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A NEW SPECIES OF *LINANTHUS* (POLEMONIACEAE) FROM SAN BERNARDINO COUNTY, CALIFORNIA

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ABSTRACT

Linanthus bernardinus is described as new from San Bernardino County, California. It is morphologically similar to *L. killipii* and *L. orcuttii* subsp. *pacificus* but differs from plants of these taxa in height, corolla length, seed morphology, and habitat. ***Linanthus bernardinus*** can be found growing in vernal moist areas within Joshua tree woodland, often in shallow depressions, or on gentle slopes, in decomposed granite sand that is surrounded by large granite boulder fields.

Key words: California, endemic, *Linanthus*, new species, Polemoniaceae, rare, San Bernardino County, San Bernardino Mountains.

INTRODUCTION

The novelty described here was discovered in 2005 when a single specimen that was misidentified as *Leptosiphon breviculus* (A.Gray) J.M.Porter & L.A.Johnson was found in the RSA herbarium (Fig. 1–4). The specimen was re-identified to the genus *Linanthus* Benth. (Polemoniaceae), but it could not be satisfactorily identified to species. It was morphologically similar to *Linanthus killipii* H.Mason and *L. orcuttii* (A.Gray ex Parry) Jeps. subsp. *pacificus* (Milliken) H.Mason. However, the plant differed from plants of both species in height, corolla length, seed color, and the habitat from which it was collected (Table 1). Additional specimens of this taxon were located at RSA and UCR; most of these had been misidentified as *L. orcuttii*. Evidence from field and herbarium studies is presented here to provide the basis for the recognition of this newly described taxon.

Taxonomic Overview of *Linanthus*

The genus *Linanthus* is endemic to North America and contains at least 25 species including the one newly described here (Porter and Johnson 2000). The genus is composed of annual and perennial species that are morphologically diverse, especially with respect to leaf morphology and inflorescence structure (Porter and Johnson 2000; Patterson and Porter 2012). Based on molecular phylogenetic studies, *Linanthus* as currently circumscribed forms a monophyletic group and includes members of Grant's sections *Linanthus* and *Dianthoides*, along with taxa formerly placed in genus *Leptodactylon* Hook. & Arn. and several species previously included in *Gilia* Ruiz & Pav. (Bell and Patterson 2000; Porter and Johnson 2000).

MATERIALS AND METHODS

This study is supported by field observations and study of herbarium specimens. Field studies conducted in 2010 and 2011 included sampling populations of the newly described taxon, *L. killipii*, and *L. orcuttii* subsp. *pacificus*. Herbarium specimen records, databases (CNDDDB 2012; CCH 2012; SEINet 2012), and literature reports were used to identify populations for field surveys. At each field site, data recorded included exact location (via Global Positioning System),

habitat characteristics (i.e., elevation, slope, aspect, microhabitat, vegetation association, and associated species), distinguishing morphological characteristics, and conservation status (i.e., existing or potential threats or disturbances). Photographs were taken of living plants. 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 herbarium specimens. Herbarium specimens were databased and georeferenced to create accurate distribution maps, and maps were prepared in ArcGIS 10.0 (ESRI 2012).

TAXONOMIC TREATMENT

Linanthus bernardinus N.S.Fraga & D.S.Bell, sp. nov. “Pioneertown linanthus” (Fig. 1–4).—TYPE: USA, California, San Bernardino County: eastern San Bernardino Mountains, Sawtooth Range, approx. 0.7 air mi NW of the intersection of Pioneertown Road and Water Canyon, and approx. 1 air mi SE of Pioneertown, 34.14562, –116.48355 W (NAD 83), 1189 m/3904 ft, 23 Apr 2011, Bell 2361 (holotype: RSA!; isotype: US!).

Annual herb. Plants (1.5) 2–9 cm tall; glandular-villous. Stems erect, simple to branched. Cotyledons sessile with sheathing bases, persistent, 1–2 mm long, ovate to lanceolate. Leaves opposite, sessile to short (1 mm) petiolate, often sheathing at the base; blades 1.5–7 (10) mm long, palmately lobed with (3) 4–5 linear divisions, adaxial surface densely villous, abaxial surface more sparsely villous, margins entire. Inflorescence a cyme, generally in 1–3 flowered units. Floral bracts leaf-like, but larger, 3–10 (12) mm long. Pedicels sessile to short (to 1 mm long). Flowers diurnal, opening in full sunlight. Calyx 5–7 mm long, campanulate to narrowly urn-shaped, with stipitate glands, sparsely villous proximally, lobes erect, costa green and herbaceous, darker and narrower than the hyaline intercostal regions, the sinuses narrowly V-shaped and divided less than half way to the base. Corolla 13–25 mm

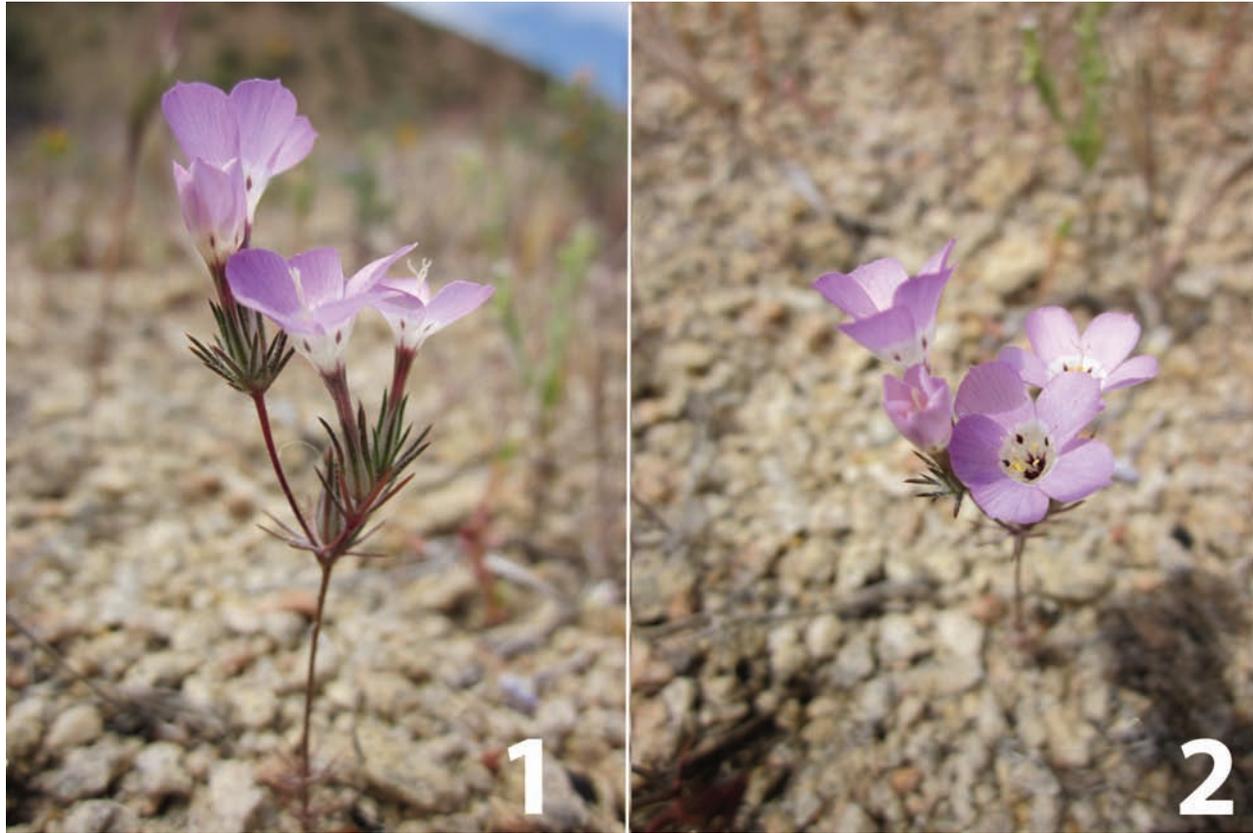


Fig. 1–2. *Linanthus bernardinus* in flower.—1. Plant habit showing lateral view of the corolla; note granite-derived gravelly soil.—2. View from above.

long, funnellform, lobes white to cream or pale lavender-pink, with a solitary maroon to red narrowly ellipse-shaped spot at the base of each lobe, apices apiculate, throat white, tube maroon to purple, glabrous throughout, tube 6–14 mm long, cylindric, expanding gradually to the limb. Stamens equal, 3–5 mm long; anthers yellow, glabrous, included, pollen yellow. Gynoecium 9–16 mm long; ovary narrowly ovoid, green; style and stigma yellow, glabrous; stigma slightly exerted. Capsules ellipsoid, 2.5–3.5 mm long, 2–10 seeds per locule. Seeds 0.5–1 mm long, irregularly shaped, sometimes angular and prism-like, light brown with net-like seed coat, producing a small amount of mucilage when wetted. Flowering occurs between March and early May, fruiting between late April and May.

Additional specimens examined.—USA. California: San Bernardino County: San Bernardino Mountains/Mojave Desert: Pioneertown Road, 1.9 mi N of Yucca Valley (at Yucca Trail), 2.1 mi S of Pioneertown, Water Canyon, 1125 m, 30 Apr 1995, *Sanders & Helmkamp 16843* (RSA, UCR); University of California Burns Piñon Ridge Reserve, ca. 1.5 mi E of Pioneertown, W of Burns House, N of campground, 1265 m, 8 May 2003, *Elvin 2809* (UCR); University of California Burns Piñon Ridge Reserve, N of Yucca Valley, 1223 m, 22 Apr 1973, *Clark s.n.* (UCR); about 2 mi E of Pioneertown, 4000–4500 ft, 29 Mar 1988, *Pendleton s.n.* (RSA); Sawtooth Range: just to the W of Chaparrosa Wash, approx. 1.4 air mi SW of Pioneertown, 1280 m/4201 ft, 21 May 2010, *Bell 1068* (RSA); Sawtooth Range: about 0.25 air mi S of Chaparrosa spring and approx. 1.6 air mi SW of Pioneertown, 1326 m/4352 ft, 23

Apr 2011, *Bell 2294* (RSA); Sawtooth Range: approx. 0.75 air mi E of Chaparrosa spring and approx. 1 air mi SW of Pioneertown, 1322 m/4338 ft, 23 Apr 2011, *Bell 2295* (RSA); Sawtooth Range: along Water Canyon, approx. 0.7 air mi SE of Chaparrosa spring and approx. 1.7 air mi SW of Pioneertown, 1266 m/4024 ft, 23 Apr 2011, *Bell 2352* (RSA); Sawtooth Range: along Water Canyon, approx. 0.5 air mi S of Chaparrosa spring and approx. 1.9 air mi SW of Pioneertown, 1228 m/4029 ft, 23 Apr 2011, *Bell 2355* (RSA); Sawtooth Range: between Chaparrosa Wash and Sorrel Horse Canyon, approx. 1.25 air mi W of Pioneertown, 20 plants growing on a gradual slope of decomposed granite at base of large boulder pile just above a small foot trail, 1257 m/4126 ft, 23 Apr 2011, *Bell 2360* (RSA); Sawtooth Range: approx. 0.8 air mi NW of where Pioneertown Road crosses Water Canyon and approx. 0.9 air mi SE of Pioneertown, 1208 m/3966 ft, 23 Apr 2011, *Bell 2367* (RSA); Sawtooth Range: between Chaparrosa Wash and Sorrel Horse Canyon, approx. 2 air mi W of Pioneertown, 1302 m/4273 ft, 24 Apr 2011, *Bell 2368* (RSA); Sawtooth Range: S of Sorrel Horse Canyon, approx. 1.4 air mi NE of Chaparrosa Peak and approx. 2.5 air mi SW of Pioneertown, 1342 m/4404 ft, 24 Apr 2011, *Bell 2369* (RSA).

Distribution and habitat.—*Linanthus bernardinus* (Fig. 1–4) is endemic to San Bernardino County, California. This taxon is known primarily from a small mountain range called the Sawtooths located 3.5 air mi NW of Yucca Valley, E of the San Bernardino Mountains and W of the Little San Bernardino Mountains (Fig. 5). Plants occur in Joshua tree

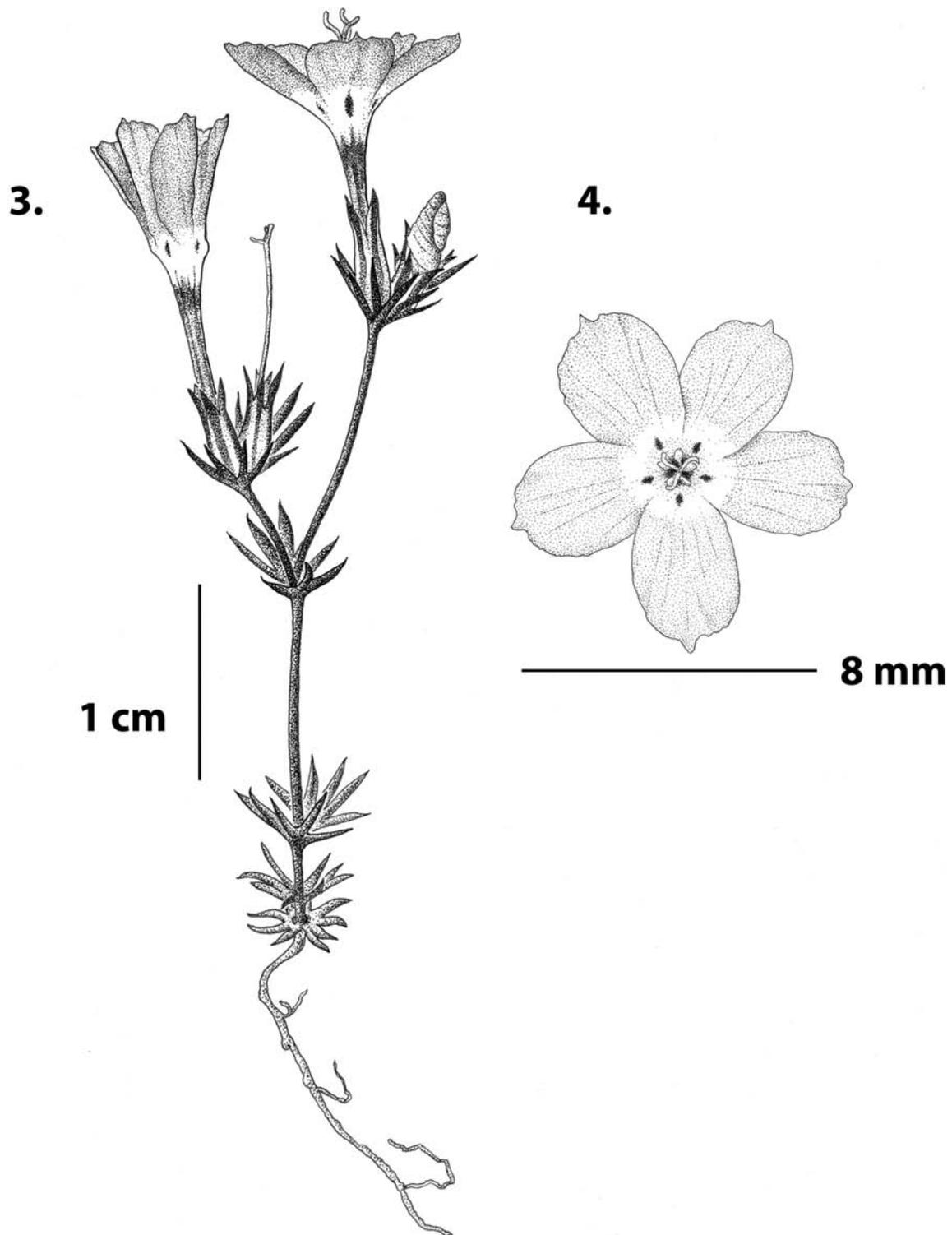


Fig. 3-4. Illustration of *Linanthus bernardinus*.—3. Plant habit and lateral view of the corolla.—4. View of the corolla from above illustrating the limb and throat. Illustration by Michelle Thomas.

woodland, often in small depressions, gentle slopes, or on hillocks surrounded by large granite boulders in decomposed granite sand (Fig. 6). Elevations range from 1098–1341 m (3600–4400 ft). Associated species include: *Allium fimbriatum* S.Watson, **Bromus madritensis* L. subsp. *rubens* (L.) Husn., **B. tectorum* L., *Gilia ochroleuca* M.E.Jones, *Gilia scopulorum*

M.E.Jones, *Calochortus kennedyi* Porter, *Centrostegia thurberi* A.Gray, *Delphinium parryi* A.Gray, *Dichelostemma capitatum* (Benth.) Alph. Wood, *Diplacus bigelovii* (A.Gray) G.L.Nesom, *Ephedra viridis* Coville, *Eriophyllum confertiflorum* (DC.) A.Gray, *E. pringlei* A.Gray, *E. wallacei* (A.Gray) A.Gray, *Eriogonum saxatile* S.Watson, **Erodium cicutarium* (L.) L'Hér.

Table 1. Comparison of morphological features and habitat for *Linanthus bernardinus*, *L. killipii*, *L. orcuttii* subsp. *pacificus*, and *L. orcuttii* subsp. *orcuttii*.

	<i>L. bernardinus</i>	<i>L. killipii</i>	<i>L. orcuttii</i> subsp. <i>orcuttii</i>	<i>L. orcuttii</i> subsp. <i>pacificus</i>
Habit	erect	tufted	erect	erect
Height (cm)	(1.5) 2–9	1–5	1–5	1–15
Corolla total length (mm)	13–25	7–15	8–18	8–23
Corolla tube length (mm)	6–14	4–8	5–15	5–15
Corolla limb color	white or pale lavender	white or bright pink	white or bright pink	white or bright pink
Corolla tube color	maroon to purple	yellow	yellow	maroon to purple
Nectar guide pattern Shape	ellipse	ellipse	chevron	chevron
Seeds	light brown	dark brown	dark red brown	red brown
Habitat	desert	montane	montane	montane

ex Aiton, *Greeneocharis circumscissa* (Hook. & Arn.) Ryd., *Hesperoyucca whipplei* (Torr.) Trel., *Lasthenia gracilis* (DC.) Greene, *Lomatium mohavense* (J.M.Coult. & Rose) J.M.Coult. & Rose, *Nolina parryi* S.Watson, *Opuntia basilaris* Engelm. & J.M.Bigelow var. *basilaris*, *Pectocarya setosa* A.Gray, *Quercus cornelius-mulleri* Nixon & K.P.Steele, *Salvia columbariae* Benth., and *Yucca brevifolia* Engelm.

Etymology.—*Linanthus bernardinus* is named for the San Bernardino Mountains and San Bernardino County, California, where this species is endemic. We suggest the common name Pioneertown linanthus because the unincorporated village of Pioneertown in San Bernardino County is situated at the center of all known occurrences of this species (Fig. 5).

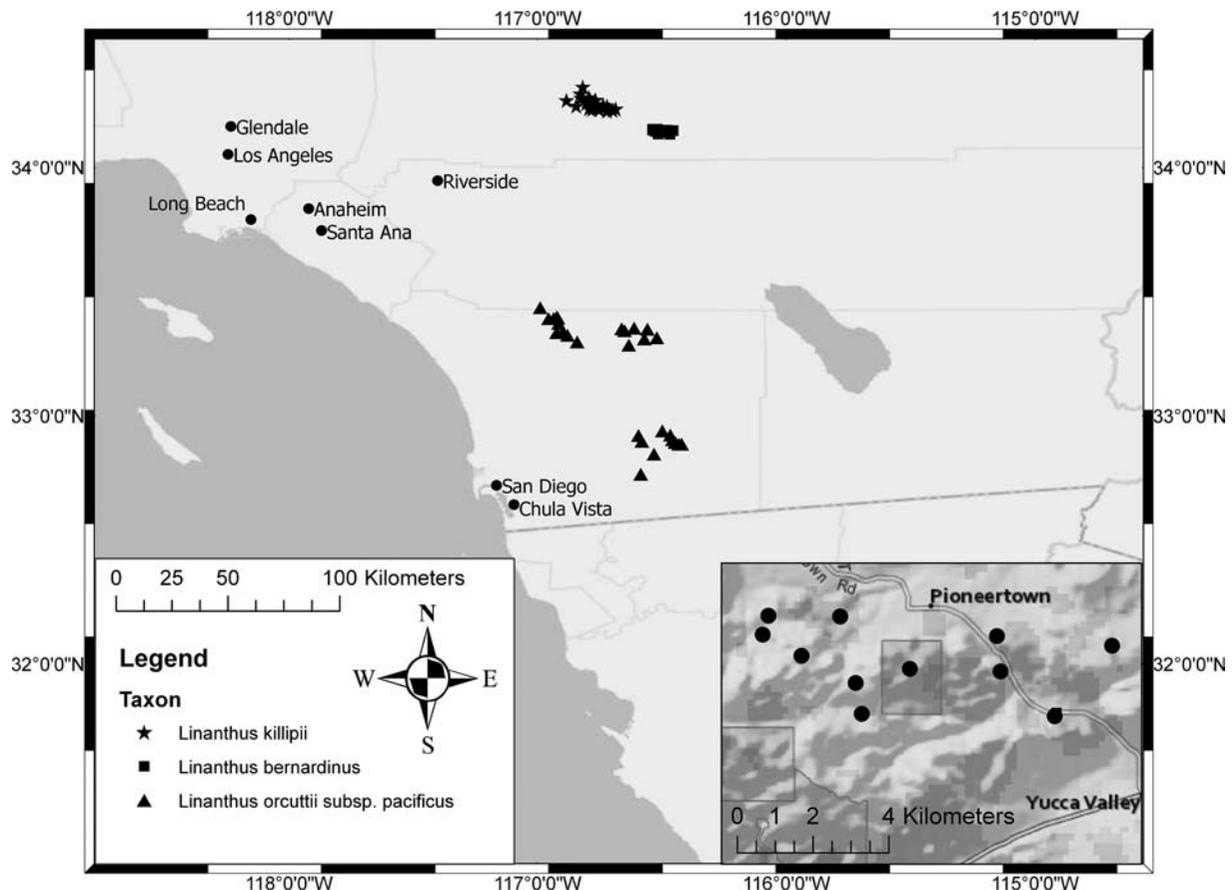


Fig. 5. Distribution of *Linanthus killipii*, *Linanthus bernardinus*, and *Linanthus orcuttii* subsp. *pacificus*. Inset map shows a close up detail of the distribution of *Linanthus bernardinus*. Map created in ArcGIS Desktop: Release 10.0 (Environmental Systems Research Institute, Redlands, CA; ESRI 2012).

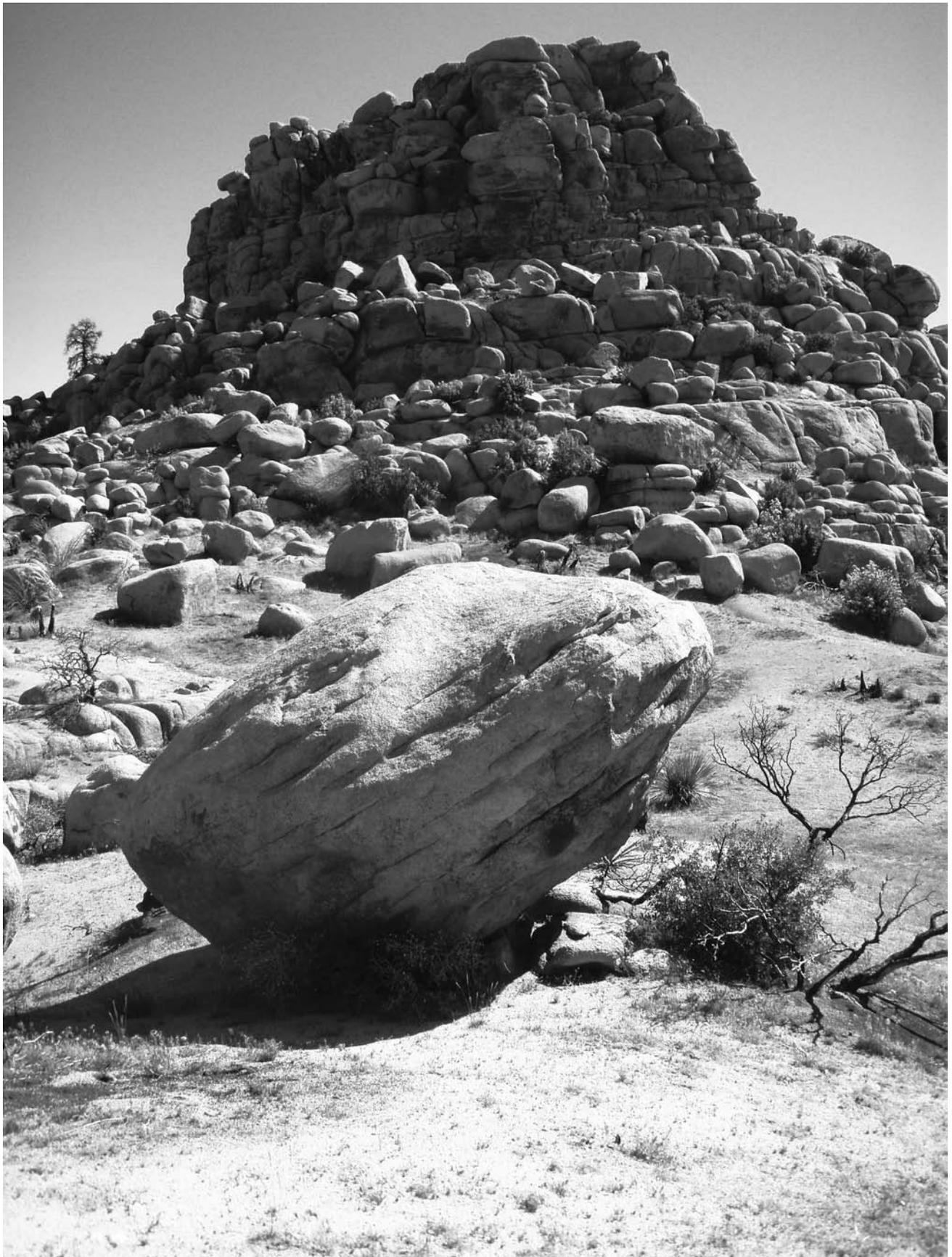


Fig. 6. Habitat of *Linanthus bernardinus* with *Quercus cornelius-mulleri* resprouting from the 2006 Sawtooth Complex fire.

KEY TO SIMILAR SPECIES

1. Nectar guide in the shape of a chevron (V-shaped) at the base of each lobe
 2. Plants 1–5 cm tall, corolla tube yellow.
. *Linanthus orcuttii* subsp. *orcuttii*
 2. Plants 1–15 cm tall, corolla tube maroon to purple.
. *Linanthus orcuttii* subsp. *pacificus*
1. Nectar guide in the shape of a narrow diamond at the base of each lobe
 3. Plants tufted, 1–5 cm tall, corolla tube yellow.
. *Linanthus killipii*
 3. Plants erect, (1.5) 2–9 cm tall, corolla tube maroon to purple *Linanthus bernardinus*

CONSERVATION STATUS

Linanthus bernardinus is known from 11 occurrences in a 27 km² (10 sq mi) area (Fig. 5) and is thus a narrow endemic. Therefore, threats to known occurrences may have a significant impact to its long-term conservation. *Linanthus bernardinus* is threatened by competition with non-native plant species, housing development in the vicinity of Pioneertown, and also potentially by renewable energy development.

Based on criteria used by NatureServe (2012) and CNPS (2012) to establish conservation status ranks, we recommend that *L. bernardinus* be considered for the global rank of G2: imperiled—“at high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors” and a California Rare Plant Rank of 1B.2, or fairly threatened in California with 20–80% of occurrences threatened. *Linanthus bernardinus* occurs on land managed by the Wildlands Conservancy (Pioneertown Mountains Preserve), the State of California (University of California Burns Piñon Ridge Reserve), and private property. This species has potential to occur on lands managed by the Bureau of Land Management because it is known from properties adjacent to BLM holdings.

Habitat for *L. bernardinus* was impacted in the summer of 2006 by the Sawtooth Complex Fire (Fig. 6). The fire was ignited by lightning and burned approx. 250 km² (96 sq mi; Cal Fire 2012) in the region. For five years following the fire, land managed by the Wildlands Conservancy in the Pioneertown

Mountain Preserve was closed to the public for habitat rehabilitation. Over the course of the study, the vegetation, including Joshua trees and oaks, were observed resprouting, and vegetation was in the early stages of recovery. The indirect effects of fire could potentially threaten *L. bernardinus* if non-native species were to become established and invade habitat following fire. Competition with non-native species is a potential threat to *L. bernardinus*.

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