Marsh sandwort (*Arenaria paludicola*)

5-Year Review: Summary and Evaluation

Photo by John Chesnut

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
Ventura, California

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GENERAL INFORMATION

Species: marsh sandwort (*Arenaria paludicola*)
Date listed: August 3, 1993
FR citation(s): 58 FR 41378
Classification: Endangered

BACKGROUND

Most recent status review:

U.S. Fish and Wildlife Service (Service). 2008. Marsh Sandwort (*Arenaria paludicola*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Ventura Fish and Wildlife Office. Ventura, California.

FR Notice citation announcing this status review:

84 FR 36116-36118. Initiation of 5-Year Status Reviews of 58 Species in California, Nevada, and the Klamath Basin of Oregon; Notice of initiation of reviews; request for information. July 26, 2019.

Critical Habitat Designation:

No critical habitat has been designated.

State Listing:

Listed as endangered by the State of California in 1990 (CDFW 2020, p. 2).

ASSESSMENT

At the time of listing, alteration of hydrology, competition with encroaching eucalyptus trees (*Eucalyptus globulus*), urban development, and stochastic extinction due to the small remaining populations were identified as the primary threats to marsh sandwort (*Arenaria paludicola*). The only known extant population was within a marshy area along Black Lake Canyon, in southwestern San Luis Obispo County. All other known historic locations were extirpated (Service 1993, 58 FR 41378). When the Recovery Plan was published in 1998, a second population was identified on the northwestern shore of Oso Flaco Lake, within the Oceano Dunes State Vehicular Recreation Area (ODSVRA), in San Luis Obispo County. The threats did not change; but became more generalized to include habitat degradation or destruction and competition with exotic species (including eucalyptus trees and veldt grass [*Ehrharta calycina*]), (Service 1998, p. 8 and 18-21). At the time of the 5-year review in 2008, the threats to the species were unchanged. The Black Lake Canyon occurrence had become extirpated and the location at Oso Flaco Lake was the only known, extant, native/wild population. The species had also been successfully outplanted in 2003 in a marsh located at the Morro Coast Audubon Society Sweet Springs Nature Preserve, in San Luis Obispo County (Service 2008, p. 5). Since

the 2008 5-year review, there is new information about the species' ecological tolerances, threats, and experimental reintroductions.

Data Review

This 5-year review was conducted by the Service's Ventura Fish and Wildlife Office (VFWO). Data for this review were solicited from interested parties through a Federal Register notice announcing this review on July 26, 2019 (84 FR 36116). We also conducted a literature review and contacted local botanists, land trusts, private land owners and state agencies. The Service also conducted surveys for marsh sandwort throughout several locations in San Luis Obispo County, in summer of 2020.

Current Distribution

Marsh sandwort was historically known from 16 California Natural Diversity Database (CNDDB) occurrences found in Los Angeles, Riverside, San Bernardino, San Francisco, San Luis Obispo, and Santa Cruz counties (CNDDB 2020, website). The Consortium of California Herbaria Portal (CCH2) contains 34 specimen records of the species collected from San Bernardino, San Luis Obispo, Mendocino, and Santa Cruz counties, as well as Mexico (CCH2 2020, website). It was also historically known from Pierce County, Washington and south-central Mexico (Service 2008, p. 5-6). Currently, the species is considered extirpated from Washington State and may no longer occur in Mexico (Service 2008, p. 5-6). All of the CNDDB occurrences are confirmed or presumed to be extirpated, except for occurrence numbers 9 and 14, which are both in San Luis Obispo County (Figure 1). Marsh sandwort also occurs at two locations within the Golden Gate National Recreation Area (GGNRA), in Marin County, where it was successfully introduced in 2011 (Figure 1). However, there are no CNDDB occurrence records for these two GGNRA locations.

CNDDB occurrence 9 is the only native/wild population of the species that remains. The occurrence consists of two separate colonies located within the northeastern portion of the marsh that is part of Oso Flaco Lake, which is within ODSVRA. The 607-hectare (1,500-acre) park is owned and managed by the California Department of Parks and Recreation and is located along the coastline, south of the community of Oceano. It is difficult to estimate the number of individuals within the population because marsh sandwort is clonal, mat-forming and perennial. However, the total area occupied by the two colonies is approximately nine square meters (100 square feet; ODSVRA 2020, p. 1). The marsh is permanently inundated and supports an array of wetland-adapted plant species. The vegetation at the more eastern colony is denser at the surface, and there is less open water. This portion of the marsh appears to be more filled in with sediment than where the western colony occurs, which has more of a mosaic of plants interspersed with areas of deep muck and open water. Marsh sandwort grows among and is supported by the other co-occurring species.

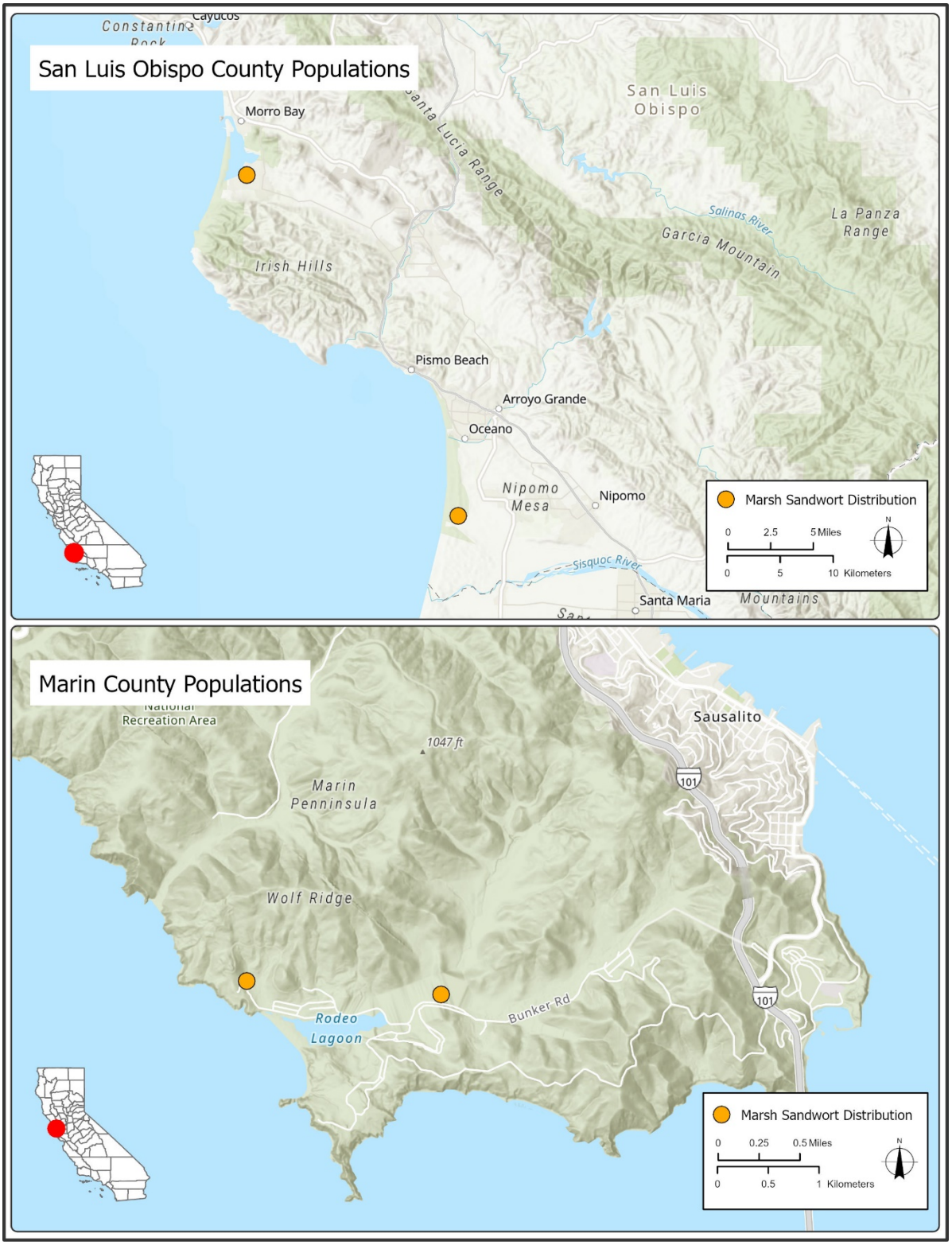

Figure 1. Approximate locations of extant marsh sandwort occurrences in San Luis Obispo County (top) and Marin County (bottom) based on CNDDB data and additional information from GGNRA (CNDDB 2020; Acierto et al. 2012, p. 3).

CNDDB occurrence 14 was established by the Service in coordination with other conservation partners via outplanting in 2003 at the Sweet Springs Nature Preserve, which is located within the community of Los Osos, on the southern end of Morro Bay. This 13-hectare (32-acre) site is owned and managed by the Morro Coast Audubon Society. The installed plantings were cultivated clones that originated from Black Lake Canyon (likely collected at CNDDB occurrence 10). All four of the CNDDB occurrences mapped within Black Lake Canyon are now considered to be extirpated. The single colony of marsh sandwort occupies approximately three square meters (30 square feet) of a marshy area that is fed by a freshwater spring. It ponds in the winter and the water recedes into a stream during the dry season. The area that supports the plants is on the upper bank and is seasonally inundated, but appears to stay saturated year-round and supports other wetland plant species.

The third extant marsh sandwort occurrence is located within the GGNRA, 30,512-hectares (75,398-acres) owned and managed by the National Park Service in Marin County. It is comprised of two separate colonies that were established as part of an experimental research project that the Service funded in 2011. The installed plantings were cultivated clones that originated from both the Black Lake Canyon (extirpated CNDDB occurrence 10) and Oso Flaco Lake (CNDDB occurrence 9) populations. Plants were installed at two different locations; Rodeo Beach, which is located northwest of Rodeo Lagoon, and Miwok Trail, which is located northeast of the lagoon. Both sites are marshy, wetland areas associated with intermittent streams that drain into the lagoon and support diverse assemblages of wetland-adapted plant species. We were unable to obtain an estimated occupied area for the colony of marsh sandwort at Rodeo Lagoon. However, the population is reported to be stable at this location (Chassé et al. 2019, p. 9). The Rodeo Lagoon site is seasonally inundated and becomes saturated at the surface during the drier months of the year. At the Miwok Trail, the colony is estimated to occupy approximately 247 square meters (2,659 square feet; GGNRA 2020, p. 1). This site is also seasonally inundated and saturated during the spring and summer months.

Habitat

In the most general sense, marsh sandwort has been described as a coastal species that requires freshwater marshes and swamps, and other mesic wetland or boggy habitats (Service 2008, p. 6). The existing habitat at Oso Flaco Lake (extant, native/wild CNDDB occurrence 9) is consistent with the description provided by Chesnut in 1998 (Service 2008, p. 6-7). Here the species occupies a marsh with perennial hydrology, where a peat-type substrate has formed clumps and floating mats in areas dominated by hydrophytic vegetation. Dominant species observed in the marsh sandwort colonies during surveys conducted by the Service and its other conservation partners in summer of 2020 include: Cusick's sedge (*Carex cusickii*), water parsley (*Oenanthe sarmentosa*), bur reed (*Sparganium eurycarpum*), cattail (*Typha latifolia*), bog bulrush (*Scirpus microcarpus*), California bulrush (*Schoenoplectus californicus*), duckweed (*Lemna* sp.), and yellow monkey flower (*Erythranthe guttata*). The occupied marsh areas are surrounded by encroaching arroyo willow (*Salix lasiolepis*), with poison oak (*Toxicodendron diversilobum*) and California blackberry (*Rubus ursinus*) in the understory. Areas that become dominated by these and other woody species (such as wax myrtle [*Morella californica*] and coast twin berry [*Lonicera involucrata*]) are no longer considered conducive for persistence of marsh sandwort. Many of the species observed at the Oso Flaco Lake population are also observed at the other

two extant locations (Sweet Springs Nature Preserve and GGNRA) including arroyo willow, bog bulrush, and water parsley. However, coast carex (*Carex obnupta*) is the dominant carex that co-occurs with marsh sandwort at GGNRA (Chassé et al. 2019, p. 9).

Marsh sandwort grows among other wetland species and is structurally supported by them, especially in perennially wet areas. It is nearly always seen clambering up from the bases of adjacent, co-occurring plants and it relies on them to be lifted out of highly saturated soil conditions. Acierto et al. (2012, p. 8) documented this at GGNRA in outplanted populations. In San Luis Obispo County, Cuskick's sedge in particular, forms dense tussocks (or hummocks) that extend up and out of the open water in the dryer months. Some sediment accumulates on the top of the clump when this happens and this seems to be an ideal condition for marsh sandwort establishment and survival. A similar phenomenon happens with floating mats of bulrush, where accumulated drift, sediment, and vegetative debris form a platform that lifts up out of the open water.

Ecological Tolerances

Our understanding of marsh sandwort's ecological tolerances has grown considerably since the 2008 5-year review. Bontrager et al. (2014) found that marsh sandwort has an ability to tolerate a wider range of salinities than expected (p. 474). Soil samples were collected across a salinity gradient in five distinct vegetation zones starting from the ocean and moving inward, as well as from soil used for a greenhouse experiment. Marsh sandwort survival was reduced in the most saline soils, with a non-linear threshold trend, suggesting that potential habitats for reintroduction are not necessarily restricted to entirely freshwater, like the three extant populations (Bontrager et al. 2014, p. 469-470, 472 and 474).

There have also been advances in our understanding of the species hydrological requirements since the 2008 5-year review. Historically, marsh sandwort was reported to grow in swampy areas and other mesic or riparian habitats, suggesting that the species needs perennial hydrological conditions (Service 2008, p. 6). Acierto et al. (2012) found that marsh sandwort transplant mortality increased with soil moisture at GGNRA and excessive moisture was detrimental to plant establishment (p. 7). Bontrager et al. (2014) found higher soil moisture content had a similar negative effect on experimental populations (now extirpated) from Santa Cruz County (p. 476). Specifically, moisture during the month of March had positive effect on marsh sandwort survival, but it had a negative effect on survival during the month of May (Bontrager et al. 2014, p. 472-473). Alternatively, prolonged drying of the soils negatively affects marsh sandwort survival. Plants will not recover from 20 days of desiccation beyond the wilting point. They will rebound and survive after up to eight days of desiccation beyond the wilting point (Bontrager et al. 2014, p. 476). The Sweet Springs Nature Preserve population has a similar hydrologic regime. The site is ponded during the wet season and the water recedes over the dry summer months, but the soils remain saturated.

Bontrager et al. (2014) also explored indicator species for marsh sandwort, where an indicator species is one that co-occurs with the focal species and occupies a similar ecological niche, which then can be used when considering potential reintroduction sites (Bontrager et al. 2014, p. 468). In experimental populations (now extirpated) from Santa Cruz County, marsh sandwort

survival was greatest in plots dominated by water parsley, compared to the other two habitat types (arroyo willow and bog bulrush) (Bontrager et al. 2014, p. 475). Similar results were observed at GGNRA, where marsh sandwort transplant success was greatest in habitats dominated by water parsley (Acierto et al. 2012, p. 9). The conclusion that water parsley is an indicator for marsh sandwort is consistent with the sites in San Luis Obispo County; both the Oso Flaco Lake and Sweet Springs Nature Preserve populations have it as one of the dominants within occupied areas. Water parsley is also dominant at extirpated locations recently surveyed in summer of 2020 within Black Lake Canyon. Chesnut (2020) hypothesizes that Cusick's sedge is another indicator species for marsh sandwort in San Luis Obispo County and recommends that this species also be outplanted at reintroduction sites, especially those with permanent inundation to facilitate the floating peat bog conditions marsh sandwort currently occupies at Oso Flaco Lake (Chesnut 2020, pers comm).

Additional progress has been made in our understanding of how canopy cover affects survival of the species. In general, if the canopy is denser, then there is less light availability and greater competition with co-occurring species. If the canopy is thinner, then there is more light exposure and less competition with adjacent plant species. Canopy cover may be affected by plant succession, natural disturbance events such as flooding that clears vegetation, or vegetation management (such as herbicide treatments, manual trimming and removal). Canopy openness from trimming and removal had a positive effect on marsh sandwort survival in experimental populations in Santa Cruz County (Bontrager et al. 2014, p. 472 and 476). Outplanted colonies did not survive in plots dominated by arroyo willow, which had the densest canopy of the experiment, or those dominated by bog bulrush, which was the moderately dense canopy cover treatment (Bontrager et al. 2014, p. 472-473 and 475). Similarly, some outplanted colonies at GGNRA did best in more open canopy habitats (Acierto et al. 2012, p. 5 and 8).

The most literal interpretation of these data is that interactions with neighboring plants generally have a negative effect on marsh sandwort survival because the canopy cover obstructs light and increases competition. However, we also know from both field observations and ecological studies that the species does rely on adjacent plants for structural support and in some cases, can facilitate growth and survival (Bontrager et al. 2014, p. 476). Therefore, use of vegetation management techniques is context dependent. Competitor removal improves survival in certain circumstances, but may have an adverse effect in others by disrupting plant establishment. For example, if competitor removal results in increased standing water directly on marsh sandwort plants or disruption of marsh sandwort's root systems, then it is not recommended. Overall, arroyo willow intrusion has a negative effect on marsh sandwort and its habitat because over time because this succession converts marsh habitats to more closed canopy riparian communities that are no longer suitable. GGNRA continues to employ pruning maintenance of arroyo willow for its populations and recommends this to maintain marsh sandwort habitat into the future (Chassé et al. 2019, p. 9). Arroyo willow maintenance may be one of the reasons that this outplanting remains persistent, whereas so many other reintroduction efforts failed. Chesnut (2020) asserts that marsh habitats are no longer suitable for marsh sandwort once arroyo willow invades them and also recommends pruning maintenance and removal (Chesnut 2020, pers comm).

Threats

The primary threats to marsh sandwort identified in the 2008 5-year review include: loss and degradation of habitat from development and urbanization, conversion of marsh habitat due to excessive vegetative growth caused by biostimultion and eutrophication and other changes in hydrology, competition with encroaching eucalyptus trees and other invasive species, and stochastic loss due to small population size and isolation of the existing populations. In 2008, the Service also noted that these threats likely act in a cumulative, synergistic manner that functions to increase the overall risk of the species extinction (Service 2008, p. 10-13).

The current primary threats to marsh sandwort are the same as in 2008. We clarify the threat of conversion of marsh habitat due to excessive vegetative growth caused by biostimultion and eutrophication and other changes in hydrology and identify climate change as a new threat to the species.

Competition with other encroaching species that occur within occupied wetland habitat; especially intruding willow and bulrush, is still a primary threat to marsh sandwort. Conversion of marsh sites to woody riparian habitats is exacerbated by biostimultion and eutrophication, development and urbanization, and other changes in hydrology. In combination, these threats act cumulatively and create synergistic cascade of negative effects on the species and its habitat. However, potential adverse effects from upland invasive species, such as eucalyptus trees and veldt grass, are no longer considered a primary threat because these factors are not acting as imminently on the species or its habitat in the rapid, cumulative and detrimental ways that the other primary threats are. Over time, upland invasive species may disrupt important ecosystem processes at the landscape scale, which may act on marsh sandwort more indirectly over extended time frames.

The Fourth Climate Change Assessment was completed for California and the key findings are summarized in a state-wide synopsis report (Bedsworth et al. 2018, entire). Several major climate change effects are expected to occur in the next 80 years and these effects may vary regionally. These include (but are not limited to): increasing temperatures, increased sea level rise, increased frequency and intensity of heavy precipitation events, increased frequency of drought, and increased frequency and area burned by wildfires (Bedsworth et al. 2018, p. 22). Any of these effects are likely to negatively impact marsh sandwort and its habitat because of its small population size, limited distribution, narrow habitat requirements and proximity to the coast. For example, slight increases in average annual temperatures and increased frequency of drought are likely to adversely affect the hydrology of marshlands occupied by the species. Similarly, small increases in sea level rise may influence all three of the extant populations, increasing salinity within the occupied habitats. King tides over the winter of 2019 occurred in Morro Bay and washed out some of the marsh sandwort at the Sweet Springs Nature Preserve. Intense high precipitation events could wash out the species from any of the three occupied areas. All of these scenarios are plausible, thus, climate change is now identified as a new threat to the species.

Evaluation of Recovery Action Progress

Downlisting criteria for marsh sandwort are listed in the Recovery Plan for Marsh Sandwort (*Arenaria paludicola*) and Gambel's Watercress (*Rorippa gambelii* [*Nasturtium gambelii*]; Service 1998, p. 30-31). Delisting criteria were developed as an amendment to the Recovery Plan in 2019 (Service 2019; p. 4-5). The downlisting criteria can be summarized as:

1. New plants of each species are established so that there are at least five populations of at least 500 individuals each;

2. Some of these populations occur in permanently protected habitats in Black Lake Canyon and the Dune Lakes area;

3. Some of the populations must be in other areas of suitable habitat within the species historical ranges within the United States; and

4. The populations remain viable for at least five years.

The delisting criteria for marsh sandwort can be summarized as:

1. Threats are reduced or eliminated so that protected populations are capable of persisting without significant human intervention or perpetual endowments are secured for management necessary to maintain the continued existence of the species. The most outstanding management needs currently are:

    a. Controlling competition with nonnative species, and

    b. Managing water conditions, particularly flow and salinity that the species depends on.

2. Protected populations are established across the species ecological settings (in addition to Black Lake Canyon and the Dune Lakes area), including San Mateo Creek in San Onofre State Park in Orange County or comparable site(s) in that region; the San Antonio Creek drainage on Vandenberg Air Force Base in Santa Barbara County or comparable site(s) in that region; and wetlands in GGNRA in San Francisco County or comparable site(s) in that region; and

3. The populations remain viable for at least 10 years. Because this species has narrow microhabitat conditions that it will tolerate, particularly with respect to soil moisture and salinity, and in light of fluctuations that can occur with climatic conditions, local groundwater table levels, and saltwater intrusion events, the persistence of populations with these varying conditions over time needs to be confirmed.

None of the recovery criteria for downlisting have been met because we do not yet have five marsh sandwort populations. Although we have not yet been able to count the numbers of individuals within any population, it is unlikely that any of them are composed of 500

individuals or more because of the relatively small areas that they currently occupy. There are no occurrences of the species within Black Lake Canyon or the Dunes Lakes regions; all of the historic occurrences within these locations are now extirpated. The GGNRA population is within the species historical range and all three of the extant occurrences have persisted for more than five years.

Marsh sandwort roots easily at the nodes and is therefore easily cultivated from cuttings. Cultivated clones have been outplanted unsuccessfully at several locations including: the Guadalupe-Nipomo Dunes National Wildlife Refuge in San Luis Obispo County (2008), the Presidio National Park in San Francisco County (2012), and Wilder Ranch State Park in Santa Cruz County (2012). The reasons that these reintroductions failed remains unknown and it is likely that any future outplanting projects will need to incorporate long term management plans to ensure that new populations persist into the future to achieve the recovery criteria. Similarly, extant populations of the species are unlikely to persist without some management to ameliorate the current threats.

SUMMARY

Marsh sandwort was once a wide ranging species with a historic range that extended along the west coast from Washington State to Mexico (Service 2008, p. 5-6). The species distribution is now reduced to three isolated occurrences, with two populations at GGNRA in Marin County and two populations in San Luis Obispo County; at the Sweet Springs Nature Preserve on Morro Bay and Oso Flaco Lake on ODSVRA (Figure 1). Threats identified at the time of listing, in the 1998 Recovery Plan, and in the 2008 5-year review remain largely unchanged (Service 1993, 58 FR 41378; Service 1998, p. 8 and 18-21; Service 2008, p. 10-13). Climate change effects, especially those resulting in hydrological changes to marsh and other wetland habitats, are a new primary threat to the species.

CONCLUSION

The current threats to marsh sandwort include: loss and degradation of habitat from development and urbanization, conversion (or loss) of marsh habitat due to excessive vegetative growth caused by biostimultion and eutrophication, changes in hydrology, stochastic loss due to small population size and isolation of the existing populations, and climate change. These threats are expected to act synergistically on the species and are cumulatively anticipated to result in its continued decline. In consideration of this and the small amount of area occupied by the three remaining extant occurrences, we find that marsh sandwort is in danger of extinction throughout all or a significant portion of its range and thus remains an endangered species.

RECOMMENDATIONS FOR FUTURE ACTIONS

The following actions are recommended based on the current 5-year review:

1. Implement annual monitoring programs and develop comprehensive management plans to ameliorate the threats at extant populations.

2. Conduct surveys within suitable marsh habitats throughout the historic range and in extirpated sites previously known to have supported the species.

3. Conduct introductions at suitable sites that include long-term management strategies to ensure success and persistence of the species at introduced locations.

4. Continue to collect seed to expand the *ex situ* conservation seed bank collection.

5. Conduct research to evaluate site-specific effects of climate change, the role of sexual reproduction, the seed bank, and genetics of the species to inform management and introduction efforts.

APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approved STEPHEN HENRY Digitally signed by STEPHEN HENRY Date: 2020.08.27 08:52:09 -07'00' Date _____

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