).

Known from a few collections, all of which are from Chihuahua, Mexico.

3. *Pennellia lasiocalycina* (O. E. Schulz) Rollins, *Contr. Gray Herb.* 210: 17. 1980. Basionym: *Heterothrix micrantha* (A. Gray) Rydberg var. *lasiocalycina* O. E. Schulz, in A. Engler, *Pflanzenr.* IV. 105 (Heft 86): 296. 1924. TYPE: Mexico. Coahuila: Sierra de Parras, 8–9000 m, July 1910, *C. A. Purpus 4604* (holotype, B; isotypes, F, GH, MO, UC, US).

Endemic to Mexico and known from many collections made in Coahuila, Hidalgo, and Nuevo León.

4. *Pennellia boliviensis* (Muschler) Al-Shehbaz, *Harvard Pap. Bot.* 2: 13. 1990. Basionym: *Streptanthus boliviensis* Muschler, *Bot. Jahrb. Syst.* 40: 268. 1908. TYPE: Bolivia. Calderillo, 3200 m, 22 Mar. 1904, *K. Fiebrig 2788* (holotype, B).

Widely distributed in Argentina (Córdoba, Jujuy, Salta, and Tucumán Provinces), but from Bolivia it is known only from the type collection.

5. *Pennellia patens* (O. E. Schulz) Rollins, *Rhodor.* 62: 16. 1960. Basionym: *Heterothrix patens* O. E. Schulz, in A. Engler, *Pflanzenr.* IV. 105 (Heft 86): 296. 1924. TYPE: Mexico. Chiapas: District Comitán, 18 Aug. 1898, *C. & E. Seler 3038* (lectotype, designated by Rollins (1980), B; isolectotype, GH).

Widespread in Mexico (Aguascalientes, Distrito Federal, Durango, Hidalgo, Jalisco, México, Michoacán, Oaxaca, Puebla, and San Luis Potosí).

6. *Pennellia juncea* (O. E. Schulz) Rollins, *Contr. Gray Herb.* 210: 19. 1980. Basionym: *Heterothrix juncea* O. E. Schulz, in A. Engler, *Pflanzenr.* IV. 105 (Heft 86): 297. 1924. TYPE: Mexico. Puebla: San Luis, 1908, *C. A. Purpus 3486a* (holotype, B; probable isotype, UC).

Known thus far only from the type collection.

7. *Pennellia hunnewellii* Rollins, *Contr. Gray Herb.* 210: 10. 1980. TYPE: Guatemala. Dept. Sacatepéquez: Cumbre de Soledad, Volcán Acatenango, 8500 ft., 16 Feb. 1937, *F. W. Hunnewell 1482* (holotype, GH).

Widespread in Guatemala (Chimaltenango, Huehuetenango, and Sacatepéquez) and Mexico (Hidalgo, Jalisco, México, Oaxaca, Puebla, Queretaro, and Veracruz).

8. *Pennellia longifolia* (Bentham) Rollins, *Rho-*

dora 62: 16. 1960. Basionym: *Streptanthus longifolius* Bentham, *Pl. Hartweg.* 10. 1839. TYPE: Mexico. “In pasceris montosis, Aguas Calientes,” 1837, *Hartweg 52* (holotype, K; isotype, GH).

The most widespread species in the genus. Distributed in Mexico (Aguascalientes? [type collection], Chihuahua, Coahuila, Distrito Federal, Durango, Guanajuato, Hidalgo, Jalisco, México, Michoacán, Nuevo León, Puebla, San Luis Potosí, Sinaloa, Tamaulipas) and in the United States in Arizona (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Mohave, Navajo, Pima, Pinal, and Yavapai Counties), Colorado (La Plata County), New Mexico (Catron, Colfax, Grant, Lincoln, Mora, Rio Arriba, Sandoval, Santa Fe, Sierra, and Socorro Counties), and Texas (Jeff Davis County).

9. *Pennellia mcvaughii* Rollins, *Taxon* 28: 24. 1979. TYPE: Mexico. Durango: Sierra Madre Occidental, 26 mi. E of El Salto, near Mexican Hwy. 40, 21 Sep. 1974, *R. C. Rollins & K. W. Roby 7423* (holotype, GH).

Known only from several collections, all of which were made from Durango.

10. *Pennellia microsperma* (Rollins) R. A. Price, C. D. Bailey & Al-Shehbaz, *comb. nov.* Basionym: *Arabis microsperma* Rollins, *Cruciferae of Continental North America* 176. 1993. TYPE: Mexico. Chihuahua: Nabogame, 28°30'N, 108°30'W, 1800 m, 10 Sep. 1987, *J. E. Laferriere 1069* (holotype, GH).

Known thus far only from the type locality.

11. *Pennellia tricornuta* (Rollins) R. A. Price, C. D. Bailey & Al-Shehbaz, *comb. nov.* Basionym: *Arabis tricornuta* Rollins, in Kearney & Peebles, *J. Wash. Acad. Sci.* 29: 478. 1939. TYPE: U.S.A. Arizona: [Pima County], Eastview, Rincon Mts., 13 Oct. 1909, *J. C. Blumer 3478* (holotype, GH).

Endemic to southern Arizona (Cochise and Pima Counties).

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