

Alkali Milk-Vetch

(*Astragalus tener* var. *tener*)

Legal Status

Federal: None

State: None



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Global and State Conservation Status: G1T1S1.1: Global Rank, G1 = Critically Imperiled: At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors; T-Rank, T1 = Same as global rank but related only to the status of the subspecies throughout its range; State Rank, S1 = Critically Imperiled: Critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state; State ranks in California often also contain a threat designation attached to the S-rank. S1.1 = Very threatened.

CNPS List: 1B.2; 1B: Rare, threatened, or endangered in California and elsewhere. 0.2: Fairly endangered in California.

Recovery Plan: Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005).

Species Description and Life History

Alkali milk-vetch (*Astragalus tener* var. *tener*) is a 4- to 40-cm (2- to 16-in) tall herbaceous annual plant in the pea family (Fabaceae) that has been differentiated from Ferris's milk-vetch (*Astragalus tener* var. *ferrisiae*) based on the morphology of its fruits (Liston 1990, 1992). The leaves of alkali milk-vetch are 2- to 9-cm (1 to 3 in) long, with seven to 17 pinnately compound, well-separated leaflets. Three to 12 pink-purple, pea-like flowers comprise a dense inflorescence.

A protein electrophoresis analysis of two populations, one from Jepson Prairie in Solano County and the other from northern Merced County, found very little genetic differentiation between the populations and high levels of genetic diversity within each population (Liston 1992). This technique uses allozymes or slight alterations in plant proteins as indicators or markers. Because small mutations in the genetic code result in markers that are generally invisible to the forces of natural selection, these allozyme markers are classified as neutral markers. Therefore, because the neutral markers used in the study have not been shown to be correlated with any traits that might provide an adaptive advantage, Liston's results provide no information concerning the extent of local adaptation or other measures of the "genetic health" of the populations and no

information regarding the amount of variation for adaptive traits (McKay *et al.* 2001, McKay and Latta 2002, Latta and McKay 2002, Wayne and Morin 2004).

Based on Liston's crossing study, the species was found to be self-compatible, and the inbreeding coefficients for the two populations were not significantly different from the expected value for a randomly mating population. Therefore, Liston concluded that insect pollinators are responsible for maintaining high levels of outcrossing within the populations. Liston also concluded that the recent dramatic range and population reductions experienced by alkali milk-vetch might explain the lack of neutral marker differentiation between the two populations and that the lack of interpopulational neutral marker differentiation might also be attributed to a seed bank, as milk-vetch species are known to produce long-lived seed banks. Liston indicated that the unique morphology of the plant's flower suggested that alkali milk-vetch is pollinated by butterflies, which is rare for a species in the pea family (Liston 1992).

It is not known when or under which environmental conditions germination of alkali milk-vetch seeds occurs (USFWS 2004). Skinner and Pavlik (1994) indicate the flowering period to be March through June. Witham observed that recruitment increased in a population near the Jepson Prairie Preserve after pipeline construction (Witham 1990). Alkali milk-vetch was also observed in an artificially constructed vernal pool near Albrae at a site where no observations had been recorded since 1923 (USFWS 2004). These observations indicate the importance of a long-lived soil seed bank and suggest that viable seed may exist in the soil seed bank in areas where mature plants have not been observed for many years.

Habitat Requirements and Ecology

Very little is known about the ecology of alkali milk-vetch. In the Central Valley, it appears to be restricted to alkaline soils in areas that are, or were historically, subject to flooding and overland flows (Silveira 2000, Witham 2003, Environmental Science Associates 2005). At the Yolo Grasslands Park site in Yolo County, it is found growing on the floodplains above the upper margins of vernal pools and swales that contain Solano grass (*Tuctoria mucronata*) and Colusa grass (*Neostapfia colusiana*) (Environmental Science Associates 2005). All individuals of the species encountered onsite were located in areas that had been subjected to a prescribed burn and which subsequently flooded briefly in February (Environmental Science Associates 2005). In two subsequent years, the same area burned due to uncontrolled fires and also flooded during the winter but only a few individuals were detected during the following springs in contrast to the large population that established after the prescribed burn (J. Gerlach unpublished data).

At the Tule Ranch Vernal Pools site in Yolo County, it is found in vernal mesic grasslands associated with alkaline vernal pools (Witham 2003). The species is also found near the City of Woodland and along the Willow Slough Bypass in Yolo County, in areas that were once alkali sinks but which were converted to rice fields and then fallowed for many years or which were converted into a levee system (Andrews 1970;

Crampton 1979; Showers 1988, 1996; EIP Associates 1998; Foothill Associates 2002). There were historic occurrences along the railroad tracks north of the City of Davis and on the Hunt and Wesson tomato canning plant property (CNDDDB 2005) but no individuals were located during surveys of those areas in 2006 (J. Gerlach unpublished data). The canning plant has been closed for several years and the alkaline soil areas are no longer farmed and fallowed and are now densely vegetated with annual ryegrass (*Lolium multiflorum*) (J. Gerlach personal observation).

The populations southeast of the City of Woodland and north of the City of Davis are in a heavily human-impacted area of what historically was alkaline sink vegetation lying on along both sides of the northern channel of Putah Creek and Willow Slough and above the Yolo Basin (U. S. Bureau of Soils 1909a, 1909b, Mann et al. 1911). The hydrology, salts, and clay soils that created and maintained the alkaline sink vegetation were deposited when floodwaters from Putah Creek flowed northward from the area near the city of Davis and emptied into Willow Slough. That flow was also supplemented when the combined floodwaters of Putah Creek, Cache Creek, and all of the drainages of the Blue Ridge filled the Cache/Putah Basin, drained eastward through a gap in the Plainfield Ridge, and flowed into the Yolo Basin through Willow Slough (Graymer *et al.* 2002).

Laguna de Santos Callé, as Willow Slough was previously known, was a unique perennial stream (Eliason 1850, Anonymous 1870) that during the dry season originated from a series of pond-like springs approximately 9 miles southwest of Woodland on the eastern edge of the Plainfield Ridge. As the slough approached the area of Merritt, south of Woodland, it transformed into a 2.5-mile-long, gravel bottomed, linear lake, with an average width of 150 ft and a maximum depth of 75 ft. Approximately 1 mile east of County Road 103, the stream flowing from the lake branched as it dropped over the edge of the alluvial deposits into the Yolo Basin, where it flowed another 2.5 miles northeastward until it emptied into a tule marsh. Large floods from Cache Creek and Putah Creek have flowed through Willow Slough as recently as 1942, but gravel mining in Cache Creek, dam building on both Cache and Putah Creeks, and the construction of the Willow Slough Bypass have drastically altered the hydrology, salt budgets, and clay deposition patterns in the area of the alkali sink vegetation. Aerial photographs show that all of the alkaline sink vegetation was converted into various kinds of agricultural fields, ditched for drainage (USDA 1952) or subsequently developed as the cities expanded. Given the intensity and extent of the agricultural impacts to the entire alkali sink area and the irreversible changes in hydrology, those areas do not currently support alkali sink vegetation and it would be very difficult to replicate the natural hydrological regimes that would allow that type of vegetation to be successfully restored in the area.

Species Distribution and Population Trends

Distribution

Alkali milk-vetch was widely distributed around the San Francisco Bay region and in the Sacramento and northern San Joaquin Valleys 100 years ago (Barneby 1964), but by 1989, only a few populations remained (Liston 1992). A 2002 survey concluded that 25

of the 65 known occurrences should be considered extirpated (Witham 2002). Sixteen of the known extant occurrences are in the Solano-Colusa Vernal Pool Region of Solano County (Keeler-Wolf *et al.* 1998), and another five are located in an area between Newman, Merced, and Los Banos in the San Joaquin Vernal Pool Region of Merced County (Silveira 1996 in USFWS 2004, CNDDDB 2005). In Yolo County, Crampton (1979) noted the presence of this species near Woodland on the Maupin property. A 1990 survey of historical collection sites in Yolo and Solano Counties found six plants at the City of Woodland Preserve and six small populations at the Jepson Prairie Preserve (Witham 1990). Currently, the Yolo County distribution of adult plants of this species includes the City of Woodland Preserve, the Woodland Regional Park, the Brauner and Maupin (near the Road 25 and 103 intersection) properties, the McClellan AFB Davis Communications Facility site, the Tule Ranch Vernal Pools, and the Willow Slough Bypass (Showers 1996; EIP Associates 1998; Foothill Associates 2002; Witham 2003; Environmental Science Associates 2004a, 2004b; University of California Davis Herbarium 2007; A. Shapiro pers. comm.).

Population Trends

There are no data documenting the population trends of alkali milk-vetch. Because most of the recent observations of individuals have been at sites where it was considered extirpated, it appears that those individuals have established from pre-existing long-lived seed banks. An observation by Witham (CNDDDB 2005) that recruitment increased in a population near the Jepson Prairie Preserve after pipeline construction appears to confirm the importance of the seed bank.

Threats to the Species and Other Conservation Issues

In Yolo County, development, intensive agriculture, and exotic plant species are considered to be the primary threats to alkali milk-vetch (Environmental Science Associates 2005, Showers 1996, Witham 2003, Dawson et al. 2007). Research should be directed on invasive species control and techniques for establishing the appropriate hydrological regime. Additional research on the pollination ecology, germination requirements, seed dispersal mechanisms and response to disturbance regimes would aid in formulating appropriate adaptive management strategies.

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