State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION

FIVE-YEAR SPECIES REVIEW OF KENWOOD MARSH CHECKERBLOOM (*Sidalcea oregana* ssp. *valida*)

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Kenwood Marsh checkerbloom, CDFW photo by Raffica La Rosa

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I. EXECUTIVE SUMMARY

Kenwood Marsh checkerbloom (*Sidalcea oregana* ssp. *valida* Greene) is currently listed as endangered under the California Endangered Species Act. Pursuant to Fish and Game Code, section 2077, subdivision (a), the California Department of Fish and Wildlife (Department) has prepared this Five-Year Species Review to evaluate whether conditions that led to the original listing of Kenwood Marsh checkerbloom are still present. This review is based on the best scientific information currently available to the Department regarding each of the components listed under Section 2072.3 of the Fish and Game Code and Section 670.1, subdivisions (d) and (i)(1)(A), of Title 14 of the California Code of Regulations. In addition, this document contains a review of the identification of habitat that may be essential to the continued existence of the species, and the Department's recommendations for management activities and other recommendations for recovery of the species (Fish & G. Code, § 2077, subd. (a)).

Kenwood Marsh checkerbloom is a long-lived perennial herb in the mallow family (Malvaceae) and is about 1 m (3.3 ft) tall with pink flowers. This species is endemic to (exists only in) California, and its range appears to be restricted to eastern Sonoma County in Kenwood Marsh and Knights Valley. When Kenwood Marsh checkerbloom was state-listed as an endangered species in 1982, it was known from only three sites in marshes adjacent to grasslands that top ancient sandstone and river deposits. All three sites are on privately owned land, and since 2001, the species has been confirmed as extant at only one site. This site in Kenwood Marsh produced only 16 flowering plants in 2019. Due to its very small population size, Kenwood Marsh checkerbloom is vulnerable to several threats and is at risk of extinction.

At the time of listing in 1982, the Department described one major threat to the survival and reproduction of Kenwood Marsh checkerbloom: present or threatened modification or destruction of its habitat. The destruction of habitat came in the form of agricultural conversion to vineyards and pasture, plus the urbanization of areas adjacent to Kenwood, CA. Today, the last three documented populations are isolated and surrounded by vineyards or residences. This isolation likely eliminates the ability of the species to move in response to climate change and also increases the chance that random events will extirpate any small population. Kenwood Marsh checkerbloom relies on wetland habitat and is therefore susceptible to changes in hydrology from agriculture, water diversion, and climate change.

Landowner actions to protect the species from grazing and mowing have contributed to the survival of the one confirmed extant population of Kenwood Marsh checkerbloom in Kenwood Marsh. Kenwood Marsh checkerbloom has benefited from coordination between the landowner, the U.S. Fish and Wildlife Service, the University of California Botanical Garden, volunteers, and the Department to collect seeds for long-term conservation, perform activities to reduce competition from nearby vegetation, and reintroduce the species into nearby suitable habitat. The Department recommends the re-initiation of reintroduction efforts, with an additional goal of quantifying the genetic diversity of the remaining natural population, the cultivated plants that the reintroductions are drawn from, and the seed-banked seeds in long-term storage, with the purpose of applying this knowledge of the remaining genetic diversity to maximize the genetic diversity of the plants used in reintroduction efforts.

In completing this Five-Year Species Review for Kenwood Marsh checkerbloom, the Department finds there is sufficient scientific information to indicate that the conditions that led to the listing of Kenwood Marsh checkerbloom as endangered are still present, and recommends no change to its status at this time.

II. INTRODUCTION

A. FIVE-YEAR SPECIES REVIEW

This Five-Year Species Review addresses Kenwood Marsh checkerbloom (*Sidalcea oregana* ssp. *valida* Greene), which is designated as an endangered species under the California Endangered Species Act (CESA) (Fish and G. Code, § 2050 et seq.; Cal. Code Regs. tit. 14 § 670.2, subd. (a)(20)(D)). This subspecies will be referred to as a species throughout this document for ease of reference. Upon a specific appropriation of funds by the Legislature, the California Department of Fish and Wildlife (Department) shall, or if other funding is available, in the absence of a specific appropriation, may, review species listed as endangered or threatened under CESA every five years to determine if the conditions that led to the original listing are still present (Fish and G. Code, § 2077, subd. (a)). Kenwood Marsh checkerbloom is also listed as endangered under the Federal Endangered Species Act. Pursuant to Fish and Game Code, section 2077, subdivision (b), the United States Department of the Interior, U.S. Fish and Wildlife Service (USFWS) was contacted in an effort to coordinate this review with their five-year review process, which was last completed in 2019 (Bainbridge, pers. comm. 2019a; USFWS 2019).

Using the best scientific information available to the Department, this Five-Year Species Review includes information on the following components pursuant to the Fish and Game Code, sections 2072.3 and 2077, subdivision (a) and of Title 14, California Code of Regulations, section 670.1, subdivision (d): species' population trend(s), range, distribution (including a detailed distribution map), abundance, life history, factors affecting the species' ability to survive and reproduce, the degree and immediacy of threats, the impact of existing management efforts, the availability and sources of information, identified habitat essential for the continued existence of the species, and the Department's recommendations for future management activities and other recovery measures to conserve, protect, and enhance the species.

B. LISTING AND STATUS REVIEW HISTORY

On November 5, 1981, the Fish and Game Commission voted to list Kenwood Marsh checkerbloom as endangered and protected under the Native Plant Protection Act (NPPA) (Fish and G. Code, § 1900 et seq.), effective January 17, 1982 (Cal. Reg. Notice Register 81, No. 51).

In 1984, plants listed as endangered under the NPPA were newly designated as endangered under CESA and added to the CESA list of endangered plants (Cal. Code Regs., tit. 14, § 670.2, subd. (a)(20)(D); Fish and G. Code, § 2062). At the time of listing, the main threat to the species was identified as modification and/or destruction of habitat due to human-related activities (e.g., agricultural conversions and urbanization).

On October 22, 1997, the USFWS listed Kenwood Marsh checker-mallow (synonym of Kenwood Marsh checkerbloom) as endangered under the authority of the federal Endangered Species Act.

The last 5-year species review was conducted by the Department in 1987. This current Five-Year Species Review was prepared by Dr. Raffica La Rosa, in the Department's Habitat Conservation Planning Branch, Native Plant Program.

C. Notifications and Information Received

On November 26, 2019, the Department notified persons who had expressed their interest in CESA actions in writing to the Commission and had provided contact information to the Commission (Fish and G. Code, § 2077(a)). The e-mail notification included a link to the Department's dedicated web page for five-year species reviews of threatened and endangered species at https://www.wildlife.ca.gov/Conservation/CESA/Five-Year-Reviews.

III. BIOLOGY

A. Taxonomic and Physical Description

Kenwood Marsh checkerbloom is a perennial herb that forms a thick fleshy root and can grow to about 1 m (3.3 ft) tall (Munz and Keck 1959; Hill 2012). The lower stem has bristles that are 1-1.5 mm long (Hill 2012). The leaves are palmately lobed; at the base of the plant, the leaves typically have 5-7 shallow lobes and further up the branches, the leaves have 3-5 deep lobes (Fig. 1). The flowers are pink, each with five petals 10-15 mm long and a fused column of stamens. The flowers form dense clusters that are 2-6 cm (0.8-2.4 in) long at the ends of the branches, with the youngest flowers near the tips. (CDFG 1981, 1987)

There are currently five recognized subspecies of *Sidalcea oregana*, which collectively are found across northern California. These subspecies are distinguishable by their flower density, length of flower clusters, and density of bristles on the stems (Hill 2012). Three of the subspecies are rare and imperiled in California (CNPS 2019b), but Kenwood Marsh checkerbloom is the only one that is state-listed. The subspecies became distinct relatively recently, therefore the evolutionary relationships between subspecies is still difficult to discern (Andreasen and Baldwin 2003). The closest relative of Kenwood Marsh checkerbloom may be the coast checkerbloom (*S. oregana* ssp. *eximia*), which grows in Humboldt County (CDFG 1987); their distributions do not overlap.

B. Life History and Ecology

Almost all that is known about the life history and ecology of Kenwood Marsh checkerbloom is the result of studying the Deerfield Ranch Winery population in Kenwood Marsh (Table 1). The plants are likely long-lived if conditions are suitable, but are difficult to track annually (Symonds, pers. comm. 2020). There is anecdotal evidence that isolated individuals cannot produce seeds (Parsons, pers. comm. 2019), which suggests that Kenwood Marsh checkerbloom relies on pollinators to move pollen between at least two genetically dissimilar plants for seeds to be produced. If true, this would have negative implications for the survival of populations with extremely low numbers of individuals, especially if they are genetically very similar.

The Department has no information on pollinators of Kenwood Marsh checkerbloom, but the closely related Oregon checkerbloom (*Sidalcea oregana* ssp. *spicata*), a species with similar floral characteristics to Kenwood Marsh checkerbloom, was observed to be pollinated by bumble bees (*Bombus* spp.), bee flies (Bombyliidae, Diptera), and skipper butterflies (Hesperiidae, Lepidoptera) (Ashman and Stanton 1991). Kenwood Marsh checkerbloom may attract a similar suite of pollinators because these pollinators are typically generalists that visit many species of plants and could possibly pollinate other checkerbloom species. Ashman and Stanton (1991) also observed visits from a solitary oligolectic bee (*Diadasia nigrafrons*) to Oregon checkerbloom. This is a bee that specializes on pollen from only one or a few plant

species. There is no evidence that this species of solitary bee visits Kenwood Marsh checkerbloom, but there may be other solitary bee species that interact with Kenwood Marsh checkerbloom in a similar way.

Seeds from Kenwood Marsh checkerbloom drop from the plant, and it is not known how long they can remain viable in the soil seedbank. In the spring, many seeds that were produced in the previous year may germinate (Symonds, pers. comm. 2020), but the seedlings must compete with the surrounding vegetation. In a nursery setting without competition, plants have produced flowers after just one year of growth (Symonds, pers. comm. 2019). Once a plant is established and has produced a substantial rootstock, it may better withstand interannual fluctuations of precipitation and competition from surrounding vegetation, but a large rootstock would likely not withstand sustained changes, such as prolonged droughts.

Kenwood Marsh checkerbloom occurs in freshwater wetlands that have a history of grazing (CDFG, in litt. 1999). If grazers are present, plants are susceptible to damage at any time of year. Grazers may eat the vegetative or reproductive portions of the plant or could damage the roots that are sometimes exposed and vulnerable to trampling (Symonds, pers. comm. 2020). Grazers may also help to reduce the surrounding vegetation that may compete with Kenwood Marsh checkerbloom for resources, so their net benefit is unknown.

(a) **(b)**

FIGURE 1. Photos of Kenwood Marsh checkerbloom (a) vegetative plant and (b) flowers. Photos by Kate Symonds (left) and Josh Hull (right).

TABLE 1. Populations of Kenwood Marsh checkerbloom (*Sidalcea oregana* ssp. *valida*).

EO[1]	Population	Status	Last Monitored	Ownership	Parcel[2]	Land use category[3]
1	Deerfield Ranch Winery	Extant, but low numbers	2019[4]	Private	050-240-32	Industrial - Winery
1	Kenwood Marsh-West	Unknown	1998[1]	Private	050-240-06	Agricultural - Pasture
2	Knights Valley	Unknown	2001[5]	Private	120-110-12	Agricultural - Vineyard

[1] Element Occurrence, (CNDDB 2019)
[2] Assessor's Parcel Number
[3] Taken from county parcel ownership data
[4] (La Rosa, pers. obs. 2019)
[5] (Cooley, in litt. 2001)

C. HABITAT NECESSARY FOR SPECIES SURVIVAL

Kenwood Marsh checkerbloom occurs on the edges of freshwater marshes (Munz and Keck 1959) and does not persist in areas that are inundated for extended periods (USFWS 2013). It currently exists in pockets of habitat surrounded by vineyards that were planted or expanded in the 1990s. The three Kenwood Marsh checkerbloom populations are recorded as two occurrences in the CNDDB, one occurrence (two populations) in Kenwood Marsh and one occurrence (one population) in Knights Valley (Table 1; CNDDB 2019).

i. VEGETATION COMMUNITIES

Sonoma County has not yet been mapped to species alliances using the California Vegetation Classification System (CNPS 2019a), but the Sonoma County Agricultural Preservation & Open Space District produced a fine scale vegetation and habitat map of Sonoma County which identified vegetation types using the National Vegetation Classification System (NVCS) and a combination of landscape imagery from 2013 and ground truthing (SCAPOSD 2017). The habitat types that were identified in the vicinity of Kenwood Marsh checkerbloom populations were classified to the scale of macrogroups, which are vegetation classifications of intermediate rank that are defined by a combination of diagnostic plant species that can reflect regional differences (FGDC 2008). The three Kenwood Marsh checkerbloom populations are at the interface of the Western North American Freshwater Marsh Macrogroup and the California Annual and Perennial Grassland Vegetation Macrogroup, a combination that is relatively uncommon in the county (Modeled Species Habitat, Fig. 2). Suitable habitat for Kenwood Marsh checkerbloom within Sonoma County based on vegetation type was modeled by Habitat Conservation Planning Branch staff. Suitable species habitat was defined as Western North American Freshwater Marsh Macrogroup that is adjacent to, and within 30.5 m (100 ft) of, California Annual and Perennial Grassland Macrogroup. The total modeled species habitat was 973 ha (2404 acres) (Fig. 2), which is only about 0.23% of the total area of Sonoma County.

Other naturally occurring NVCS vegetation types within approximately 100 m (328 ft) of all of the populations are the *Quercus lobata* Alliance, the Vancouverian Riparian Deciduous Forest Group, and either the Southwestern North American Riparian Evergreen and Deciduous Woodland Group or the Southwestern North American Riparian/Wash Scrub Group. Groups describe sets of diagnostic plants more narrowly defined than macrogroups, and alliances are narrower still (FGDC 2008).

Broadly, the species associated with the Kenwood Marsh checkerbloom have likely shifted over the past 40 years from changes in hydrology, adjacent land use, and grazing regime. The subpopulations within the Deerfield Ranch Winery population also differ in soil moisture and light availability. The associated species that have been observed with one or more populations since the time of listing include: creeping St. John's wort (*Hypericum anagalloides*), hardstem bulrush (*Schoenoplectus acutus* var. *occidentalis*), Himalayan blackberry (*Rubus armeniacus*), pennyroyal (*Mentha pulegium*), rush (*Juncus* sp.), sedges (*Carex* spp.), slough sedge (*Carex obnupta*) or valley sedge (*Carex barbarae*), smartweed (*Polygonum* sp.), sneezeweed (*Helenium puberulum*), teasel (*Dipsacus* sp.), velvetgrass (*Holcus lanatus*), and willows (*Salix* spp.) including arroyo willow (*Salix lasiolepis*) (Guggolz and Guggolz 1986; USFWS 2007; USFWS 2009; CNDDB 2019; Symonds pers. comm. 2019; USFWS 2019).

ii. GEOLOGY AND SOILS

Both marshes that support Kenwood Marsh checkerbloom overlay relatively young geological substrates from the Pleistocene Epoch of the Quaternary Period that are less than two million years old (CDOC 2010). The underlaying rock is composed of deposits of sandstone, shale, gravel, and other alluvial deposits from ancient bodies of water (CDOC 2010). Figure 2 overlays the potential suitable habitat of Kenwood Marsh checkerbloom based on vegetation type with the geologic deposits that are associated with the known sites (Appendix A). The overlap of these two components, vegetation and geology, predict the areas that might support Kenwood Marsh checkerbloom or be suitable for reintroductions.

The soils of both marshes share characteristics of texture, mixing, and cation activity (Appendix B). The soil series Huichica and Los Robles that underlie Kenwood Marsh and Knights Valley, respectively, are both described as having fine-loamy texture with mixed topsoil and superactive cation activity (Soil Survey Staff 2019).

iii. CLIMATE AND HYDROLOGY

Kenwood Marsh checkerbloom grows in a Mediterranean climate that is characterized by hot, dry summers and cool, wet winters. Based on 30 years of temperature and precipitation data between 1981-2010, gathered from local weather stations near the natural populations, the estimated annual rainfall total is between 89-104 cm (35-41 in) (PRISM Climate Group 2004). The estimated monthly average high/low temperatures range from 13.9°/3.3°C (57°/38°F) in December and January to 31.1°/12.2°C (88°/54°F) in July (PRISM Climate Group 2004). Plants bloom June-September during the driest months of the year when the average monthly rainfall is less than 1 cm (0.4 in) and the average high/low temperature is 30.0°/11.7°C (86°/53°F).

Kenwood Marsh checkerbloom occurs around 120 m (400 ft) elevation (Hill 2012) in areas that are gently sloped (1-5 degrees) (Esri 2019), and where water runoff and permeability is typically slow (Soil Survey Staff 2001, 2003). In 1993, the State Water Resources

Control Board, Division of Water Rights determined that Kenwood Marsh was fed by both surface and groundwater flows (Turner 1993; Wilcox, in litt. 1994). An unnamed stream that fed into Kenwood Marsh was susceptible to water diversions for agricultural purposes (e.g., irrigating vineyards) and had sometimes been diverted to the point that the streambed was a dry channel (Turner 1993). The source of water that feeds the marsh in Knights Valley, where the Kenwood Marsh checkerbloom is also recorded, remains unknown.

IV. DISTRIBUTION AND ABUNDANCE

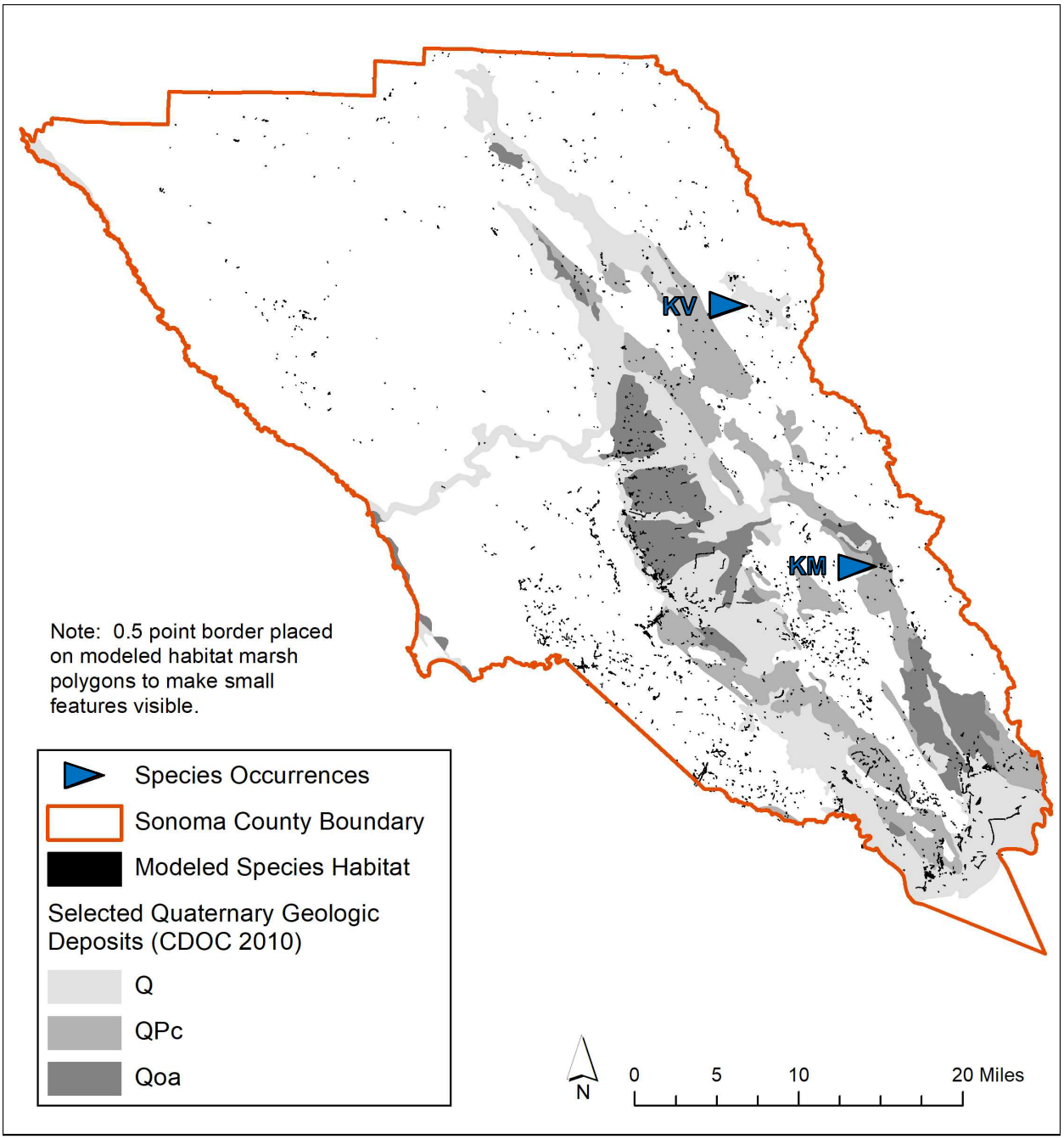
A. RANGE AND DISTRIBUTION

The first collection of Kenwood Marsh checkerbloom was from Knights Valley and was described by William H. Brewer in 1861, and later named by Edward L. Greene (1897). The three populations of Kenwood Marsh checkerbloom are all at around 120 m (400 ft) in elevation, but the possible range of suitable elevations is unknown because the original extent of the species range is not known. Given that the populations occur on sandstone and alluvial deposits, Kenwood Marsh checkerbloom may be restricted to low elevation sites with a geologic history as ancient seabed.

The range of Kenwood Marsh checkerbloom is extremely small. The species is restricted to Sonoma County and is known from only two locations: Kenwood Marsh near Kenwood, CA, and Knights Valley near Kellogg, CA which is about 29 km (18 mi) northwest of Kenwood Marsh. Kenwood Marsh once covered a much larger area, but the growth of the town of Kenwood and the expansion of vineyards west of town drastically reduced the habitat for Kenwood Marsh checkerbloom over the past 70 or more years. The two small populations at Kenwood Marsh are on adjacent privately-owned parcels with different owners. The population at Knights Valley is less than 0.1 ha (0.25 acre) in area (USFWS 2009) and is also privately owned.

TABLE 2. Deerfield Ranch Winery subpopulations of Kenwood Marsh checkerbloom (*Sidalcea oregana* ssp. *valida*) (Symonds, pers. comm. 2020).

Subpopulation	Flowering plants in 2019	Light	Type	Notes
Road	16	Full sun	Natural	Unknown number of immature plants present.
Willow	0	Shaded	Natural	No longer supports Kenwood Marsh checkerbloom
#3	0	Shaded	Introduced	Mimics surrounding vegetation of “Willow” subpopulation.
#4	0	Full sun	Introduced	Mimics surrounding vegetation of “Road” subpopulation.



California Department of Fish and Wildlife. Habitat Conservation Planning Branch. D.Mastalir. 20200106

FIGURE 2. Modeled suitable habitat for Kenwood Marsh checkerbloom in Sonoma County. Potential suitable habitat was modeled by CDFW based on the vegetation types and geologic substrates associated with Kenwood Marsh checkerbloom. Black represents portions of Western North American Freshwater Marsh Macrogroup vegetation that is within 30.5 m (100 ft) of adjacent California Annual and Perennial Grassland Macrogroup vegetation. A 0.5 point border was added to all patches to make small features visible. Shades of gray represent types of geologic deposits that are associated with the known sites (Appendix A). The overlap of these two layers, vegetation and geology, predict the areas that might best support Kenwood Marsh checkerbloom, or be suitable for reintroductions. Kenwood Marsh (KM) and Knights Valley (KV) are identified by blue arrows.

The distribution of Kenwood Marsh checkerbloom is documented within the California Natural Diversity Database (CNDDB). The CNDDB documents “elements,” which are plant or animal taxa, or natural communities that are of conservation concern within California. For plants, an “element occurrence” (EO) is a location record for a site which contains an individual, population, or “colony” of a special status element. Populations, individuals, or colonies that are located within 1/4 mile of each other generally constitute a single occurrence (Bittman 2001).

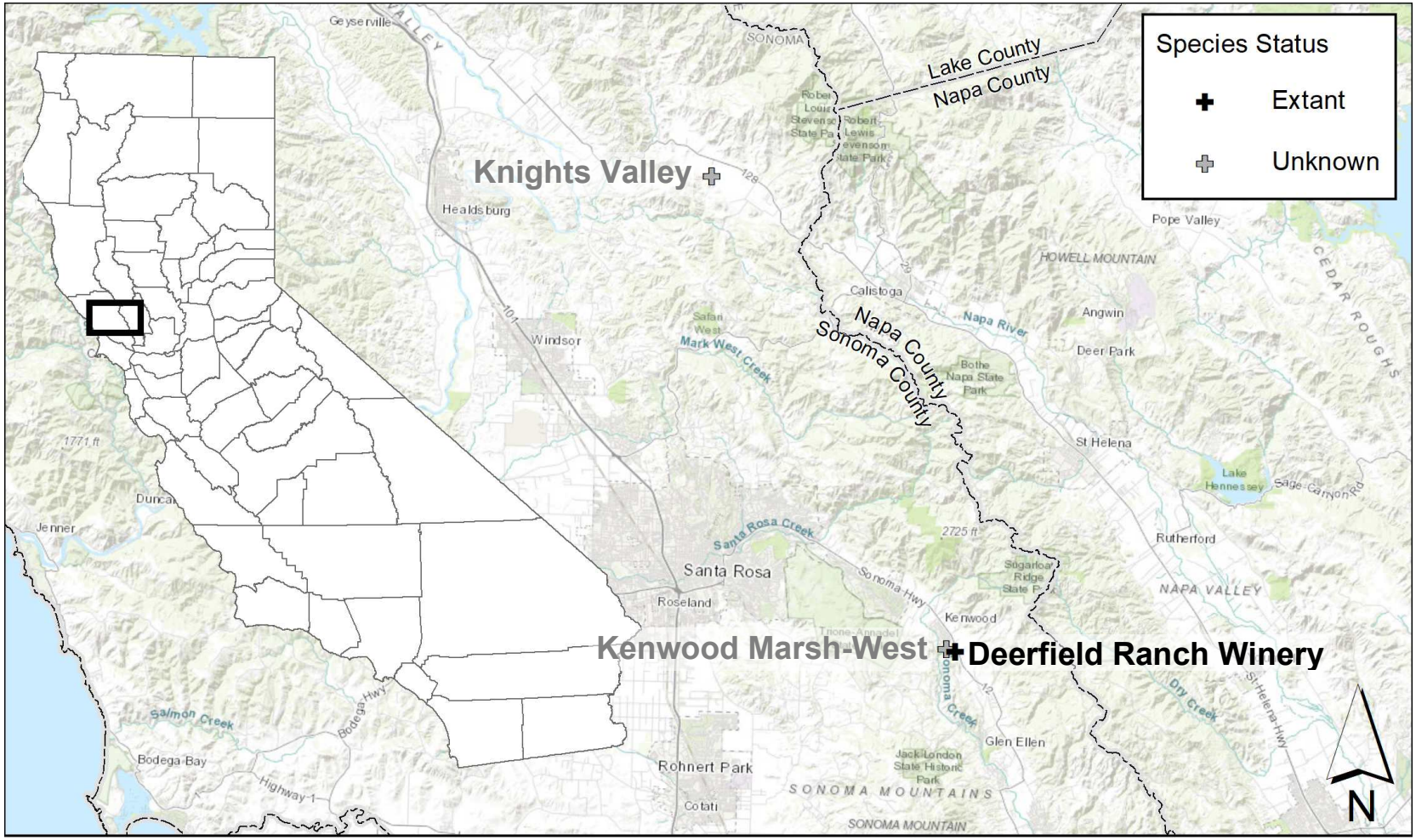
There are currently two occurrences of Kenwood Marsh checkerbloom that are documented in the CNDDB; however, one of these occurrences consists of two separately mapped parts. To make it easier to refer to the different occurrences and their parts in this species review, each occurrence or part of an occurrence has been named as a separate “population” in Table 1 and below. Kenwood Marsh is the element occurrence (EO 1) containing two populations and Knights Valley (EO 2) contains one population, for a total of three populations. The full known distribution of the species is displayed in Figure 3, and the three populations are described in more detail below.

- *Deerfield Ranch Winery* (extant) – this is the southernmost population on record and occurs in Kenwood Marsh on private property in the Kenwood U.S. Geological Survey 7.5-minute topographic quadrangle. There are herbarium collections dating back to 1927, presumably before much of Kenwood Marsh was developed for vineyards and housing. The last voucher specimen was collected in 1998. The population of Kenwood Marsh checkerbloom at this site is fenced and actively managed. In 2009, there were four subpopulations at this site (Table 2). Two of these subpopulations were natural; one was near the road in a clearing (“Road”, Fig. 4) and the other was about 50-80 m (165-265 ft) to the north among small willows (“Willow”). Two additional subpopulations were created in April 2009, one in the willows (“#3”) and one in open sun (“#4”), mimicking the two natural subpopulations (Symonds, pers. comm. 2019). The #4 subpopulation did not last more than a year, and by 2019, the other reintroduced subpopulation, #3, no longer supported any plants. As early as 2015, the natural patch in the willows appeared to be extirpated, so by 2019, the Road subpopulation was all that remained at Deerfield Ranch Winery.

- *Kenwood Marsh-West* (presumed extant) – this site is located about 400 m (0.25 mi) north-northwest of Deerfield Ranch Winery, and also in the Kenwood U.S. Geological Survey 7.5-minute topographic quadrangle. It is on private property and has not been monitored in over 15 years; its current status is unknown, but until the site can be surveyed, it is presumed to be extant.

- *Knights Valley* (presumed extant) – this is the northernmost population on record and occurs northwest of Calistoga, CA on private property in an area known as Knights Valley. The population is mapped within the Mount St. Helena U.S. Geological Survey 7.5-minute topographic quadrangle. There are herbarium collections dating back to 1890, with additional collections in 1979, 1984, and most recently, in 1998. This site was last surveyed in 2001.

Based on satellite images, the wetlands where the three populations are known have not been developed or converted, but without updated plant or hydrological surveys of the areas, it is not possible to determine if changes in hydrology or other threats have led to a change in the plant community, and to the extirpation of Kenwood Marsh checkerbloom in two of the three populations.



Background Image Source: ESRI (Topographic)

FIGURE 3. **Distribution and range map of Kenwood Marsh checkerbloom.** The only confirmed extant population is shown in black and populations of unknown status (presumed extant) are shown in gray.

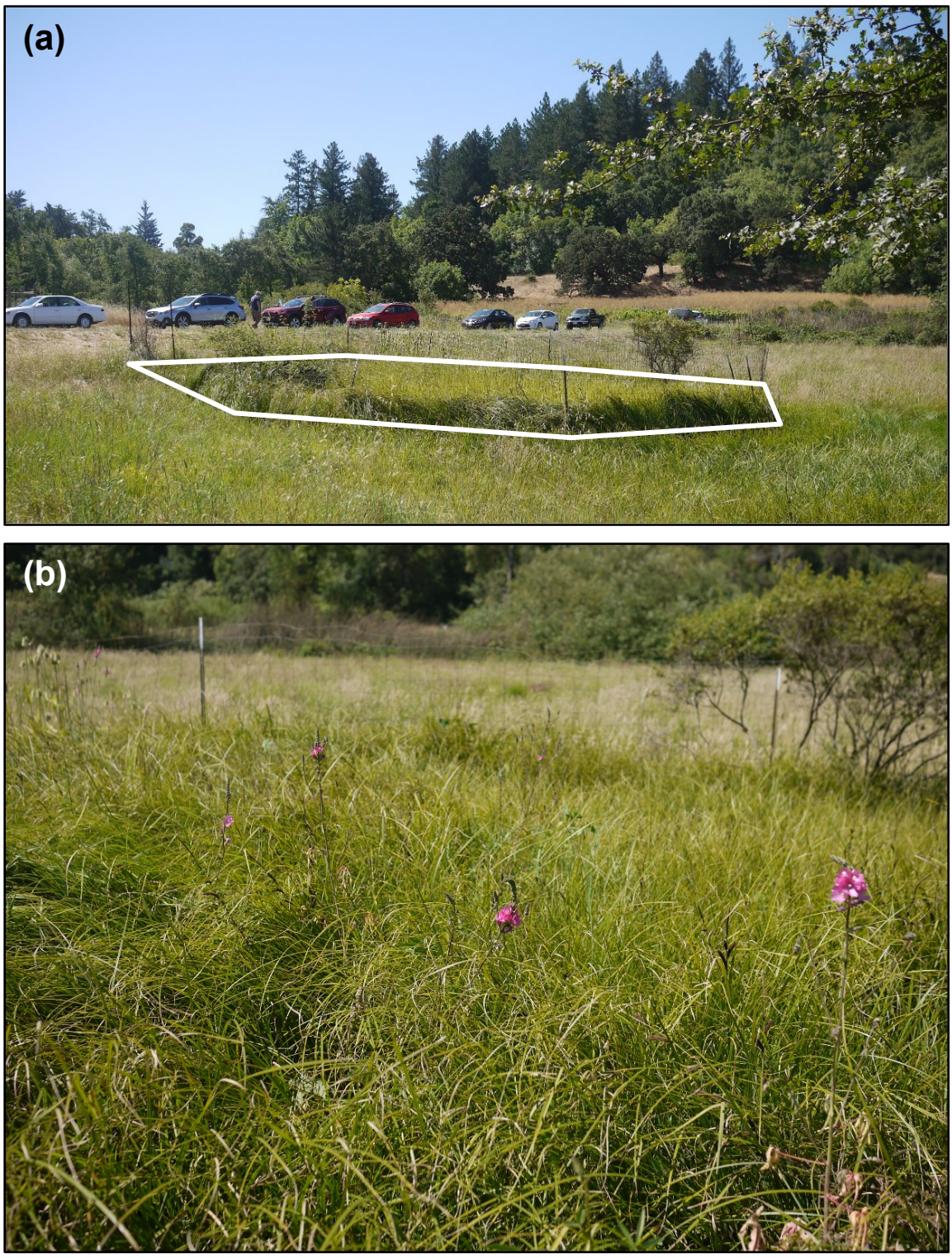


FIGURE 4. Photos of the Road subpopulation at Deerfield Ranch Winery showing (a) the fenced enclosure protecting the only known extant patch, and (b) a closer view into the enclosure showing Kenwood Marsh checkerbloom in bloom surrounded by sedges (*Carex* spp.)**.** Photos by R. La Rosa.

B. Population Trend and Abundance

The periodic monitoring of Kenwood Marsh checkerbloom at Deerfield Ranch Winery and Knights Valley since 1981 shows fluctuating populations, but the way in which population sizes were estimated sometimes differed between years (Appendix C). Because Kenwood Marsh checkerbloom is a long-lived perennial with a large root stock, it can produce many stems each year, which each have branching inflorescences, so flower number per stem can vary greatly. Kenwood Marsh checkerbloom often grows among thick vegetation, making it difficult to determine which stems are growing from a common root base to identify individual plants. Plant surveyors have also been hesitant to get too close to plants for fear of trampling young plants (Symonds, pers. comm. 2019). Consequently, plant censusing across years has not been consistent and has sometimes estimated population size using different "currencies," such as number of genetic individuals, stem number, or number of blooming branch tips. This makes it difficult to compare population estimates across years to identify population trends. In the most recent survey of the single extant subpopulation in 2019, there were 16 flowering individuals, which was fewer than in previous years (Symonds, pers. comm. 2020). Deerfield Ranch Winery is the only site that has been monitored in any of the past 18 years; there is no information on population trends or abundance for the other two populations. Because the condition of the other two populations is unknown, they are presumed extant, but that is unconfirmed.

There is no genetic information from this species to give any indication of its genetic variability and its ability to adapt to changing environmental conditions. It is also unknown how much gene flow occurred between the two populations in Kenwood Marsh (Deerfield Ranch Winery and Kenwood Marsh-West), and whether or not they are one interbreeding population.

V. THREATS AND SURVIVAL FACTORS

A. Factors Affecting Ability to Survive and Reproduce

At the time of listing in 1982, the threat to Kenwood Marsh checkerbloom was identified as modification and/or destruction of habitat (i.e., conversion of land to vineyards and urbanization). After its listing, the Department identified additional threats to the species in the first five-year species review (CDFG 1987), including cattle grazing and trampling, and competition. For this review in 2020, the Department has identified additional threats, including: human-related activities (e.g., climate change, mowing, and wildfire), predation (i.e., herbivory), competition from invasive species, and random events that pose a threat to species with small populations. Explanations of how these factors threaten Kenwood Marsh checkerbloom's survival are described below.

- *Present or threatened modification or destruction of its habitat* – Conversion of land to agriculture (i.e., viticulture) (CDFG 1981) was an immediate threat to Kenwood Marsh checkerbloom when it was listed in 1982. The area that supported habitat for Kenwood Marsh checkerbloom became increasingly fragmented as it was quickly being converted into vineyards. This conversion of land continues to threaten the survival of Kenwood Marsh checkerbloom, both directly and indirectly. At least two populations are now landlocked and surrounded by vineyards or reservoirs. Lack of adequate habitat adjacent to the current populations diminishes the chances of Kenwood Marsh checkerbloom expanding beyond its current restricted habitat.

In October 2019, the Kincade Fire burned 77,758 acres of Sonoma County, including the entire marsh in Knights Valley where Kenwood Marsh checkerbloom was most recently documented in 2001. It is not known how dry the marsh was leading up to the fire, the intensity of the fire (i.e., how hot it burned), or if Kenwood Marsh checkerbloom root stock or seeds were harmed. It is not known if Kenwood Marsh checkerbloom might benefit from periodic burns to also remove competing vegetation or buildup of dead plant material.

- *Herbivory* – Herbivores can pose a threat to Kenwood Marsh checkerbloom. The most likely herbivores were identified as: deer (*Odocoileus* sp.), slugs (several genera in the Phylum *Mollusca*), snails (*Helix aspersa*), spittle bugs (Family *Cercopidae*), and small rodents such as California voles (*Microtus californica*) (USFWS 2009; Symonds, pers. comm. 2019). These herbivores become a particular threat if a population is fenced, and the vegetation within the exclosure is not properly managed. Dense, overgrown vegetation has the potential to further attract the herbivores listed above.

- *Human-related activities* – In 1987, threats to the hydrology of the regions around the three Kenwood Marsh checkerbloom populations was identified in the Department's five-year species review (CDFG 1987). Because Kenwood Marsh checkerbloom is reliant on fresh water, the modification of regional hydrology through water diversion and wells can have devastating effects on populations. A private reservoir was built adjacent to the Knights Valley population sometime between 1993 and 2004, based on aerial photographs (UCSB 2019). The long-term effects of this reservoir on the adjacent marsh is not known, but it may be diverting water from the marsh.

  The landowner of Deerfield Ranch Winery fenced the Kenwood Marsh checkerbloom population around 2000 to protect it from the threat of mowing or other accidental destruction. There is no longer cattle grazing at Deerfield Ranch Winery (USFWS 2009), but it is unknown if there is currently grazing, or future plans to graze Knights Valley or Kenwood Marsh-West.

  Kenwood Marsh checkerbloom is susceptible to environmental changes associated with climate change (e.g., changes in temperature ranges and increased drought). The Climate Change Vulnerability Index (CCVI) quantifies the vulnerability of a species under current climate change models, using information on the needs of a species, its range, life history, and ecology (NatureServe 2016). Kenwood Marsh checkerbloom is rated as "Extremely Vulnerable" (CDFW 2019), meaning its "abundance and/or range are extremely likely to substantially decrease or disappear by 2050" (NatureServe 2016). The factors that greatly increase the vulnerability of Kenwood Marsh checkerbloom are: natural and anthropomorphic barriers (e.g., hills, dry upland habitat, and vineyards) that restrict the species' ability to shift its range in response to climate change; low dispersal, which limits the distance the species can move per generation; and a narrow physiological hydrological niche, because the species is restricted to wetlands and highly sensitive to drought (CDFW 2019). Other factors that increase its vulnerability are: low historical mean temperature variation (i.e., annual temperature range) of 9.4°C (49°F), which suggests Kenwood Marsh checkerbloom may not be well adapted to changes in climate; an historical hydrological niche, of very little variation in rainfall across the range (mean = 94 cm (37 in), st. dev. = 6.7 cm (2.6 in)); competition from other plant species; and reliance on pollinators for sexual reproduction.

- *Other natural occurrences* – With such small population sizes, confined to very small areas, Kenwood Marsh checkerbloom is highly vulnerable to random events. In 2012 rodents were likely responsible for the destruction of many reproductive stalks, reducing the population's ability to produce seed. Documented random events that have or may have negatively affected the natural population include rodent outbreaks, extended periods of inundation, and wildfire. Small populations are also susceptible to inbreeding depression, which results in low genetic variation and the potential inability to adapt to environmental changes (Ellstrand and Elam 1993). The ability to adapt is crucial in the face of climate change.

- *Competition* – Kenwood Marsh checkerbloom competes with dense surrounding vegetation for resources such as sunlight, soil moisture, and soil nutrients. Depending on the site, Kenwood Marsh checkerbloom competes with invasive species like velvetgrass (*Holcus lanatus*), Himalayan blackberry (*Rubus armeniacus*), and pennyroyal (*Mentha pulegium*). Kenwood Marsh also supports dense patches of sedges (*Carex* spp.) and common tule (*Schoenoplectus acutus* var. *occidentalis*), which were listed as a threat to the species in 1987.

B. Degree and Immediacy of Threats

Threats faced by Kenwood Marsh checkerbloom have increased since this species was placed on the list of endangered species in 1982. This species remains in extreme danger of extinction. Without continued protection of the natural populations, and management through recovery projects, Kenwood Marsh checkerbloom could become extinct at any time. Competition from dense surrounding vegetation, changes in hydrology from viticulture and climate change, loss of genetic diversity due to population reductions, and random events are likely the greatest threats to Kenwood Marsh checkerbloom. Timing and outcome of some of these types of threats are, by nature, unpredictable and require diligent monitoring and management actions to reduce the risk of extinction.

VI. MANAGEMENT AND RECOVERY

A. Impact of Existing Management Efforts

Management efforts have been undertaken only at Deerfield Ranch Winery. This management consisted of fencing subpopulations, collecting and storing seeds for long-term conservation, reducing dead plant material, and reintroducing cultivated plants to create new subpopulations. Funding to continue these activities has not been secured, and any management efforts are being conducted on a voluntary basis.

Current and past management efforts are described in more detail below.

i. Erecting Fence Exclosures

In 2000, the private landowner at Deerfield Ranch Winery fenced the two small subpopulations of Kenwood Marsh checkerbloom that were growing on the property (USFWS 2009). Fenced exclosures protect the species from human activities (e.g., mowing) and from grazing by large wildlife and livestock; however, fencing subpopulations also requires continued management to prevent a buildup of thatch and overgrown vegetation (see *ii.* below).

ii. REMOVAL OF THATCH

After the Road subpopulation at Deerfield Ranch Winery was fenced, thatch buildup became an issue because plant material could not be removed by other means (e.g., grazing or mowing). It built up over time, making it difficult for seedlings to become established. Current management is provided by the landowner and a team of volunteers, which visit the population annually to carefully remove dead plant material from around the Kenwood Marsh checkerbloom individuals. The thick layer of thatch is removed completely from the fenced exclosure. Anecdotally, removing thatch increases the number of seedlings (Symonds, pers. comm. 2020), benefitting the subpopulation. The subpopulation is too small to have control plots where thatch is left intact for an experimental comparison. The thatch removal occurs in the spring when plants are beginning to (re)sprout.

iii. CONSERVATION SEED STORAGE

In 2001, 2007, 2008, 2009 and 2018, about five percent or less of total seeds were collected by the Department, USFWS, or K. Symonds (CESA permit 2081(a)-09-04-RP) for the preservation of Kenwood Marsh checkerbloom (USFWS 2009; RSABG 2019; Symonds, pers. comm. 2019). Seeds were collected from Deerfield Ranch Winery and Knights Valley in 2001 and from only Deerfield Ranch Winery in subsequent years. The seeds are stored at Rancho Santa Ana Botanic Garden (RSABG) and the University of California Botanical Garden (UCBG) for long-term conservation. Some seeds from the 2007 collection were used for reintroduction efforts (see *iv* below) and were germinated by UCBG for reintroduction activities (USFWS 2009; Symonds, pers. comm. 2019). Seeds may also be stored by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS), but the NRCS could not confirmation this.

iv. REINTRODUCTION OF PLANTS AT KENWOOD MARSH (2004-PRESENT)

Beginning in 2004, efforts to protect the population of Kenwood Marsh checkerbloom growing in Kenwood Marsh were undertaken through a collaboration between the private landowner, the USFWS, NRCS, and the Department. A Wildlife Extension Agreement between the landowner and USFWS was signed in 2007 with a cost-sharing agreement and conservation plan in place. ~~As part of the agreement, a permanent conservation easement was recorded in April 2007.~~ Prior to this agreement, the landowner had fenced the two subpopulations that occurred on the property.

Two reintroduced subpopulations were outplanted through a Wildlife Extension Agreement. A grant from the Partnership Program in 2007 allowed for plants to be grown at UCBG and outplanted into two new sites at Deerfield Ranch Winery in April 2009 with permission from the private landowner. The two natural sites differed in soil moisture, associated plants, and light levels (USFWS, in litt. 2008a); the two new small outplanting sites were chosen to mimic one of each of the natural sites (Table 2). The new subpopulations were fenced, and 13 mature individuals were planted into the wetter, shaded, #3 site, and nine were planted into the drier, full sun, #4 site.

These sites were monitored for ten years. The drier, full sun subpopulation (#4) failed to establish after just one year, likely due to the very wet winter in 2009-2010 (Symonds, pers. comm. 2020). The wetter, low light subpopulation (#3) had very large plants with large leaves for many years, but declined to zero by 2019. Symonds (pers. comm. 2020) hypothesized this was because the surrounding willows grew much larger and the site became too shady to support the subpopulation. In 2019, only the Road subpopulation supported Kenwood Marsh checkerbloom. The Wildlife Extension Agreement expired in

2017, but the landowner has continued conservation efforts on the property with help from local volunteers and non-profit organizations.

B. Recommendations for Management Activities and Other Recommendations for Recovery of the Species

The Department's recommendations for management and recovery of Kenwood Marsh checkerbloom begin with the continued preservation of the current natural populations through monitoring activities and promotion of recruitment of plants into the population. Recovery of Kenwood Marsh checkerbloom is dependent on reintroductions into the historical range of the species to boost the number of individuals and occurrences. Recommendations include:

- Continue outreach efforts to the private landowners in the historical range of Kenwood Marsh checkerbloom for permission to survey the remaining populations and to discuss employing tools such as Safe Harbor Agreements (Fish and G. Code § 2089.2 et seq.) to incentivize recovery and conservation of the species.
- Coordinate with other resource agencies and organizations to establish a formal recovery team to support the recovery efforts that began with a 10-year Wildlife Extension Agreement through the USFWS in 2007 (USFWS 2009). The USFWS is in the process of developing a recovery plan for the species (Bainbridge, pers. comm. 2019b).
- Continue collecting seeds following protocols that consider genetic diversity and rarity (e.g., RSABG 2009) and place them in long-term conservation storage at Department-approved facilities.
- Conduct research into developing habitat management techniques that improve the longevity and reproductive success of existing mature plants, and provide habitat for the successful establishment of seedlings.
- Conduct a genetic analysis of the natural population in Kenwood Marsh, and others if possible, to quantify current genetic diversity, providing the most scientifically-grounded information for making decisions about management actions. It is critical to preserve genetic diversity of the species to increase its chances of adapting to environmental changes (i.e., climate change). Care should be taken when collecting tissue for such genetic studies, seeking techniques that minimize impacts to the natural population. Additionally, understanding the genetics of the cultivated stock will facilitate recovery efforts to promote genetic diversity in any new introduced populations.
- Consider expanding the natural population by planting seedlings that have been cultivated from wild-collected seeds. However, all proposals should strongly weigh the risk of unintended introductions of pathogens or other factors that may negatively affect the current highly vulnerable population.
- Promote educational outreach to the communities in the range of Kenwood Marsh checkerbloom to promote botanical surveys. Model habitat criteria to identify possible suitable habitat in the vicinity of Kenwood Marsh and Knights Valley, then survey to locate new occurrences that may have gone undetected. Additionally, post-fire surveys of areas that were previously surveyed will be important to understand the effects of wildfire on Kenwood Marsh checkerbloom.

VII. RECOMMENDATION TO THE COMMISSION

Pursuant to Fish and Game Code, section 2077, the Department has prepared this Five-Year Species Review based upon the best scientific information available to the Department to determine if conditions that led to the original listing are still present. Based on this Five-Year Species Review, the Department submits the following recommendation to the Commission:

In completing this Five-Year Species Review for Kenwood Marsh checkerbloom, the Department finds there is sufficient scientific information to indicate that the conditions that led to the listing of Kenwood Marsh checkerbloom as endangered are still present, and recommends no change to the status of Kenwood Marsh checkerbloom on the list of endangered species at this time.

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APPENDIX A. Quaternary geologic deposits associated with Kenwood Marsh checkerbloom occurrences. Sites include Deerfield Ranch Winery (DRW), Kenwood Marsh-West (KMW) and Knights Valley (KV). Descriptions are taken from the California Geological Survey (CDOC 2010).

Geological Series	Population	Description
QPc	DRW, KMW	Pleistocene and/or Pliocene sandstone, shale, and gravels deposits; mostly loosely consolidated
Qoa	KMW	Older alluvium, lake, playa, and terrace deposits
Q	KV	Alluvium, lake, playa, and terrace deposits; unconsolidated and semi-consolidated

APPENDIX B. Soil composition of naturally occurring Kenwood Marsh checkerbloom sites. Sites include Deerfield Ranch Winery (DRW), Kenwood Marsh-West (KMW), and Knights Valley (KV). The soils series share a similar profile: fine-loamy texture, mixed topsoil, and superactive cation activity (Soil Survey Staff 2001, 2003, 2019).

Soil Series	Site	Texture	Topsoil	Cation activity	Soil group
Huichica	DRW, KMW	fine-loamy	mixed	superactive	thermic Abruptic Haplic Durixeralfs
Los Robles	KV	fine-loamy	mixed	superactive	thermic Typic Haploxerepts

APPENDIX C. Population and subpopulation census of Kenwood Marsh checkerbloom. Survey method likely differed between years, so counts may represent individuals, flowering stalks, or flower clusters. Populations include Deerfield Ranch Winery (DRW), Kenwood Marsh-West (KMW), and Knights Valley (KV). *flowering stalks only; ** reproductive individuals only.

Population	DRW	DRW	DRW	DRW	DRW	KMW	KV	Collector	Source
Subpop.	Road	Willow	#3	#4					Table 2
EO	1	1	1	1	1	1	2		CNDDB 2019
1979							<100	Unknown	USFWS 2009
1981							500	Unknown	CDFG 1981
1986					85		38	B & J Guggolz	CNDDB 2019
1987					136			B & J Guggolz	CNDDB 2019
1988					150	400		E. Parsons	USFWS, in litt. 2008c
1989					100	125		E. Parsons	USFWS, in litt. 2008c
1990					200	150		E. Parsons	USFWS, in litt. 2008c
1991					92	80		E. Parsons	USFWS, in litt. 2008c
1993							70	B & J Guggolz	CNDDB 2019
1993					600	500		N. Wilcox	USFWS, in litt. 2008c
1998					40+		47	B & J Guggolz	CNDDB 2019
2001					232*		25	G. Cooley	Cooley, in litt. 2001
2007					33			K. Symonds	USFWS 2019
2008	11	13			24			K. Symonds	USFWS, in litt. 2008b
2009			13**	9**				K. Symonds	Symonds, pers. comm. 2019
2010	126*		13**	0				K. Symonds	USFWS 2019
2012	42*	20*	39*	0	103*			K. Symonds	USFWS 2012
2013	162*	9*	14*	0	185*			K. Symonds	USFWS 2013
2016	256*							K. Symonds	Symonds, pers. comm. 2020
2019	16**	0	0	0	16**			K. Symonds	Symonds, pers. comm. 2019