

Notes on a new subspecies of *Linanthus maculatus* from San Diego and Imperial Counties

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Abstract: *Linanthus maculatus* subsp. *maculatus* is known from Riverside and San Bernardino Counties in the vicinity of the Little San Bernardino Mountains. *L. maculatus* subsp. *emaculatus* J.M. Porter, D.S. Bell & R. Patt. was recently described from Palm Canyon Wash and the adjacent drainage at the eastern base of the Jacumba Mountains in San Diego and Imperial Counties, California. We describe the habitat and distribution of this new subspecies. A review of collections of *L. maculatus* subsp. *emaculatus* shows that the earliest collections were in 2010 and that this taxon was rapidly recognized as distinctive. An assessment of threats and conservation needs of this new subspecies leads us to propose that *L. maculatus* subsp. *emaculatus* be given the CNPS global rank of G2 and CNPS California Rare Plant Rank 1B.1.

Background: *Linanthus maculatus* (Parish) Milliken is a diminutive, ephemeral annual characterized by white corollas bearing red to maroon spots at the base of each lobe and alternate, narrowly ovate leaves. While red spots at the corolla lobe bases are not an uncommon trait in *Linanthus*, alternate leaves are unusual. This in part explains its former inclusion in *Gilia* (Patterson 1989; Day 1993) and Grant's 1999 suggestion that it should be treated in the monotypic genus, *Maculigilia*. *Linanthus maculatus* usually flowers between April and May (Patterson and Porter 2011; Jepson Manual Online 2013), but it has been observed in flower as early as February and often flowers in March (pers. obs.). A population in Whitewater Canyon, Riverside County, CA has been shown to be self-incompatible (LaDoux 2004) and presumably pollinated by soft-winged flower beetles of the family Melyridae (L. Johnson, pers. com.). *Linanthus maculatus* plants are remarkably small, usually no larger than a quarter. This species is endemic to California and is only known from a few areas in the Mojave and Colorado deserts. The California Native Plant Society has designated it as a California Rare Plant Rank (CRPR) 1B.2, meaning that it is both rare and fairly endangered across its range (CNPS 2016).

Linanthus maculatus was recently split into two subspecies: *L. maculatus* subsp. *maculatus* from Riverside and San Bernardino Counties in the vicinity of the Little San Bernardino Mountains, and *L. maculatus* subsp. *emaculatus* J.M. Porter, D.S. Bell & R. Patt., in Imperial and San Diego Counties, where it is found in a small number of locations at the eastern base of the Jacumba Mountains (Porter & Patterson 2015) (Figure 1A). As the name of the new subspecies implies (*emaculatus* = without spots), *Linanthus maculatus* subsp. *emaculatus* differs from *Linanthus maculatus* subsp. *maculatus* in that it lacks the characteristic red spots at the base of the corolla lobes (cover photo). The subspecies also differ in the length of the style, which is much shorter than the stigma lobes in subsp. *maculatus*, but as long as or longer than the stigma lobes in subsp. *emaculatus*.

Distribution: *Linanthus maculatus* subsp. *emaculatus* is a narrow endemic found in Palm Canyon Wash and the drainage immediately to the south at the eastern base of the Jacumba Mountains in San Diego and Imperial Counties, California. Its elevation range is from approximately 335 to 580 meters (1100 to 1900 ft.).

The population in Palm Canyon Wash is found from the head of the drainage near Dos Cabezas Spring down to the elevation of 345 m (1130 ft.) near the old railroad tracks (Figure 1B). The census numbers in Palm Canyon Wash in 2013, ranged from a few localized plants to clusters of over 150 individuals. The southern population mainly occurs on the margins and base of the sand ramp that has formed on the northeastern facing side of a large boulder hill. In 2013 over 600 individuals were observed here in an area of approximately one acre. Smaller, scattered subpopulations have also been found on the north side of this boulder hill, to the southwest along the road, and at the base of a small dune system on the northwest side of the road.

This new subspecies represents a significant extension of the overall range of *Linanthus maculatus*. Previously, the species was known from a series of populations around the bases of the Little San Bernardino Mountains and eastern San Bernardino Mountains (Figure 1A).

Habitat: *Linanthus maculatus* subsp. *emaculatus* is found in the western Sonoran/Colorado Desert within washes in an area best described as ocotillo woodland, although the majority of the ocotillos are on the benches above the washes (Figure 2A). Perennial species most directly associated with *Linanthus maculatus* subsp. *emaculatus* include *Acmispon haydonii* (Orc.) E. Greene, *Ambrosia dumosa* (A. Gray) Payne, *Ambrosia salsola* A. Gray, *Bebbia juncea* (Benth.) Greene, *Cylindropuntia wolfii* (L.D. Benson) M.A. Baker, *Ephedra nevadensis* S. Watson, *Lupinus excubitus* M.E. Jones var. *medius* (Jepson) Munz, *Petalonyx thurberi* A. Gray, *Psorothamnus schottii* (Torrey) Barneby, *Psorothamnus spinosus* (A. Gray) Barneby, and *Simmondsia chinensis* (Link) C. Schneider. Annual associates include *Brassica tournefortii* Gouan, *Chaenactis fremontii* A. Gray, *Chylismia*

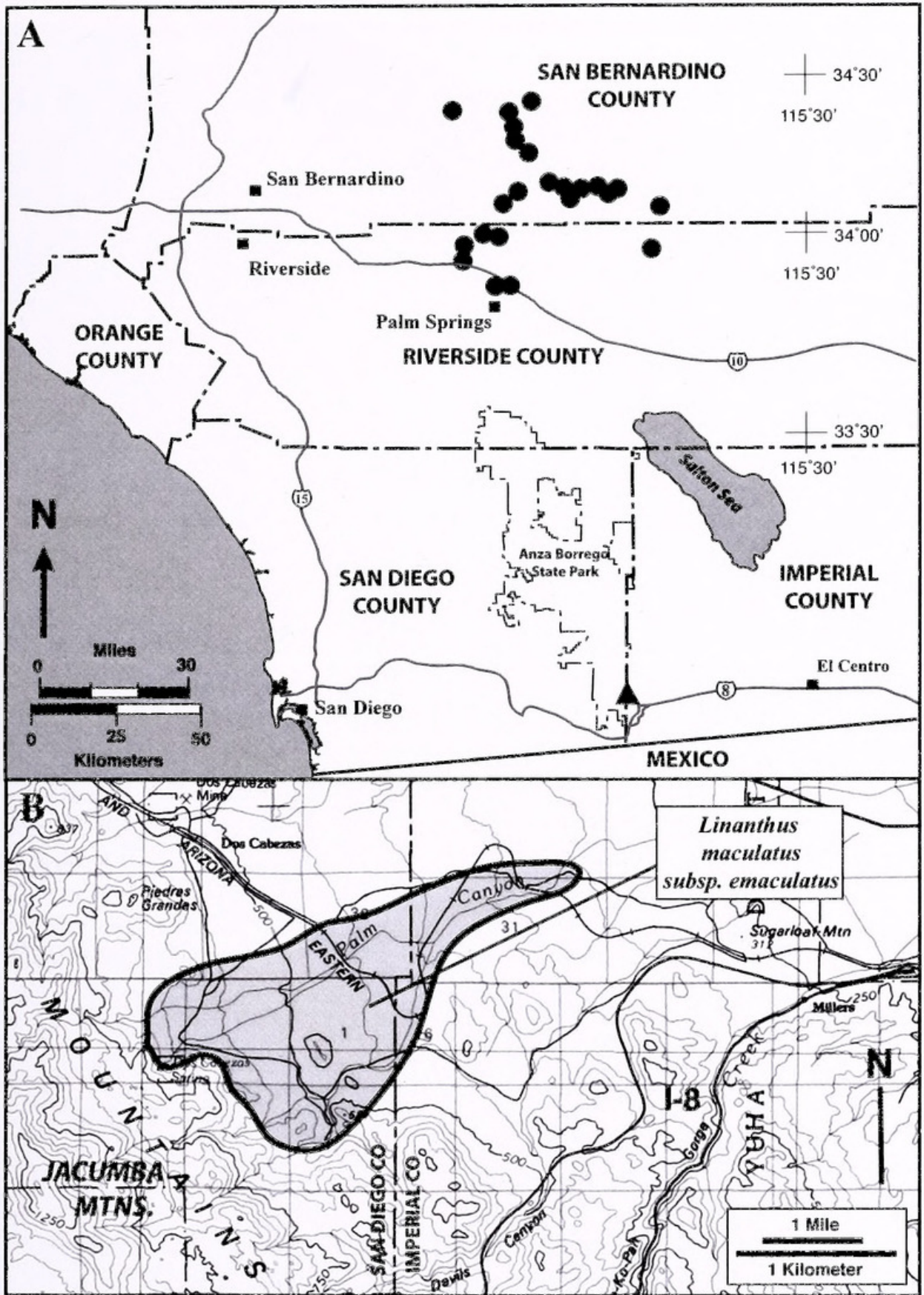


Figure 1A: Distribution of both *Linthanthus maculatus* subsp. *maculatus* (indicated on map with circles), and *Linthanthus maculatus* subsp. *emaculatus* (indicated by the single triangle in the lower section of map). **Figure 1B:** The entire known distribution of *Linthanthus maculatus* subsp. *emaculatus*, known from just a few square miles in the upper portion of Palm Canyon Wash.

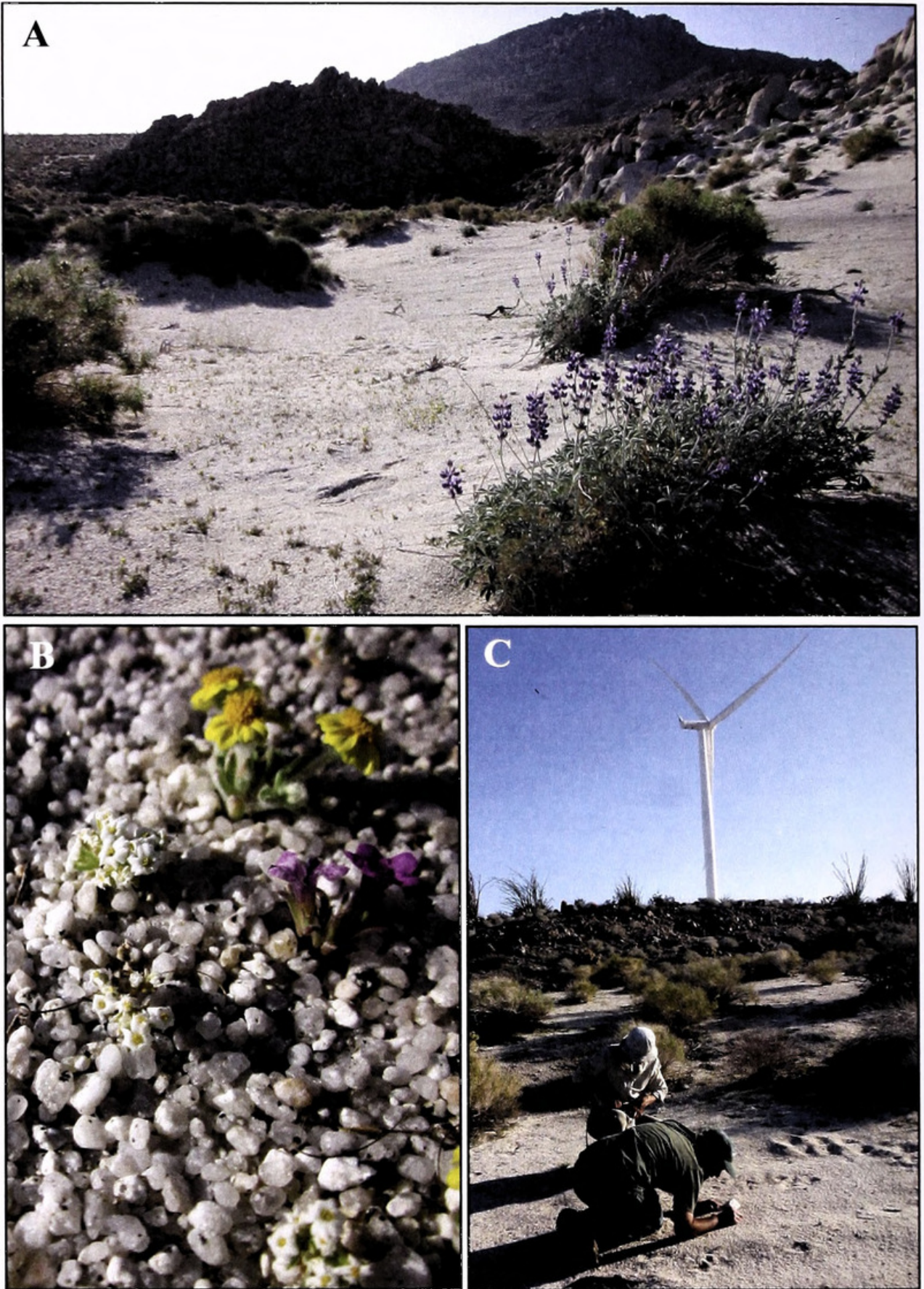


Figure 2A: Habitat of *Linanthus maculatus* subsp. *emaculatus*. **Figure 2B:** *Linanthus maculatus* subsp. *emaculatus* and typical associates, *Eriophyllum wallacei* and *Diplacus bigelovii*. **Figure 2C:** The author and Jane Tirrell collecting information and monitoring a population of *Linanthus maculatus* subsp. *emaculatus* at the Ocotillo Wind Energy Facility.

claviformis (Torrey & Fremont) Raven, *Cryptantha micrantha* (Torrey) I.M. Johnston, *Diplacus bigelovii* A. Gray, *Eriogonum thomasi* Torrey, *Eriophyllum wallacei* A. Gray, *Erodium cicutarium* (L.) L'H-r. *Eschscholzia minutiflora* S. Watson, *Malacothrix glabrata* A. Gray, *Phacelia crenulata* Torrey, *Phacelia distans* Benth., and *Schismus barbatus* (L.) Thell. (Figure 1B).

Linanthus maculatus subsp. *emaculatus* occurs mainly on a specific soil consisting of opaque, quartz- or plagioclase-like decomposed granite between the texture of sand and gravel. It is found in open flat sections of wash bottoms, in small drainages within these washes, on the margin of sand dunes, and occasionally on fine gravelly slopes. This differs significantly from *Linanthus maculatus* subsp. *maculatus*, which generally occurs in open, flat drainage systems.

Collection History: The first collection of *Linanthus maculatus* subsp. *emaculatus*, from Palm Canyon Wash, was made by Larry Hendrickson in April of 2010 and identified as *Linanthus maculatus* (Hendrickson 4927 [SD], California Consortium of Herbaria, 2013). Curious about this range extension of nearly 100 miles, Bell visited this population in March of 2012 and found Hendrickson's population as well as the second, previously undocumented population to the east. None of the individuals within these populations had the spots at the base of their corolla lobes characteristic of *L. maculatus*, and it was therefore determined that these populations possibly represented an undescribed subspecies. This information was passed to Porter, who then visited these populations and verified that this was a subspecies distinct from the San Bernardino and Riverside County populations.

Within months of determining that the Imperial County populations of *Linanthus maculatus* were a distinct subspecies, construction began on the Ocotillo Wind Energy Facility (OWEF) in the immediate vicinity of the newly-recognized subspecies. On return to the location in November of 2012, Bell found that bulldozers had missed the easternmost population of *Linanthus maculatus* subsp. *emaculatus* by only 20 meters. This raised serious concern that these two small populations, which were the only ones known at the time, were in immediate danger of extirpation.

In March of 2013 nearby regions of Anza-Borrego Desert State Park (ABDSP) in San Diego County were surveyed for additional populations of *Linanthus maculatus* subsp. *emaculatus*. During this survey, additional larger populations were discovered near the head of Palm Canyon Wash and in the drainage to the south of Palm Canyon Wash (*D.S. Bell* 4589 [RSA]; *D.S. Bell* 4590 [RSA]; *D.S. Bell* 4591 [RSA]).

Management & Conservation Threats/Needs: *Linanthus maculatus* subsp. *emaculatus* is found in Imperial County on Bureau of Land Management (BLM) land and in San Diego County on land managed by ABDSP. The populations in ABDSP are larger than the populations on the adjacent BLM lands but are localized in a few narrow areas highly susceptible to OHV activity. During fieldwork in March of 2013, we noted evidence of recent OHV activity in the drainage from Dos Cabezas Spring, and at least one vehicle was observed driving in the southern wash, which is clearly not an open route. Although the northern section of Palm Canyon Wash from the railroad tracks to Mortero Palms is not shown on park maps as an open OHV route, it is heavily used as such. This drainage was surveyed for *Linanthus maculatus* subsp. *emaculatus* in spring of 2013, but no plants were found. Although the section of this drainage surveyed seemed too rocky/gravelly for *L. maculatus* subsp. *emaculatus*, there were other sections of the drainage with potential habitat, and further surveys could lead to discoveries of new occurrences.

The habitat in ABDSP at the base of the sand ramp where the largest population was found was in excellent condition in March of 2013. However, this area is extremely vulnerable to OHV use, as it is very close to both the ABDSP road and the border of the park and is therefore an easily-accessible area for OHV users seeking sand dunes. A heavily-impacted sand dune area less than a mile to the northeast on the ABDSP border appears to be suitable habitat for *L. maculatus* subsp. *emaculatus*, but no plants have been observed there to date. The smaller subpopulation, growing beside the ABDSP to the west of the sand ramp locality, is vulnerable to OHV use, camping, and other forms of roadside recreation.

Non-native plant species were present at the ABDSP *Linanthus maculatus* subsp. *emaculatus* localities but not in large numbers. Non-native plants noted included *Brassica tournefortii*, *Erodium cicutarium*, and *Schismus barbatus*. If population densities of *Brassica tournefortii* were to increase, this could pose another major threat for *Linanthus maculatus* subsp. *emaculatus*, as it could be crowded out by this invasive non-native species (Bangle, et al 2008).

The two populations of *Linanthus maculatus* subsp. *emaculatus* in Imperial County are small and highly localized. The western population in Imperial County occurs on the southern margin of Palm Canyon Wash near where the train tracks cross the wash. While very near the OWEF, this population is not actually located within the wind farm (Fig. 2C). OHV traffic and non-native weeds are currently the most significant threats to this population, but expansion of the OWEF would present the most substantial threat.

The easternmost population of *Linanthus maculatus* subsp. *emaculatus* in Imperial County, also located in Palm Canyon Wash, is currently the most threatened

population. Until 2012 this population was relatively safe, as it was away from any large, open travel route. But in the summer of 2012, the OWEF project was granted permission to break ground, and a large access route was quickly bulldozed across Palm Canyon Wash, missing this population by approximately 20 meters. A substantial amount of suitable habitat was lost due to this bulldozing, but the known population was not damaged. The greatest threats to this small, localized population are impacts from OWEF maintenance vehicles and OHVs. With the increased traffic due to the development of the OWEF, the potential increase of non-native plant species, particularly *Brassica tournefortii*, from tires and undercarriages of vehicles is a new threat to this population. Trash dumping has not yet been observed in this area, but this is a new potential threat common along well-maintained roads. Fire can also be a potential threat, as wind turbines can throw sparks, leak hot oil, and occasionally explode, causing fires, as was seen in January of 2015 when one of the wind turbines at the Ocotillo Wind Farm exploded into flames (Hales, 2015). The introduction of non-native species will also increase the fuel load for these potential fires (Keeley 2011).

Recommendations: Based on criteria used by NatureServe (2016) and CNPS (2016) to establish conservation status ranks, it is recommended that *Linanthus maculatus* subsp. *emaculatus* 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 CNPS California Rare Plant Rank of 1B.1: seriously threatened in California with over 80% of occurrences threatened. It is also suggested that land managers of both BLM and ABDSP revisit these populations/occurrences annually during appropriate flowering times (March-April) to evaluate these populations. These annual evaluations should include population estimates, GPS coordinates, current threats, and any other relevant information that will add to and assist in the proper management of this unique subspecies.

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