5-YEAR REVIEW
White Sedge (*Carex albida*)

GENERAL INFORMATION:

Species: White Sedge (*Carex albida*)
Date listed: October 22, 1997
FR citation: 62 FR 55791
Classification: Endangered

BACKGROUND:

Most recent status review:

[USFWS]. 2009. *Carex albida* (White sedge), *Lilium pardalinum* ssp. *pitkinense* (Pitkin Marsh lily) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Sacramento, California. 24pp. [CLICK HERE TO VIEW DOCUMENT]

FR Notice citation announcing this status review:

[USFWS] U.S. Fish and Wildlife Service. 2018. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews for 50 Species in California, Nevada, and the Klamath Basin of Oregon. Federal Register 83:28251 – 28254. [CLICK HERE TO VIEW DOCUMENT]

ASSESSMENT:

Information acquired since the last status review: This 5-year review was conducted by the U.S. Fish and Wildlife Service's (USFWS) Sacramento Fish and Wildlife Office. Data for this review were solicited from interested parties through a Federal Register notice announcing this review on June 18, 2018, but we did not receive any information regarding this species. Information on the current status of white sedge was provided by Sonoma Land Trust, a non-profit organization. For reasons described later in this document, geographic and taxonomic data were also gathered on Lemmon's sedge (*Carex lemmonii*) from the Jepson Herbarium online, and Calflora web application. Additionally, we conducted a literature search and review of information from our own files.

White sedge (*Carex albida*) is an herbaceous perennial in the sedge family (Cyperaceae). There has only ever been one, confirmed population in Sonoma County, California since 1997 at a site known as Pitkin Marsh (USFWS 1997). The marsh is a riparian wetland with a unique microclimate, fed most of the year by underground seeps (USFWS 1997).

Today, the lower portion of Pitkin Marsh is owned and managed by the non-profit land management agency, Sonoma Land Trust (SLT). This property contains all known white sedge plants. The upper portion of the marsh is divided into several private properties (USFWS 2009).

Botanical surveys have been denied on the upper marsh properties since the 1980s (USFWS 2009).

There is a current management plan for Pitkin Marsh, which includes different techniques for maintaining white sedge at the site (ARNelson 2010). In 1997, there were approximately 1,000 individual white sedge plants at Pitkin Marsh (USFWS 1997). Since then, white sedge abundance at the site has fluctuated seasonally (Doolin and Nelson 2012), sinking as low as a few hundred to well over two thousand individuals (Edwards *et al.* 2013). The abundance of white sedge has responded positively to adaptive management at Pitkin Marsh; data show numbers increase when mowing and hand weeding techniques are implemented to control invasive, non-native plants (Edwards *et al.* 2013). Drought appears to be the main reason for years of low abundance (Edwards *et al.* 2013; T. George, *in litt.* 2018). Our overall understanding of the threats to white sedge or its distribution has not changed since the last status review (USFWS 2009).

Taxonomic classification and changes to nomenclature: Since the previous status review (USFWS 2009), white sedge (*Carex albida*) has been found to be morphologically indistinguishable from Lemmon's sedge (*Carex lemmonii*), a species which is wide-ranging and abundant throughout the North-Coast and Sierra Cascade mountain ranges of California (Calflora 2018; Zika *et al.* 2015). In light of this new information, here we summarize the available taxonomic information available on white sedge.

The first specimen for white sedge was collected in 1854 by botanists during an exploratory expedition to find a railway route from the Mississippi River to the Pacific Ocean (Torrey and Gray 1857). These specimens were probably collected from Santa Rosa Creek, in the Laguna de Santa Rosa wetland complex in Sonoma County (Howell 1957; Best *et al.* 1996). No specimens were collected again until the early 1900's (Howell 1957). The initial type specimen from 1854 was immature, which lead to confusion among botanists, and for many decades, there were few additional collections of the species to compare (Zika and Wilson 2012).

Several early taxonomic studies questioned the validity of white sedge as a distinct species. Mackenzie (1922) combined white sedge with the woodrush sedge (*C. luzulina*), and later grouped white sedge with the Lemmon's sedge (Mackenzie 1940). Sedge specimens from Pitkin Marsh were initially defined as a distinct species, *C. sonomensis* (Stacey 1937). However, in 1957 *C. sonomensis* was combined with white sedge, while remaining distinct from Lemmon's sedge (Howell 1957). Howell based his taxonomic description on the immature specimen collected in 1854, and used assumptions about the suspected morphology of mature plants to conclude that adult white sedge plants would have unique morphology from Lemmon's sedge (Howell 1957). This nomenclature has been accepted since 1957, although it has been difficult for botanists to reconcile similarities in morphology between the species (Mastrogiuseppe 1993; Zika *et al.* 2012).

According to the 2009 status review (USFWS 2009), there were several traits which distinguish white sedge from closely related sedge species. White sedge inflorescences have staminate (male) flowers above the pistillate (female) flowers (USFWS 2009) and the leaves are generally shorter than the stems (USFWS 2009). However, Lemmon's sedge have similar leaf, stem, and inflorescence traits (Zika *et al.* 2015). The only trait specifically mentioned to differentiate the

white sedge and Lemmon's sedge was the size of the perigynium (scale-like leaf enclosing a pistil (male flower)) and achene (small, dry seed or fruit) (USFWS 2009). Taxonomists often use the shape of perigynia to separate closely related *Carex* species (Zika and Wilson 2012), as the character is unique to the sedge family (Harris and Harris 2001).

Zika and Wilson (2012) evaluated the morphological characters various botanists have used to discriminate between white sedge and Lemmon's sedge. The authors first reviewed the literature to determine morphological characters used to separate the taxa in previous taxonomic descriptions (Ball and Mastrogiuseppe 2002). Based on their research, morphological characters of the perigynum, achene, inflorescence, and foliage (leaf width) were measured on museum specimens (Zika and Wilson 2012; Harris and Harris 2013). Specimens of Lemmon's sedge came from 12 counties in California, and represented several isotypes (Zika and Wilson 2012). Leaf width was measured on fresh specimens of Lemmon's sedge from three counties and on cultivated white sedge (Zika and Wilson 2012).

Zika and Wilson (2012) were not able to separate white sedge and Lemmon's sedge using perigynium differences, which was a previously accepted method for differentiating the two taxa (USFWS 2009). The only character, which was measurably different in white sedge plants, was leaf blade width (Zika and Wilson 2012). However, field visits to Butte, Mariposa, and San Bernardino counties show broad variation in many characteristics within Lemmon's sedge, including a number of individuals that resembled white sedge (Zika and Wilson 2012).

Statistical results for all characteristics showed that white sedge did not differ from Lemmon's sedge ($F=0.27$, P-value = 0.99) (Zika and Wilson 2012). Except for leaf width, all characteristics were well within the range of variation found among Lemmon's sedge plants (Zika and Wilson 2012). If considered alone, the variation of leaf width might be enough to distinguish between the two taxa. However, there is still significant overlap in leaf width variation between the white sedge and Lemmon's sedge (Zika and Wilson 2012). Therefore, statistical results fail to separate white sedge and Lemmon's sedge as distinct entities. Because Lemmon's sedge was named before white sedge, it is appropriate to synonymize both entities under the same scientific name for Lemmon's sedge, *Carex lemmonii*. Currently, botanists are testing Zika and Wilson's (2012) hypothesis to determine if genetics can confirm the conclusion of their 2012 study (Quach *et al.* 2019).

Conclusions: White sedge was listed as endangered in 1997 (USFWS 1997). At that time, this species was known from a single site: Pitkin Marsh in Sonoma County, California. This was the entire, known range of the species, and as such, white sedge was considered highly susceptible to extinction or extirpation from its range due to stochastic events such as flood, drought, disease, or other such occurrences due to its restricted range and small population size (USFWS 1997). The potential of destruction due to changes in hydrology and urban development were high (USFWS 1997). Today, the portion of the marsh that contains the species is protected by a conservation easement and a management plan is in place (ARNelson 2010).

White sedge is no longer believed to be a uniquely valid species; it is synonymous with Lemmon's sedge, a California endemic species that is common and wide-ranging (Calflora 2018; Zika *et al.* 2015). Because recent information indicates white sedge is no longer considered a

valid species that is distinct from the more widely abundant and distributed Lemmon's sedge (USFWS 1973, Calflora 2018; Zika *et al.* 2015), we recommend white sedge (*Carex albida*) be removed from the Federal List of Endangered and Threatened Wildlife and Plants due to taxonomic error.

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 5/2/2019

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