Keil, D.J. and D.W. Taylor. 2018. *Atriplex flavida* (Chenopodiaceae), a new combination for a recently described annual saltbush. Phytoneuron 2018-65: 1–7. Published 11 September 2018. ISSN 2153 733X

ATRIPLEX FLAVIDA (CHENOPODIACEAE), A NEW COMBINATION FOR A RECENTLY DESCRIBED ANNUAL SALTBUSH

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ABSTRACT

Atriplex flavida (S.C. Sand. & G.L. Chu) D.J. Keil & D.W. Taylor, **comb. nov**., is proposed based on *Obione flavida* S.C. Sand. & G.L. Chu (Chenopodiaceae). This species, which is endemic to the Carrizo Plain of eastern San Luis Obispo Co., California, has been misidentified for many years as *Atriplex vallicola* Hoover or its nomenclatural synonym, *A. coronata* S. Wats. var. *vallicola* (Hoover) S.L. Welsh.

Hoover (1938) described an annual saltbush from north of Lost Hills in the San Joaquin Valley of Kern Co., California as *Atriplex vallicola* Hoover. Subsequently Hoover (1970) applied the name *A. vallicola* to an annual saltbush that occurs in the vicinity of Soda Lake on the Carrizo Plain, an arid valley in eastern San Luis Obispo Co., California (average annual rainfall ~160 mm; Intellicast 2018). In the latter publication he noted that the plant from the Carrizo Plain "seems to be essentially like the type of *A. vallicola* . . . although the latter is overmature and therefore difficult to compare." Following the publication of Hoover's flora in 1970, the name *A. vallicola* was in common use for the Carrizo Plain plant (e.g., Skinner 1994). In the 1980s the junior author, with more information about the Lost Hills plants, expressed doubt that the Carrizo Plain plants were the same species. In their Jepson Manual treatment of *Atriplex*, Taylor and Wilken (1993) noted the Carrizo Plain plants to be an undescribed species. In the 1990s the junior author annotated specimens from the Carrizo Plain with the ined. name *Atriplex* 'natrophila.' Welsh (2000) reduced *Atriplex vallicola* to varietal status as *A. coronata* S. Wats. var. *vallicola* (Hoover) S.L. Welsh without directly commenting on the Carrizo Plain plants. In a note under *A. coronata* var. *vallicola* in his treatment of *Atriplex* for the Flora of North America, Welsh (2003) cited the Taylor and Wilken (1993) notation about the Carrizo Plain plants being an undescribed species. Zacharias (2012, 2013) did not mention the Carrizo Plain plants in her treatments of *Atriplex* for the Jepson Manual and Jepson eFlora, and the name *A. coronata* var. *vallicola* is currently in use for these plants (e.g., California Native Plant Society 2018). However, Zacharias (unpubl.) has investigated their relationships (Bruce Baldwin, pers. comm.).

In a recently published conspectus of the Chenopodiaceae, Sanderson and Zhu (2017) recognized *Obione* Gaertn. as a genus distinct from *Atriplex* L. In their treatment *Obione* is differentiated from *Atriplex* by a suite of characters, most notably C_4 photosynthesis and leaves with Kranz venation versus C_3 photosynthesis and leaves with non-Kranz venation. The Sanderson and Zhu study appears to be based largely on morphological evidence, and taxonomic circumscriptions appear not to have been influenced by recent molecular phylogenetic evidence. Kadereit et al. (2010) carried out a molecular phylogenetic survey of the tribe Atripliceae Ulbrich. From the Kadereit et al.

study it is evident that *Atriplex* (sensu stricto) as circumscribed by Sanderson and Zhu is polyphyletic, and the C_4 lineage (*Obione* sensu Sanderson and Zhu) is nested within a more broadly defined and well-supported monophyletic *Atriplex*. Zacharias and Baldwin (2010) provided a strongly supported circumscription of American chenopods in tribe Atripliceae C.A. Mey, consistent with Kadereit et al. (2010) and erected a new genus, *Extriplex* E.H. Zacharias, as one well-supported segregate, with two endemic California species (*E. californica* (Moq.) E.H. Zacharias and *E. joaquiniana* (A. Nels.) E.H. Zacharias). *Atriplex* sensu Kadereit et al. (2010) and Zacharias and Baldwin (2010) is a large genus, distributed widely, with about 300 species (Mabberley 2017).

Zhu and Sanderson (2017) published the name *Obione flavida* S.C. Sand. & G.L. Chu as a new species for the annual saltbush from the Carrizo Plain. We do not agree with the segregation of *Obione* as a genus distinct from *Atriplex,* and therefore we transfer *Obione flavida* to *Atriplex*.

ATRIPLEX FLAVIDA (S.C. Sand. & G.L. Chu) D.J. Keil & D.W. Taylor, **comb. nov.** *Obione flavida* S.C. Sand. & G.L. Chu, Gen. New Evol. System World Chenopod. 339. 2017. **TYPE**: **USA. California.** San Luis Obispo Co.: Carrizo Plain on the N side of Soda Lake [ca. 35.26131°, −119.89006°, 585 m], 20 May 1967, *R.F. Hoover 10584* (holotype: UC1315100!; isotypes: OBI17262!, CAS477088).

Atriplex flavida doubtless resides within *Atriplex* subg. *Obione* (Gaertn.) S.L. Welsh sect. *Obione* subsect. *Pusillae* (Standl.) S.L. Welsh, a group of halophytic herbs nearly endemic to California (Welsh 2000). This subsection comprises 13 taxa treated within 5 species, only one of which, *A. pusilla* (Torr.) S. Wats., ranges outside the state (to central Nevada and southeastern Oregon) (Holmgren & Holmgren 2012). A molecular phylogeny of subsect. *Pusillae* is unavailable; only *A. pusilla* has been included in published DNA-based phylogenies (Zacharias & Baldwin (2010).

Description. Zhu and Sanderson (2017) provided a detailed description of *Obione flavida*, but their publication is likely to be unavailable to many North American botanists. We therefore provide our own description of this species (Figs. 1, 2, 3).

Annual yellowish-green herbs, 1–40 cm tall. **Stems** ascending to erect, branched from the basal nodes with branches simple to much branched, slender, terete, not strongly ribbed or striate, initially furfuraceous throughout but glabrescent except distally. **Leaves** all cauline, plane, with Kranz anatomy; proximal leaves very short-petiolate but most leaves sessile; blades ovate-lanceolate to elliptic or broadly ovate, 3–14 mm long, 2–7 mm wide, strongly furfuraceous on both surfaces, the scurf edges strongly greenish-yellow-margined, base attenuate to rounded, truncate, or subcordate, apex acute to shortly acuminate, margins entire or rarely obscurely toothed at the most proximal nodes. **Inflorescence** of staminate and pistillate flowers in mixed axillary glomerules, these appearing at about the third or fourth node; flowers of both kinds mixed throughout all nodes, each glomerule usually containing 1 or 2 staminate flowers and 2–4 pistillate flowers. **Staminate flowers** sessile; perianth obovoid to subglobose, ca. 1 mm long, generally 3-merous (rarely 4-merous), sepals linear to obovate, usually unequal in size, membranous, slightly fleshy and green dorsally near apex; stamens as many as perianth segments, anthers oblong, ca. 0.5 mm long, filaments united at base. **Pistillate flowers:** bracteole margins united proximal to middle; style very short, stigmas 2, filiform, 1.5–2.5 mm long. **Fruiting bracteoles** sessile, monomorphic, 2.8–3.8 mm long, 2.6–3.6 mm wide, rhombic-obovate to obovate-deltoid, broadly cuneate at base, smooth to more or less prominently tuberculate on both surfaces, this often variable within a glomerule, distal margin irregular denticulate, middle tooth usually largest and longer than lateral teeth, surface densely yellow scurfy. **Utricle** obovate, pericarp membranous. **Seeds** brown, ca. 1 mm wide; radical superior.

Figure 1. *Atriplex flavida*. A. *A. flavida* (yellow-green) with *A. coronata* (gray-green). B. Close-up of foliage and fruiting bracts. Bottom. Habitat on Carrizo Plain north of Soda Lake. Colonies of *A. flavida* in lower left center of photo. Photos by David Keil

Figure. 2. Dried specimen of *Atriplex flavida* (*Taylor 9499*, to be distributed). White balance in image was adjusted to neutrality to show the subtle, characteristic yellow color cast. Photo by Dean W. Taylor.

Comparison with *Atriplex coronata*. *Atriplex flavida* and *A. coronata* (Fig. 1A) are both annuals with small, entire, sessile or proximally short-petioled leaves. Herbage in both is densely scurfy, but the overall color of *A. flavida* is yellow-green whereas that of *A. coronata* is gray-green (Fig. 1A) making it easy to distinguish the species where sympatric (except perhaps for very young plants). Staminate and pistillate flowers in both species are mixed in small axillary glomerules. Staminate flowers of *A. flavida* are 3(4)-merous whereas those of *A. coronata* are (4)5-merous. Fruiting bracteoles of *A. flavida* are 2.8–3.8 mm long, 2.6–3.2 mm wide, obovate to obovate-deltoid in profile, broadly cuneate at base, smooth to more or less prominently tuberculate on both surfaces. The middle tooth of the distal margin generally is more prominent than the other teeth (Fig. 3). Fruiting bracteoles of *A. coronata* vary between varieties but are 2–6 mm long, 3–7 mm wide, broadly cuneate to semicircular in profile, broadly obtuse to truncate at base, with sides smooth or obscurely to prominently tuberculate. The middle tooth of the distal margin generally is not larger than the other teeth. Fruiting bracteoles of var. *coronata*, with which *A. flavida* co-occurs, are semicircular, (2)3–5 mm long, 3–7 mm wide, and broadly cuneate to truncate at base. Var. *vallicola* is characterized by fruiting bracteoles 2–2.5 mm long.

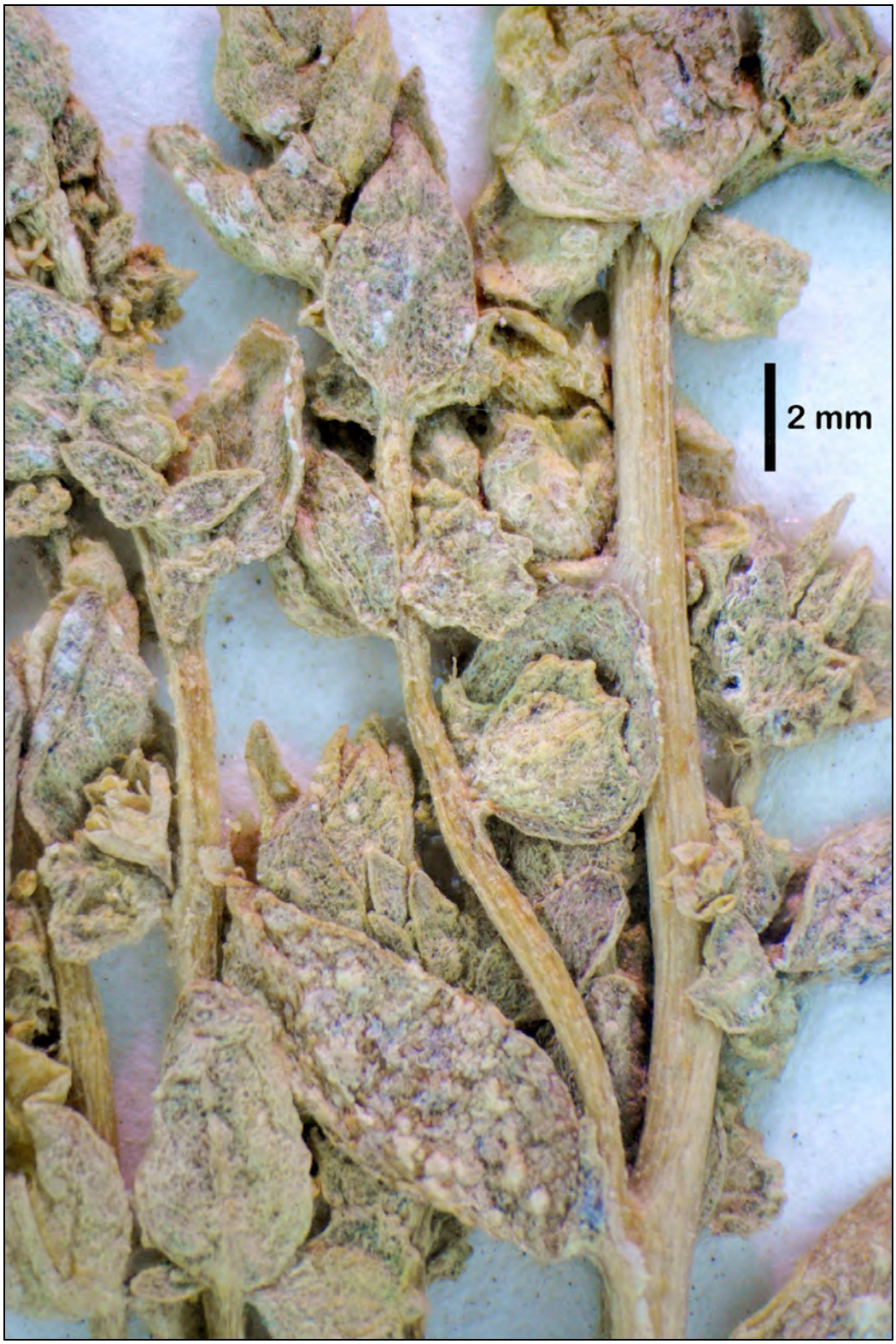

Figure. 3. Detail of *Atriplex flavida* specimen (*Taylor 9499*, to be distributed). White balance in image was adjusted to neutrality to show the subtle, characteristic yellow color cast. Photo by Dean W. Taylor.

Habitat characterization. *Atriplex flavida* occurs in a semi-arid region of sodic, alkaline soils vegetated by annual herbs or scrub (Buck-Diaz & Evans 2011) (Fig. 1C), often dominated by *Atriplex spinifera*, *Suaeda nigra*, and/or *Allenrolfea occidentalis*. Annual associates include *Atriplex coronata*, *Deschampsia danthonioides*, *Hordeum depressum*, *Lasthenia ferrisiae*, *Lepidium dictyotum*, *Lepidium jaredii* var. *jaredii*, and *Spergularia marina*. The regional pattern of vegetation on the Carrizo Plain is strongly controlled by substrate, with many areas on the floor of the valley having barren alkali scalds concentrating sulfates and carbonates (Eghbal et al. 1989). These 'slickspots' are common features on sodic soil landscapes and are often entirely barren of higher plant vegetation. Typically, slickspots are saturated or inundated in an adequate wet season (Reid et al. 1993), and alkali vernal pools are locally present. *Atriplex flavida* often grows around the margins of these pools. Adjoining uplands are vegetated by various native annual herbs and sometimes by non-native annual grasses. Buck-Diaz and Evans (2011) classified an *Atriplex vallicola–Lasthenia ferrisiae–Lepidium jaredii* Herbaceous Association. *Atriplex vallicola* [*A coronata* var. *vallicola*] is absent from the Carrizo Plain, making this an association characterized by *Atriplex flavida.* Typically, *A. flavida* is most abundant on the immediate margins of such slickspots.

Conservation assessment. All 12 previously described taxa of *Atriplex* subsect. *Pusillae* are threatened or endangered to some degree (CNPS 2018), and we indicate here that *A. flavida* qualifies for CRPR List 1B.3, being a narrow endemic known from ca. < 20 occurrences limited to the Carrizo Plain, San Luis Obispo Co., California. When evaluated using IUCN (2000) Red List criteria, *A. flavida* qualifies as Endangered (EN) – High risk of extinction in the wild, based on extent of occurrence estimated to be less than ~100 km². Annotations on individual specimens suggest population sizes in favorable years might approach 10^5 individuals. Approximately half of known specimen locations for *A. flavida* come from locations now within the Carrizo Plain National Monument, created in 2001 and administered by the Bureau of Land Management. The remainder are mostly from privately owned parcels in the failed California Valley subdivisions north of Soda Lake where in recent years a number of lots have been converted to *Cannabis* cultivation. Including *A. flavida*, all taxa within the *Pusillae* are endangered: one species, *A. tularensis* , is presumed extinct (last seen in 1923). In essence, the *Pusillae* comprise a radiation centered in the southerly San Joaquin Valley, a geographic region where very little native habitat remains from conversion to irrigated, intensive agriculture (Preston 2010).

Representative specimens. **USA**. **California**. San Luis Obispo Co.: Carrizo Plain. NE edge of Soda Lake, 2 Jun 1982, *Chamberlain-Bowen 472a* (OBI); E side of Soda Lake, 2 Jun 1982, *Chamberlain-Bowen 482c* (OBI); beside Panorama Rd, 1.3 mi N of Soda Lake Rd., 10 Apr 1995, *Butterworth 39* (OBI); 10 ft E of Panorama Rd., 1.8 mi N of Soda Lake Rd., 20 Jul 1997, *Butterworth 140* (OBI); 1 mi S of Simmler, 2 Jun 1946, *Hoover 6140* (OBI); same location, 16 Jun 1946, *Hoover 6170* (OBI); S end of Soda Lake, 25 May 1952, *Hoover 8238* (OBI); S of Soda Lake, 4 Jun 1967, *Hoover 10616* (OBI); road at S end of Soda Lake, ca. 1/4 mi E of Soda Lake Rd., 24 Apr 1981, *Keil et al. 14470* (OBI); 2.5 mi S of California Valley Fire station along Soda Lake Rd., 24 Apr 1981, *Keil 14492* (OBI); N of Soda Lake, 1.8 mi E of Soda Lake Rd. on Belmont Trail, 22 Mar 1986, *Keil 19072* (OBI); S end of Soda Lake at jct. of Simmler-Soda Lake Rd. with Soda Lake Rd., 22 Mar 1986, *Keil 19091* (OBI); S of Belmont Trail, E of where drainage crosses road between Delray and Cochise roads, 1 Jun 2010, *Keil 30839* (OBI); W of Simmler Rd., 0.5 km NNE of its jct. with Soda Lake Rd., E side of S arm of Soda Lake, 19 May 2011, *Wilken 17950* with Painter (OBI); Calif. Valley, 6 May 1967, *B.W. and T.W. s.n.* (OBI).

ACKNOWLEDGEMENTS

We thank Bruce Baldwin for reviewing this manuscript.

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