

## Solano Grass

(*Tuctoria mucronata*)

### Legal Status

*Federal:* Endangered.

*State:* Endangered.



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*Global and State Conservation Status:* G1S1.1: 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; 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.1; 1B: Rare, threatened, or endangered in California and elsewhere. 0.1: Seriously endangered in California.

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

### Species Description and Life History

Solano grass (*Tuctoria mucronata*), also commonly known as Crampton's tuctoria, is an annual grass ranging from 2 to 12 cm (1 to 5 inches) tall (Hickman 1993). It is restricted to areas within alkaline vernal pools that have sodium and boron salt affected soils and to similar salt affected areas in alkaline playas (Crampton 1959, Environmental Science Associates 2005, J. Gerlach unpublished data). Leaves are yellow-green and covered by a sticky aromatic fluid that dries as the plant matures (Crampton 1959). This is also a characteristic of Colusa grass (*Neostapfia colusana*). At the extirpated population in Olcott Lake, each plant generally produced one stem (normal range was 1-4), although herbarium specimens collected from the same site were generally much larger (Woodward 1985). The lower portions of the stems lie on the ground while the upper portions are erect (Hickman 1993). The leaves lack ligules (membrane-like tissue where the leaf joins the stem) and there is no tissue differentiation between sheath and leaf. Seeds of Solano grass germinate in very shallow water as the vernal pools and playas dry during late spring. Plants begin flowering in May, June, or July depending on seasonal conditions (Anonymous (S.J.B.). 1990, Environmental Science Associates 2005, J. Gerlach unpublished data). Columbus and Porter (2003) conducted germination studies on Solano grass seeds and found a 2.6% germination rate under both aerobic and anaerobic control conditions. This rate was increased to 6.0% and 8.5% by the

introduction of fungicide (Dithane M-45) and fungicide plus soil extract, respectively, under anaerobic conditions but the same treatments under aerobic conditions were not studied. While Crampton (1976) states that mature seeds are retained on the flowering culms of the dead plants until they are dispersed by water, as the pools and playas begin refilling in the fall, recent seed collections at Yolo Grasslands Park found that the seeds are retained on the plants for a significantly longer period of time than Colusa grass which begins to shed its seed immediately with the first significant fall rains (J. Gerlach, unpublished data).

### **Habitat Requirements and Ecology**

Solano grass only grows on salt affected clay soils in alkaline vernal pools or alkaline playas that are subject to long periods of inundation (Crampton 1959, Environmental Science Associates 2005, J. Gerlach unpublished data). It is also generally found immediately above or in the lowest areas of vernal pools and in shallow depressions on the otherwise flat bottoms of alkaline playas (Woodward 1985, Environmental Science Associates 2005, J. Gerlach unpublished data). When Crampton (1959) discovered the Solano County population in 1958 it was only growing in three 3 to 8-meter diameter patches in areas with cracked soil that were covered by a brownish film and was not growing on the smooth white areas that covered most of Olcott Lake. In contrast, the Yolo County population grows only in areas with a cracking white soil (J. Gerlach unpublished data). According to historical aerial photographs, the population in Yolo County currently exists in a series of shallow agricultural drainage ditches that were excavated in an area of alkaline vernal pools and alkaline playas prior to 1937 (USDA 1937).

Hydrology and soil materials, both rock and soil, are responsible for the unique patterns of species distributions in alkaline vernal pools and alkaline playas in Yolo County and Solano County. Williamson et al. (2005) and Rains et al. (2008) summarized the situation well with regard to parent material: “The vernal pools on clay-rich soils formed on alluvium derived from sedimentary and metasedimentary rocks of marine origin. The soils that developed on these sediments are fine grained, saline, and sodic. These soils support vernal pools that are perched surface water systems, have relatively saline, sodic, and turbid surface water, and may be nitrogen and light limited.” Other studies have confirmed the nitrogen and light limitations (Barclay and Knight 1981).

Because of its underlying and extremely unique geologic structure, the Jepson Prairie alkaline vernal pools and alkaline playas are much older than the alkaline vernal pools and alkaline playas in Yolo County (Graymer et al. 2002). Jepson Prairie owes its unique species assemblages and the continued existence of the alkaline playas and vernal pools to the presence of the underlying Montezuma Block (Band 1998). The inward-sloping sides of the block with increasing depth assures that the Montezuma Block pops up and floats like an iceberg among other crustal blocks without distorting. This unique characteristic has allowed this single flat piece of the earth’s crust to persist in the same location since the oceanic plate and its accompanying archipelago of volcanoes first crashed into the North American continent and has maintained the only opening from the Central Valley to the Pacific Ocean through the rapidly rising Coast Ranges (Band 1998).

After the Montezuma Block rose above the ocean it was covered by eroded materials from the Coast Ranges that became deeply weathered infertile soils and which are clearly visible in aerial photographs (Band 1998). An ancient river channel cut across the northern edge of the block and apparently deposited the clays that underlie the Jepson Prairie alkaline vernal pools and alkaline playas. The Montezuma Block later tilted slightly to the north which raised the Jepson Prairie area slightly above the surrounding area preventing the non-saline flood waters of the Sacramento River from flushing the salts present in its clays into the Delta.

In contrast, north of the Montezuma Block, the alkaline vernal pools and alkaline playas in Solano and Yolo Counties are located on a low alluvial terrace that formed above the Yolo Basin and Sacramento River Delta through the deposition of outwash clay materials when Putah Creek and Cache Creek flooded over their natural levees (Graymer *et al.* 2002). The spreading flood waters deposited coarser alluvium near the channels and fine clays further away from the main channels in calmer water. As the flood waters receded, the suspended clay and dissolved salts were deposited as a relatively thin surface coating across the lower portions of the alluvial terrace. Successive flood events deposited successive layers of clay and the flooding history of the terrace is recorded in the alternating bands of alluvial material (State of California 1987). Historically, these alkaline vernal pools and alkaline playas occurred on the terrace in a broad arc from the Montezuma Hills to Cache Creek and in the two basins in Yolo County between the coast range and the Dunnigan Hills/Plainfield Ridge anticline (U. S. Bureau of Soils 1909a, 1909b, Mann *et al.* 1911). As described above, the salts (sodium, boron, magnesium) and the clay minerals were transported to the terrace by the creeks and did not develop in-situ.

The clays deposited in the Jepson Prairie Preserve area are older than 10,000 years, at least 30 feet thick near Olcott Lake, and thin to 6 feet thick near Jepson Prairie's northern edge (C. Witham per. com.). In contrast, the clay surface deposits at the Solano grass location in Yolo County could be as young as 60-years old and were periodically replenished by floodwaters from Putah Creek prior to the completion of Monticello Dam on Putah Creek, which altered the hydrology of the entire region. At the Yolo Grasslands Park site a former distributional branch of Putah Creek forms the largest drainage and the alkaline vernal pools or drainage ditches lie above the natural drainage (Department of the Air Force 1993, Environmental Science Associates 2005). Prior to the construction of the Monticello Dam, when Putah Creek routinely flooded, the site was submerged and the turbulent hydraulics of the floodwaters scoured basins and channels in the higher surfaces that became alkaline vernal pools and swales after the flood waters receded. The Monticello Dam and other diversions have eliminated the natural floods that created and maintained the alkaline vernal pools and alkaline playas.

## Species Distribution and Population Trends

### *Distribution*

Solano grass was first discovered in 1958 by Beecher Crampton, who collected it from Olcott Lake, which is now within the Solano Land Trust's Jepson Prairie Preserve (Witham 2006). Solano grass was last observed in Olcott Lake in 1993 when four plants were present. A second population was discovered in Solano County on a private ranch in 1985 (Woodward 1985) and a third population was discovered by Bob Holland in 1993 on the Yolo Grasslands Park site. Solano grass may have been more broadly distributed prior to conversion of Yolo County's alkaline vernal pools and alkaline playas to rice fields and drainage ditches. Its rarity in playas in the Jepson Prairie area suggests that it may have been limited to just a few alkaline pools or alkaline playas at both sites.

### *Population Trends*

The population at the Yolo Grasslands Park site is distributed in four small sub-basins and its size has varied considerably since 1993. During drought years the species only exists as a soil seed bank. Approximately twenty thousand plants were observed at this site in 2004 (Environmental Science Associates 2005) and zero reproductive plants were observed in 2007 (J. Gerlach unpublished data). Prior to its extirpation, the population in Olcott Lake was also similarly variable (Holland 1986). The population on the private ranch is relatively small and has varied from a few hundred individuals to zero plants during drought years (C. Witham per. com.) As discussed above (see Habitat Requirements and Ecology), unique geologic and hydrologic conditions are necessary to support suitable habitat for Solano grass. Due to the alternation of hydrologic processes by the construction of Monticello Dam and the cultivation of most of the formerly suitable habitat in the County, it is unlikely that Solano grass will ever occur at other sites in Yolo County. Therefore, conservation of the known occupied habitat in this area is essential to conserve this species in Yolo County.

## Threats to the Species and Other Conservation Issues

Immediate threats to Solano grass in Yolo County are primarily due to the invasion of its habitat by swamp timothy (*Crypsis schoenoides*) and perennial pepperweed (*Lepidium latifolium*) (Environmental Science Associates 2005). There are no known effective management tools for reducing the impacts of swamp timothy but in 2007 Yolo County began a long term perennial pepperweed eradication program that has proved to be effective. Swamp timothy also occurs with Solano grass at the Solano County site (Woodward 1985) but in very small numbers as compared with the Yolo County site (Witham pers. comm.). This species is vulnerable to chance extinction as it only exists in a single large population and a single small population. The extensively altered hydrology of the Yolo County site may pose an additional long-term threat to this occurrence of the species.

Solano grass is an annual plant that grows in turbid vernal pools and playas on infertile, and highly salt-affected soils that are underlain by clay soils. Its annual population sizes

are sensitive to annual climatic variations but the environmental triggers and the biological traits that allow the species to respond to those triggers are unknown. Factors that control the timing of seed germination, seedling survival in highly turbid water, and the impacts of swamp timothy are critically important as are its breeding system, the factors that control seed production and the factors that control seed dispersal. Studies to control swamp timothy and prevent reintroduction from nearby waterfowl management areas may be critically important to the persistence of Solano grass on the Yolo Grasslands Park site. Additional seed germination trials should be conducted to determine if other treatments might increase germination rates.

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