

**RECOGNIZING SUBSPECIES IN THE POLYMORPHIC SPECIES
STREPTANTHUS POLYGALOIDES (BRASSICACEAE: THELYPODIEAE),
A SERPENTINE ENDEMIC OF THE CALIFORNIA SIERRA NEVADA**

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ABSTRACT

Seven subspecies are recognized for *Streptanthus polygaloides* (Brassicaceae: Thelypodieae), a species endemic to serpentine outcrops in the Sierra Nevada of California. This species is well-documented as a nickel hyperaccumulator and has been the subject of many ecological studies. Several morphologically distinct morphs have been distinguished, suggesting that ecotypic differentiation may also have occurred. Additional field surveys and study of herbarium specimens revealed that additional morphs are evident. The purpose of this paper is to recognize the morphs as subspecies, both to serve as a formal hypothesis for reinterpreting the results of previous studies and to guide future studies and to identify taxa that have conservation needs. The subspecies differ in flower color, sepal shape, petal shape, and free vs. fused adaxial filaments, and each has a discrete geographic distribution within the species' range. A key to the subspecies and images of the subspecies are provided.

The genus *Streptanthus* Nutt. currently consists of 38 species in western North America (Al-Shehbaz 2010; Preston et al. 2019; Jensen 2020). Cacho et al. (2014) found *Streptanthus* to be polyphyletic, consisting of two clades: one consisting of species occurring in Texas and adjoining states, and a second consisting of species with the primary center of diversity in the California Floristic Province. The genus is well known as the subject of many ecological studies, especially with respect to edaphic endemism (Kruckeberg 1951; Reeves et al. 1981; Boyd et al. 1994; Strauss & Cacho 2013). The serpentine endemic species of the California Coast Ranges are well known for a wide range of morphological variation, especially in flower color, that has resulted in the recognition of multiple subspecies for several of these species (Kruckeberg 1958; Kruckeberg & Morrison 1983; Dolan & LaPré 1989; Al-Shehbaz & Mayer 2008; Mayer & Beseda 2010).

Fifteen *Streptanthus* species are known to occur on serpentine soils, fourteen of which are strict endemics (Safford & Miller 2020; Preston et al. 2019). Most of the species are endemic to the Coast Ranges; *S. polygaloides* A. Gray is the only serpentine endemic *Streptanthus* that is endemic to the Sierra Nevada. Based on the unique calyx morphology of *S. polygaloides*, compared to all other *Streptanthus* species, Greene (1904) proposed to place the species in a monotypic genus, *Microsemia* Greene. Unlike the Coast Range species, *S. polygaloides* hyperaccumulates nickel (> 1000 µg/g Ni in dry leaf tissue) (Reeves et al. 1981; Kruckeberg & Reeves 1995). Nickel hyperaccumulation in *S. polygaloides* has been shown to provide defense against predators and pathogens (Boyd et al. 1994; Jhee et al. 2005; Martens & Boyd 2002; Mincey & Boyd 2018; Mincey et al. 2018; Wall & Boyd 2006). The presence of nickel in the pollen and nectar affects both pollinator behavior and composition of the floral visitors (Meindl & Ashman 2014, 2015). Reeves et al. (1981) suggested that the ability to hyperaccumulate nickel was further evidence to support *Microsemia*. However, the phylogenetic analyses of both Mayer and Soltis (1994) and Cacho et al. (2014) found that *S. polygaloides* is sister to the group of species allied with *Streptanthus tortuosus* Kellogg, and recognizing *Microsemia* would render the *Streptanthus* clade that includes both *S. polygaloides* and *S. tortuosus* polyphyletic.

The level of infraspecific morphological variation observed in the Coast Range species had not been recognized for *Streptanthus polygaloides* until a comparison of populations found that four morphologically distinct color morphs were distinguishable: a morph with yellow sepals (Y), a morph with purple sepals (P), a morph with yellow sepals in buds that turned purple at anthesis (Y/P), and a morph with strongly undulate sepals (U) (Wall & Boyd 2006; Boyd et al. 2009). A statistical analysis of morphological variation, timing of flowering, and elemental concentrations found significant differences between the floral morphs and also suggested that additional variation among populations of the Y morph was present (Boyd et al. 2009). The authors further suggested that the morphological and elemental uptake data supported the recognition of these morphs as separate taxa, although no formal nomenclatural treatment was proposed. Sánchez-Mata et al. (2013) later described the P morph as a new species, *Streptanthus purpureus* Sánchez Mata et al.

The purpose of this paper is to present a taxonomic treatment of *Streptanthus polygaloides* to formally recognize infraspecific taxa. One objective of having a formal taxonomic treatment is that it serves as a model for testing ecotype differences, such as was attempted by Pope et al. (2014). Other studies testing for differences in the uptake of nickel and other elements among the color morphs have had mixed results (Boyd et al. 2009; Pope et al. 2014); however, combining material from different taxa could have confounded the results if the groups thus created were heterogeneous for their physiological responses. A second purpose is to make the names available for a forthcoming update of *Streptanthus* for The Jepson Manual Project, which would bring greater public recognition to the different taxa and facilitate gathering of additional locality information.

The approach taken here is to recognize each of the morphs as a subspecies, following the previous example set for *Streptanthus glandulosus* by Kruckeberg (1958), who recognized subspecies on the basis of more or less well-delimited morphological discontinuities and geographic range, coupled with genetic data from crossing studies. Similarly, the four *S. polygaloides* color morphs have different geographic distributions and differ genetically, shown by complete plastid genome sequences from eight populations (Mincey 218). However, Mincey (2018) also found that two genetically distinguishable forms of the Y morph were apparent. As noted above, Boyd et al. (2009) found that Y morphs from different areas exhibited differences in size and leaf characters.

To further resolve the differences between Y morph populations, I examined floral characters of herbarium specimens at the U.C. Davis Herbarium (DAV), on-line specimen images available at the Consortium of California Herbaria (<https://cch2.org/portal/>, accessed June 2023), and field-collected material. I found that the Y morph can be further segregated by geography and flower color variation. In the northern group of populations occurring in Butte and Plumas counties, the flowers are initially yellow but develop red-purple pigment in the petals, stamens, and sepals as anthesis progresses (Figure 1A). The red-purple pigment initially develops in the upper part of the petal claw, spreading basipetally and into the petal blade. It also develops at the filament apex and spreads basipetally. Although the upper sepals remain yellow, the lower and lateral sepals develop various amounts of red-purple pigment as anthesis progresses, although not turning entirely purple as in the Y/P morph (Figure 1D) and P morph (Figure 1E). In pressed plants, specimens often appear similar to the Y/P morph but are not as deeply purple-pigmented. Plants in the northern populations also differ by having the adaxial filaments completely separate to the base, unlike the P morph and other Y morph populations, in which the adaxial filaments are fused to their tips.

In the central group of Y morph populations, occurring from El Dorado County to Amador County, the sepals, stamens, and petal blades remain yellow throughout anthesis (Figure 1B). In the southern group of Y morph populations, occurring from Calaveras County to Mariposa County, (including the type of *S. polygaloides*), red-purple pigment develops in the petals as anthesis progresses, but all sepals remain yellow (Figure 1D). In a fourth group of Y morph populations, occurring in the Red Hills of Tuolumne County, the flowers develop red-purple pigment as in the northern population

group, but the adaxial filaments are fused, and color of the lower and lateral sepals can vary from light purple to deep purple.

In the following treatment, seven subspecies are recognized. Specimens examined at DAV or as digital images are indicated by an exclamation point “!”.

TAXONOMIC TREATMENT

Key to the subspecies of *Streptanthus polygaloides*

1. Sepals pale yellow to golden yellow, margins pale and strongly undulate, with papillae or short bristles distally; abaxial and adaxial petals similar in size and shape; filaments of adaxial stamens free to base; Fresno County subsp. **undulatus**
1. Sepal yellow or red-purple, not or only weakly undulate, papillae or bristles 0; claw of adaxial petals longer and wider than that of abaxial petals, blade reduced; filaments of adaxial stamens fused to tip (free to base).
 2. Sepals yellow/yellow-green at anthesis, lacking red-purple pigmentation.
 3. Adaxial petal claws with red-purple veins; Calaveras to Mariposa County subsp. **polygaloides**
 3. Adaxial petal claws uniformly yellow; Nevada to Amador counties subsp. **aureus**
 2. Sepals purple or yellow with red-purple markings on abaxial and lateral sepals at anthesis.
 4. Sepals purple at anthesis.
 5. Sepals purple in buds and flowers, margins pale; Sierra to El Dorado counties subsp. **purpureus**
 5. Sepals yellow in buds, uniformly purple at anthesis; Calaveras to Mariposa counties subsp. **alternans**
 4. Adaxial sepals yellow, abaxial and lateral sepals with red-purple markings at anthesis.
 6. Filaments of adaxial stamens free to base; Butte, Plumas, and Yuba counties subsp. **liber**
 5. Filaments of adaxial stamens fused to their tips; Calaveras to Tuolumne County subsp. **bicolor**

STREPTANTHUS POLYGALOIDES A.Gray, Proc. Amer. Acad. Arts 1: 519. 1865. *Erysimum polygaloides* (A. Gray) Kuntze, Revis. Gen. Pl. 2: 933. 1891. *Microsemia polygaloides* (A. Gray) Greene, Leaf. Bot. Observ. Crit. 1: 89. 1904. **Lectotype** (designated here): **California**. [Tuolumne Co.]: On very dry hillsides, in serpentine soil, along the Tuolumne River, [11 Jun 1863, *W.H. Brewer 1615*] (GH00019713!; isolectotypes: K000653792!, US320589!, YU.066322!).

1. *Streptanthus polygaloides* subsp. **polygaloides**

Additional specimens examined. California. Calaveras Co.: Harmon [Carmen] Peak, May 1895, *Davy 1434* (GH, UC). Mariposa Co.: Hwy 49, near head of Coe Gulch, ca. 1 linear km NW of Virginia Point, *Wilkin 15619* (SBBG!); summit of road between Coulterville and Bagby, *Mason 11118* (GH!, NO!, RSA!, SBBG!, UC!); 1 mi N of Bagby, *Belshaw 1945* (UC!); Bagby, *Hall 8841* (GH!, RSA!, UC!); along CA-49 at Hell Hollow, 1.5 mi S of the Merced River, *Helmkamp 95-5-8* (RSA!); Mt. Bullion, June 1866, *Bolander 4848* (BRU!, GH!, PAC!, UC!); Mariposa, serpentine hillside W of the County jail, *Taylor 15661 et al.* (JEPS!, RSA!).

Geographic distribution and habitat. *Streptanthus polygaloides* subsp. *polygaloides* is endemic to the southern Sierra Nevada foothills from Calaveras County to Mariposa County. It occurs on open gravelly slopes and roadcuts in serpentine chaparral and foothill pine-blue oak woodland, at elevations between 250 and 760 m. It is associated with soils derived from ultramafic serpentine rocks, mapped as Henneke extremely rocky clay loam (UC-Davis 2019).

Conservation status. *Streptanthus polygaloides* subsp. *polygaloides* is currently known from a 2-km-wide band between Coulterville and Mariposa, in Mariposa County. About 10 occurrences are documented in this reach. However, the occurrences near Mariposa and the occurrences along the Bagby Grade are both on large, continuous serpentine exposures and may represent just two large populations. The location of the type locality is currently unknown and may have been inundated by the creation of Don Pedro Reservoir; however, serpentine exposures near the confluence with Moccasin Creek and along the east side of Don Pedro Reservoir are likely to harbor populations. The location of the Calaveras County occurrence is also currently unknown, as no serpentine exposures are present on Carmen Peak (UC-Davis 2019). Potential habitat is present about 1.5 km southeast of Carmen Peak along Highway 4, north of Copperopolis (UC-Davis 2019). Although this subspecies is rare, it does not appear to face any immediate threats. This subspecies (and the other subspecies) occurs on roadcuts that may be subject to periodic maintenance; however, the plants typically occur in open, barren habitat, which the roadcuts provide. Therefore, it would merit a rare plant rank of 1B.3 in the CNPS Rare Plant Inventory (California Native Plant Society 2023).

2. *Streptanthus polygaloides* A. Gray subsp. *purpureus* (Sánchez Mata, Fuente, Rufo, Nuria Rodr. & Amils) R.E. Preston, **comb. et stat. nov. *Streptanthus purpureus* Sánchez Mata, Fuente, Rufo, Nuria Rodr. & Amils, *Lazaroa* 34: 278. 2013. **TYPE: California.** Placer Co.: Forest Hill, Sugar Pine Road to Sugar Pine Reservoir, 23 Jun 2004, *D. Sánchez-Mata s.n.* (holotype: MAF 171942; isotypes: MAF, DAV, JEPS, WTU, K, P, G, M, MA).**

Additional specimens examined. California. Sierra Co.: above North Fork of the Yuba River, 3.8 mi W of Downieville, 08 Jun 1938, *Constance* 2293 (GH!, UC!); about 2½ mi SW of Alleghany, 25 May 1973, *Ahart* 237 (CHSC). Nevada Co.: on road to Washington, 1.3 mi N of State Highway 20, 14 Jul 1963, *Mann s.n.* (DAV!, IND!, SFV!, UCR!); Placer Co.: near Placer County and Nevada County border, W of I-80, Drum Powerhouse Rd, 16 Jun 2002, *Shapiro s.n.* (DAV!); Casa Loma Road, *Cacho* IC-SS233-234. (DAV!); 6 mi E of Iowa Hill, 20 Jul 1952, *Bacigalupi* 3875 (JEPS!). El Dorado Co.: 3.5 mi NE of Georgetown, on E slope of Little Bald Mtn., *Preston* 2973, 11 Jun 2014 (DAV!); Riverton, Moore's Bridge, 11 Jul 1908, *Brandegge s.n.* (UC!).

Geographic distribution and habitat. *Streptanthus polygaloides* subsp. *purpureus* is found in the northern High Sierra Nevada from Sierra County to El Dorado County, at elevations between 810 and 1460 m. It occurs on serpentine barrens and in grassy openings in serpentine chaparral and lower montane coniferous forest. It is often associated with soils derived from ultrabasic rocks with large amounts of serpentine minerals, mapped as Dubakella stony loam or as serpentine rock land (UC-Davis 2019). This subspecies inhabits an area of colder temperatures and greater precipitation than the other subspecies (Pope et al. 2014).

Conservation status. *Streptanthus polygaloides* subsp. *purpureus* is a plant of limited distribution, currently known from a 10 km-wide band spanning four counties along the west slope of the Sierra Nevada. It appears to merit a rare plant rank of 4.3 in the CNPS Rare Plant Inventory (California Native Plant Society 2023).

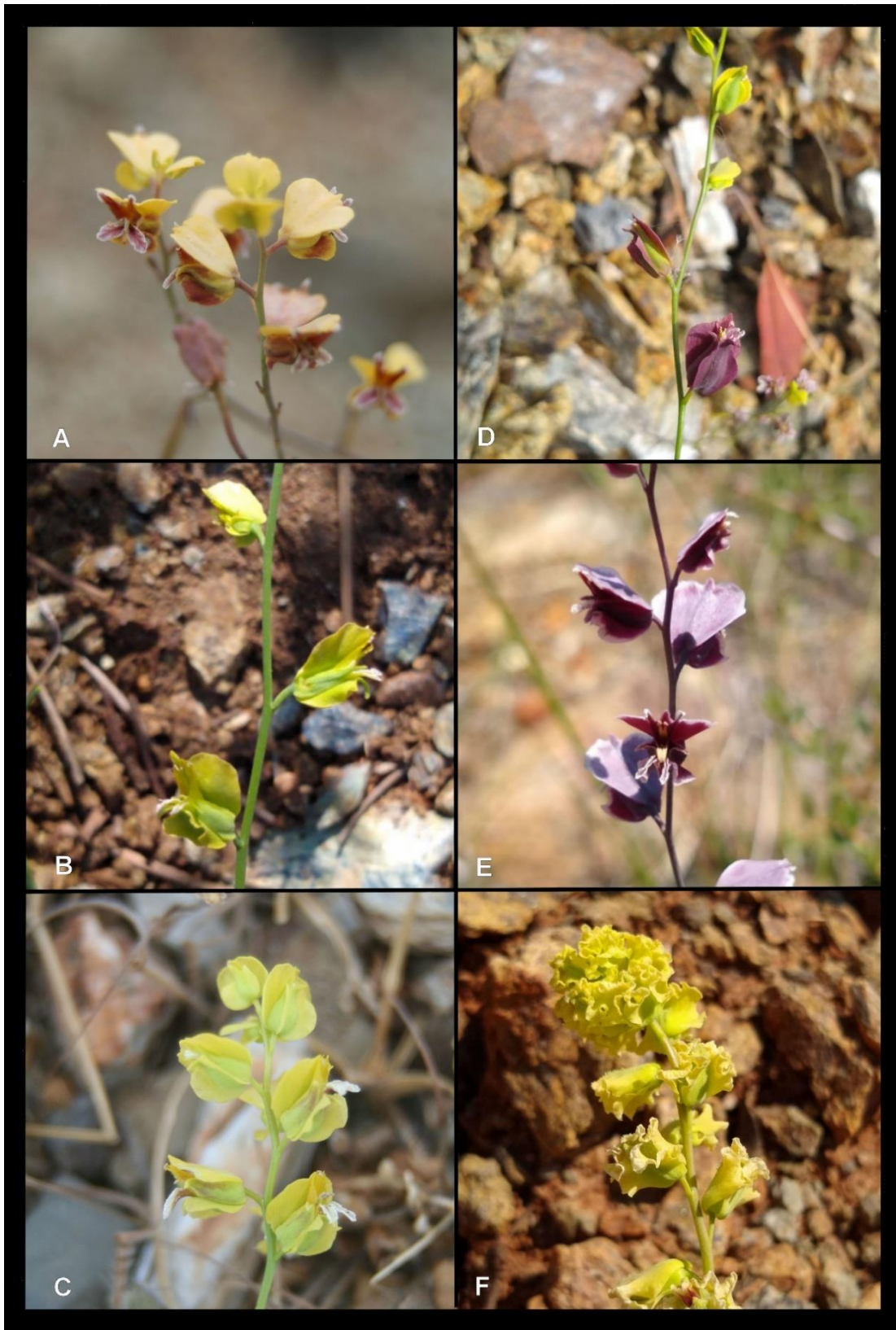


Figure 1. Flowers of *Streptanthus polygaloides*. A. subsp. *liber*. B. subsp. *aureus*. C. subsp. *polygaloides*. D. subsp. *alternans*. E. subsp. *purpureus*. F. subsp. *undulatus*.

- 3. *Streptanthus polygaloides* A. Gray subsp. *alternans* R.E. Preston, subsp. nov. TYPE: California.** Tuolumne Co.: 4.4 mi S of Moccasin, 14 Jun 2023, *R.E. Preston 3432* (holotype DAV!; isotype: JEPS! [to be distributed]). Figure 1D.

Differs from *Streptanthus polygaloides* subsp. *polygaloides* by the color change that the sepals undergo, changing from yellow in bud to purple as the flowers enter anthesis.

Additional specimens examined. California. Calaveras Co.: 2.5 mi NW of San Andreas, 09 Jun 1936, *Johannsen 899* (UC!). Tuolumne Co.: Priest's Hill, 20 May 1885, *Blasdale s.n.* (UC!); 4 mi N of Mariposa-Tuolumne county line on road from Coulterville to Moccasin Dam, 04 Oct 1948, *Hoffman 2393* (UC!); 3 mi S of Jacksonville on #49, 23 May 1965, *Howe 4074* (SDSU!); 5.6 mi N of Coulterville on Hwy 49, 1.6 mi N of Mariposa Co. line, 31 May 1988, *Pitzer 1020* (RSA!, UCR!, UCSB!); Jumper Mine, ca. 1.2 mi S of Stent, 03 Apr 1991, *Preston 598* (DAV!); Highway 49, ca. 6 road mi N of Coulterville, 23 Jun 1995, *Taylor 15096* (JEPS!, RSA!); BLM parcels near McAlpine Mine, located on the S side of Highway 49 about a half mi N of the county line, 22 Jun 2005, *CNPS SN Foothill Team SNNR0363* (DAV!). Mariposa Co.: near jet of Black's Creek Rd and St. Hwy 49, ca. 2 km NW of Coulterville, 29 Jun 1998, *Wilkin 15617* (SBBG!).

Etymology. The epithet for this subspecies alludes to the yellow flower buds that transition to purple flowers at anthesis. I suggest "Tuolumne jewelflower" as the common name for this subspecies.

Geographic distribution and habitat. *Streptanthus polygaloides* subsp. *alternans* is found in a narrow elevational band paralleling Highway 49 between Mokelumne Hill, in Calaveras County, and Coulterville, in Mariposa County. It occurs on open gravelly slopes and roadcuts in serpentine chaparral, at elevations between 260 and 780 m. It is associated with soils derived from serpentinite, mapped as Crimeahouse very gravelly loam or Sixbit gravelly loam (UC-Davis 2019).

Conservation status. *Streptanthus polygaloides* subsp. *alternans* is rare, known primarily from a 2-km-wide band between Jamestown (Tuolumne County) and Coulterville (Mariposa County). A disjunct population occurs in Calaveras County just north of San Andreas, 45 km north of the nearest population in Tuolumne County. One occurrence may have been inundated by the construction of Don Pedro Reservoir. Although this subspecies is rare, it does not appear to face any immediate threats. Therefore, it would merit a rare plant rank of 1B.3 in the CNPS Rare Plant Inventory (California Native Plant Society 2023).

- 4. *Streptanthus polygaloides* A. Gray subsp. *aureus* R.E. Preston, subsp. nov. TYPE: California.** Nevada Co.: Near Gautier Bridge over Bear River, 7 Jun 1916, *H.M. Hall & F.M. Essig 10161* (holotype: UC198971!; isotypes: CAS87454, CAS87455, GH004222!, LA0060637!, RSA015053!, US1328135!). Figure 1B.

Differs from *Streptanthus polygaloides* subsp. *polygaloides* by the yellow petal blades that remain yellow and do not develop red-purple pigmentation during anthesis.

Additional specimens examined. California. Nevada Co.: Nevada City, 20-22 Jun 1912, *Eastwood 562* (CAS, GH!, NY!, UC!, US!). El Dorado Co.: Traverse Creek Special Interest Area, 08 Jul 2007, *Janeway 9098* (CHSC!); 1 mi SW of Garden Valley, on road to Coloma, *Crampton 2030* (AHUC!); near E bank of American River, 2.8 miles S of Rattlesnake Bridge, *Hoffman 4198* (UC!); Rose Springs, ca. 1895, *Gates s.n.* (SBBG!); Amador Co.: Tonzi Road, 0.4 mi E of its junction with CA-124, 4.5 air mi NE of Ione, 08 May 2014, *Helmkamp 22851* (RSA!, UCR!).

Etymology. The epithet for this subspecies alludes to the yellow sepals and petal claws that lack red-purple pigments. I suggest "Golden jewelflower" as the common name for this subspecies.

Geographic distribution and habitat. *Streptanthus polygaloides* subsp. *aureus* is found in the northern Sierra Nevada foothills and along the lower edge of the northern High Sierra Nevada, between El Dorado County and Amador County. It occurs on open gravelly slopes and roadcuts in serpentine chaparral and foothill pine-blue oak woodland, at elevations between 190 and 740 m. It is associated with soils derived from ultramafic rock, mapped as Henneke gravelly loam; ultrabasic rock with large amounts of serpentine minerals, mapped as Dubakella stony loam; or, mapped as serpentine rock land (UC-Davis 2019).

Conservation status. *Streptanthus polygaloides* subsp. *aureus* is a plant of limited distribution, restricted to serpentine outcrops, mostly in the Sierran Foothills between Grass Valley, in Nevada County, and Ione, in Amador County. Threats include habitat loss associated with urbanization in Grass Valley and along the Highway 50 corridor between El Dorado Hills and Placerville. It would merit a rare plant rank of 4.1 or 4.2 in the CNPS Rare Plant Inventory (California Native Plant Society 2023).

5. *Streptanthus polygaloides* A. Gray subsp. *bicolor* R.E. Preston, subsp. nov. TYPE: California. Tuolumne Co.: 3 mi N of Keystone, 3 Jun 1937, *R.F. Hoover 2362* (holotype: UC767809!; isotypes: CAS87469, CAS87470, GA153041!, GH00422249!, GH00422253!, HSC201550!, NCS00078!, P05445740!, RSA0150545!, UC596400!).

Differs from *Streptanthus polygaloides* subsp. *polygaloides* by the development of red-violet pigmentation in the petals, stamens, and lower and lateral sepals during anthesis. Differs from subsp. *liber* by the fused (vs. free) adaxial filaments.

Additional specimens examined. California. Tuolumne Co.: canyon of Spring Gulch on Rawhide Hill, 18 May 1919, *Williamson 112* (RSA!, UC!); ranch of W.E. Menke, Chinese Camp, 18 Jun 1948, *Tucker 1686* (DAV!); about 1 mi E of Rawhide, on the Rawhide Road, 21 Jun 1967, *Dempster 4360* (JEPS!); 3 mi S of Chinese Camp, 23 May 1969, *Hoover 11332* (OBI!, UC!); Red Hills, along road into Six-Bit tailings, about 1 mi S of summit Taylor Hill, 16 May 1974, *Heckard 3714* (JEPS!); Red Hills, 4.2 air km WSW of Chinese Camp, *Janeway & B. Castro 10035* (CHSC!).

Etymology. The epithet for this subspecies alludes to the bicolored calyx. I suggest “Red Hills jewelflower” as the common name for this subspecies.

Geographic distribution and habitat. Red Hills jewelflower is restricted to Tuolumne County, occurring west of Sonora on Rawhide Hill, and south of Sonora in the Red Hills Recreation Management Area. It occurs in open areas in serpentine chaparral at elevations between 200 m and 500 m. This subspecies is associated with soils derived from serpentinite, mapped as Crimeahouse very gravelly loam and Sixbit gravelly loam (UC-Davis 2019).

Conservation status. Red Hills jewelflower is rare, having a limited distribution and few known occurrences. However, most of the plants are located on public lands administered by the U.S. Bureau of Land management. Although this subspecies is rare, it does not appear to face any immediate threats. Therefore, it would merit a rare plant rank of 1B.3 in the CNPS Rare Plant Inventory (California Native Plant Society 2023).

6. *Streptanthus polygaloides* A. Gray subsp. *liber* R.E. Preston, subsp. nov. TYPE: California. Butte Co.: 2 mi SE of Forest Ranch, 22 Jun 2004, *L. Ahart 11111* (holotype: CHSC 087883!; isotypes: CDA0025182, JEPS106170, RSA0150524!). Figure 1A.

Differs from *Streptanthus polygaloides* subsp. *polygaloides* by the development of red-violet pigmentation in the petals, stamens, and lower and lateral sepals during anthesis and by the filaments of the adaxial stamens, which are free to the base.

Additional collections examined. California. Butte Co.: dirt road to Minnie-Ha-Ha Mine located on Big Chico Creek, 05 June 1991, *Oswald and Ahart 4648* (CHSC!); Magalia, ca. 320 mi N of the jct of the Skyway and Coutelenc Rd, 05 May 1981, *Preston 70* (CHSC!); Lake Oroville, ca. 0.9 mi NE of Lime Saddle Powerhouse, 22 Apr 19182, *Preston 258* (CHSC!); ½ mi N of the intersection of Lunt Road and Highway 70, N of Yankee Hills, *Ahart 4975* (CHSC!); ca. 100 m N of Bardee's Bar Rd, ca. 0.8 km from its jct with Big Bend Rd, 02 Jun 1981, *Preston 76* (CHSC!); Bardee's bar Road, about 2.5 mi SW of Pulga, 10 May 2008, *Ahart 12612* (CHSC!); S side of Concow Rd, ca. 0.5 mi S of its jct with Ponderosa Way, 21 May 1981, *Taylor 3765* (CHSC!); ca. 0.5 mi S of Coyote Gap on Four Trees Rd, ca. 4 mi E of Pulga, 15 May 1981, *Taylor 3737* (CHSC!); along the Western Pacific right-of-way between Pulga and Dogwood Creek, 21 April 1985, *Oswald 1715* (CHSC!); 0.5 mi SW of Forbestown Dam, 18 May 1982, *Preston 285* (CHSC!). **Plumas Co.:** 12 mi E of Pulga, 02 Jul 1070, *Ahart 60* (CHSC!); between Forest Service Road 25N18Y and Caribou Road, S of Northfork Campground, *Boes 2015-007E* (CHSC!).

Etymology. The epithet for this subspecies alludes to the unfused filaments of the adaxial stamens. I suggest "Feather River jewelflower" as the common name for this subspecies.

Geographic distribution and habitat. *Streptanthus polygaloides* subsp. *liber* is present on serpentine outcrops in the Feather River watershed in northern Butte County, western Plumas County, and northern Yuba County. It occurs in chaparral, foothill woodlands, McNab cypress woodland, Ponderosa pine forest, and mixed evergreen forest, at elevations between 270 m and 1,210 m. This subspecies is associated with several soil series derived from ultramafic rock, including Earlal gravelly loam, Cerpone gravelly loam, Millerridge gravelly sandy clay loam, Boxrobber cobbly sandy clay loam, Woodleaf gravelly loam, and Dubakella stony loam (UC-Davis 2019).

Conservation status. *Streptanthus polygaloides* subsp. *liber* is a plant of limited distribution, restricted to serpentine outcrops, mostly in Butte County. Extensive areas of serpentine exposures are present in the watersheds of the West Branch and North Fork of the Feather River, and the subspecies is relatively common in this area. No immediate threats to the subspecies are evident. It would merit a rare plant rank of 4.3 in the CNPS Rare Plant Inventory (California Native Plant Society 2023).

7. *Streptanthus polygaloides* A. Gray subsp. *undulatus* R.E. Preston, subsp. nov. TYPE: California. Fresno Co.: Watts Valley Road 3.3 mi from junction of Pitman Hill Road (ca. 15 air mi E of Fresno), 36.9137 -119.41956, 549 m, 12 Jun 1996, *D.W. Taylor 15660* (DAV!; isotypes: CAS, CBA, CHSC, DAV, GH, HSU, JEPS, MO, OBI, OSU, NY, SBBG, SD, UCR, US [to be distributed]). Figure 1F.

Differs from *Streptanthus polygaloides* subsp. *polygaloides* by the highly undulate sepal margins, the presence of papillae or short stiff hairs distally on the sepals, and by the filaments of the adaxial stamens, which are free to the base.

Additional collections examined. California. Fresno Co.: Near Kings River, about 4 or 5 mi below Trimmer, 2 Jun 1943, *Carter 58* (FSC!, GH!, RSA!, UC!); ca. 33 km NE of Fresno, 6.3 km SSW of Tollhouse, Big Dry Creek Basin, 16 Jun 1996, *York 902* (JEPS!).

Etymology. The epithet for this subspecies alludes to the undulate sepal margins. I suggest "Pine Flat jewelflower" as the common name for this subspecies.

Geographic distribution and habitat. *Streptanthus polygaloides* subsp. *undulatus* is endemic to a small area of the Sierra Nevada foothills in Fresno County, in the vicinity of Pine Flat Reservoir. It occurs in serpentine grasslands and on serpentine outcrops and roadcuts, in blue oak woodland with sparse chaparral shrubs, at an elevation between 200 m and 725 m. This subspecies is associated with soils derived from serpentine rock, including Delpiedra stony loam and Fancher loam (UC-Davis 2019).

Conservation status. *Streptanthus polygaloides* subsp. *undulatus* is very rare and highly localized. No threats are currently evident, although inundation of Pine Flat Reservoir is likely to have eliminated habitat for the subspecies. Although this subspecies is rare, it does not appear to face any immediate threats. Therefore, it would merit a rare plant rank of 1B.3 in the CNPS Rare Plant Inventory (California Native Plant Society 2023).

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