A NEW SPECIES OF *STREPTANTHUS* (BRASSICACEAE) FROM THE NORTH COAST RANGE OF CALIFORNIA (U.S.A.)

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ABSTRACT

Streptanthus callizoi R. O'Donnell is a newly described annual endemic species growing in the serpentine soils on Snow Mountain (near Hopland) in Mendocino County, California. The type locality is a serpentine barren, southwest of Hopland along County Road 110 near the summit of Snow Mountain. Previous collections of this taxon at the type locality had been determined as *Streptanthus barbiger* Greene or *S. batrachopus* J.L. Morrison. The new species exhibits several character states that distinguish it from *S. barbiger*: basal rosette, auriculate and non-auriculate cauline leaf bases, small stature (usually < 30 cm), and low branching habit. Several character states distinguish it from *S. batrachopus*: basal rosette and possession of both auriculate and non-auriculate cauline leaf bases. This rare serpentine endemic merits recognition as a species of conservation concern.

Key Words: *Streptanthus barbiger*, Freed Hoffman, serpentine, endemic, Edward L. Greene, new species, California North Coast Range, Joe Callizo

RESUMEN

Streptanthus callizoi R. O'Donnell es una especie endémica anual recientemente descrita que crece en los suelos serpentinos de Snow Mountain (cerca de Hopland) en el condado de Mendocino, California. La localidad tipo es un yermo de serpentina, al suroeste de Hopland a lo largo de la carretera 110 del condado, cerca de la cumbre de Snow Mountain. Colecciones anteriores de este taxón en la localidad tipo habían sido determinadas como *Streptanthus barbiger* Greene o *S. batrachopus* J.L. Morrison. La nueva especie presenta varios caracteres que la distinguen de *S. barbiger*: roseta basal, bases de las hojas caulinares auriculadas y no auriculadas, pequeña estatura (normalmente < 30 cm) y hábito de ramificación baja. Varios caracteres la distinguen de *S. batrachopus*: la roseta basal y la posesión de bases de hojas caulinares auriculadas y no auriculadas. Este raro endemismo serpentino merece ser reconocido como especie de interés para la conservación.

TAXONOMIC TREATMENT

Streptanthus callizoi R. O'Donnell, **sp. nov.** (**Figs. 1, 2**). Type: U.S.A. California. Mendocino Co.: near the summit of Snow Mountain, on serpentine barren (associates: *Eriogonum vimineum*, *Allium falcifolium*, *Ceanothus jepsonii*, *Hesperocyparis sargentii*, *Arctostaphylos* spp., and *Aspidotis densa*), 2663 ft [812 m], 6.1 mi SW of Hopland along County Road 110, 38.943806 N, -123.193763 W, 18 Jun 2018, *Richard O'Donnell s.n.* (holotype: UC).

Plants annual. **Stems** (4)15–25(30+) cm; several branches spread out and up from the base; greenish-brown or reddish-brown in color. **Leaves** leathery; basal in rosette, deciduous, petiolate, blade oblong, 15–40 mm long, 4–14 mm wide, base attenuate, margin toothed, teeth tipped with orange callosities, abaxial surface purplish with whitish bloom, adaxial surface brownish-green or reddish-brown, marked with faint purplish spots; proximal linear, ±20 mm long, 1 mm wide, distal always shorter and narrower than proximal, blade channeled, base auriculate or not, margins remotely toothed or entire, teeth tipped with orange callosities. **Inflorescence** racemose, ebracteate. **Flowers** zygomorphic; calyx urceolate, sepals 5.5 mm long, 2.5 mm wide, pale yellow-green or pale rose at maturity, ribbed, reflexed at tip, glabrous or with pilose or retrorse hairs; petals in two unequal pairs, claw scarious margined, 4 mm long, limb of upper pair 3 mm long, 0.5 mm wide crisped, white (sometimes lightly veined purplish), limb of lower pair 3 mm long, 0.5 mm wide, crisped, white with purple veining; stamens in three unequal pairs, upper pair filaments ± 3.5 mm long, 0.5 mm wide, channeled, involute, connate almost to tip, anthers sagittate, 1 mm; middle pair filaments 1.2 mm long, connate three quarters of their length, anthers sagittate, 2 mm; lower pair filaments 0.7 mm long, < 0.5 mm wide,

J. Bot. Res. Inst. Texas 19(3): 167–176. 2025
https://doi.org/10.17348/jbrit.v19.i3.1416
Published online: 23 September 2025

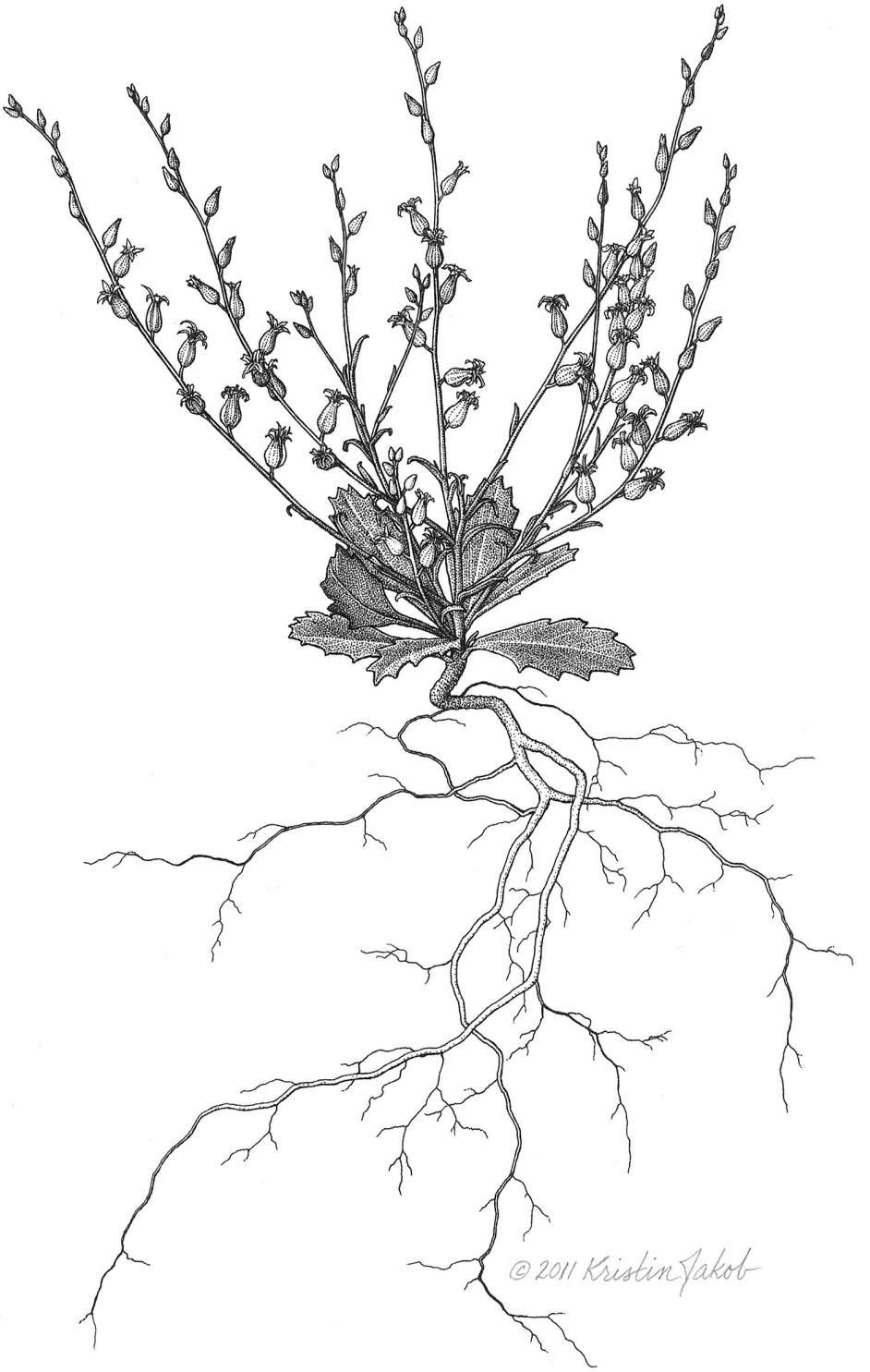

Fig. 1. Pen and ink drawing of *Streptanthus callizoi* sp. nov. from a live specimen. Illustration by Kristin Jakob.

Fig. 2. The type locality of *Streptanthus callizoi* on Snow Mountain. This is a small part of a patchy serpentinite outcrop that is exposed on and around the top of Snow Mountain for hundreds of acres. The outcrop supports Sargent's Cypress forest and manzanita chaparral. The new species grows in both of those environments. Plants are most numerous, however, on barrens like the one pictured.

anthers 2.5 mm; style < 1.5 mm long, cylindrical, stigma entire. **Fruit** pedicel ascending; silique 10–40 mm long, 1 mm wide, arched, slightly torulose; replum straight, not constricting seeds. **Seeds** 6–20 per fruit, < 1 mm, wingless.

Paratypes: **U.S.A. CALIFORNIA. Mendocino Co.:** serpentine ridge top, 6.6 mi W of Hopland, 2025 ft [617 m], 24 Jun 1948, *Hoffman*, (UC [bar code 956565, 956566]); Old Yorkville-Hopland Rd., 5.1 mi S of Felix Creek bridge, ca. 6 air mi WSW of Hopland, *Taylor*, (JEPS 101076); NE side Snow Mt., 5 mi SW of Hopland, *Stebbins* (CAS-BOT-BC 61166).

***Etymology.*—**The specific epithet "callizoi" honors Peter Joseph "Joe" Callizo (1937–2011), native of Pope Valley, CA, and longtime manager of the Wantrup Preserve (Land Trust of Napa County). Throughout his 20-year career, Joe mentored many doctoral students who came to pursue research on the Preserve. Through his local connections Joe arranged access for them on private lands where their plants occurred. A founding member of the Napa Valley Chapter of the California Native Plant Society, he served as president, rare plant chairman, and in other important functions. Joe led numerous field trips for CNPS chapter members, as well as historical tours of Pope Valley for the Napa Historical Society. Joe was a member of the Board and key advisor to the Land Trust of Napa County and influenced the direction that this organization pursued. He was a knowledgeable, self-effacing and energetic person who was appreciated and admired by many.

***Common Name.*—**Suggested common name for this taxon "Joe's jewel-flower."

DISCUSSION

Some who have collected or observed specimens of *Streptanthus callizoi* (e.g., Freed Hoffman, John Morrison, Dean Taylor, and others) perceived it as a form of *S. barbiger* Greene, while others (e.g., G. Ledyard Stebbins, Roger Raiche) saw it as *S. batrachopus* J.L. Morrison. My first impression of this plant in 2003 was that it differed

substantially from any of the *S. barbiger* populations I had seen. That it could be *S. batrachopus*, a species I know well, never even occurred to me. Over the course of at least 8 years of annual visits to the Snow Mountain site, sometimes twice or three times a year, that impression has been reinforced, as I explain below.

I examined specimens labeled *S. barbiger* at several herbaria. A specimen from the herbarium of the California Academy of Sciences collected in 1970 by G. Ledyard Stebbins from the "NE side of Snow Mt." (CAS-BOT-BC61166) is from the type locality of *S. callizoi* as indicated by the coordinates on the California Consortium of Herbaria (CCH) record for this collection. Stebbins labeled the specimen *S. batrachopus*. Later, Ihsan Al-Shehbaz, author of the *Streptanthus* section of *The Jepson Manual* (Al-Shehbaz 2012b), annotated the specimen *S. barbiger*. Likewise, a review of *S. barbiger* specimens preserved at the University and Jepson Herbaria turned up a specimen from the type locality of *S. callizoi*, JEPS82542, which the collector, Roger Raiche, initially identified in 1984 as *Streptanthus morrisonii* F.W. Hoff. subsp. *hirtiflorus* F.W. Hoff. . Later that year, he annotated it "not as determined. Probably closest to *S. batrachopus* but with setose calyx." Ihsan Al-Shehbaz annotated that specimen in 2007 "*S. batrachopus*." Thus, two specimens collected at the type locality were annotated differently. Finally, my review of the specimens collected by Freed Hoffman that are preserved at the Gray Herbarium at Harvard University, especially *Hoffman 2305* (which bears the note "new subspecies?"), indicated that Hoffman thought that plants from the Snow Mountain locality were a form of *S. barbiger* sufficiently distinguished from other *S. barbiger* variants to warrant taxonomic recognition. Hoffman 2305 was determined in 2007 by Ihsan Al-Shehbaz to be *S. barbiger*.

My several years of field studies of *S. barbiger*, *S. batrachopus*, *S. vernalis*, and *S. hesperidis* Jeps., and other taxa that by their stature and habit resemble the proposed new species, confirmed my first impression that the proposed new species differs from similar species in more ways than it resembles them.

In 2009, I summarized descriptions of *S. barbiger* from several floras (O'Donnell 2009). The summary showed that four different authors described *S. barbiger* differently and that none of those descriptions fit *S. callizoi*. Table 1 supplements that summary with a comparison of *S. barbiger* and *S. vimineus* (Greene) Al-Shehbaz & D.W. Taylor, and *S. batrachopus* to *S. callizoi*. These data show major differences between *S. callizoi* and *S. vimineus* and *S. barbiger*, supporting my hypothesis that *S. callizoi* is a new species.

The cauline leaves of both *S. barbiger* and *S. callizoi* are linear, or nearly so. In *S. barbiger*, the cauline leaf base is never auriculate; in *S. vimineus* the cauline leaf base is always auriculate (Al-Shehbaz & Mayer 2008). The cauline leaf bases in *S. callizoi* can be either auriculate or non- auriculate on the same plant. The presence of both auriculate and non-auriculate cauline leaves on many *S. callizoi* plants is evidence that it is neither *S. barbiger* nor *S. vimineus*.

Like *S. barbiger* and *S. vimineus*, *S. callizoi* can have calyx vestiture. The calyces of some *S. callizoi* plants are invested with slightly tapered, simple, retrorse trichomes or white pilosity whereas calyces of other individuals in the same population are glabrous. Like *S. barbiger* and *S. vimineus,* the new species has an urceolate calyx. The stamens and style within are a slightly smaller overall but have the same floor plan: post-like style with stigma entire and three unequal pairs of stamens.

There are small differences between *S. callizoi*, and *S. barbiger,* and *S. vimineus*, such as the color of leaves and stems. *Streptanthus callizoi* has leaves and stems that are greenish-brown or reddish-brown, while the overall color for *S. barbiger* is most often gray-blue or yellow-green. These and other character states are summarized in Table 1.

That *Streptanthus callizoi* has character states similar to *S. barbiger* (and, by implication, *S. vimineus*) is borne out by the high frequency with which collectors have confused the two. While an in-depth discussion of variation in *S. barbiger* is beyond the scope of this paper, a brief discussion of the large amount of variation among *S. barbiger* populations will further illuminate how and why *S. callizoi* merits recognition at species rank.

Populations of *Streptanthus barbiger* and *vimineus* are scattered across the North Bay counties. Since 1888, when Edward Lee Greene described *S. barbiger* and noted its variability, numerous other botanists have observed this variability and commented on it (e.g., Jepson 1936; Morrison 1938; Al-Shehbaz & Mayer 2008).

Table 1: Comparison of the character states of *Streptanthus barbiger* and *Streptanthus* species that have been called *S. barbiger*.

	Streptanthus barbiger Greene	*Streptanthus vimineus* (Greene) Al-Shebhaz & D.W. Taylor	*Streptanthus batrachopus* J.L. Morrison	*Streptanthus callizoi* sp. nov.
Life form	Annual herbs, glabrous (sometimes sepals pubescent)	Annual herbs, glabrous (sometimes sepals pubescent)	Annual herbs; glabrous and glaucous, mottled	Annual herbs, glabrous (sometimes sepals pubescent)
Stems	(0.7–)1–6.7(–8) dm tall; Branched basally	1–7.5 dm. tall, erect. Branched distal to base	Stem erect, simple, branched distally; 4–18 cm. high	10–25 cm. Branched from base
Basal leaves	(soon withered); not rosulate; petiolate; blade oblanceolate or oblong to blade oblanceolate or oblong to lanceolate, 2–5(7) cm (5–15 mm wide), margins remotely dentate	Not rosulate, petiolate, soon withered, narrowly ovate to oblong, entire, 2.5–5.0 cm	Leaves few, mostly basal, thick, purple beneath and brown or purple spotted above, 0.3–3.2 cm long; 0.2–1.0 cm wide	Rosette, deciduous, petiolate; succulent; adaxial surface cryptically colored brownish green with small, faint purplish spots; abaxial surface purplish with whitish bloom; blade oblong, 15–40 mm. long, 4–14 mm wide; base attenuate, margin toothed; sometimes each tooth is tipped with an orange blunt enlargement
Cauline leaves	Blade linear to linear lanceolate, (1.5–) 3–9(–10) cm × 0.5–2 mm (smaller distally), base not auriculate, margins entire	Linear to narrowly linear-lanceolate, 2–12 cm × 1–3(–4) mm, entire, sessile, auriculate at base	Long- petioled, spatulate-obovate to oblong, saliently-lobed	Leaf base auriculate or not; attachment sessile; blade linear ± 20 mm long, 1 mm wide, channeled, margins entire or remotely toothed; sometimes each tooth is tipped with an orange blunt enlargement; the distal always shorter and narrower than the proximal
Upper leaves1		Similar to cauline leaves, reduced	Sessile, auriculate-clasping, linear-lanceolate to oblong, sub-entire	
Inflorescence	Racemes ebracteate, (lax, often secund)	Racemes ebracteate, usually secund, lax, without a terminal cluster of sterile flowers		Racemes; ebracteate
Fruiting pedicels	Ascending to divaricate 1–2.5(–4) mm	Divaricate, straight, 1–3(–6) mm	0.2–0.3 cm. long, ascending	Divaricate
Sepals	Erect, green to purplish, ovate, 4–6 mm, slightly keeled, apex recurved, glabrous or hirsute, trichomes retrorse	Pale green to pale purple, ovate-lanceolate, 6–8 mm, keeled, recurved at apex, glabrous or rarely sparsely pubescent	Sepals green or purple, ovate and keeled at base, narrowed above, tips spreading, margins hyaline or reddish, 0.4 cm long	5.5 mm long × 2.5 mm wide, pale rose or pale greenish-yellow at maturity, keeled, reflexed at tip, either glabrous or invested with strigose, retrorse hairs
Petals	White, abaxial pair with purplish veins, 6–9 mm, blade 2–4 × 1.5–2.5 mm, margins not crisped, claw 4–6 mm, narrower than blade	White with purple veins on abaxial pair, unequal, 8–12 mm, adaxial pair longer; 5–7 mm, narrower than blade blade 3–5 × 2–3 mm not crisped; claw	Well exserted, white with purple midvein, linear-lanceolate to spatulate, acute, 0.6–0.7 cm long	Zygomorphic; Two unequal pairs. Limb of upper pair crisped, white, sometimes with faint purplish veining, 3 mm long, 0.5 mm wide; claw scarious margined, 4 mm long. Limb of lower pair crisped, white with purple veining, 3 mm long; claw scarious, 4 mm long

Table 1: continued

	Streptanthus barbiger Greene	*Streptanthus vimineus* (Greene) Al-Shebhaz & D.W. Taylor	*Streptanthus batrachopus* J.L. Morrison	*Streptanthus callizoi* sp. nov.
Stamens	Filaments: abaxial pair (connate to middle), 4.5–5.5 mm, lateral pair 2.5–3.5 mm, adaxial pair (connate, strongly recurved, purplish) 7–9 mm; anthers: abaxial and lateral pairs fertile, 1.5–2.2 mm, adaxial pair sterile, 0.4–1 mm	In 3 pairs of unequal length; adaxial pair united full length, 7–11 mm, recurved; anthers 0.5–1.2 mm, sterile; abaxial pair 4–7 mm, united to middle, anthers 2–2.7 mm, fertile; lateral pair 2–4 mm, anthers 2–2.7 mm, fertile	In three pairs, anthers sagittate upper pair 0.6 cm long, filaments connate to the apex, anthers reduced; lower pair 0.5 cm long, filaments connate for about half to two- thirds their length, anthers longer; lateral pair free, ca. 0.3 cm long, anthers longest	Three unequal pairs: upper, lower and lateral. Filaments of upper pair ~3.5 mm long, 0.5 mm wide, channeled, involute, connate almost to tip, anthers sagittate 1 mm long. Filaments of lower pair 1.2 mm long, connate ¾, anthers sagittate, 2 mm; Filaments of lateral pair 0.7 mm long, < 0.5 mm wide, anthers 2.5 mm
Gynophore	0.3–1 mm	0.2–0.5 mm	NA	NA
Fruits	Divaricate-ascending to reflexed, slightly torulose, curved or, rarely, straight, slightly flattened, 2–6(–7) cm mm × 1.2–1.5	3.5–6.5 × 1–1.2 mm, divaricate, recurved, flattened, slightly torulose	silique 2.5—3.0 cm long, erect, falcate-spreading, slightly torulose, green, spotted with purple, style about 0.1 cm long	Silique 10–40 mm long × 1 mm wide; recurved from divaricate pedicel, slightly torulose
Valves	Each with obscure midvein.	Valves glabrous with obscure midvein	NA	Glabrous
Replum	Straight (constriction not described)	Straight, Not constricted around seeds	NA	Straight, Not constricted around seeds
Ovules	22–38 per ovary	28–40 per fruit	NA	6–20 per fruit
Style	0.1–0.7 mm	0.1–0.3 mm	about 0.1 cm long	< 1.5 mm long, cylindrical
Stigma	Entire	Entire	Entire	Entire
Seeds	Narrowly oblong 1.3–1.8 × 0.6–0.8 mm; wing (0–) 0.1–0.25 mm wide distally, narrower at margin or absent)	28–40 per fruit. Narrowly oblong 1–1.5 × 0.6–0.8 mm. Wing absent or distal, 0.1 mm[2]	brown, striate-reticulate, winged, about 0.2 cm long	6–20 per fruit, ± 1 mm; wingless
Flowering	May–August	May–July	NA	May–July
Habitat	Serpentine ridges and barrens, openings in chaparral, cypress or pine-oak woodland, 200–1500 m	Serpentine grassland, ridges, barrens, openings in chaparral. Elev. 250–800 m	Serpentine, Mt. Tamalpais; San Geronimo Ridge	Serpentine barrens
Conservation status	Limited distribution; CNPS 4.2	Not listed by CNPS		As an isolated population in a remote location facing no immediate threats, it should be considered rare.

[1]The distinction between cauline and upper leaves is not material for *S. callizoi* and not described for *S. barbiger*.

[2]Description in the second edition of the *Jepson Manual* (Baldwin et. al.) is very similar to the original description published in *Novon*. The author of both treatments was Ihsan Al-Shehbaz. Where the descriptions differ in wording only, I use the original description. The original description does not describe the seed; the *Jepson Manual* does. According to the former, the seed wing is about 0.0–0.1 mm wide.

Hoffman observed up to eight forms of *S. barbiger* in his wide-ranging exploration of northern California serpentine outcrops during the 1940s and 1950s (University and Jepson Herbaria Archives, Freed Hoffman papers, 1941–1959).

After Greene (1888), descriptions of *S. barbiger* that reflected the range of variability proliferated, and several authors described *S. barbiger* differently (See Table 1 in O'Donnell 2009). The different descriptions suggest that such widespread and obvious variability in important characters might be evidence that more than one species was traveling under the name *S. barbiger*. This proved to be the case when John Morrison segregated *Streptanthus batrachopus* (Morrison 1938) from *S. barbiger*, the former having been considered a variant of the latter (University and Jepson Herbaria Archives), and when Al-Shehbaz and Taylor detected variability in leaf-base morphology that led them to segregate *S. vimineus* from *S. barbiger*. As Al-Shehbaz and Mayer note:

Streptanthus barbiger is easily distinguished from all of the California congeners by having sessile, non-auriculate, linear cauline leaves. By contrast, *S. vimineus*, including *M[esoreanthus] fallax*, has well-developed auricles on all cauline leaves (Al-Shehbaz & Mayer 2008).

Given the variability of *S. barbiger*, it might seem reasonable to conclude that *S. callizoi* is simply another variant of *S. barbiger*. To reach that conclusion, however, one would have to ignore the important fact that many variations of *S. barbiger* are matters of degree: height, calyx color, and length and width of leaves, whereas the key differences between *S. callizoi* and *S. barbiger* are binary. *Streptanthus callizoi* is distinguished from *S. barbiger* by the presence of a basal rosette (Figs. 3, 4) that is absent in *S. barbiger,* the presence of both sessile and auriculate cauline leaf attachment that in *S. barbiger* is sessile only, and its low stocky habit that contrasts with *S. barbiger*'s height. These differences support the conclusion that *S. callizoi* is a separate species and not a variant of *S. barbiger*. Other differences, such as vegetative color, calyx color and petal color, add weight to the conclusion.

Streptanthus callizoi and *S. batrachopus* are also compared on Table 1. Despite their comparable habit, the cauline leaf bases of *S. batrachopus* are auriculate while in *S. callizoi* the cauline leaf bases can be auriculate or not.

As for the place of *S. callizoi* in the genus *Streptanthus*, its morphology locates it in subgenus *Euclisia*, as defined by Kruckeberg and Morrison:

The salient features of subgenus *Euclisia* include zygomorphic flowers, non-bracteate inflorescences, filaments of one or two pairs of stamens partially to completely connate, and the upper pair of stamens usually with reduced to vestigial (and sterile) anthers. While no one of these features is unique to *Euclisia*, the consistent co-occurrence of them distinguishes the group from other subgenera of *Streptanthus* (Kruckeberg & Morrison 1983).

KEY TO THE *STREPTANTHUS BARBIGER* COMPLEX IN NORTHERN CALIFORNIA

1. Plant height usually 15–30 cm tall, leaves and stem brownish or blue-gray.
   2. Cauline leaf base auriculate ____ **S. vimineus**
   2. Cauline leaf base not auriculate ____ **S. barbiger**
1. Plant height usually 4–17 cm tall, leaves and stem red-brown or greenish-brown.
   3. Cauline leaf base auriculate; basal leaves not forming a rosette ____ **S. batrachopus**
   3. Cauline leaf base auriculate and not auriculate; basal leaves forming a rosette ____ **S. callizoi**

ECOLOGY AND CONSERVATION

Streptanthus callizoi is a serpentine endemic species that is confined to a small serpentine outcrop in northern California. As a result, it is local, narrowly distributed and isolated (Anacker et al. 2010). The narrow distribution of some serpentine endemic *Streptanthus* species such as *S. callizoi* can be attributed in part to the discontinuous distribution of serpentine outcrops. Serpentine outcrops have been compared to islands and like islands they are surrounded by a substrate that is inhospitable to serpentine endemics (Kruckeberg 1984). This tends to limit gene flow between populations confined to one outcrop or only a few. Populations on separate outcrops respond uniquely to their conditions and in the absence of gene flow can, over time, develop discrete phenotypes (Kruckeberg 1957, 1984). In addition, *S. callizoi* may be autogamous, which could also lead to isolation and phenotypic distinctness. Although *Streptanthus* species are typically outcrossing (Preston 1991), I have

Fig. 3. A diagnostic character state of Streptanthus callizoi is its basal rosette. The plants pictured are young.

Fig. 4. The basal rosettes are fully developed prior to anthesis and often persist through flowering. Along with other distinguishing character states, the rosette is one character state that sets the new species apart from *S. barbiger* and *S. vimineus* neither of which have a basal rosette.

observed that *S. callizoi* releases pollen well before anthesis (pers. obs.), dusting the interior of the corolla and the stigma with pollen. This could indicate selfing, which can lead to phenotypic distinctiveness. It could also indicate that *S. callizoi* is protandrous like *S. tortuosus*. Further study would be needed to determine the facts.

Isolated populations of serpentine endemic plants on serpentine islands might represent surviving remnants of once more wide-spread populations. Likewise, the different phenotypes occupying serpentine islands might represent the products of vicariant allopatric speciation or ecological segregation (Anacker & Strauss 2014). These adaptational pathways are some of the conventional hypotheses of general applicability and could be, but are not necessarily, applicable to *S. callizoi*. Very little research of this nature has been done on any specific lineage in *Streptanthus*.

The current configuration of isolated serpentine islands in the North Bay counties is the consequence of major volcanic activity between 10 and 1 million years ago (perhaps as recently as 10,000 years ago), which buried hundreds of thousands of acres of serpentine under lava and ash, wiping out whatever plant populations existed there at the time (Donnelly-Nolan et al. 1981). It is certainly possible that a more homogeneous population of *Streptanthus* existed on the unbroken expanse of serpentine prior to the volcanic activity. Since then, erosion has exhumed some of the underlying serpentine and provided opportunities for surviving populations to recolonize. The resurgence of some of the affected genera (e.g., *Hesperolinon*, *Streptanthus*, *Navarretia*) after being reduced by volcanic activity, might have led to the current highly diversified populations of similar species distinguished from one another by one or two unique character states (O'Donnell 2010; Schneider et al. 2016). Whether *S. callizoi* descended from *S. barbiger,* or *S. vimineus*, or all three descended from a common ancestor, this scenario could explain some of the diversification in serpentine endemic *Streptanthus* species.

Few potential homesites exist in the steep serpentine chapparal but signs of development, including flattened space and driveway, were seen on June 14, 2024. Thus, anthropogenic threats to the population are known. A more dangerous threat to the *Streptanthus* population is the flammable chaparral that surrounds the outcrop.

ACKNOWLEDGMENTS

I am grateful to Kristin Jakob for her excellent line drawing (Fig. 1) and to Ihsan Al-Shehbaz for his analysis of the character states of *S. callizoi* when I began to suspect that the Snow Mountain population was a new species and for his comments on this and an earlier draft. I thank Steve O'Kane for his generous comments on this draft and Sharon Strauss who provided very useful comments on an earlier draft. I thank her for her thoughtful guidance on this and many other botanical subjects. I am also grateful to Roger Raiche for sharing information about this unusual population of *Streptanthus* many years ago and populations of *S. barbiger* he found throughout northern California, especially those in The Cedars. He encouraged me to write this paper. I am deeply grateful to Amy Kasameyer, archivist of the University and Jepson Herbaria, for facilitating my access to the Archives. Finally, thanks to Barney Lipscomb for ably managing the review of this draft.

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