

ALISO

**A journal of taxonomic
and evolutionary botany**

A REVISION OF *ERYTHRANTHE MONTIOIDES* AND *ERYTHRANTHE PALMERI* (PHYRMACEAE), WITH
DESCRIPTIONS OF FIVE NEW SPECIES FROM CALIFORNIA AND NEVADA, USA

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ABSTRACT

The genus *Erythranthe* (Phrymaceae) continues to be a source of floristic novelty, especially in the American West, as evidenced by recent discoveries presented here. Two species in *Erythranthe* section *Paradantha* (*E. montioides* and *E. palmeri*) have long been a source of taxonomic confusion. Recent research reveals that a total of ten species have previously been treated as part of these two species. Here I present a revised taxonomy for *E. montioides* and *E. palmeri* including clarification of species circumscriptions (***E. montioides***, ***E. palmeri***), recognition of three species that have previously been treated as synonyms (*E. barbata*, *E. discolor*, *E. diffusa*), and descriptions of five new species (***E. calcicola***, ***E. carsonensis***, ***E. hardhamiae***, ***E. rhodopetra***, ***E. sierrae***). Information on geographic distribution, habitat, phenology and pollination biology, conservation status, detailed taxonomic descriptions, and a key for their identification are provided.

Key words: California, conservation, *Erythranthe*, *Mimulus*, new species, Phrymaceae, rare plants.

INTRODUCTION

Flowering plants form the structural basis and are a species-rich component of almost all terrestrial habitats, thus their study underpins ongoing efforts to conserve global biodiversity (Malcom et al. 2006; Joppa et al. 2011). Our knowledge of plant species, however, remains remarkably incomplete (Mabberley 2009) and basic biodiversity research, including species discovery, is needed. This is especially true for areas with high levels of diversity and endemism, such as western North America (Joppa et al. 2011). Notably, it has been estimated that 5% of the flowering plant species in western North America are yet to be described (Ertter 2000), and The Jepson Interchange (2012) reports 139 taxa, or 2% of the native California flora, are newly described since *The Jepson Manual: Higher Plants of California* was published in 1993. The discipline of systematics offers essential information to conservation biology, especially with regard to the identification of taxa and distinct lineages that are in need of conservation. Undescribed species that remain uncollected or are unrecognized in herbaria or outdated taxonomic treatments result in inaccurate tallies of species diversity and may lead to incorrect identification of species (Soltis and Gitzendanner 1999; Bebbler et al. 2010), undoubtedly hampering conservation efforts. Resolving taxonomic issues and identifying the basic units of diversity, namely species, is vital for scientifically-based conservation measures to be established (Skinner et al. 1995; Joppa et al. 2011).

The genus *Erythranthe* Spach. (Phrymaceae) formerly treated as part of *Mimulus* L. (see Barker et al. 2012 for modified taxonomic concepts), has a high incidence of rarity and endemism. Twelve sections and 110 taxa are currently recognized in *Erythranthe* (Barker 2012); however, species delimitation and taxonomic relationships have been unclear, with as few as 50 taxa recognized in previous treatment (Grant 1924; Pennell 1951; Thompson 2012). The genus is particularly diverse in western North America, with more than 80% of

species represented in this region (Barker et al. 2012). At least 25 species of *Erythranthe* are currently listed by US government agencies and native plant societies as sensitive, rare, or endangered, making *Erythranthe* a group of conservation concern (California Native Plant Society Inventory of Rare and Endangered Plants 2012; Colorado Rare Plant Field Guide 2012; Nevada Rare Plant Atlas 2012; Oregon Natural Heritage Information Center 2012; The Nature Conservancy 2012; The New England Wildflower Society 2012; Utah Rare Plants 2012; Washington Natural Heritage Program 2012; Wyoming Rare Plant Field Guide 2012). In several regional treatments of the group, some previously recognized rare species have been synonymized with more common species (Thompson 2002, 2012).

Erythranthe section *Paradantha* includes 16 species and is noted for having many endemic species, considerable variation in breeding systems, and problematic species delimitations (Grant 1924; Beardsley et al. 2004; Table 1). Taxonomic confusion has persisted in two species of section *Paradantha*: *E. montioides* and *E. palmeri* (Table 1). The most recent treatment took a conservative approach, placing three species into synonymy with *E. montioides* and one species into synonymy with *E. palmeri* (Thompson 2012). My work has yielded evidence for recognition of ten species where two species (i.e., *E. montioides* and *E. palmeri*) were previously recognized (Table 1), including reinstatement of three species that were treated as synonyms and five that have been newly identified. Here I provide the necessary lectotype designations for *E. montioides*, describe five new species, provide revised descriptions for the five species previously treated as either *E. montioides* or *E. palmeri*, and clarify the circumscriptions of these last two species. Taxonomy of the group has been previously reviewed by Greene (1885), Gray (1886), Grant (1924), Munz (1968), Pennell (1951), and Thompson (1993, 2012). A historical overview of taxonomic concepts for *E. montioides* and *E. palmeri* is presented below.

Table 1. Comparison of the present treatment to selected historical (Grant 1924) and more recent (Thompson 2012) treatments of taxa included in *Erythranthe montioides* and *Erythranthe palmeri* by the last author.

Species of <i>Erythranthe</i> treated in the current study	Other synonyms	Grant (1924)	Thompson (2012)
<i>E. barbata</i>	<i>Mimulus deflexus</i>	<i>M. deflexus</i>	<i>M. montioides</i>
<i>E. calcicola</i>		<i>M. montioides</i>	<i>M. montioides</i>
<i>E. carsonensis</i>	<i>M. rubellus</i> var. <i>latiflorus</i>	<i>M. montioides</i>	<i>M. montioides</i>
<i>E. diffusa</i>	<i>M. grantianus</i>	<i>M. diffusus</i>	<i>M. palmeri</i>
<i>E. discolor</i>		<i>M. discolor</i>	<i>M. montioides</i>
<i>E. hardhamiae</i>		<i>M. palmeri</i>	<i>M. palmeri</i>
<i>E. montioides</i>		<i>M. montioides</i>	<i>M. montioides</i>
<i>E. palmeri</i>		<i>M. palmeri</i>	<i>M. palmeri</i>
<i>E. rhodopetra</i>		<i>M. palmeri</i>	<i>M. palmeri</i>
<i>E. sierrae</i>		<i>M. palmeri</i>	<i>M. palmeri</i>

Taxonomic Overview of *Erythranthe montioides*

Erythranthe montioides was originally described by Asa Gray (1868) based on five specimens examined by him and cited in the protologue. These five syntypes were later found to represent three different species. Gray (1868) later determined two of the syntypes as *E. suksdorfii* (A.Gray) N.S.Fraga; this species continues to be recognized. The current study reveals that the remaining three syntypes represent two distinct species such that a lectotype for *E. montioides* must be designated and a new species must be described. The original protologue described a range of morphological characteristics that are representative of the three species included among the five syntypes. The lectotype designated here for *E. montioides* maintains the most common usage of the name for a species that occurs in the high central Sierra Nevada in California.

Additionally, previous treatments variously placed three species into synonymy with *E. montioides*: *Erythranthe barbata*, *Mimulus deflexus*, and *E. discolor*. *Erythranthe barbata* was described by Greene in 1884; however, he soon placed it into synonymy with *E. montioides* in his 1885 treatment of the group. Gray (1886) followed Greene and treated *E. barbata* as a synonym of *E. montioides*. *Erythranthe barbata* was later recognized by Grant (1924), Pennell (1951), and Munz (1968) before it was synonymized again with *E. montioides* by Thompson (1993, 2012). Note that although Grant recognized *E. barbata* as a synonym of *M. deflexus*, *M. deflexus* is a later name and is treated here as a synonym of *E. barbata*.

Erythranthe discolor was described by Grant (1924) in her monograph of *Mimulus*. This species was aptly named for its polymorphic flower color, and both morphs appear on the type specimen. This species was later recognized by Pennell (1951) and Munz (1968); however it was not accepted by others who treated it under *E. montioides* (Munz 1974; Thompson 1993, 2012). Grant's concept of the species was, in fact, confused with *E. montioides*, as evidenced by her annotations: Grant frequently annotated specimens of *E. montioides* as *E. discolor*. *Erythranthe discolor* is endemic to the southern Sierra Nevada where it is known to hybridize with *E. barbata*; it is the subject of further studies of species boundaries and relationships in section *Paradantha* (Fraga unpubl.).

The current study has identified two additional species that were previously confused with *E. montioides* and are newly

described here. *Erythranthe carsonensis* was included among the original syntypes of *E. montioides*; it is described as a new species here because the lectotype chosen for *E. montioides* represents a species that is endemic to the Sierra Nevada in California. *Erythranthe calcicola* has been consistently identified as *E. montioides* despite the fact that it can be easily distinguished morphologically from all other taxa that have been previously treated as *E. montioides*.

Taxonomic Overview of *Erythranthe palmeri*

Erythranthe palmeri was described in 1876 by Gray. In his treatment of *Mimulus* for the Synoptical Flora of North America, he included *E. androsaeca* (Curran ex Greene) N.S.Fraga as a variety of *E. palmeri*, but this species is easily segregated from *E. palmeri* based on floral and vegetative characteristics. Most authors including Green (1885), Grant (1924), Pennell (1951), Munz (1968), and Thompson (1993, 2012) have recognized *E. androsaeca* as a distinct species.

In her monograph, Grant (1924) segregated two species from *E. palmeri*: *E. diffusa* and *E. purpurea*. *Erythranthe purpurea* has consistently been recognized in subsequent treatments because it is easily distinguished from *E. palmeri* by floral and vegetative characters. *Erythranthe diffusa*, however, is distinguished morphologically from *E. palmeri* by more cryptic features including differences in ciliation on the margin of the calyx and gynoeceum vestiture. Although it was previously recognized by Pennell (1951) and Munz (1968, 1974), *E. diffusa* has been synonymized with *E. palmeri* in more recent treatments (Thompson 1993, 2012). Here I recognize *E. diffusa* as a distinct species based on morphological and molecular characters. In addition, three species (*E. hardhamiae*, *E. rhodopetra*, *E. sierrae*) were discovered while reviewing *E. palmeri* herbarium specimens and conducting field work, and are described here for the first time.

MATERIALS AND METHODS

Data from field, herbarium, and molecular studies based on analysis of nuclear ribosomal ITS and three non-coding chloroplast regions (*petA-psbJ*, *psbD-trnT*, *rpl32-trnL*; Fraga unpubl.) support the species concepts proposed here. Field studies were initiated in 2007 and have been conducted at more than 75 populations. Herbarium specimen records, databases (CCH, SEINet, and CNDDDB), and literature reports were used to identify target populations for field surveys, including

Table 2. A. Comparison of morphological features for species previously treated as *Erythranthe montioides*.—B. Comparison of morphological features for species previously treated as *Erythranthe palmeri*.

A.	<i>E. barbata</i>	<i>E. calcicola</i>	<i>E. carsonensis</i>	<i>E. discolor</i>	<i>E. montioides</i>
Leaf shape	linear to oblanceolate	lanceolate to ovate	linear to spatulate	linear to oblanceolate	linear to oblanceolate
Leaf width (mm)	0.5–2	2–8	1–5	1–4	0.5–2
Total corolla length (mm)	13–20	6–13	11–18	15–20	10–17
Tube-throat length (mm)	(5) 8–12	5–10	(5) 8–11	8–15	6–11
Limb width (mm)	6–13	3–7 (9)	7–15	7–15	7–15
Calyx margins	glabrous	ciliate	glabrous	glabrous	ciliate
Flower color	bicolored (maroon + yellow) or yellow	white or yellow	yellow	yellow or pink	yellow

B.	<i>E. diffusa</i>	<i>E. hardhamiae</i>	<i>E. palmeri</i>	<i>E. rhodopetra</i>	<i>E. sierrae</i>
Leaf shape	linear-oblanceolate to ovate	linear to oblanceolate	linear to lanceolate	linear-oblanceolate to elliptic	linear to oblanceolate
Leaf width (mm)	1–10	1–3	1–4	1–10	1–11
Total corolla length (mm)	11–20	9–17	15–25	12–26	12–22
Tube-throat length (mm)	8–14	5–10	10–29	9–17	8–17
Limb width (mm)	6–14	7–11	8–15	16–25	5–17
Calyx margins	glabrous	glabrous	ciliate	glabrous	ciliate
Flower color	pink to purple	deep pink to purple	pink to purple	light pink	light pink to pink

type localities. Populations were selected in order to sample each species throughout its known range. Several populations were visited more than once to permit collection of mature fruits and seeds, as well as flowering specimens. At each field site, data recorded included exact location (via Global Positioning System), habitat characteristics (i.e., elevation, slope, aspect, microhabitat, vegetation association, associated species), distinguishing morphological characteristics, life history attributes (i.e., abundance of plants, presence of pollinators), and conservation status (i.e., existing or potential threats or disturbances). Photographs were taken of living plants with common objects (pencils and coins) for scale. Seeds and herbarium specimens were collected for later study. Conservation assessments are based on criteria outlined by the California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants (2012), and Natureserve (2012). Line drawings presented in the treatment are based on photographs, herbarium material, and descriptions provided to the illustrator.

Vegetative and floral measurements provided in the descriptions are all inclusive ranges from study of fresh material in the field, dried and pressed material collected in the field, and herbarium specimens. Qualitative characters were described from photographs, observations made in the field, and herbarium specimens. Terms used to describe morphological characters follow Grant (1924) and Thompson (2005). The “calyx teeth” are extensions of the costa beyond the margin of the usually plicate calyx. The transition between the corolla tube and throat is gradual, thus the term “tube-throat” is used for the whole of the tube.

More than 500 herbarium specimens were examined from eleven herbaria: CAS/DS, DEVA, GH, MO, POM, RENO, RSA, SBBG, SD, UC/JEPS, and UNLV. Morphological measurements (Table 2) were taken from dried and pressed specimens. Herbarium specimens were databased and geo-referenced to create accurate distribution maps; maps were prepared in ArcGIS 10.1 (ESRI 2012). Elevation ranges provided in the taxonomic treatment are compiled from

herbarium specimen label data, and field sites for all species. Associated species lists include dominant species that are diagnostic of the vegetation association, annual plant species sharing similar habitats, and non-native species that are indicators of disturbance.

KEY TO SPECIES

(See Fig. 1–10 for corolla limb colors, morphology, and relative sizes)

1. Corolla yellow or white
 2. Leaves linear to spatulate, corolla with one large central red spot on the lower limb.....*Erythranthe carsonensis*
 2. Leaves linear-oblanceolate to ovate, corolla without one large central red spot on the lower limb
 3. Corolla yellow, tube-throat funnellform, and tinged red on adaxial surface of tube-throat...*Erythranthe discolor* (in part)
 3. Corolla yellow, white, or bicolored with the upper lip maroon, and the lower lip yellow, tube-throat funnellform to cylindrical, and not tinged red on adaxial surface of tube-throat
 4. Corolla yellow or white, 6–13 mm long, herbage glandular pubescent, calyx costa prominent.....*Erythranthe calcicola*
 4. Corolla yellow, 10–20 mm long, herbage glabrous to minutely puberulent, with eglandular trichomes, calyx costa weak
 5. Corolla yellow, lobes entire, tube-throat funnellform to cylindrical, palate glabrous to sparsely bearded with trichomes.....*Erythranthe montioides*
 5. Corolla yellow or bicolored, lobes bifid, tube-throat cylindrical, palate bearded with trichomes.....*Erythranthe barbata* (in part)
 1. Corolla pink, purple, or bicolored with the upper lip maroon, and the lower lip yellow
 6. Calyx lobe margins ciliate
 7. Leaf margins entire, never toothed; limb deep pink to purple; stamens yellow Transverse Ranges.....*Erythranthe palmeri*



Fig. 1–5. Diversity in corolla limb color, morphology and size in species previously included in *Erythranthe montioides*.—1. *Erythranthe barbata* (bicolored and yellow morph).—2. *Erythranthe calcicola* (white and yellow morph).—3. *Erythranthe carsonensis*.—4. *Erythranthe discolor* (yellow and pink morph).—5. *Erythranthe montioides*.

7. Leaf margins entire, or sometimes toothed; limb pale pink to pink; stamens white; Sierra Nevada.....*Erythranthe sierrae*
6. Calyx lobe margins glabrous
8. Pedicels erect to ascending, not spreading horizontally with age
9. Corolla deep pink to purple with two yellow ridges on the lower limb and palate, corolla width (pressed) 7–15 mm.....*Erythranthe discolor* (in part)
9. Corolla pale pink to rose colored with a broad yellow palate, corolla width (pressed) 16–25 mm.....*Erythranthe rhodopetra*
8. Pedicels ascending to spreading, often spreading horizontally with age
10. Flowers yellow or bicolored with the upper lip maroon, and the lower lip yellow.....*Erythranthe barbata* (in part)
10. Flowers pink with two yellow ridges on the lower limb
11. Style distally pubescent, stigma included.....*Erythranthe diffusa*
11. Style glabrous, stigma equal with the tube-throat to exerted.....*Erythranthe hardhamiae*

TAXONOMIC TREATMENT

ERYTHRANTHE BARBATA (Greene) N.S.Fraga “bearded monkey-flower” *Phytoneuron* **39**: 1–60 (2012). *Mimulus barbatus* Greene, *Bull. Calif. Acad. Sci.* **1**: 9 (1884).—TYPE: Location not provided on specimen label (holotype CAS digital image!; isotype UC!) *Mimulus deflexus* S.Watson. *Proc. Amer. Acad. Arts* **24**: 84 (1889).—TYPE: USA, California: Tulare Co., Long Meadow, Jun 1888, *Palmer 176* (holotype GH!; isotypes MO!, NY digital image!, US digital image!).

Annual herb. Plants 2–15 cm tall × 0.5–7 cm wide; sparsely glandular pubescent. Stems erect, simple to branched, internodes 0.5–2 cm. Cotyledons persistent, oblanceolate to ovate, 1–6 mm long, with clasping bases. Leaves opposite, epetiolate; blades 5–19 mm long × 0.5–2 mm wide, linear to oblanceolate, palmately veined with three prominent veins from the base in

wider leaves, margins entire. Flowers solitary in each axil, fruiting pedicels (5) 9–25 mm, exceeding calyx, erect to ascending, or spreading horizontally. Calyx 1–3 mm long × (2) 3–6 mm wide, campanulate, enlarging in fruit; costa weak, darker than intercostal regions; calyx teeth equal, 0.5–1 mm long, acute and spreading, margins glabrous. Corolla 12–20 mm long × 6–13 mm wide, bicolored, adaxial lip maroon-purple and abaxial lip yellow, or entirely yellow, lobes bifid, limb strongly zygomorphic; tube-throat (5) 8–12 mm long, cylindric, expanding abruptly to the limb, palate bearded, spotted with red markings. Stamens didynamous, 9–11 mm long; yellow, glabrous, included. Gynoecium 12–13 mm long, yellow; style glabrous; stigma lobes apically fringed, subequal, equal to corolla or slightly exerted from the orifice. Capsules 2–5 mm long, included to equal to calyx, cylindric, thin walled and fragile, dehiscing to the base along both sutures. Seeds 0.3–0.5 mm long × 0.2 mm wide, elliptic to ovoid, brown.

Representative specimens examined.—USA. California, Kern Co.: trail to Little Cannell Meadow above Pine Flat, 7350 ft, 24 Jul 1964, *Twisselmann 9861a* (JEPS); Pine Flat, 7400 ft, 28 Jul 1965, *Twisselmann 11334* (JEPS, CAS); Bartolans Creek, near its summit, 6950 ft, 25 Jun 1966, *Twisselmann 12462* (CAS); Fay Creek at Little Cannell Meadow, 6400 ft, 26 Jun 1967, *Twisselmann 13396* (CAS, SD); Tulare Co.: SE end of Rode Flat, 7400 ft, 27 Jun 1967, *Twisselmann 13518* (CAS, JEPS, RSA, SBBG); Siberian Pass Creek, 11,000 ft, 25 Jul 1949, *Munz 14199* (RSA); W of South Fork Kern River, W of Kennedy Meadows, 6000 ft, 19 May 1986, *Erter 6152* (RSA, UC); Big Meadow, 7800 ft, 26 Jun 1970, *Twisselmann 16879* (CAS, RSA); Chimney Creek, E of Chimney Creek Campground, 5800 ft, 30 May 1969, *Wheeler s.n.* (RSA); Kern Plateau, Dome Land, 8000 ft, 11 Jun 1972, *DeDecker 2924* (RSA); South Fork of Kern River at Tunnel Meadow, 9100 ft, 25 Jul 1970, *Twisselmann et al. 16934* (JEPS, RSA); Long Meadow, 2200 m, 14 Jun 1904, *Hall & Babcock 5107* (CAS, POM, UC); Salmon Creek, Horse Meadow public campground, 7500 ft, 12 Jun 1960, *Wheeler 7704* (RSA); head of Monache Meadow, South Fork of Kern River, 8050 ft, 14 Jul 1950, *Munz 15021* (RSA); Cannell Meadow, 7000 ft, 15 Jun 1904, *Hall & Babcock* (UC); South Fork Kern River at Monache Meadow, 8000 ft, 12 Aug 1968, *Twisselmann et al.*



Fig. 6–10. Diversity in corolla limb color, morphology and size in species previously included in *Erythranthe palmeri*.—6. *Erythranthe hardhamiae*.—7. *Erythranthe diffusa*.—8. *Erythranthe palmeri*.—9. *Erythranthe rhodopetra*.—10. *Erythranthe sierrae*.

14779 (CAS, JEPS); Templeton Mountain near Kern Peak, 8700 ft, 5 Jul 1912, *Jepson 4968* (JEPS); True Meadow, 6825 ft, 26 Jun 1967, *Twisselmann 13402* (JEPS); Poison Meadow, Kern Plateau, 7600 ft, 20 Jul 1962, *Twisselmann 7548* (CAS); 6 mi N of South Fork Kern River bridge on road to Troy Meadow, 7500 ft, 5 Jul 1967, *Howell & True 43146* (CAS); Cannell Meadows, Southern Sierra Nevada Mountains, 7000 ft, 15 Jun 1904, *Hall & Babcock 5113a* (UC); Summit Meadow, Olancha Mountain, 9500 ft, 25 Jun 1904, *Hall & Babcock 5278* (UC); Troy Meadows on upper Fish Creek, just off Sherman Pass Road, 20 Jun 1982, *Sanders 2750* (UC); lake on the ridge between Rattlesnake Meadow and Long Meadow, 7600 ft, 28 Jul 1965, *Twisselmann 11316* (CAS); Horse Meadow, Kern Plateau, 7400 ft, Jul 1966, *Howell & True 41724* (CAS); Embree Mine jeep road, near the turn to the new road (S slope of Sherman Peak), 7300 ft, 2 Aug 1969, *Twisselmann 15903* (CAS, SD); Long Meadow, 7800 ft, 26 Jun 1970, *Twisselmann 16829* (CAS); Bakeoven Meadows, 8100 ft, 13 Jul 1950, *Howell 26801* (CAS); Ground Hog Meadow, 8700 ft, 21 Jul 1942, *Ferris & Lorraine 10717* (DS); Fish Creek Campground, 9 mi NW of Kennedy Meadows, 7200 ft, 28 May 1973, *Keefe 13176* (CAS); Big Meadow to Manter Meadow, 7000 ft, 3–6 Jul 1964, *Hardham 12096e* (CAS); Trout Creek, 7500 ft, 3–6 Jul 1964, *Hardham 12134a* (CAS); N end of Casa Vieja Meadows, 8300 ft, 30 Jun 1973, *Keefe 13-512* (CAS); Siberian Pass Creek, 11,000 ft, 25 Jul 1949, *Howell 25729* (CAS); Taylor Creek, S of Church Dome, 7200 ft, 1 Oct 1969, *Howell & True 46460* (CAS); 1 2/10 mi S of Troy Meadows, 7800 ft, 4 Jul 1967, *Howell & True 42982* (CAS); Lloyd's Meadow Basin: Lower Freeman Creek, 5500 ft, 14 May 1971, *Shevock 240* (CAS); Fish Creek at the N end of Troy Meadow, 7600 ft, 30 Jul 1967, *Meng 457* (CAS, SBBG); 3 mi NE of Beach Meadow, 8200 ft, 7 Aug 1967, *Howell et al. 53789* (CAS); Cannell Meadow, 7200 ft, 28 Aug 1967, *Twisselmann 13619* (CAS); Paloma Meadows, 8500 ft, 16 Jul 1980, *Howell et al. 53864* (CAS); Inyo Co.: Horseshoe Meadow, 10,000 ft, 14 Aug 1995, *DeDecker 6504* (RSA); Cottonwood Creek, 11,000 ft, 18 Jul 1949, *Munz 14046* (RSA); Cottonwood Lakes, 11,000 ft, 18 Jul 1949, *Munz 14057* (RSA); Manter Meadow, 7100 ft, 28 Jun 1969, *DeDecker 2136* (RSA); Rock Creek near Mount Whitney, 9600 ft, 20 Jul 1912, *Jepson 5058* (JEPS).

Phenology and pollination biology.—Flowering occurs between May and August and fruiting between June and September. *Erythranthe barbata* has relatively large flowers, a narrow corolla tube that expands abruptly to the limb, and exhibits approach herkogamy. Presumably the beard of trichomes serve as an advertisement to pollinators. Based on evidence from corolla morphology, this species is presumed to be primarily outcrossing; but pollinators were not observed on this species over the course of this study.

Distribution and habitat.—*Erythranthe barbata* is endemic to the eastern Sierra Nevada in Kern, Tulare, and Inyo counties, California (Fig. 11). Plants primarily occur on decomposed granite at the edges of meadows and streams but also occasionally in open sandy barrens and in the understory of lodgepole pine forest. *Erythranthe barbata* is associated with the following vegetation communities: pinyon-juniper woodland, montane coniferous forest, subalpine forest, riparian scrub, montane meadows, and alpine barrens. Elevation 1800–3400 m (5900–11,200 ft). Associated species include: *Abies concolor* (Gordon & Glend.) Hildebr., *Aquilegia formosa* Fisch. ex DC., *Achillea millefolium* L., *Artemisia douglasiana* Besser, *A. tridentata* Nutt., *Calocedrus decurrens* (Torr.) Florin, *Collinsia parviflora* Lindl., *Deschampsia danthonioides* (Trin.) Munro, *Erythranthe breweri* (Greene) G.L.Nesom & N.S.Fraga, *E. floribunda* (Douglas ex Lindl.) G.L.Nesom, *E. guttata* (Fisch. ex DC.) G.L.Nesom, *E. moschata* (Douglas ex Lindl.) G.L.Nesom, *E. primuloides* (Benth.) G.L.Nesom & N.S.Fraga, *Juncus* L. spp., *Perideridia parishii* (J.M.Coult. & Rose) A.Nelson & J.F.Macbr., *Phacelia exilis* (A.Gray) G.J.Lee, *Pinus balfouriana* Grev. & Balf., *P. contorta* Loudon subsp. *murrayana* (Grev. & Balf.) Critchf., *P. jeffreyi* Grev. & Balf., *P. monophylla* Torr. & Frém., *Polygonum polygaloides* Meisn. subsp. *kelloggii* (Greene) J.C.Hickman, *Quercus chrysolepis* Liebm., and *Q. wislizeni* A.DC.

Phylogenetic relationships and similar species.—*Erythranthe barbata* is inferred to share a close relationship with *E. discolor* (Fraga unpubl.). These species can be distinguished by corolla morphology and color throughout the majority of their range, but they are known to hybridize in the southern Sierra Nevada where they co-occur. *Erythranthe barbata* typically has

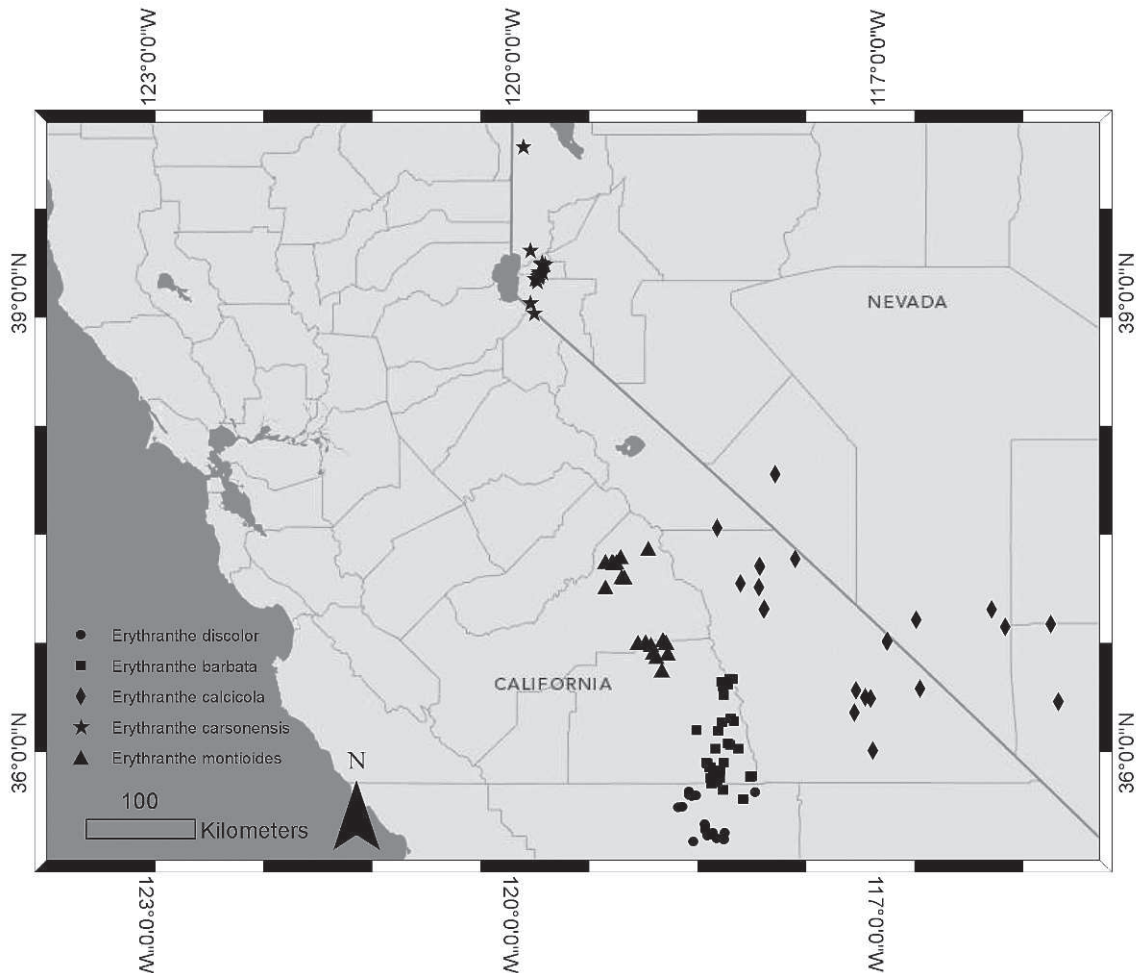


Fig. 11. Distribution of species previously treated as *Erythranthe montioides*. Map created in ArcGIS Desktop: Release 10. ESRI Redlands, CA: Environmental Systems Research Institute.

bicolored flowers with a maroon-purple adaxial lip and a yellow abaxial lip, but occasionally plants have flowers that are entirely yellow (Fig. 1). The frequency of yellow versus bicolored plants can change from year to year. The corolla has a distinct cylindrical tube that is relatively narrow and expands abruptly to a bearded palate. In contrast, *E. discolor* has monochromatic flowers that are usually yellow, less frequently pink, and the corolla tube-throat is funnellform and expanding gradually to a sparsely bearded to glabrous palate.

Etymology.—*Erythranthe barbata* is named for the beard of trichomes on the lower limb of the corolla.

Conservation concern.—*Erythranthe barbata* is not currently ranked by the California Native Plant Society (CNPS) as rare, threatened, or endangered. *Erythranthe barbata* is endemic to the southern Sierra Nevada in California and occurs in several high-use areas throughout its range. This species has been observed in areas that are subject to impacts from grazing, off-highway vehicle use, hiking trails, campgrounds, and road maintenance. It was considered by CNPS for ranking in 2006, but was rejected because it was too common (CNPS 2012). However, the conservation status of this species should be reevaluated in light of the current taxonomic revision. At the

time of its evaluation by CNPS, populations that are currently identified as *E. discolor* and *E. montioides* may have been included within the distribution of *E. barbata*.

Erythranthe calcicola N.S.Fraga & D.A.York, sp. nov. “limestone monkeyflower”.—TYPE: USA. California, Inyo Co.: Death Valley National Park, Panamint Mountains, along a saddle 420 m NE of Aguerberry Point, 36°21′34″N, 117°02′35″W (NAD 83), 1780 m/5850 ft, 9 Apr 2004, *York & Schoenig 2849* (holotype RSA!; isotypes CAS!, US!).

Annual herb. Plants 2–15 cm tall × 1–8 cm wide; sparsely glandular pubescent. Stems erect, simple to branched, turning reddish with age; internodes 0.5–1.5 cm. Cotyledons persistent, ovate to round, 1–6 mm long, with clasping bases. Leaves opposite, epetiolate or with petioles short (0.5–1 mm long), connate at the base; blades 3–25 mm long × 2–8 (10) mm wide, lanceolate to ovate, palmately veined with three prominent veins from the base in wider leaves, margins entire or sometimes toothed. Flowers solitary in each axil, fruiting pedicels 3–20 mm, exceeding calyx, erect to ascending. Calyx 4–8 mm long × 2–4 (5) mm wide, widely campanulate to cylindrical, enlarging in fruit; costa prominent, darker than intercostal regions; calyx teeth equal, 0.5–1 mm long, acute to

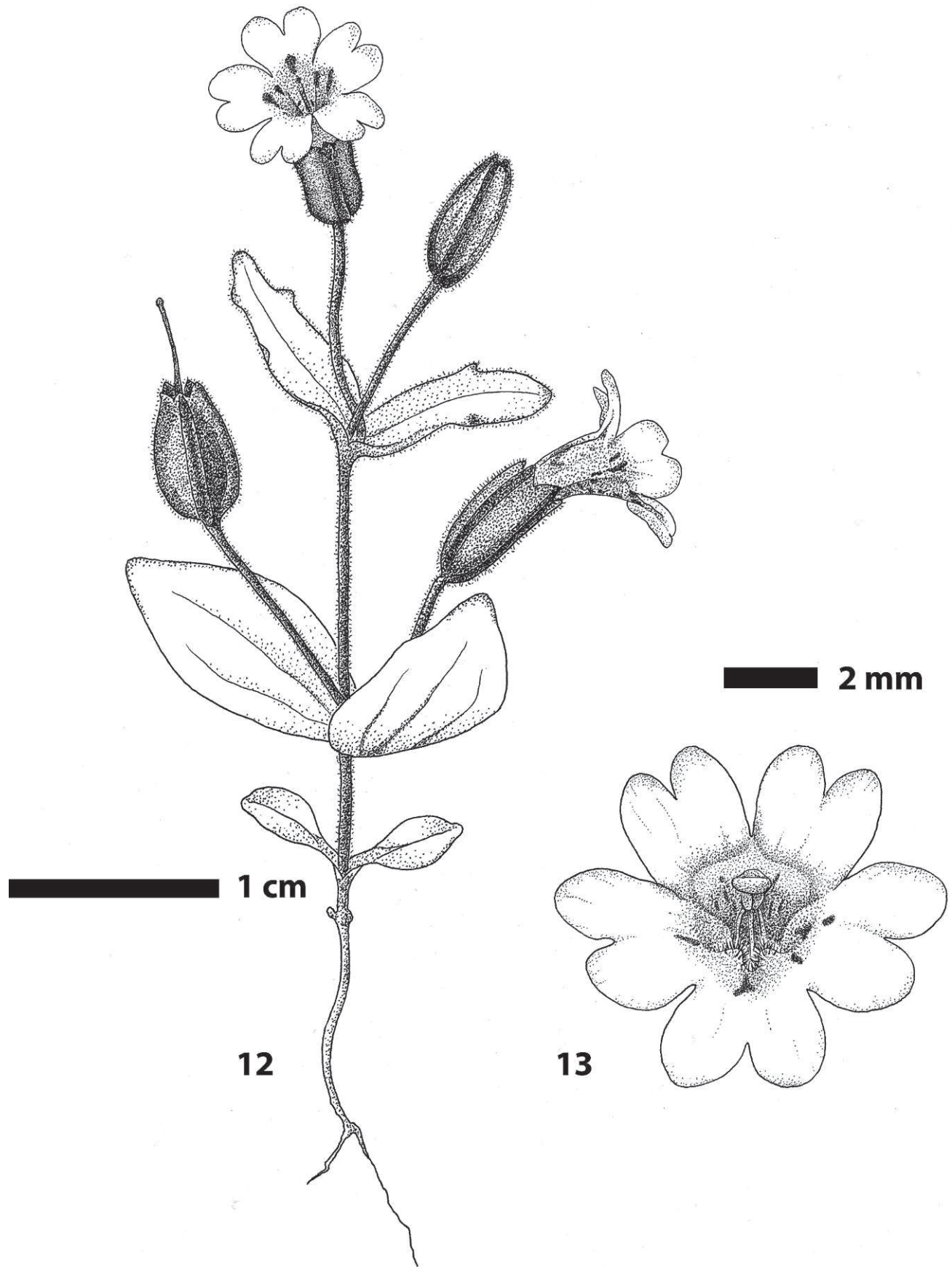


Fig. 12-13. *Erythranthe calcicola* N.S.Fraga & D.A.York.—12. Habit—13. Face view of corolla. Illustration by Michelle Thompson.

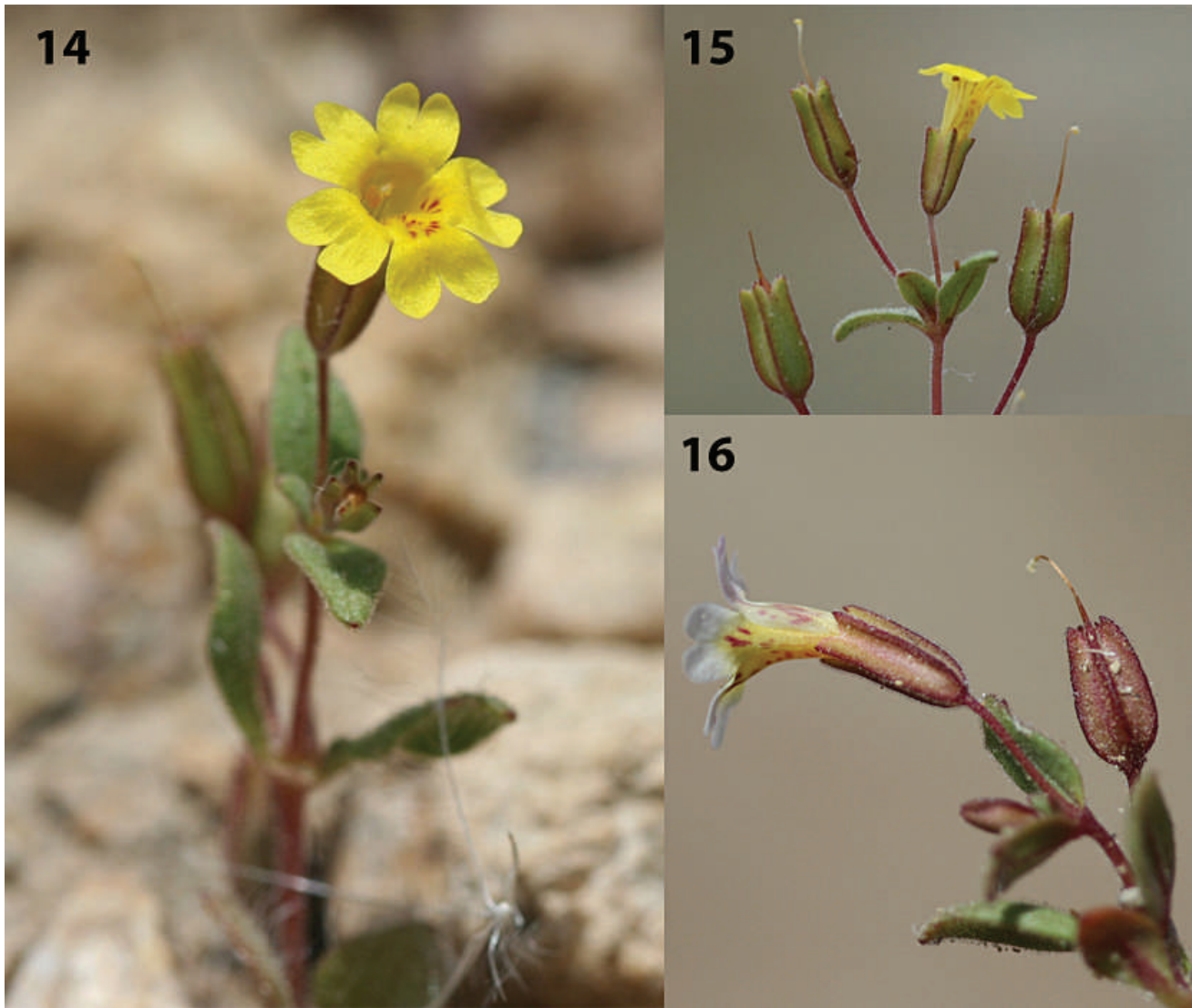


Fig. 14–16. *Erythranthe calcicola*.—14. Habit.—15. Corolla and calyx with maturing fruit.—16. Lateral view of corolla and reddish calyx with maturing fruit.

obtuse, margins ciliate. Corolla 6–13 mm long \times 3–7 (9) mm wide, yellow or white with a yellow throat, early deciduous, lobes emarginate, limb weakly zygomorphic; tube-throat 5–10 mm long, cylindric, expanding gradually to the limb, palate sparsely bearded, spotted with red markings. Stamens didynamous, 3–9 mm long; yellow, glabrous, included. Gynoecium 5–10 mm long, light yellow to white; style glabrous; stigma lobes slightly apically fringed, subequal, included. Capsules 4–8 mm long, included to equal to calyx, cylindric, thin walled and fragile, dehiscing to base along both sutures. Seeds 0.5–0.9 mm long \times 0.2–0.3 mm wide, elliptic to ovoid, brown.

Additional specimens examined.—USA. California, Inyo Co.: Death Valley National Park, Panamint Mountains, Panamint Mountains, ridge just E & below Aguerberry Point, 1780 m/5830 ft, 18 Apr 2001, *York et al. 2536* (DEVA); Death Valley National Monument, Panamint Mountains, Emigrant Canyon 2 mi E of Burro Spring on the Gold King mining claim, 1463 m 11 Apr 1978, *Holland & Schramm 1801* (UCR, UNLV); Death Valley National Monument, Panamint Mountains, Arrastra

Spring, 5200 ft, 17 May 1978 (UNLV); Death Valley National Monument, Panamint Mountains, Wildrose Canyon, 4290 ft, 29 Apr 1973, *Fisher 1643* (UNLV); Death Valley National Monument, Funeral Mountains, Keane Canyon, 3800 ft, 30 Apr 1937, *Gilman 2317* (DEVA, RSA); Death Valley National Monument, Funeral Mountains, Keane Spring Canyon, 3000 ft, 30 Apr 1937, *Gilman 2318* (RSA); Death Valley National Monument, Funeral Mountains, near Kean Spring, 3700 ft, 24 Apr 1978, *DeDecker 4600* (RSA); Death Valley National Monument, Funeral Mountains, canyon NE of Red Amphitheatre, 3750 ft, 7 May 1983, *Annable et al. 716* (UNLV); Saline Valley, 4700 ft, 8 Apr 1967, *DeDecker 1671* (RSA); Saline Valley, 4900 ft, 8 Apr 1967, *Munz 18017* (RSA); Inyo Mountains, Marble Canyon, 5500 ft, 5 May 1962, *Raven 17550* (RSA); Inyo Mountains, “Teufel Canon”, 5000 ft, 30 May 1939, *Jaeger s.n.* (RSA); Waucoba Road, 22.4 mi E of junction with Westgard Road, toward Eureka Valley, 5650 ft, 22 May 1976, *Davidson 3999* (RSA); Last Chance Range, W of Last Chance Spring, 6200 ft, 24 May 1978, *DeDecker 4688-a* (RSA); Death Valley National Park, N end of Saline Valley

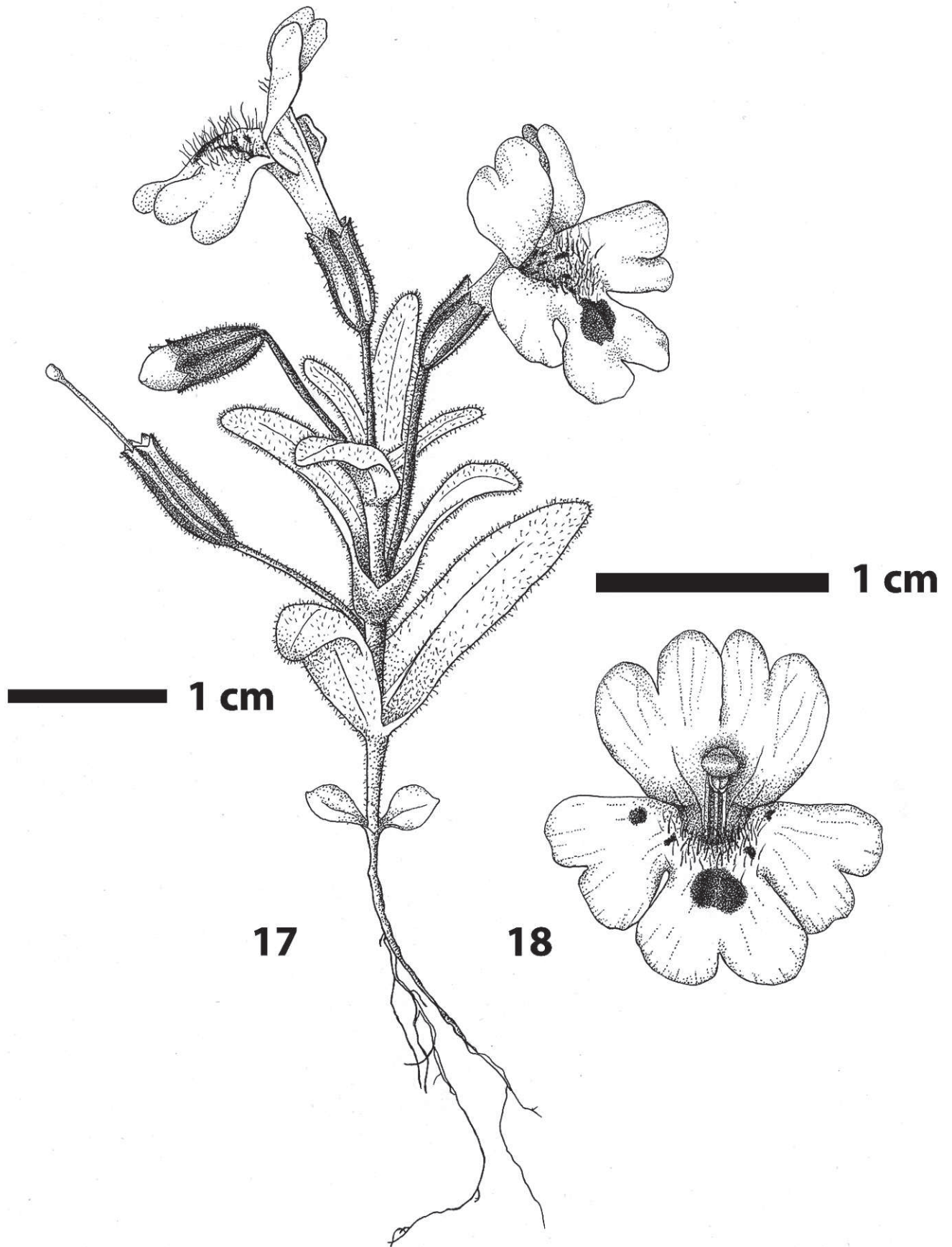


Fig. 17–18. *Erythranthe carsonensis* N.S.Fraga.—17. Habit.—18. Face view of corolla. Illustration by Michelle Thompson.

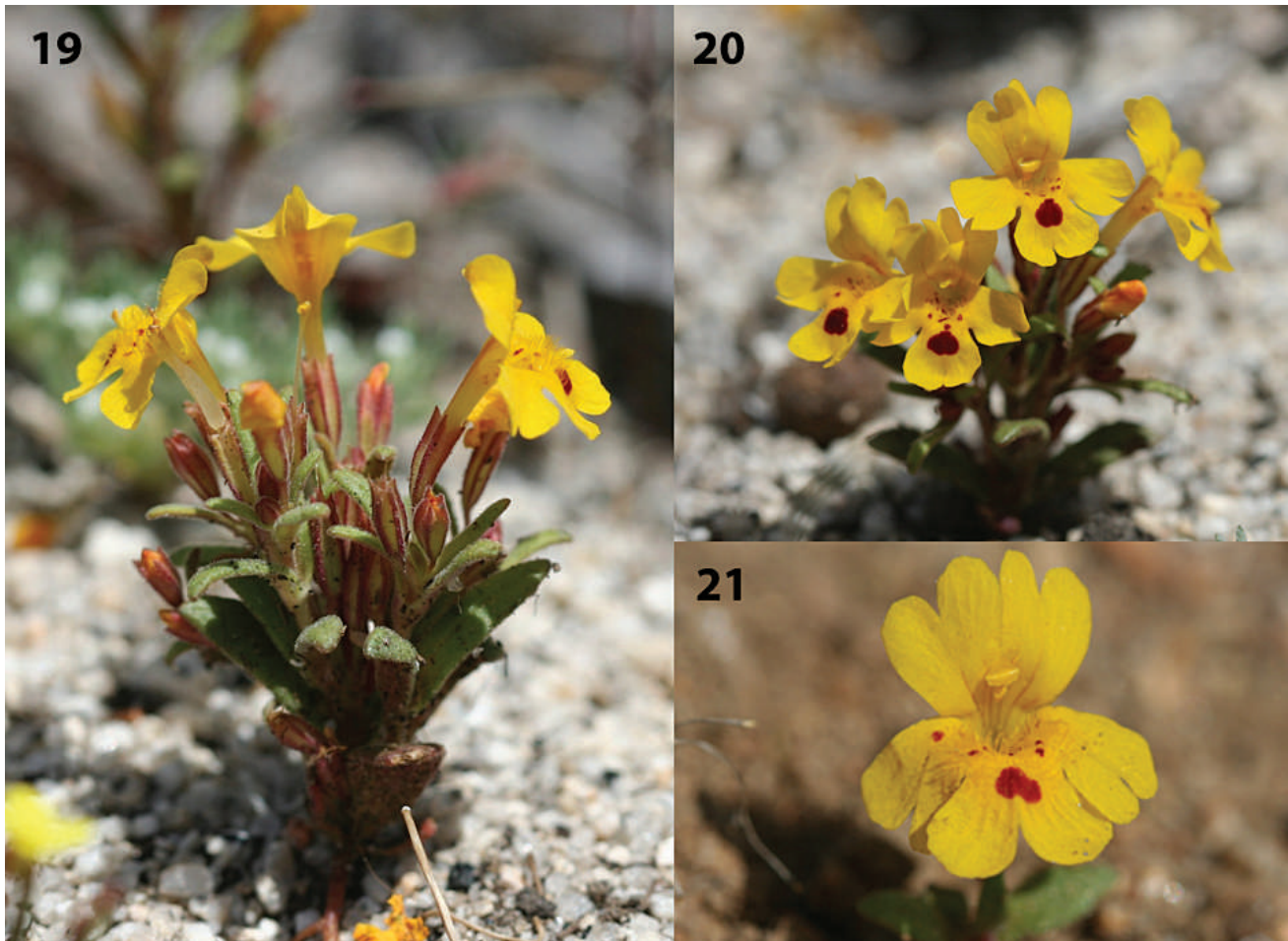


Fig. 19–21. *Erythranthe carsonensis*.—19. Plant habit with corolla lateral and abaxial view.—20. Plant habit with corolla face view.—21. Close up of corolla.

Road, ca. 14 mi S of Death Valley Road, 5600 ft, 8 Apr 2008, *Fraga et al.* 1995 (RSA); Death Valley National Park, Gold King Mining claim, off Wildrose Road, ca. 6 mi S of Hwy 190, 4900 ft, 17 Apr 2010, *Fraga et al.* 3306 (RSA); Death Valley National Park, ridge NE of Aguerberry Point, 5600 ft, 17 Apr 2010, *Fraga et al.* 3308 (RSA); Death Valley National Park, SE slope above Wildrose Canyon, 4400 ft, 24 Apr 2010, *Fraga & Prince* 3310 (RSA); Death Valley National Park, gentle slope N of road to Aguerberry Point, ca. 2.6 mi E of Wildrose Road, 5200 ft, 24 Apr 2010, *Fraga & Prince* 3315 (RSA); Death Valley Road, ca. 22 mi E of Hwy 168, N side of the road on slope, 5800 ft, 9 May 2011, *Fraga* 3347 (RSA); Death Valley National Park, Marble Canyon off Saline Valley, Waucoba Road, 5900 ft, 9 May 2010, *Fraga* 3348 (RSA); Mono Co.: White Mountains, 1 mi up Coldwater Canyon in side drainage, 5450 ft, 15 Apr 1986, *Morefield & McCarty* 3419 (RSA). Nevada, Clark Co.: Spring Mountains, ridge NE of Grassy Spring, 5200 ft, 14 May 1983, *Peterson & Lathrop* 960 (UNLV); Spring Mountains, slopes W of Grassy Spring, 5500 ft, 15 May 1983, *Peterson & Lathrop* 965 (UNLV); Pintwater Range, E of Tim Spring, 5800–6100 ft, 5 May 1979, *Ackerman* 30434 (UNLV, RENO); Nye Co.: Bajada W of Ranger Mountains on old Indian Spring Road, 24 Apr 1978, *Cochrane & Holland* 991 (UNLV); Bare Mountains, S slope of Meiklejohn Peak, above Secret Pass, 5200 ft, 9 Jun 1995, *Niles*

et al. 4493 (UNLV); Nevada Test Site, along Mercury Highway, 20 mi N of Mercury on old road to Indian Springs, 3200 ft, 24 Apr 1978, *Holland & Cochrane* 1910 (UNLV); N and W end of Spotted Range, 4000 ft, 24 Apr 1969, *Beatley* 8033 (RSA, RENO); Esmeralda Co.: Silver Peak Range, 1.3 road mi W of Cave Springs on the Coyote Road from Silver Peak to Fish Lake Valley, 7200 ft, 25 Jun 1987, *Tiehm* 11335 (RSA).

Phenology and pollination biology.—Flowering occurs between April and June; fruiting plants most commonly seen in May and June. *Erythranthe calcicola* has relatively small flowers (Fig. 2) that are early deciduous. Corollas were observed falling by mid-day and are presumed to be one-day flowers. Flowers of this species exhibit approach herkogamy but the distance between the stigma and anthers is sometimes less than 1 mm, suggesting that this species has a mixed mating system with a mechanism to facilitate self-pollination with some frequency. No floral visitors were observed over the course of this study.

Distribution and habitat.—*Erythranthe calcicola* (Fig. 12–16) is known from several mountain ranges in the northern Mojave Desert of eastern California and southwestern Nevada (Fig. 11), as follows. California: Funeral Mountains, Inyo Mountains, Last Chance Range, Panamint Mountains, White

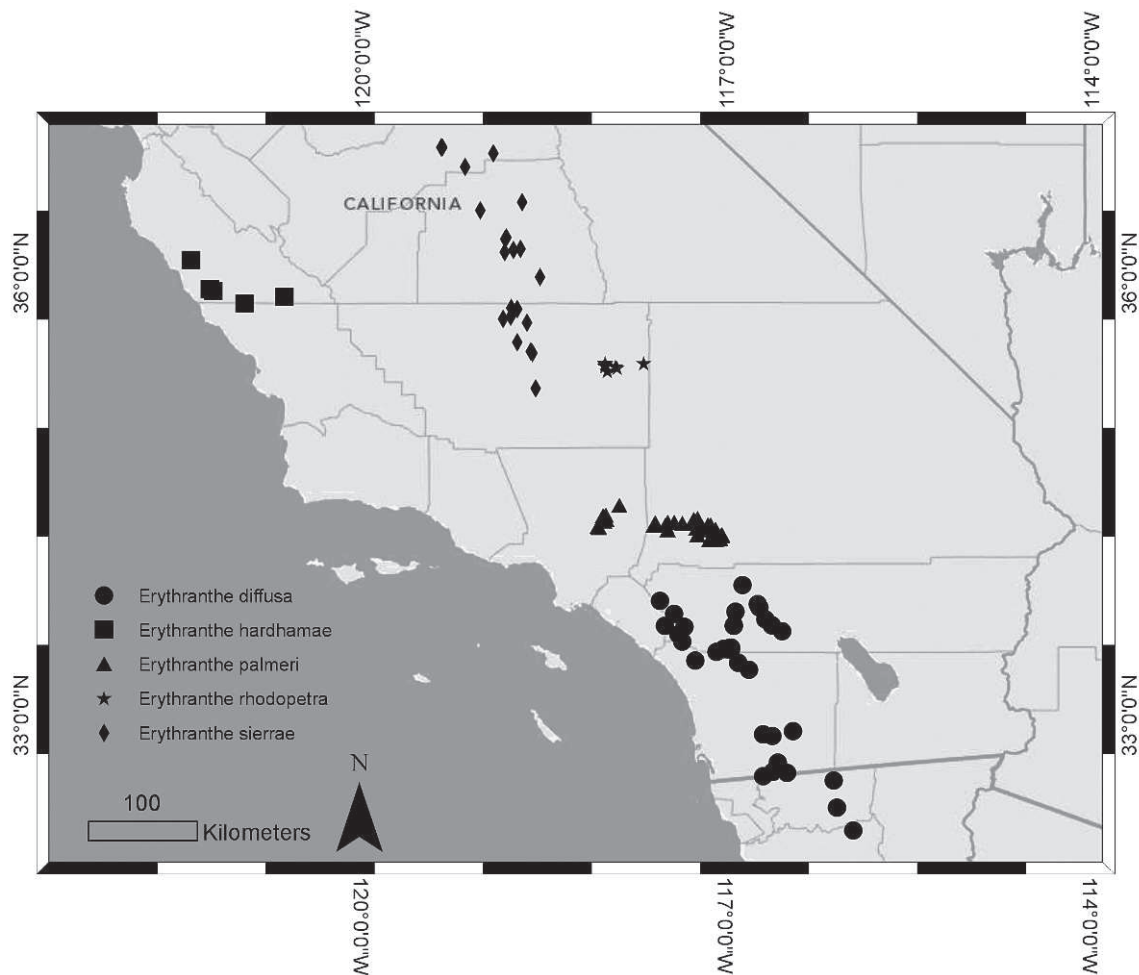


Fig. 22. Distribution of species previously treated as *Erythranthe palmeri*. Map created in ArcGIS Desktop: Release 10. ESRI Redlands, CA: Environmental Systems Research Institute.

Mountains; Nevada: Bare Mountain, Pintwater Range, Sheep Range, Silver Peak Range, Spotted Range, Spring Mountains. Plants of this species primarily occur on talus slopes on substrates derived from carbonate rock and are associated with the following vegetation communities: creosote bush scrub, Joshua tree woodland, and juniper woodland. Elevation 915–2165 m (3000–7100 ft). Associated species include: *Antirrhinum kingii* S.Watson, *Ambrosia dumosa* (A.Gray) W.W.Payne, *Artemisia tridentata*, *Atriplex confertifolia* (Torr. & Frém.) S.Watson, *Chylismiella pterosperma* (S.Watson) W.L.Wagner & Hoch, *Coleogyne ramosissima* Torr., *Diplacus bigelovii* (A.Gray) G.L.Nesom & N.S.Fraga, *Ephedra nevadensis* S.Watson, *Ephedra viridis* Coville, *Eriogonum fasciculatum* Benth., *Ericameria linearifolia* (DC.) Urbatsch & Wussow, *Grayia spinosa* (Hook.) Moq., *Juniperus osteosperma* (Torr.) Little, *Krascheninnikovia lanata* (Pursh) A.Meeuse & A.Smit, *Larrea tridentata* (Sessé & Moç. ex DC.) Coville, *Linanthus filiformis* (A.Gray) J.M.Porter & L.A.Johnson, *Nama demissum* A.Gray, *Phacelia fremontii* Torr., *Pinus monophylla* Torr. & Frém., *Sphaeralcea ambigua* A.Gray, *Stipa speciosa* Trin. & Rupr., *Xylorhiza tortifolia* (Torr. & A.Gray) Greene, and *Yucca brevifolia* Engelm.

Phylogenetic relationships and similar species.—*Erythranthe calcicola* is morphologically similar to *E. rubella* (A.Gray)

N.S.Fraga and is inferred to share a close relationship with this species (*Fraga* unpubl.). These species are easily distinguished by leaf shape and calyx morphology. The leaves of *E. calcicola* are lanceolate to ovate and the calyx is widely campanulate to cylindrical with margins ciliate. In comparison, the leaves of *E. rubella* are linear to elliptic and the calyx is narrowly cylindrical with glabrous margins.

Etymology.—The specific epithet and common name were chosen because *E. calcicola* appears to occur nearly exclusively on substrates of carbonate (limestone) origin.

Conservation concern.—All known occurrences for *E. calcicola* are on public lands administered by public agencies: Bureau of Land Management, Department of Defense, National Park Service, or the US Fish and Wildlife Service. *Erythranthe calcicola* is known from fewer than 20 occurrences and is therefore of limited distribution and should be considered for conservation status by the federal, state, and other agencies that manage this species. Historic mining operations and the presence of exotic plant species were the only visible disturbances observed over the course of field surveys in this study.

Erythranthe carsonensis N.S.Fraga, sp. nov. “Carson Valley monkeyflower”.—TYPE: USA, Nevada, Carson City:

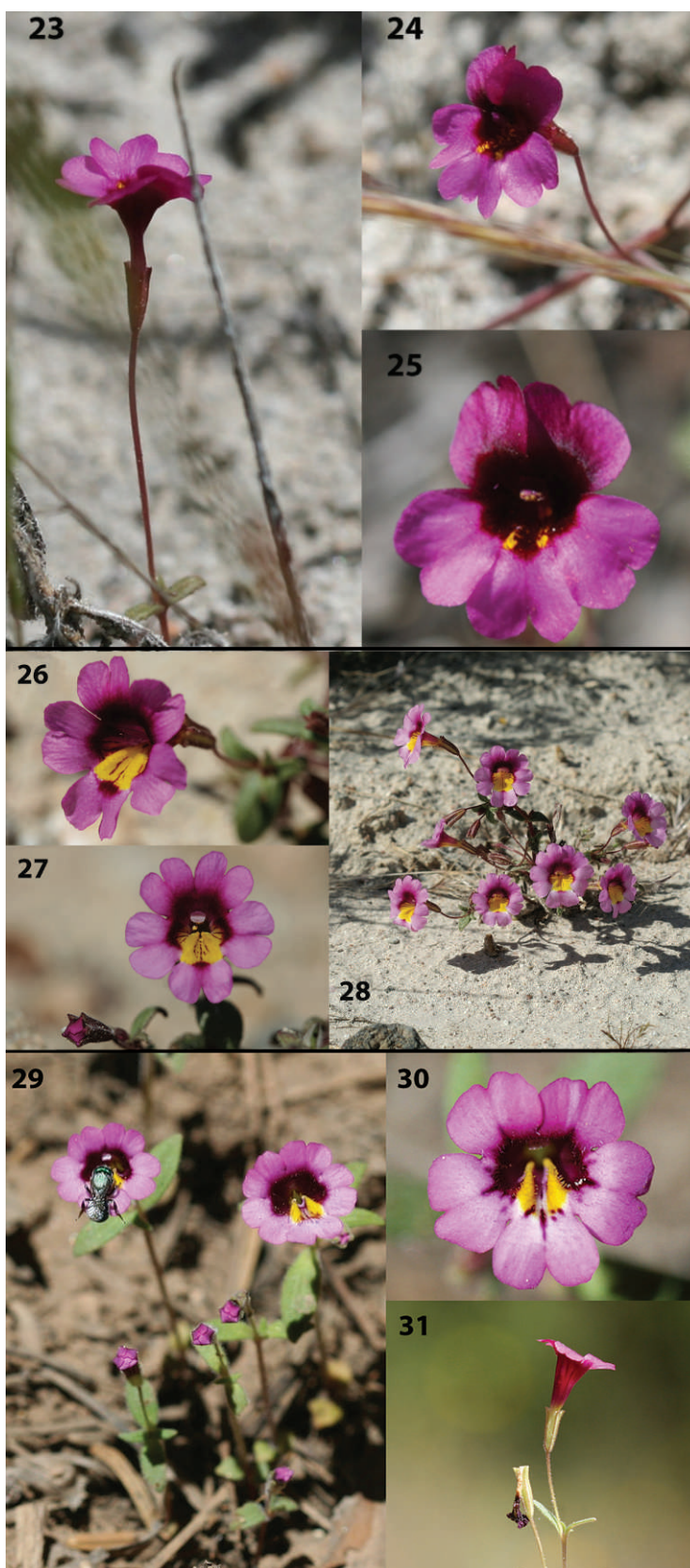


Fig. 23–31. Plant habit and corolla lateral views.—23–25. *Erythranthe hardhamiae* N.S.Fraga.—23. Plant habit.—24. Corolla lateral view.—25. Corolla face view.—26–28. *Erythranthe rhodopetra* N.S.Fraga.—26. Corolla lateral view.—27. Corolla face view and floral bud.—28. Plant habit.—29–31. *Erythranthe sierrae* N.S.Fraga.—29. Habit, halictid (Halictidae) bee visiting flower, and floral buds.—30. Corolla face view.—31. Corolla lateral view and developing fruit.

Carson Valley, eastern terminus of Clear Creek Road at the base of Prison Hill, 39°7'43.54"N, 119°44'19.23"W (NAD 83), 1460 m/4800 ft, 17 May 2010, *Fraga, Morefield, & Howle 3377* (holotype RSA!; isotypes US!, UC!). *Mimulus rubellus* var. *latiflorus* S.Watson, United States Geological Exploration of the Fortieth Parallel. vol. 5, botany: 226 (1871).—TYPE: USA, Nevada, Carson City Co., Carson City, Apr 1868, *Watson 798* (GH!).

Annual herb. Plants 1–7 cm tall × 1–4.5 cm wide; sparsely glandular. Stems erect, simple to branched, internodes (0.2–1 cm), usually obscuring the stem. Cotyledons persistent, 0.2–1.2 mm long, round to reniform, with clasping bases. Leaves opposite, epetiolate, connate at the base; blades 3–17 mm long × 1–5 mm wide, linear to spatulate, palmately veined with three prominent veins from the base in wider leaves, margins entire. Flowers solitary in each leaf axil, fruiting pedicels 3–14 mm, exceeding calyx, ascending to erect. Calyx (3) 5–7 mm long × 2–3 (4) mm wide, campanulate to widely urn shaped, enlarging in fruit, costa prominent with sparse pubescence, and darker than the glabrous intercostal regions; calyx teeth equal, 0.5–1 mm long, acute and slightly recurved, margins glabrous. Corolla 11–18 mm long × 7–15 mm wide, yellow with red striations on the adaxial surface of the upper lobes, lobe bifid, strongly zygomorphic; tube-throat (5) 8–11 mm long, cylindrical, expanding abruptly to the limb, palate bearded, and maculate with red markings and one large central spot. Stamens didynamous, 5–13 mm long; white to light yellow, glabrous, included. Gynoecium 6–15 mm long, yellow; style glabrous; stigma lobes apically fringed and subequal, equal with the throat to exerted from the orifice. Capsules 3–6 mm long, included in the calyx, campanulate, thin walled and fragile, dehiscing to the base along both sutures. Seeds 0.5–0.8 mm long × 0.1–0.2 mm wide, elliptic, brown.

Additional specimens examined.—USA. Nevada: Carson City: Eagle Valley, 0.5 mi S of Carson Hot Springs, 0.5 mi ENE of Lone Mountain summit, 4690 ft, 12 May 1991, *Morefield 5452* (RSA); Empire City, *Jones s.n.* (POM); Eagle Valley, 4743 ft, 7 Jun 1902, *Baker 1023* (POM); Eagle Valley, 4743 ft, 7 Jun 1902, *Baker 1029* (RSA); Topsy Lane S of Clear Creek, T14N R20E S.6, 4800 ft, 15 May 1979, *Genz 9097* (RENO); corner of Topsy Lane and Hwy 395, on the N side of the road, 4800 ft, 15 May 2009, *Fraga & Morefield 2743* (RSA); corner of Lynette Avenue and Arthur Drive, NE corner across from Nevada DOT building, 4800 ft, 16 May 2010, *Fraga 3370* (RSA); corner of Old Hot Springs Road and Goni Road, 4700 ft, 16 May 2010, *Fraga 3371* (RSA); Douglas Co.: near trailhead parking for Faye-Luther Trail, 4850 ft, 15 May 2009, *Fraga 2744* (RSA); 5 mi S of Genoa, 27 Apr 1950, *Woodbury 23* (RENO); 3 mi S of Carson City, 4600 ft, 11 Apr 1941, *Solari 19* (RENO); on Gardenville Hwy, SW of Carson Indian Agency, 4700 ft, 24 Apr 1937, *Archer 5047* (RENO); Indian Hill, 3 mi S of Carson City near the Jacks Valley Road, 4850 ft, 13 Apr 1976, *Wise 4850* (RENO); Jacks Valley Management Area near Plymouth Drive turn-off from Hwy 395, 4800 ft, 16 May 2010, *Fraga 3366* (RSA); Jacks Valley Management Area near Plymouth Drive turn-off from Hwy 395, 4800 ft, 16 May 2010, *Fraga 3367* (RSA); James Lee Memorial Park near baseball field, USFS property, 4800 ft, 16 May 2010, *Fraga 3369* (RSA); Jacks Valley Management Area, W of elementary school and S of Jacks Valley Road, 5000 ft, 17 May 2010,

Fraga et al. 3372 (RSA); N side of Jacks Valley Road near Jacks Valley Management Area, 5100 ft, 17 May 2010, *Fraga 3374* (RSA); Washoe Co.: Franktown, 11 May 1925, *P.A.L. s.n.* (RENO); Red Rock Canyon, T21N E 18E, 4800 ft, 30 Apr 1960, *Urrutia s.n.* (RENO). California, Alpine Co.: near Fredericksburg, 23 May 2011, *Fraga & Matson 3803* (RSA).

Phenology and pollination biology.—Flowering occurs between late April and June and fruiting is most common in May and June. *Erythranthe carsonensis* has relatively large flowers (Fig. 3), a long and distinct corolla tube that expands abruptly to the limb, which is bearded with trichomes. This species also exhibits approach herkogamy and has prominent nectar guide patterns on the palate. Based on evidence from corolla morphology, this species is presumed to be primarily outcrossing. Several insects were observed visiting this species, including skipper butterflies (Hesperiidae), and halictid bees (Halictidae).

Distribution and habitat.—*Erythranthe carsonensis* (Fig. 17–21) is endemic to northwestern Nevada in Carson City, Douglas, and Washoe counties, and adjacent Alpine County in California (Fig. 11). There are ten known extant occurrences across its range; surveys of potential habitat may reveal additional occurrences. The majority of the known occurrences are located in Carson Valley region, with one disjunct occurrence documented in Red Rock Canyon approximately 36 mi to the north. This species occurs in open areas of Great Basin sagebrush/bitterbrush scrub in coarse granite soils on gentle to moderate slopes (0–15 percent), usually on N aspects but also occasionally on S–SW aspects. Elevation 1400–1580 m (4600–5200 ft). Associated species include the following (* denotes non-native species): *Artemisia tridentata* Nutt., *Bromus tectorum* L., *Calyptidium roseum* S.Watson, *Camissonia parvula* (Nutt. ex Torr. & A.Gray) P.H.Raven, *Cryptantha circumscissa* I.M.Johnst., *Chrysothamnus viscidiflorus* Nutt., *Descurainia pinnata* (Walter) Britton, *Diplacus nanus* (Hook. & Arn.) G.L.Nesom & N.S.Fraga, *Draba verna* L., *Ephedra viridis*, *Erodium cicutarium* (L.) L'Hér., *Erythranthe suksdorfii*, *Grayia spinosa*, *Gymnosteris nudicaulis* (Hook. & Arn.) Greene, *Layia glandulosa* Hook. & Arn., *Plectritis* (Lindl.) DC. sp., *Phacelia curvipes* Torr. ex S.Watson, *Phacelia linearis* (Pursh) Holz., *Plagiobothrys* Fisch. & C.A.Mey. sp., *Prunus andersonii* A.Gray, *Purshia tridentata* (Pursh) DC., *Sisymbrium altissimum* L., *Uropappus lindleyi* (DC.) Nutt., *Vulpia octoflora* (Walter) Rydb., *V. microstachys* (Nutt.) Munro, and *Zigadenus paniculatus* (Nutt.) S.Watson.

Phylogenetic relationships and similar species.—*Erythranthe carsonensis* is inferred to have a sister relationship with *E. suksdorfii* (Fraga unpubl.). These species are easily distinguished by corolla morphology and leaf shape. *Erythranthe carsonensis* has a longer corolla tube-throat (8–11 mm) than *E. suksdorfii* (4–6 mm) and the corolla lobes are bifid. In contrast, the lobes of *E. suksdorfii* are weakly notched to entire. The leaves of *E. carsonensis* are linear to spatulate and are clasping at the base, while the leaves of *E. suksdorfii* are linear to lanceolate or ovate and are not clasping at the base.

Etymology.—The specific epithet and common name allude to the Carson Valley region of Nevada, where this species primarily occurs.

Conservation concern.—Threats to *Erythranthe carsonensis* include loss of habitat due to development and agriculture, the presence and abundance of non-native species, and recreation. Evidence from herbarium specimen label data, literature, and personal observations indicate that development in the region has severely fragmented and reduced populations. Sereno Watson noted (1871) that this species formed “bright patches of color among the sage-brush in the lower valleys.” A population that was observed to be marginal with less than 100 individuals in 2010 had been noted as “common” in 1979 (RENO 057126). Attempts to relocate historic occurrences from herbarium specimen records found several populations that are now extirpated. Road maintenance, the presence and abundance of exotic plant species, the presence of off-highway vehicle trails, and a baseball park have been noted as sources of disturbance at extant occurrences. Because *E. carsonensis* has a limited distribution, is known from few occurrences, and has several threats documented throughout its range, it is recommended that the species conservation status be evaluated with Federal, State, and local agencies, and conservation organizations.

ERYTHRANTHE DIFFUSA (A.L.Grant) N.S.Fraga “Palomar monkeyflower” *Phytoneuron* 39: 1–60 (2012). *Mimulus diffusus* A.L.Grant, *Ann. Missouri Bot. Gard.* 11: 257–258 (1924 [1925]).—TYPE: USA, California, San Diego Co.: Palomar, 29 May 1901, *Jepson & Hall 1959* (holotype MO!; isotypes DS!, JEPS, NY digital image!, UC!, US digital image!). *Mimulus grantianus* Eastw., *Proc. Calif. Acad. Sci.* (ser. 4) 20: 153 (1931).—TYPE: USA, California, San Diego Co.: Campo, 23 Apr 1920, *Eastwood 9442* (holotype CAS digital image!).

Annual herb. Plants 3.5–25 cm tall × 1–19 cm wide; minutely puberulent. Stems erect, simple to branched, internodes 1–4 cm. Cotyledons persistent, obovate to round, 0.2–1 mm long, with clasping bases. Leaves opposite, epetiolate or with petioles short (0.5–1); blades 2–18 mm long × 1–10 mm wide, linear-oblongate to ovate, palmately veined with three prominent veins from the base in wider leaves, margins entire or sometimes toothed. Flowers solitary in each axil, fruiting pedicels (2) 12–60 (–68) mm, exceeding calyx, erect to ascending, or spreading horizontally. Calyx 4–7 mm long × (2) 3–6 mm wide, campanulate, enlarging in fruit; sometimes spotted red, costa weak, darker than intercostal regions; calyx teeth equal, 0.5–1 mm long, acute and spreading, with margins glabrous. Corolla 11–20 mm long × 6–14 mm wide, pink to purple, lobes emarginate, weakly zygomorphic; tube-throat 8–14 mm long, funnelliform, expanding gradually to the limb, palate sparsely bearded with two yellow ridges. Stamens didynamous, 5–11 mm long; white, glabrous, included. Gynoecium 8–12 mm long, white to pink; style pubescent in the distal half; stigma lobes apically fringed, equal, included in the corolla. Capsules 3–6 mm long, included in the calyx, campanulate, thin walled and fragile, dehiscing to the base along both sutures. Seeds 0.3–0.6 mm long × 0.1–0.2 mm wide, elliptic to ovoid, brown.

Representative specimens examined.—USA. California, Riverside Co.: N slope of Agua Tibia Mtn., E of the Dripping Springs Alcove Area, 1640 ft, 3 May 1995, *Banks & Boyd 0200* (RSA); Shipley multi species reserve, SW of Tualota Creek, 1601 ft, 28

Apr 1995, *Bramlet 2397* (RSA); San Mateo County Wilderness area, San Mateo Canyon, 1200 ft, 12 May 1993, *Ross 7349* (RSA); Santa Ana Mountains, SE and E side of Elsinore Peak, 3300 ft, 7 May 1991, *Boyd 6158* (RSA); lower flank of range along the Bedford Truck trail on ridge between Bedford and McBride Canyons, 2800 ft, 10 May 1991, *Boyd 6207* (RSA); along Thomas Mtn. Rd. W of Hwy 74 and S of Lake Hemet, 10 Jun 1980, *Busenberg 1988* (RSA); San Jacinto Mountains above Pine Cove, 6800 ft, 6 Jun 1949, *Cooper 2002b* (RSA); Upper San Juan Canyon, along San Juan Loop Trail, 1706 ft, 26 Apr 2003, *Roberts 5661* (RSA); San Jacinto Valley, Santa Rosa Hills, Simpson Park, 2460 ft, 13 Apr 2008, *Wall 445* (RSA); San Diego Co.: W face of Poser Mountain ca. 1/4 mi N of the intersection of Conejos Truck Trail and Viejas Grande Road, 2 Apr 1995, *Hirshberg 260* (RSA); Tecate Mountain, 3608 ft, 26 Apr 1969, *Moran 15835* (RSA, UC); N of Hauser Mountain: SW of Morena Lake and NW of Cameron Corners, 1837 ft, *Rebman et al. 8930* (RSA); E side of El Prado Meadow at Laguna Camp, 5500 ft, 23 May 2010, *Fraga & Brock 3389* (RSA). Mexico. Baja California: 5 km W of La Rumorosa, Sierra Juarez, 14 Apr 1979, *Moran s.n.* (RSA); E of main summit Sierra Blanca, 1175 m, 16 May 1976, *Moran 23241* (RSA); 9 mi SE of Tecate, 12 May 1925, *Munz 9497* (RSA, UC); Sierra de Juarez, Laguna Hanson, Constitución National Park, 1625 m, 28 May 1983, *Thorne et al. 55769* (UC).

Phenology and pollination biology.—Flowering occurs from late April to June and fruiting is most common in June and July. *Erythranthe diffusa* has relatively large flowers with distinctive yellow nectar guides (Fig. 7) and approach herkogamy. Based on evidence from corolla morphology, this species is presumed to be primarily outcrossing, but no insect visitors were observed over the course of this study.

Distribution and habitat.—*Erythranthe diffusa* is endemic to the Peninsular Ranges in southern California, USA, and Baja California, Mexico (Fig. 22). This species occurs in moist areas in openings of chaparral, dry meadows in pine and oak woodlands, grassland savanna, and riparian scrub. Elevation 300–2100 m (980–6800 ft). Associated species include: *Artemisia californica* Less., *Adenostoma fasciculatum* Hook. & Arn., *Ceanothus crassifolius* Torr., *Chaenactis glabriuscula* DC., *Collinsia concolor* Greene, *C. parviflora*, *Eriodictyon crassifolium* Benth., *Lasthenia californica* DC. ex Lindl., *Melica imperfecta* Trin., *Plantago erecta* E.Morris, *Platanus racemosa* Nutt., *Plagiobothrys tenellus* (Nutt.) A.Gray, *Populus fremontii* S.Watson, *Quercus agrifolia* Née, *Q. engelmannii* Greene, *Salvia apiana* Jeps., *S. mellifera* Greene, and *Zigadenus fremontii* (Torr.) Torr. ex S.Watson.

Phylogenetic relationships and similar species.—*Erythranthe diffusa* is inferred to have a close relationship with *E. purpurea* (Fraga unpubl.), but *E. diffusa* is easily distinguished from *E. purpurea*. *Erythranthe diffusa* is generally taller (3.5–25 cm) than *E. purpurea*, has pink flowers, and pedicels that spread horizontally. In contrast, *E. purpurea* is 3–10 cm tall, has pink to purple flowers with the upper lip darker than the lower lip, and pedicels erect to ascending and not spread horizontally.

Etymology.—*Erythranthe diffusa* is named for the diffuse branching habit which is characteristic of this species.

Conservation concern.—*Erythranthe diffusa* currently has a CNPS Rare Plant Rank of 4.3, which means it is uncommon in California but not very endangered, and a State Rank of S3.3 which means it is vulnerable but no current threats are known. Naturereserve provides a Global Rank of G4Q, which means it is apparently secure considering the populations outside of the US, and is marked with a Q to denote the taxonomic uncertainty associated with this species (CNPS 2012). *Erythranthe diffusa* has a relatively widespread distribution and is known from western Riverside Co. in California, USA, to northern Baja California, Mexico. Anthropogenic change including development, grazing, off-highway vehicle use, road and trail maintenance, and power line development have all been documented as possible threats to known occurrences. Therefore the threat ranks for this species should be reassessed by the appropriate agencies.

ERYTHRANTHE DISCOLOR (A.L.Grant) N.S.Fraga “parti-colored monkeyflower” *Phytoneuron* 39: 1–60 (2012). *Mimulus discolor* A.L.Grant, *Ann. Missouri Bot. Gard.* 11: 257–258 (1924 [1925]).—TYPE: USA, California, Kern Co.: “gravely slopes, Pah Ute Peak”, *Purpus* 5311 (holotype MO!; isotypes UC!, US digital image!).

Annual herb. Plants 5–12 (–15) cm tall × 0.5–4 cm wide; sparsely glandular pubescent. Stems erect, simple to branched, internodes 1–3 cm. Cotyledons persistent, obovate to ovate, 0.3–1.1 mm long, with clasping bases. Leaves opposite, epetiolate or with petioles short (1–2 mm); blades 6–25 mm long × 1–4 mm wide, linear to oblanceolate, palmately veined with three prominent veins from the base in wider leaves, margins entire. Flowers solitary in each axil, fruiting pedicels 6–32 mm, exceeding calyx, erect to ascending. Calyx 4–8 mm long × 2–4 mm wide, campanulate, enlarging in fruit; costa weak and slightly darker than intercostal regions, sometimes red dotted; calyx teeth equal, 0.5–1 mm long, acute, erect to slightly spreading in fruit, margins glabrous. Corolla 15–20 mm long × 7–15 mm wide, yellow and tinged red on adaxial surface of tube-throat, or deep pink to purple, lobes emarginate, strongly zygomorphic, tube-throat 8–15 mm long, funnellform, expanding abruptly to the limb, palate glabrous to sparsely bearded, mottled red on yellow plants and 2 yellow ridges on pink plants. Stamens didynamous, 11–13 mm long; yellow, glabrous, included. Gynoecium 13–14 mm long, white in yellow-flowered plants, and pink to white in pink-flowered plants; style glabrous; stigma lobes apically fringed, subequal, included in the corolla. Capsules 4–7 mm long, included in the calyx, campanulate, thin walled and fragile, dehiscing to the base along both sutures. Seeds 0.5–0.8 mm long × 0.2–0.3 mm wide, elliptic to ovoid, brown.

Representative specimens examined.—USA. California, Kern Co.: Greenhorn Mountains, Little Poso Creek Falls, 4500 ft, 23 May 1937, *Benson* 8344 (RSA); Greenhorn Mountains, Rancheria Road from Shirley Meadows Campground to Sawmill Road, 21 May 1989, *Harper s.n.* (RSA); Greenhorn Mountains, Rancheria Road just S of Evans Flat Campground, 6100 ft, 13 Jun 2010, *Fraga & Brock* 3474 (RSA); Kernville, 13 May 1891, *T.S. Brandegee s.n.* (UC); fork of Cannell Creek on Pine Flat, 7100 ft, 10 Jul 1963, *Twisselmann* 8674 (RSA); Piute Mountains, Piute Mountain Road, ca. 1.5–2 mi N of French Meadow, 7200 ft, 31 May 2008, *Fraga* 2147 (RSA); mouth of N fork of Esperanza Canyon, S of Marino

Canyon at the E base of the Piute Mountains, 4300 ft, 18 Apr 2008, *Fraga et al.* 2005 (RSA); 4 mi W on Piute Mountain Road from Kelso Valley Road, 5500 ft, 30 May 2010, *Fraga & De Groot* 3413 (RSA); Piute Mountain/Saddle Springs Road, just E of Valley View Mine, 6725 ft, 12 Jun 2011, *Fraga & Jolles* 3850 (RSA); Piute Mountains Brown Meadow, 7400 ft, 12 Jun 2011, *Fraga & Jolles* 3855 (RSA); Piute Mountains, Piute Mountains Brown Meadow, 7400 ft, 12 Jun 2011, *Fraga & Jolles* 3856 (RSA); Piute Mountains; Tulare Co.: Cannell Meadows, 7000 ft, 15 Jun 1904, *Hall & Babcock* 5113 (UC).

Phenology and pollination biology.—Flowering occurs from April to June and fruiting is most common in June and July. *Erythranthe discolor* has two distinctive floral morphs—one is yellow with red spots on the palate, and the other is pink with two yellow ridges on the palate (Fig. 4). Populations can be monomorphic (usually yellow) or mixed, with the yellow morph most often in higher frequency. *Erythranthe discolor* exhibits approach herkogamy and has relatively large flowers with trichomes and nectar guide patterns on the lower limb. Based on evidence from corolla morphology this species is presumed to be primarily outcrossing. Halictid bees (Halictidae) have been frequently observed visiting flowers of this species and are presumed to serve as the primary pollinators.

Distribution and habitat.—*Erythranthe discolor* is endemic to the southern Sierra Nevada in Kern and Tulare counties, California (Fig. 11). This species primarily occurs in decomposed granite in vernal wet depressions, swales, at the edges of streams, dry meadows, and in openings of pine forest, oak woodland, pinyon-juniper woodland, desert chaparral, and sagebrush scrub. Elevation 1310–2468 m (4300–8100 ft). Associated species include the following: *Abies concolor*, *Artemisia tridentata*, *Cercocarpus betuloides* Nutt., *Claytonia perfoliata* Willd., *Collinsia callosa* Parish, *C. parviflora*, *Erythranthe androsacea*, *E. barbata*, *E. floribunda*, *E. guttata*, *E. suksdorfii*, *Fremontodendron californicum* (Torr.) Coville, *Mimetanthe pilosa* (Benth.) Greene, *Muhlenbergia rigens*, *Phacelia exilis*, *Pinus jeffreyi*, *P. monophylla*, *Quercus chrysolepis*, *Q. kelloggii* Newb., *Q. wislizeni*, and *Salix lasiolepis* Benth.

Phylogenetic relationships and similar species.—*Erythranthe discolor* is inferred to share a close relationship with *E. barbata* (Fraga unpubl.). A putative hybrid swarm was observed in the Scodie Mountains in the southern Sierra Nevada, where these two species overlap in distribution. See the expanded discussion under *E. barbata*.

Etymology.—The epithet for this species means “of different colors” and refers to the two color morphs that are present.

Conservation concern.—There are twenty known occurrences of *E. discolor*. There is currently little known regarding occurrence status and population trends, but recent surveys have found this *E. discolor* to be abundant where it occurs. Off-highway vehicle use, road maintenance, and campgrounds have been observed as possible sources of disturbance at known occurrences. Development has likely affected populations at lower elevations and several occurrences may have been extirpated in the vicinity of Kernville. *Erythranthe discolor* is of limited distribution and should be considered

for conservation status by the federal, state, and other agencies that manage this species.

Erythranthe hardhamiae N.S.Fraga, sp. nov. “Santa Lucia monkeyflower”.—TYPE: USA. California, Monterey Co.: Santa Lucia Mountains, mouth Los Burros Creek, 1 May 1960, *Hardham 5558* (holotype RSA!; isotypes CAS!, JEPS!).

Annual herb. Plants 2–13 cm tall × 1–13 cm wide; glabrous to minutely puberulent. Stems erect, simple to branched, internodes 1–3.5 cm. Cotyledons persistent, obovate to ovate, 0.1–1 mm long, with clasping bases. Leaves opposite, epetiolate; blades 2–12 mm long × 1–3 mm wide, linear to oblanceolate, palmately veined with three prominent veins from the base in wider leaves, margins entire or sometimes toothed. Flowers solitary in each axil, fruiting pedicels 10–60 mm, exceeding calyx, erect to ascending, or spreading horizontally. Calyx 4–8 mm long × 2–4 mm wide, campanulate, enlarging slightly in fruit; costa weak, darker than intercostal regions, sometimes spotted red; calyx teeth equal, 0.1–0.5 mm long, acute, with margins glabrous. Corolla 9–17 mm long × 7–11 mm long, deep pink to purple, lobes bifid, strongly zygomorphic; tube-throat 5–10 mm long, funnelliform to cylindric, expanding abruptly to the limb, palate and orifice densely bearded with two yellow ridges. Stamens didynamous, 5–11 mm long; white, and included to occasionally exerted from the orifice. Gynoecium 7–12 mm long, pink, style glabrous, stigma lobes apically fringed, subequal, equal to the tube to exerted from the orifice. Capsules 2–5 mm long, included in the calyx, cylindric, thin walled and fragile, dehiscent to the base along both sutures. Seeds 0.3–0.5 mm long × 0.1–0.2 mm wide, elliptic to ovoid, brown.

Additional specimens examined.—USA, California, Monterey Co.: Vineyard Canyon Road to Parkfield (E side of summit), 9 Apr 1961, *Hardham 6762* (JEPS); Vineyard Canyon Road, N side of road just E of summit, 2300 ft, 2 May 2010, *Fraga 3344* (RSA); Santa Lucia Mountains, S of Los Burros Creek, 9 Apr 1961, *Hardham 5568* (SBBG); Santa Lucia Mountains, Los Bueyes Creek Road, 2 Apr 1960, *Hardham 5480* (CAS, RSA, JEPS); Santa Lucia Mountains, road from San Antonio Mission to The Indians (Del Venturi Caves), 7 Apr 1960, *Hardham 5392* (JEPS); San Luis Obispo Co.: Santa Lucia Mountains, 1 mi NW of Bee Rock, 1000 ft, 28 Mar 1960, *Hardham 5252* (JEPS, RSA, SBBG).

Phenology and pollination biology.—Flowering occurs from late March to May and fruiting is most common in May. *Erythranthe hardhamiae* has relatively large flowers with distinctive yellow nectar guides (Fig. 6), an exerted stigma, and approach herkogamy. Based on evidence from corolla morphology, this species is presumed to be primarily outcrossing, but no pollinators were observed over the course of this study.

Distribution and habitat.—*Erythranthe hardhamiae* (Fig. 23–25) is endemic to the Coast and Inner Coast ranges in Monterey and San Luis Obispo counties, California (Fig. 22). This species occurs in sandy soils in openings of chaparral, and in sand-filled crevices of sandstone outcrops. Elevation 300–500 m (1000–1650 ft). Associated species include the following (* denotes non-native species): *Adenostoma fasciculatum*, *Camissonia* Link sp., *Chorizanthe* R.Br. ex Benth. sp., *Crassula*

connata (Ruiz & Pav.) A.Berger, **Erodium botrys* (Cav.) Bertol., **E. cicutarium* (L.) Aiton, *Eriogonum fasciculatum* Benth., *Festuca microstachys* Nutt., **F. myuros* L., *Minuartia californica* (A.Gray) Mattf., *M. pusilla* (S.Watson) Mattf., *Nemacladus* Nutt. sp., and *Quercus chrysolepis*.

Phylogenetic relationships and similar species.—*Erythranthe hardhamiae* appears to be closely related to *E. androsacea* (Fraga unpubl.). These species are easily distinguished from each other by fruiting pedicel characters and corolla size. *Erythranthe hardhamiae* has pedicels that are 10–60 mm long and spread horizontally in fruit, and a limb that is 7–11 mm when pressed. In contrast, *E. androsacea* has pedicels that are 5–30 mm long, are ascending to spreading in fruit, and do not spread horizontally, and a limb that is extended 3–7 mm when pressed.

Etymology.—*Erythranthe hardhamiae* is named in honor of Clare Butterworth Hardham (1918–2010). Hardham was a botanist who lived in Paso Robles, California; she studied the flora of the Santa Lucia Mountains. Her contributions have been many as evidenced by the many plants that bear her name in the region. Hardham collected specimens of *E. hardhamiae* at nearly all of the currently known locations.

Conservation concern.—There are eight known locations for *E. hardhamiae*; five are on lands managed by the Department of Defense (Fort Hunter Liggett), two are on private property, and one is in Los Padres National Forest. Grazing, road maintenance, the presence and abundance of exotic plant species, and development have all been noted as sources of disturbance. *Erythranthe hardhamiae* is of limited distribution and should be considered for conservation status by the federal, state, and other agencies that manage this species.

Erythranthe montioides (A.Gray) N.S.Fraga “montia-like monkeyflower” *Phytoneuron* 39: 1–60 (2012). *Mimulus montioides* A.Gray, *Proc. Amer. Acad. Arts* 7: 380 (1868).—TYPE: USA. California, Tulare Co.: mountains E of Visalia, 17–18 Jun 1864, *Brewer 2785* (lectotype, here designated: GH!).

Annual herb. Plants 3–9 cm tall × 1–13 cm wide; glabrous to minutely puberulent. Stems erect, simple to branched, internodes 0.5–1.5 cm. Cotyledons deciduous. Leaves opposite, epetiolate or with petioles short (0.5–1 mm); blades 4–15 mm long × 0.5–2 mm wide, linear to oblanceolate, palmately veined with three prominent veins from the base in wider leaves, margins entire. Flowers solitary in each axil, fruiting pedicels 3–15 mm, exceeding calyx, erect to ascending. Calyx is 3–6 mm long × 1–3 mm wide, campanulate, enlarging in fruit; costa weak, slightly darker than intercostal regions, sometimes spotted red; calyx teeth equal, 0.5–1 mm long, acute, margins ciliate. Corolla 10–17 mm long × 7–15 mm wide, yellow, lobes entire, strongly zygomorphic; tube-throat 6–11 mm long, funnelliform, expanding gradually to the limb, palate glabrous to sparsely bearded, spotted with red markings. Stamens didynamous, 7–8 mm long, yellow, glabrous, included. Gynoecium 10 mm long, white; style glabrous; stigma lobes apically fringed, equal, included. Capsules 3–5 mm long, included to calyx, campanulate, thin walled and fragile, dehiscent to the base along both sutures. Seeds 0.5–0.7 mm long × 0.2–0.3 mm wide, elliptic to ovoid, brown.

Additional specimens examined.—USA, California, Fresno Co.: Markwood Meadows, 5800 ft, Jun 1900, *Hall & Chandler* 339 (CAS, UC); Hume Lake Christian Camp, 5400 ft, 14 Jun 1998, *Schoenig* 98-36 (UC); 7.2 km S-SE of Hume Lake, vicinity of Weston Meadow, T14Sm R28E, S11, NW1/4 of NE1/4, 1960 m, 28 Jun 1996, *York & Shevock* 982 (CAS), on first road from Dinkey Creek Road, just W of Bald Summit, 13 Jul 2005, *Gowen* 476 (JEPS); W end of Rabbit Meadow, W of Big Meadows, 7800 ft, 19 Jul 1979, *Heckard et al.* 5142 (JEPS); E side of Kaiser Pass, near summit, 19 Jun 1997, *Wisura* 5064 (RSA); Pittman Creek, above Huntington Lake, 27 Jul 1918, *Grant* 1480 (RSA); trail to Nellie Lake, 8000 ft, 11 Jul 1917, *Grant* 1080 (RSA); 9 mi S of General Grant National Park on road to Sequoia National Park, 26 Jul 1942, *Ferris & Lorraine* 10827 (RSA, UC); trail to Dinkey Lakes, Dinkey Lakes Wilderness, 8800 ft, 12 Jul 2008, *Fraga & Brock*, 2366 (RSA); Tulare Co.: Alta Trail, Giant Forest, 7500 ft, 8 Aug 1905, *Brandegge* s.n. (UC); SW of Stoney Creek Campground, between Sequoia and Kings Canyon National Parks, 6400 ft, 18 Jun 1956, *Tillett & Sternback* 486 (UC); along road between Moro Rock and Crescent Meadow, 18 Jun 2011, *Fraga et al.* 3869 (RSA).

Phenology and pollination biology.—Flowering occurs from June to August and fruiting is most common in July and August. *Erythranthe montioides* exhibits approach herkogamy and has relatively large flowers (Fig. 5). Based on evidence from corolla morphology this species is presumed to be primarily outcrossing. Solitary bees have been observed visiting flowers of this species and are presumed to serve as the primary pollinators.

Distribution and habitat.—*Erythranthe montioides* is endemic to the Sierra Nevada in Fresno and Tulare counties, California, and is documented from 19 occurrences on Forest Service and National Park Service lands (Fig. 11). This species primarily occurs on the dry edges of meadows and in seasonally moist depressions in the open understory of mixed coniferous and lodgepole pine forest. Elevation 1645–2900 m (5400–9500 ft). Associated species include: *Abies magnifica*, *Arctostaphylos* Adans. sp., *Calocedrus decurrens*, *Ceanothus* L. sp., *Diplacus leptaleus* (A.Gray) G.L.Nesom, *Erythranthe laciniata* (A.Gray) G.L.Nesom, *Leptosiphon* Benth. sp., *Lewisia triphylla* (S.Watson) B.L.Rob., *Pinus contorta* subsp. *murrayana*, *P. jeffreyi*, *P. lambertiana*, and *P. monticola* D.Don.

Phylogenetic relationships and similar species.—*Erythranthe montioides* is inferred to share a close relationship with *E. palmeri* (Fraga unpubl.). *Erythranthe montioides* is easily distinguished morphologically from *E. palmeri*. *Erythranthe montioides* has yellow flowers with entire lobes that are smaller (10–17 mm) than those of *E. palmeri* (15–25 mm). In contrast, *E. palmeri* has pink flowers that are notched on each lobe.

Etymology.—*Erythranthe montioides* is named for its resemblance to the genus *Montia* L. (Montiaceae) and has been given the common name montia-like monkeyflower.

Conservation concern.—*Erythranthe montioides* has been confused with other closely related species including *E. barbata*, *E. calcicola*, *E. carsonensis*, and *E. discolor*. It was previously thought to be a widely distributed species because of this taxonomic confusion. The majority of occurrences have not been surveyed in

recent years; thus little information exists regarding population status and trends. Several hundred to several thousand individuals, however, were observed at Big Meadow and between Moro Rock and Crescent Meadow in 2010 and 2011. *Erythranthe montioides* should be evaluated for conservation status by the federal, state, and other agencies that manage this species.

Erythranthe palmeri (A.Gray) N.S.Fraga “Palmer’s monkey-flower” *Phytoneron* **39**: 1–60 (2012). *Mimulus palmeri* A.Gray, *Proc. Amer. Acad. Arts* **12**: 82 (1876).—TYPE: USA, California, San Bernardino Co.: Mohave River, 1 Jun 1876, *Palmer* 321½ (holotype GH!, isotypes MO!, PH, UC!, US digital image!).

Annual herb. Plants 4–17 cm tall × 1–15 cm wide; minutely puberulent. Stems are erect, simple to branched, internodes 1–4 cm. Cotyledons persistent, obovate/ovate to round, 0.2–1 mm long, with clasping bases. Leaves opposite, epetiolate or with petioles short (0.1–1 mm); blades are 3–17 mm long × 1–4 mm wide, linear to lanceolate, palmately veined with three prominent veins from the base in wider leaves, margins entire. Flowers solitary in each axil, fruiting pedicels 4–32 mm, exceeding calyx, erect to ascending, or spreading horizontally. Calyx 4–8 mm long × 2–4 mm wide, campanulate, enlarging in fruit; costa weak, darker than intercostal regions, sometimes red spotted; calyx teeth equal, 0.5–1 mm long, acute and spreading, margins ciliate. Corolla 15–25 mm long × 8–15 mm wide, pink to purple, yellow at the base of the tube, lobes emarginate, strongly zygomorphic; tube-throat 10–19 mm long, funnellform, expanding gradually to the limb, palate glabrous to sparsely bearded with two yellow ridges. Stamens didynamous, 8–12 mm long, yellow, glabrous, included. Gynoecium 12–16 mm long, pink; style glabrous; stigma lobes apically fringed, subequal, included. Capsules 3–5 mm long, included in the calyx, campanulate, thin walled and fragile, dehiscing to the base along both sutures. Seeds 0.5–0.9 mm long × 0.1–0.3 mm wide, elliptic to ovoid, brown.

Representative specimens examined.—USA, California, Los Angeles Co.: San Gabriel Mountains, Upper Big Tujunga Canyon, margin of Big Tujunga Creek T2N R11W, NE/4 SE/4 SE/4 sec 5, 3980–4040 ft, 8 Jun 1990, *Ross et al.* 2987 (RSA); Chilao Creek headwaters, T3N, R11W, NW/NE, sec 24, 5900 ft, 1 Jun 1968, *Wheeler* s.n. (RSA); Upper Big Tujunga at Vetter Gulch, 25 May 1963, *Wheeler* 8258 (RSA); Pine Flats, 9 Jul, *Peirson* 1124 (RSA); ca. 0.3 mi below Alder Saddle, along a dry branch of the S Fork of Little Rock Creek, 5300 ft, 30 Jun 1971, *Thorne & Tilforth* 40764 (RSA); San Bernardino Co.: San Bernardino Mountains, near Mojave River, about 0.5 mi W of junction between roads to Hesperia and Lake Arrowhead, 3200 ft, 10 May 1979, *Thorne & Prigge* 52892 (RSA); E of Running Springs, W of Deer Lick Station, 6000 ft, 29 May 1992, *Hirshberg* 33 (RSA); Summit Valley on Hwy 173, 5.4 mi NE of Hwy 138 junction and 1 mi S of the Grass Valley Creek crossing, 3280 ft, 24 Apr 1993, *Sanders & Spilman* 13774 (RSA); Fredalba, 5000 ft, 8 Jun 1919, *Munz & Johnston* 2855 (RSA); Hunsaker Flats, 5200 ft, 8 Jun 1919, *Munz & Johnston* 2856 (RSA); Fish Camp, 6900 ft, 17 Jun 1921, *Johnston* 2837 (RSA); NE of Rock camp station, N of Lake Arrowhead, 4785 ft, 21 May 2008, *Gross & Vanderplank* 3420 (RSA); intersection of Forest Service roads 3N34 (Pilot Rock Road) and 3N33, 4800 ft, 21 May 2008, *Fraga et al.* 2092

(RSA); Keller Peak Road, 7200 ft, 11 Jun 2008, *Fraga & Kempton 2190* (RSA); along OHV trail 1W17, N of Crab Flats, 5400 ft, 17 Jun 2008, *Fraga & Bell 2246* (RSA); 2.2 mi below junction for Smiley Park (along City Creek Road), 17 Jun 1953, *Bacigalupi et al. 4224* (JEPS); 9.7 mi above bridge crossing Deep Creek, Kinley Creek drainage, Deep Creek Grade, 4900 ft, 17 Jun 1953, *Bacigalupi et al. 4220* (JEPS); Horsthief Canyon, 15 May 1935, *Clokey & Anderson 6909* (JEPS); Strawberry Peak, 25 Jul 1901, *Abrams 1978* (DS).

Phenology and pollination biology.—Flowering occurs from April to July and fruiting is most common in June and July. *Erythranthe palmeri* exhibits approach herkogamy and has relatively large flowers (Fig. 8). Based on evidence from corolla morphology this species is presumed to be primarily outcrossing. Solitary bees have been observed visiting flowers of this species and are presumed to serve as the primary pollinators.

Distribution and habitat.—*Erythranthe palmeri* is restricted to the San Gabriel and San Bernardino Mountains of the Transverse Ranges in Los Angeles and San Bernardino counties (Fig. 22). This species primarily occurs in decomposed granite in vernal wet depressions, swales, at the edges of streams and creeks, dry meadows, and in openings of pine forest, oak woodland, and desert chaparral. Elevation 976–2200 m (3200–7200 ft). Associated species include the following (* denotes non-native species): **Bromus tectorum*, *Calochortus palmeri* S.Watson, *Castilleja lasiorhyncha* (A.Gray) T.I.Chuang & Heckard, *Ceanothus leucodermis* Greene, *Erythranthe breweri*, *E. guttata*, *E. suksdorfii*, *Eschscholzia californica* Cham., *Fremontodendron californicum*, *Gilia capitata* Sims, *Iris hartwegii* Baker var. *australis* Parish, *Phacelia mohavensis* A.Gray, *Pinus coulteri* Lamb. ex D.Don, *P. jeffreyi*, *Juncus mexicanus* Willd. ex Schult. & Schult.f., *Leptosiphon ciliatus* (Benth.) Jeps., *Madia minima* (A.Gray) D.D.Keck, *Platystemon californicus* Benth., *Quercus kelloggii*, *Thysanocarpus laciniatus* Nutt., and *Trichostema austromontanum* F.H.Lewis.

Phylogenetic relationships and similar species.—*Erythranthe palmeri* is inferred to share a close relationship with *E. montioides* (Fraga unpubl.). *Erythranthe palmeri* is easily distinguished morphologically from *E. montioides*. See discussion under *E. montioides* for distinguishing morphological features.

Etymology.—*Erythranthe palmeri* is named in honor of Edward Palmer (1829–1922), a botanist and explorer of the American West. Palmer collected the type specimen of *E. palmeri*.

Conservation concern.—*Erythranthe palmeri* has been confused with other closely related species including *E. diffusa*, *E. discolor* (pink form), *E. rhodopetra*, and *E. sierrae*. It was previously thought to be a widely distributed species because of this taxonomic confusion. *Erythranthe palmeri* is endemic to the Transverse Range in the San Gabriel and San Bernardino Mountains and is therefore of limited distribution. Off-highway vehicle use, road maintenance, hiking trails, and campgrounds have all been observed as possible sources of disturbance to known occurrences. *Erythranthe palmeri* should be evaluated for conservation status by the federal, state, and other agencies that manage this species in light of clarification in taxonomy.

Erythranthe rhodopetra N.S.Fraga, sp. nov. “Red Rock Canyon monkeyflower”.—TYPE: USA. California, Kern

Co.: El Paso Mountains, Last Chance Canyon, Old Cuddhay Camp, 35°24', 40.2°N; 117°55'40.1"W, 828 m/2717 ft, 23 Apr 2011, *Fraga & Gardner 3787* (holotype RSA!; isotypes CAS!, UC!, US!).

Annual herb. Plants 5–15 (–21) cm tall × 1–15 cm wide; sparsely glandular pubescent. Stems erect, simple to branched, internodes 2–8 cm. Cotyledons persistent, obovate to ovate, 3–1.2 mm long, with attenuate bases. Leaves opposite, petioles short (0.5–1 mm) to epetiolate; blades 5–22 mm long × 1–10 mm wide, linear-oblongate to elliptic, palmately veined with three prominent veins from the base in wider leaves, margins entire. Flowers solitary in each axil, fruiting pedicels 10–40 mm, exceeding calyx, erect to ascending. Calyx 5–10 mm long × 3–4 mm wide, campanulate to cylindrical, enlarging in fruit; costa prominent and darker than intercostal regions; calyx teeth subequal and 0.5–1 mm long, acute and spreading, margins glabrous. Corolla 12–26 mm long × 16–25 mm wide, pink to rose colored, lobes bifid, weakly zygomorphic; tube-throat 9–17 mm long, funnelform, expanding abruptly to the limb, palate glabrous with a large yellow patch with dark pink longitudinal lines. Stamens didynamous, 10–13 mm long, yellow, glabrous, included. Gynoecium 12–14 mm long, pale pink to white; style glabrous; stigma lobes slightly apically fringed, subequal, included in the corolla. Capsules 4–8 mm long, included in the calyx, cylindrical to campanulate, thin walled and fragile, dehiscent to the base along both sutures. Seeds 0.7–0.9 mm long × 0.2–0.3 mm wide, elliptic to ovoid, brown.

Additional specimens examined.—USA. California, Kern Co.: Red Rock Canyon, 2300 ft, 14 Mar 1959, *DeDecker 1000* (RSA); Fremont Valley drainage; Red Rock Canyon N of Visitor's Center, 3 Apr 1993, *DeDecker 6378* (RSA); near Ricardo, Red Rock Canyon, 29 Mar 1922, *Fultz 17074* (RSA); Red Rock Canyon, 1 Apr 1935, *Woghum 659* (RSA); Red Rock Canyon, 19 Apr 1958, *Munz & Gregory 23311* (RSA, UC); Red Rock Canyon, 1 May 1927, *Abrams 11856* (POM); Red Rock Canyon State Park, Hagen Canyon, 2200 ft, 12 Apr 2008, *Fraga et al. 1996* (RSA); N of Randsburg, 10 Apr 1922, *Pierce s.n.* (POM); Saltdale, Petrified Forest, 14 Apr 1933, *Johnston & Raiselis 17230* (RSA); El Paso Mountains, Petrified Forest, 20 Apr 1952, *Wheeler 6856* (RSA).

Phenology and pollination biology.—Flowering occurs from March to April and fruiting is most common in April and May. *Erythranthe rhodopetra* exhibits approach herkogamy and has very large flowers (Fig. 9) compared with the vegetative growth. Based on evidence from corolla morphology this species is presumed to be primarily outcrossing. Insect visitors were not observed visiting flowers of this species over the course of this study.

Distribution and habitat.—*Erythranthe rhodopetra* (Fig. 26–28) is endemic to the El Paso Mountains in Kern County, California (Fig. 22). This species occurs in highly compacted sandy soils in washes derived from sedimentary rock of the Ricardo Formation (Cox and Diggles 1986). The Ricardo Formation is of Miocene origin and is colorful with alternating bands of red, white, and brown and is composed of sandstones and consolidated conglomerates (Cox and Diggles 1986). Elevation 610–915 m (2000–3000 ft). Associated species include the following (* denotes non-native species): **Bromus madritensis* L. subsp. *rubens* (L.) Husn., **B. tectorum*, *Calyptidium monandrum* Nutt., *Eremothera boothii* (Douglas)

W.L. Wagner & Hoch, *Erythranthe guttata*, *Lepidium flavum* Torr., *Juncus bufonius* L., *Plagiobothrys arizonicus* (A. Gray) A. Gray, and *Platystemon californicus*.

Phylogenetic relationships and similar species.—*Erythranthe rhodopetra* appears to be closely related to *E. palmeri* (Fraga unpubl.). These species are easily distinguished from one another based on corolla size, corolla color, and nectar guide patterns. *Erythranthe rhodopetra* has a wider limb (16–25 mm) than *E. palmeri* (8–15 mm) and has pale pink flowers with a broad yellow palate and orifice. In contrast, *E. palmeri* has deep pink flowers with two yellow ridges on the palate.

Etymology.—*Erythranthe rhodopetra* is named for the red sedimentary rocks of Red Rock Canyon State Park in Kern County, California. The species is endemic to the region and is associated with sandy canyon washes at the base of the red sedimentary cliffs.

Conservation concern.—*Erythranthe rhodopetra* occurs in less than ten populations within a 120 km² region and is therefore of limited distribution. All known occurrences are on public lands administered by the Bureau of Land Management or California State Parks. This species should be considered for conservation status by the federal, state, and other agencies that manage for this species. Historic mining operations, off-highway vehicle use, and the presence of exotic plants species were visible disturbances observed over the course of field surveys conducted by this study.

Erythranthe sierrae N.S. Fraga, sp. nov. “Sierra Nevada monkeyflower”.—TYPE: USA. California, Kern Co.: Sierra Nevada, Breckenridge Mountain, along Breckenridge Mountain Road, ca. 2 mi NW of Breckenridge Campground, 35.4724°N, 118.6029°W, 5900 ft, *Fraga, Fraga, & Fraga 3445* (holotype RSA!; isotypes CAS!, UC!, US!).

Annual herb. Plants 4–20 cm tall × 2–19 cm wide; sparsely glandular pubescent. Stems erect, simple to branched, internodes 1–4 cm. Cotyledons persistent, obovate–ovate, 3–5 mm long, short petiole with clasping bases. Leaves opposite, petioles short (0.5–1 mm) to epetiole; blades (3–) 5–27 mm long × 1–11 mm wide, linear to oblanceolate, palmately veined with three prominent veins from the base in wider leaves, margins entire or sometimes toothed. Flowers solitary in each axil, fruiting pedicels (4–) 9–43 mm, exceeding calyx, erect to ascending. Calyx 4–8 mm long × 3–4 mm wide, campanulate, enlarging in fruit; costa weak and darker than intercostal regions; calyx teeth equal, 0.5–1 mm long, acute and spreading, margins ciliate. Corolla 12–22 mm long × 5–17 mm wide, pale pink to pink, lobes notched, weakly zygomorphic; tube-throat 8–17 mm long, funnellform, expanding gradually to the limb, palate with two yellow ridges. Stamens didynamous, 7–10 mm long; white, glabrous, included. Gynoecium 10–13 mm long, pink; style glabrous; stigma lobes apically fringed, subequal, included. Capsules 3–6 mm long, included to equal to calyx, cylindrical, thin walled and fragile, dehiscing to the base along both sutures. Seeds 0.5–0.8 mm long × 0.2–0.3 mm wide, elliptic to ovoid, brown.

Additional specimens examined.—USA, California, Kern Co.: Greenhorn Mountain Range, Little Poso Creek Falls, 4500 ft, 23 May 1937, *Benson 8344* (POM); Greenhorn Range, 6000 ft, *Hall & Babcock 5050* (POM); Breckenridge Mountain, 6000 ft, 26 May 1928, *Bauer 213* (RSA); Howling Gulch near Woody,

1900 ft, *Smith 339* (RSA); Howling Gulch E of Woody Granite Road, 35.68991N, 118.82803W, 30 May 2010, *Fraga et al. 3410* (RSA); Greenhorn Mountains, summit between Glenville and Wood, 3000 ft, *Hughes 178* (POM); Keane, 1700 ft, *Jones s.n.* (POM); N slope Breckenridge Mountain (at head of creek), 27 Jun 1965, *Twisselmann 11229* (JEPS); Breckenridge Mountain, 5700 ft, 6 Jun 2010, *Fraga et al. 3441* (RSA); Breckenridge Mountain Campground, 6600 ft, 4 Jul 2010, *Fraga & Brock 3514* (RSA); Rancheria Rd. (dirt road) S of Poso Flat Rd. and NW below fire lookout, near National Forest boundary and Oak Flat, 9 Jun 2005, *Gowen 432* (JEPS); Greenhorn Range, NW slope Basket Peak, 5250 ft, 27 Jun 1963, *Twisselmann 8546* (RSA); Fresno Co.: 100 m W of Hume Lake Road, where USFS campground road forks off at Hume Lake, 36°47′30″N; 118°54′00″W, 5300 ft, *Schoenig 37* (RSA); just above Crawford Ranch, Pine Flat, Kings River about 6 mi below Trimmer, 650 ft, *Carter 48* (RSA, UC); Sand Creek, 6 May 1918, *Kelley s.n.* (JEPS); Tulare Co., N fork of Tule River, 1 2/10 mi above Milo, 2500 ft, 14 May 1933, *Wolf 4674* (RSA); middle fork of Tule River, 1750 ft, *Peirson 5619* (RSA); California Hot Springs to Durrwood, 11 May 1940, *Woghum 2713* (RSA); Tule River, 3000 ft, *Munz 3000* (RSA); 1/4 mi E of Milo junction and 7.5 mi N of Springville, *Robbins & Heckard 3535* (RSA); 0.25 mi NE of Milo junction (7.5 mi N of Springville), 30 May 1953, *Heckard 456A* (RSA); hills N of Springville, 800 ft, Apr 1897, *Purpus 5048* (UC); Kaweah River Basin, 15 Apr 1901, *Hopping 111* (UC).

Phenology and pollination biology.—Flowering occurs from March to July and fruiting is most common in June and July. *Erythranthe sierrae* exhibits approach herkogamy and has relatively large flowers (Fig. 10). Based on evidence from corolla morphology this species is presumed to be primarily outcrossing. Halictid bees (Halictidae) have been frequently observed visiting flowers of this species and are presumed to serve as the primary pollinators.

Distribution and habitat.—*Erythranthe sierrae* (Fig. 29–31) is endemic to the Sierra Nevada in Kern, Fresno, and Tulare counties, California (Fig. 22). This species primarily occurs in decomposed granite in vernal wet depressions, swales, at the edges of streams, dry meadows, and in openings of pine forest and oak woodland. Elevation 200–2100 m (650–6800 ft). Associated species include the following: *Abies concolor*, *Claytonia perfoliata*, *Diplacus bolanderi* (A. Gray) G.L. Nesom & N.S. Fraga, *D. constrictus* (A.L. Grant) G.L. Nesom & N.S. Fraga, *Erythranthe breweri*, *E. floribunda*, *Nemophila maculata* Lindl. *Pinus jeffreyi*, *P. sabiniana* D. Don, *Phacelia curvipes*, *Plagiobothrys* sp., *Quercus chrysolepis*, *Q. douglasii* Hook. & Arn., *Q. kelloggii*, *Ribes quercetorum* Greene.

Phylogenetic relationships and similar species.—*Erythranthe sierrae* is inferred to have a sister relationship with *E. gracilipes* (B.L. Rob.) N.S. Fraga (Fraga unpubl.). These species are easily distinguished by corolla morphology. *Erythranthe sierrae* has corolla lobes that are more or less equal in size and a tube-throat that is funnellform and expands gradually to the limb. In contrast, *E. gracilipes* has two reduced adaxial lobes that are smaller than the three abaxial lobes and a tube-throat that is cylindrical and expands abruptly to the limb.

Etymology.—*Erythranthe sierrae* is endemic to the Sierra Nevada in California and is named for the range.

Conservation concern.—*Erythranthe sierrae* has a relatively widespread distribution and is known from Kern, Fresno, and Tulare counties in the foothills of the Sierra Nevada. Anthropogenic change including development, grazing, off highway vehicle use, road and trail maintenance, campgrounds, and the presence and abundance of exotic species have all been documented as possible threats to known occurrences. Several populations at lower elevations may be highly impacted from these disturbances with several populations possibly extirpated. This species should be reassessed for threats at known occurrences.

ACKNOWLEDGMENTS

Lucinda McDade, Jim Morefield, Guy Nesom, and an anonymous reviewer provided useful comments on an early draft of this manuscript. I would like to thank the following herbaria for study of their specimens: CAS/DS, DEVA, GH, MO, POM, RENO, RSA, SBBG, SD, UC/JEPS, and UNLV. Michelle Thomas provided the original illustrations. This work benefited from the assistance of many field companions who generously donated their time to assist me in the field. This research was funded by The California Native Plant Society, The California Native Plant Society Bristlecone Chapter, The Community Foundation, Nevada Native Plant Society, Rancho Santa Ana Botanic Garden, Switzer Foundation Fellowship, and The Torrey Botanical Society. The Nevada Native Plant Society provided funding for the two illustrations.

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