

Cirsium hydrophilum var. *hydrophilum*
(Suisun thistle)

**5-Year Review:
Summary and Evaluation**



Image Credit: Doug Wirtz

**U.S. Fish and Wildlife Service
San Francisco Bay-Delta Fish and Wildlife Office
Sacramento, California**

5-YEAR REVIEW

Cirsium hydrophilum var. *hydrophilum* (Suisun thistle)

GENERAL INFORMATION:

Species: *Cirsium hydrophilum* var. *hydrophilum*

Date listed: November 20, 1997

FR citation(s): 62 FR 61916

Classification: Endangered species

BACKGROUND:

Most recent status review:

U.S. Fish and Wildlife Service. 2009. *Cirsium hydrophilum* var. *hydrophilum* (Suisun thistle). Five-year review: summary and evaluation. Sacramento Fish and Wildlife Field Office. Sacramento, California. January 2009. 19 pp.

FR Notice citation announcing this status review:

86 FR 27462, Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 76 Species in California and Nevada; May 20, 2021.

Purpose of 5-year reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, the Service recommends whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and the Service must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, the Service considers the best available scientific and commercial data on the species, and focuses on new information available since the species was listed or last reviewed. If the Service recommends a change in listing status based on the results of the 5-year review, the Service must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Methodology used to complete this review:

Staff of the San Francisco Bay-Delta Fish and Wildlife Office, U.S. Fish and Wildlife Service prepared this review. Information was compiled from papers published in peer-reviewed scientific journals, technical and data reports published by other federal agencies, published and unpublished Service reports, and Service documents related to Suisun thistle. These documents were used to consider the current condition of this species, the threats this species has been, and is being, exposed to, how the current status of this species compares to the recovery criteria

described for this species, and recommendations for future actions and research. Biologists who have been actively engaged in activities associated to Suisun thistle were also asked for recommendations on recovery activities for the next five years.

ASSESSMENT:

Species overview:

Cirsium hydrophilum var. *hydrophilum* (Suisun thistle) is a variety of *Cirsium hydrophilum*, which is a species of thistle in the Asteraceae family (Keil 2012). *Cirsium hydrophilum* var. *hydrophilum* is an herbaceous plant characterized by purple and/or pink flower heads and tall, branched stems that can reach four or five feet in height (Figure 1; Service 2013). The variety is a biennial, and generally takes two years to complete its life cycle. In the first year, the plant grows vegetative structures including roots, stems, and leaves, and the stem and leaves form a rosette and tend to remain close to the ground. During the second year, the stem elongates and flower heads form, followed by fruits, seed production, and then the plant tends to senesce, and die that year or the following year (Service 2013, Vasey *et al.* 2020). *Cirsium hydrophilum* var. *hydrophilum* blooms between March and August, with the peak bloom period tending to occur in spring (Service 2013, Vasey *et al.* 2020). Service (2013) provides a detailed discussion of the morphological characteristics of *Cirsium hydrophilum* var. *hydrophilum*.

Cirsium hydrophilum var. *hydrophilum* is endemic to suitable tidal marsh and upland marsh habitat in the San Francisco Bay and California Delta region. The use of “Suisun” in the common name indicates that this species is native to the Suisun Marsh (Service 2013). This variety is historically only known from the Suisun Marsh ecosystem (Service 2013), which is situated between the confluence of the Sacramento and San Joaquin rivers to the east and San Pablo Bay to the west (Figure 2). *Cirsium hydrophilum* var. *hydrophilum* typically occurs in association with locations in upper intertidal marsh, and is often found on the banks of tidal creeks and ditches (Service 2013). *Cirsium hydrophilum* var. *hydrophilum* is pollinated by a variety of insect groups, including butterflies, bees, and other insects (Schneider 2013). Service (2013) discusses the tidal marsh ecosystems of northern and central California and Moyle *et al.* (2014) discusses the Suisun Marsh ecosystem, including its geography, geology, hydrology and historical ecology.

Taxonomy:

Cirsium hydrophilum var. *hydrophilum* was first described by Greene (1892) as *Carduus hydrophilus*. This nomenclature was subsequently changed to *Cirsium vaseyi* var. *hydrophilum*, then *Cirsium hydrophilum*, and eventually described as *Cirsium hydrophilum* var. *hydrophilum* (Howell 1949, 1970; Jepson 1925; Munz and Keck 1959; Munz 1968, Mason 1969). Since the late 1960’s there appears to be a reasonable consensus in the botanical taxonomic community that this variety should continue to be considered *Cirsium hydrophilum* var. *hydrophilum*. Fiedler *et al.* (2007), Service (2013), and Vasey *et al.* (2020) provide more detailed discussions of the taxonomic history of this variety.



Image A

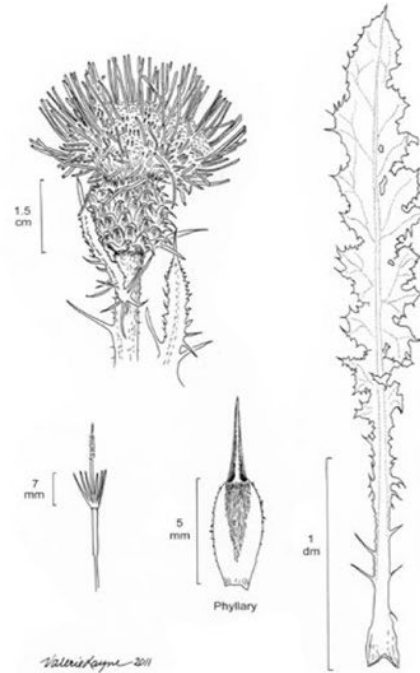


Image B

Figure 1. Images of representative *Cirsium hydrophilum* var. *hydrophilum* (Suisun thistle). Image A shows the flower head in context; Image B shows a drawing of the various plant structures. (Image A by Doug Wirtz; Image B by Valerie Layne, USFWS).



Map A - California



Map B – Suisun Marsh

Figure 2. Maps of the location of Suisun Marsh, which is the location of *Cirsium hydrophilum* var. *hydrophilum* (Suisun thistle) populations. Map A shows the approximate location of Suisun Marsh (black star) in the state of California; Map B shows the Suisun Marsh relative to the adjacent cities and other landmarks.

INFORMATION ON THE SPECIES AND ITS STATUS:

Population status and trends:

Cirsium hydrophilum var. *hydrophilum* is only known from Suisun Marsh in northern California and has a very restricted distribution (Service 1997, 2009, 2013). At the time of listing (Service 1997) only two populations were known, the Rush Ranch population and the Peytonia Slough Ecological Reserve population (Service 1997, 2009). Figure 3 shows the locations of the known populations of *Cirsium hydrophilum* var. *hydrophilum*. Contemporary estimates placed the total acreage of these two populations at less than 1 acre. As more surveys were conducted, four possible populations were identified (Service 2009; Figure 3): (1) the Rush Ranch population, which was considered the largest population in terms of spatial extent; (2) the Grizzly Island population, which was documented on the Joice Island portion of Grizzly Island and was considered to potentially be part of the larger and adjacent Rush Ranch population; (3) the Peytonia Slough population, which was small and well-removed from the Rush Ranch population; and (4) the Hill Slough population, which was also small and well-removed from the Rush Ranch population. These populations were all associated with the upper reaches of tidal marsh within the Suisun Marsh. Suitable habitat may exist on some portions of adjacent private lands (Service 1997, 2009). An extensive survey of Rush Ranch in 2003 concluded that *Cirsium hydrophilum* var. *hydrophilum* was distributed across the study area and consisted of approximately 8.5 acres (LCLA 2003). At the time of this 5-year review, the Service concluded that the known occurrences of *Cirsium hydrophilum* var. *hydrophilum* likely consist of three distinct populations (Service 2009, 2013; Vasey *et al.* 2020) including the Rush Ranch, Peytonia Slough, and Hill Slough populations (Figure 3).

In Greene's original description of what became known as *Cirsium hydrophilum* var. *hydrophilum*, he described the plant as "very common" in Suisun Bay (Greene 1892, pp. 357). However, by the 1950's *Cirsium hydrophilum* var. *hydrophilum* was much less common and from the early 1960's through 1975 it was not documented and considered possibly extinct (Service 1997). At the time of listing in 1997, it was estimated by one expert that the total population of *Cirsium hydrophilum* var. *hydrophilum* likely consisted of a few thousand plants (Service 1997). In 2003, LCLA (2003) conducted extensive surveys of the Rush Ranch population and estimated the population size at 137,500, but this survey resulted in a broad range of estimates from 22,300 to 873,200. In 2018, Bjerke (2018) conducted a survey of *Cirsium hydrophilum* var. *hydrophilum* at the Grizzly Island Wildlife Area, Peytonia Slough Ecological Reserve, and Hill Slough Wildlife Area, searching the Peytonia Slough area using kayaks and the other areas on foot; surveys were not conducted in Rush Ranch Open Space. This survey resulted in a total count of roughly 550 plants. In 2019, Bjerke (2019) conducted a similar survey of *Cirsium hydrophilum* var. *hydrophilum* at the Joice Island unit of the Grizzly Island Wildlife Area and Hill Slough Wildlife Area. This survey resulted in a total count of 209 plants. Since *Cirsium hydrophilum* var. *hydrophilum* was listed as endangered (Service 1997), surveys have not been regularly conducted, and when they have been performed, there has been a lack of consistency in the location, timing, and methods used to conduct surveys. Figure 4 shows counts associated with *Cirsium hydrophilum* var. *hydrophilum* surveys conducted at each population and a total of these counts for each year from 1980–2021.

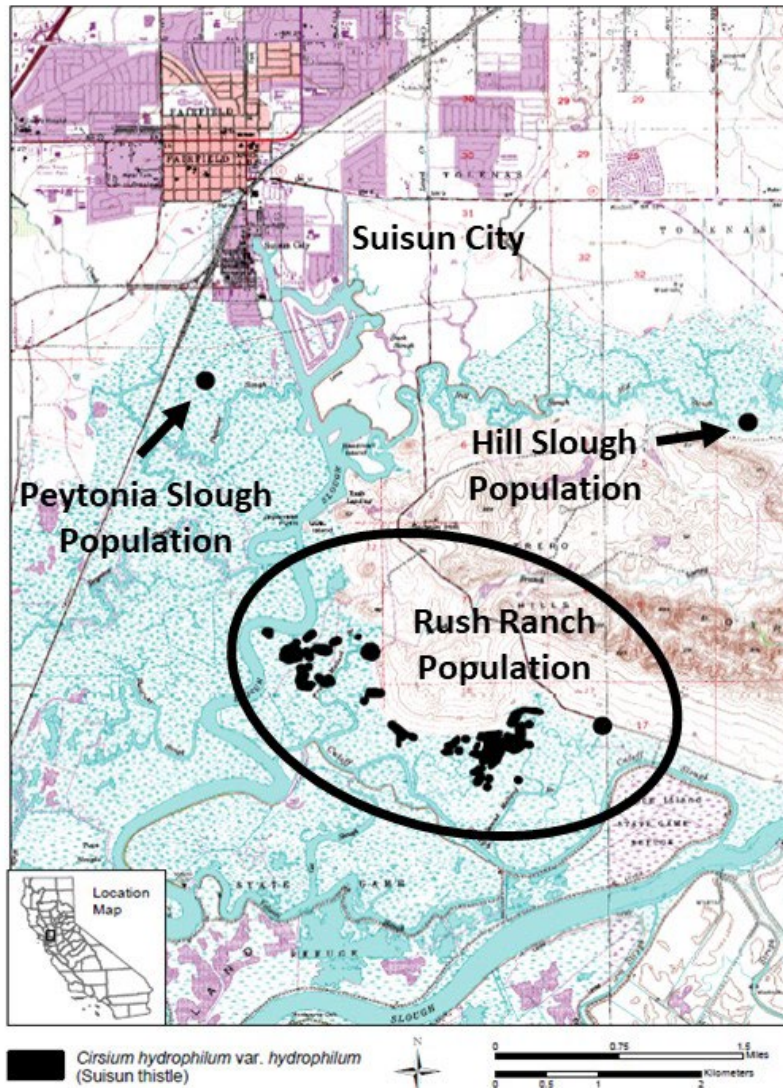


Figure 3. Locations of *Cirsium hydrophilum* var. *hydrophilum* occurrences as documented in Service (2013). This figure is adapted from Figure II-2 of Service (2013, pp. 59). Black circles represent locations where *Cirsium hydrophilum* var. *hydrophilum* have been documented. A label for each population has been added to show the names and approximate locations associated with each population. See text for more information.

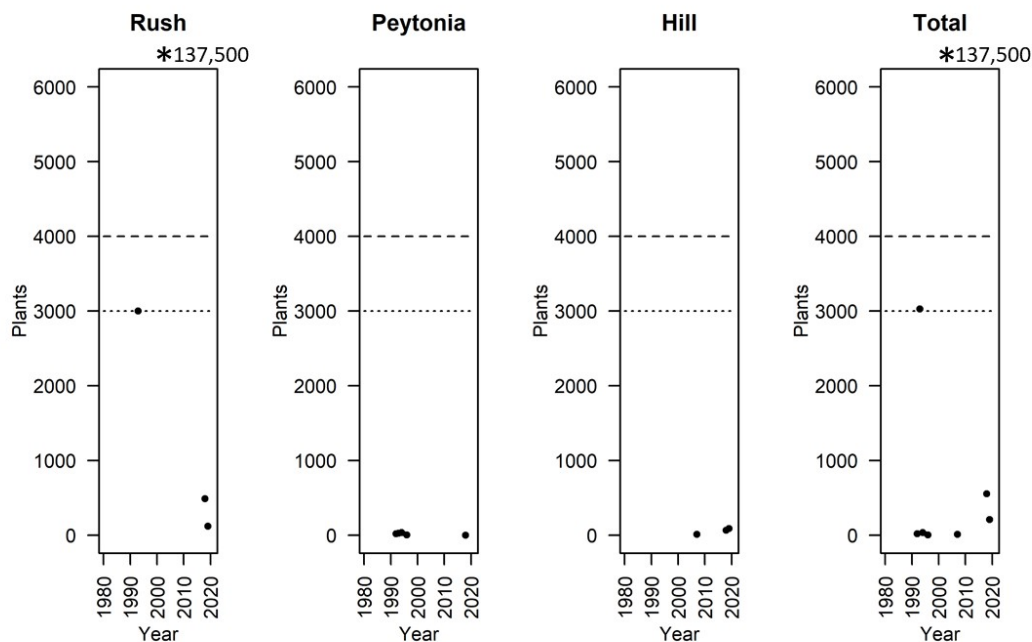


Figure 4. Counts associated with *Cirsium hydrophilum* var. *hydrophilum* (Suisun thistle) surveys conducted at each population area and a total of these counts for each year from 1980–2021. Black dots indicate the number of plants counted for a given year and population. Because of large gaps in the years surveys were conducted, moving 5-year averages could not be calculated and plotted. The dotted line indicates the downlisting criteria of 3,000 plants in total for all populations, and the dashed line indicates the delisting criteria of 4,000 plants in total for all populations (Service 2013). The asterisk (*) above the Rush and Total plots at approximately 2003 represents the estimated count of 137,500 for the year 2003 (LCLA 2003). Abbreviations: Rush = Rush Ranch population; Peytonia = Peytonia Slough population; Hill = Hill Slough population; Total = the total of the Rush, Peytonia, and Hill populations. See text for more information.

Analysis of threats and stressors under the five factors:

This section contains a review of the five factors and specific threats and stressors known to impact *Cirsium hydrophilum* var. *hydrophilum*. Information was synthesized from prior Service documents, including *Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Service 2013); the most recent 5-year review (Service 2009); papers from scientific journals; graduate student research; unpublished agency reports; other unpublished resources; and personal communications with biologists with expertise in this species and tidal marsh ecology. A section for each of the five factors specified in the Act is included. Some of these sections include subsections describing important threats and stressors.

Factor A: Present or threatened destruction, modification, or curtailment of habitat or range

Habitat loss, degradation, and fragmentation—Human settlement of the San Francisco Bay and Sacramento–San Joaquin River Delta region since the mid-1800s has had substantial influences

on tidal marsh ecosystems in northern and central California (Lund *et al.* 2007, Moyle *et al.* 2014) and on the Suisun Marsh (Service 2013, Moyle *et al.* 2014). These changes have resulted in habitat loss and conversion of tidal marsh to wetlands lacking tidal influence, and a reduction of habitat at the interface of high marsh and upland zones (Service 2013, Vasey *et al.* 2020). These modifications to the historic habitat at Suisun Marsh have also resulted in substantial changes to hydrologic processes and patterns of salinity (Service 2013, 2019). Likewise, the extensive development of dikes and other human structures has fragmented the native habitat in Suisun Marsh, introducing barriers to dispersal and reducing gene-flow among sub-populations of *Cirsium hydrophilum* var. *hydrophilum*.

Invasive species—In recent years biologists and managers have become increasingly concerned about habitat degradation caused by invasive and introduced plant and insect species on *Cirsium hydrophilum* var. *hydrophilum*. Non-native plants such as *Lepidium latifolium* (perennial pepperweed) and *Cirsium vulgare* (bull thistle) compete with and can negatively impact *Cirsium hydrophilum* var. *hydrophilum* (Schneider 2013, Service 2013, Vasey *et al.* 2020). Biologists have also expressed concerns about the potential hybridization of *Cirsium vulgare* with *Cirsium hydrophilum* var. *hydrophilum* (Service 2013), but other biologists concluded that such hybridization is very unlikely (see Vasey *et al.* 2020). Non-native thistle weevils (*Rhinocyllus conicus*) and other weevils prey upon the seeds and rosettes of *Cirsium hydrophilum* var. *hydrophilum* (Herr 2004, Service 2013, Vasey *et al.* 2020).

Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

Overutilization for commercial, recreational, scientific, or educational purposes has not been considered a significant threat to *Cirsium hydrophilum* var. *hydrophilum* and is not currently considered a substantial threat to this subspecies (Service 1997, 2013).

Factor C: Disease and predation

Plant diseases and predation by birds and animals have not been identified as a significant threat to *Cirsium hydrophilum* var. *hydrophilum* (Service 2013). Non-native thistle weevils (*Rhinocyllus conicus*) and other weevils prey upon the seeds and rosettes of *Cirsium hydrophilum* var. *hydrophilum* and can have negative impacts (Herr 2004, Service 2013, Vasey *et al.* 2020).

Factor D: Inadequacy of existing regulatory mechanisms

Service (1997, 2013) reviewed the federal regulatory mechanisms related to *Cirsium hydrophilum* var. *hydrophilum*, which include: the Act, which includes the listing of *Cirsium hydrophilum* var. *hydrophilum* as an endangered species; the Clean Water Act; and the National Environmental Policy Act. State of California regulatory mechanisms related to *Cirsium hydrophilum* var. *hydrophilum* were also reviewed, which include: the California Endangered Species Act and the California Environmental Quality Act. *Cirsium hydrophilum* var. *hydrophilum* is not currently listed as a threatened or endangered plant species by the state of California (<https://wildlife.ca.gov/Conservation/Plants/Endangered>). The three known populations of *Cirsium hydrophilum* var. *hydrophilum* occur on properties owned and managed

by the California Department of Fish and Wildlife and the Solano Land Trust and would be subject to the above applicable regulatory mechanisms. *Cirsium hydrophilum* var. *hydrophilum* may occur on privately owned properties near these three populations and regulatory mechanisms are in place that apply to state and federal actions that may be proposed on privately owned properties. The Service is not aware of regulatory mechanisms associated with Solano County or the adjacent cities of Suisun City, Fairfield, or other municipalities that specifically relate to *Cirsium hydrophilum* var. *hydrophilum*.

Factor E: Other natural or manmade factors affecting continued existence

Wildfire—Wildfires occur at Suisun Marsh that are started unintentionally, and perhaps intentionally, by unauthorized visitors and other sources (Service 2013, Moyle *et al.* 2014). These wildfires can have negative consequences for *Cirsium hydrophilum* var. *hydrophilum* populations. Service (2013) briefly discusses the possible influences of wildfires on *Cirsium hydrophilum* var. *hydrophilum*. Gilless and Smith (2012) considered how collaboration and planning among stakeholders, along with associated educational efforts, can reduce the occurrence and impacts of wildfires. However, unintended fires at Suisun Marsh can be difficult to prevent on relatively small and fragmented properties associated with *Cirsium hydrophilum* var. *hydrophilum* population.

Disturbance by large mammals—Historical accounts suggest that, prior to modern human settlement, pronghorn (*Antilocapra americana*), mule deer (*Odocoiles hemionus*), tule elk (*Cervus canadensis nannodes*), and grizzly bear (*Ursus arctos*) frequented Suisun Marsh (Moyle *et al.* 2014) and that *Cirsium hydrophilum* var. *hydrophilum* would have co-occurred with these animals. These large mammals would likely have intermittently disturbed vegetation and soil, and would have added nutrients to the ecosystem—benefiting the variety. It seems likely, based on Greene’s (1892, pp. 357) description of *Cirsium hydrophilum* var. *hydrophilum* being “very common” at Suisun Marsh, that this plant has the potential to co-occur with some large mammal species. Nevertheless, biologists have expressed concerns about the impacts of feral pigs (*Sus scrofa*) and cattle (*Bos taurus*) on *Cirsium hydrophilum* var. *hydrophilum*, especially given the small population sizes of this variety (Service 2013, Bjerke 2019). Some biologists have suggested that these mammals could be beneficial to *Cirsium hydrophilum* var. *hydrophilum* seeds and seedlings by creating disturbances of the vegetation that result in increased light availability for seedling (Schneider 2013). This is a question that would benefit from more research.

Changing climate conditions—Biologists, ecologists, and managers are just beginning to investigate how changing weather, climate, and water resource conditions in western North America might influence native thistle distributions and populations, including *Cirsium hydrophilum* var. *hydrophilum*. Scientists and managers involved in Suisun Marsh conservation have considered the possible influences of changing future climate and hydrological conditions on this tidal marsh ecosystem (Schneider 2013, Service 2013, 2019; Moyle *et al.* 2014; Vasey *et al.* 2020). These changes may include an increasing sea-level; changes in the volume of suspended sediment; water salinity; and the location and dimensions of the transition zone between tidal wetland and upland areas. Changes in ambient temperature and precipitation

patterns associated with a changing climate in Northern California also have the potential to affect *Cirsium hydrophilum* var. *hydrophilum*. For example, more frequent and longer droughts and abnormally high heat events have the potential to reduce germination and seedling recruitment rates, and potentially result in higher levels of mortality in some life stages of plants (Vasey *et al.* 2020). Changes in temperature and precipitation patterns in the future also have the potential to change plant and insect diversity, abundance, spatial distribution, and phenology, all of which could in turn have cascading influences on *Cirsium hydrophilum* var. *hydrophilum* populations. Changes in temperature and precipitation patterns may also influence the frequency and intensity of wildlife in the Suisun Marsh. However, the potential impacts of a changing climate on *Cirsium hydrophilum* var. *hydrophilum* are complex and challenging to predict. This is an area of research that will benefit from increased attention in the future.

Information acquired since the last status review:

The Service compiled survey reports, research, and documents related to *Cirsium hydrophilum* var. *hydrophilum* completed since the last 5-year review (Service 2009). This included documents produced by species experts, researchers, and graduate students who have previously participated in research and monitoring related to *Cirsium hydrophilum* var. *hydrophilum*. A literature search, a review of information in Service files, and outreach to biologists who have experience with this species (e.g., Bloom 2021) were also conducted. Information acquired since the last status review is summarized below. Each section represents a substantive source of new information that the Service considered during this review.

Schneider master's thesis (2013)

Schneider (2013) studied the reproductive output of *Cirsium hydrophilum* var. *hydrophilum* and the impacts of invasive *Lepidium latifolium* (perennial pepperweed) on *Cirsium hydrophilum* var. *hydrophilum*. This study included an analysis of seed set and predation, seed dispersal, seed germination, soil properties, and influence of *Lepidium latifolium* removal. The study also considered the impacts of changing climate in the San Francisco Bay area, including potential changes in hydrologic regimes and salinity. This research focused on areas at First Mallard Slough that contained both *Cirsium hydrophilum* var. *hydrophilum* and *Lepidium latifolium*. Schneider concluded that invasive *Lepidium latifolium* has the potential to negatively impact *Cirsium hydrophilum* var. *hydrophilum* through competition for light and nutrients, changes in soil chemistry, and via interference with reproductive output and recruitment. Schneider speculated that low genetic diversity in *Cirsium hydrophilum* var. *hydrophilum* could contribute to reduced reproductive output.

Tidal marsh recovery plan (Service 2013)

In 2013, a comprehensive recovery plan was published for tidal marsh species in northern and central California (Service 2013). This recovery plan includes an introduction to the tidal marsh ecosystems of California; species accounts for the five species listed under the Act, including *Cirsium hydrophilum* var. *hydrophilum*; recovery strategies for the various species and recovery units covered by the plan, including a species-specific recovery strategy for *Cirsium hydrophilum* var. *hydrophilum*.

Bjerke survey reports (2018–2019)

Bjerke (2018, 2019) conducted surveys during August for *Cirsium hydrophilum* var. *hydrophilum* on California Department of Fish and Wildlife (CDFW) properties. The 2018 and 2019 surveys both documented and mapped *Cirsium hydrophilum* var. *hydrophilum* populations at the Grizzly Island Wildlife Area and the Hill Slough Wildlife Area. Survey counts in 2019 were substantially lower than in 2018. Surveys were also conducted at the Peytonia Slough Ecological Reserve, but *Cirsium hydrophilum* var. *hydrophilum* was not documented at this site.

Vasey et al. report (2020)

In 2020, Vasey and colleagues completed an evaluation of the challenges associated with possible reintroduction of *Cirsium hydrophilum* var. *hydrophilum* into areas of Suisun Marsh. This report also describes research projects conducted by students at San Francisco State University. These projects included describing the habitat characteristics of locations occupied by *Cirsium hydrophilum* var. *hydrophilum*, an analysis of seed production and seedling survival, an analysis of the genetics of *Cirsium hydrophilum* var. *hydrophilum* populations, and development of a preliminary species distribution model for *Cirsium hydrophilum* var. *hydrophilum*.

RECOVERY CRITERIA:

The U.S. Fish and Wildlife Service uses recovery criteria to measure the progress made towards reducing or removing threats to a given endangered or threatened species. These recovery criteria are not binding when deciding to downlist or delist a given species, but they do provide guidance in making these decisions (for more information, see *Friends of Blackwater v. Salazar*, U.S. Court of Appeals, District of Columbia, 2012). The *Recovery Plan for Tidal Marsh Ecosystems of Northern and Southern California* (Service 2013) include objective, measurable criteria as required by the Act (section 4(f)(1)(B)(ii)) and as directed by the *Department of Interior's Strategic Plan for Fiscal Years 2018-2022* (DOI 2018). This recovery plan (Service 2013) describes the recovery criteria for downlisting *Cirsium hydrophilum* var. *hydrophilum* from endangered to threatened status, and delisting criteria for this species. The recovery criteria to downlist *Cirsium hydrophilum* var. *hydrophilum* from endangered to threatened, or to delist are shown in Table 1. See Service (2013) for a detailed description of these criteria.

No.	Code	Brief Description	Units/Approach	Current Status	Downlist Criteria	Delist Criteria
1	A/1	Area inhabited (acres)	Acres	Not completed	2,000 acres over 5 years	3,000 acres over 8 years
2	A/2	Area preserved (acres)	Acres	Not completed	4,000 acres	6,000 acres
3	A/3	<i>Lepidium latifolium</i> area (%)	%	Not completed	< 10% of cover over 5 years	< 10% cover over 5 years and an ED&C plan
4	A/4	Tidal marsh restored	Qualitative assessment	Not completed	Restoration at Hill Slough and Rush Ranch	Restoration at Hill Slough and Rush Ranch
5	A/5	Propagation and reintroduction methods	Qualitative assessment	Not completed	N/A	Methods developed and available
6	A/6	Elimination of feral pig damage	Qualitative assessment	Not completed	N/A	Completed
7	C/1	Thistle weevil predation pressure	To be determined	Not determined	N/A	Does not affect population persistence
8	E/1a	Number of populations	Integer value	2 or 3 populations (this review).	≥ 3 populations or 1 large population	≥ 4 populations or 1 large population
9	E/1b	Number of individuals from full census	Integer value	The most recent survey on CDFW lands counted 209 individuals (Bjerke 2019).	Mean of ≥ 3,000 over 5 years (≥ 5,000 if < 3 population)	Mean of ≥ 4,000 over 5 years (≥ 7,000 if 1 population)
10	E/1c	Minimum number of individuals from full census	Integer value	The most recent survey on CDFW lands counted 209 individuals (Bjerke 2019).	≥ 800 over 2 years	≥ 1,000 over 2 years
11	E/2	Seed banking	Qualitative assessment	Not completed	N/A	Completed
12	E/3	Research on hybridization	Qualitative assessment	Not completed	N/A	Completed, and monitoring plan in place if necessary
13	E/4	Spill response plan	Qualitative assessment	Not completed	N/A	Revised
14	E/5	Marsh upland preservation	Qualitative assessment	Not completed	N/A	Completed

Table 1. Downlist and delist criteria for *Cirsium hydrophilum* var. *hydrophilum*. These downlist and delist criteria listed are abbreviations of the criteria listed in Service (2013). See that document for more information and details on each downlist and delist criteria. Abbreviations: ED&C = Early Detection and Control.

CONCLUSION:

The Service used several guiding principles and practices (Smith *et al.* 2018) when evaluating the current and potential future conditions of *Cirsium hydrophilum* var. *hydrophilum*, and in considering whether to downlist or delist this variety. A core consideration in this decision was the current resiliency, redundancy, and representation of the subspecies (Smith *et al.* 2018). The resiliency of *Cirsium hydrophilum* var. *hydrophilum* refers to the ability of this variety to continue to maintain viable populations when exposed to environmental and demographic stochasticity, such as that associated with typical variation in climate and weather conditions at Suisun Marsh, and in the reproductive and survival rates of the plants in the various populations. Redundancy refers to the ability of *Cirsium hydrophilum* var. *hydrophilum* to withstand catastrophic events that have the potential to cause the extinction of one or more populations of plants, but that would not be expected to cause the extinction of the variety, so long as there are multiple populations distributed in geographic space with suitable distance among populations. Representation refers to the ability of *Cirsium hydrophilum* var. *hydrophilum* to adapt to changes in environmental conditions that might plausibly occur at Suisun Marsh and nearby locations. The Service assumes that genetic diversity and/or diversity among populations that are physiologically or behaviorally adapted to a variety of environmental conditions would improve the viability of the variety.

Meeting the downlist or delist criteria for *Cirsium hydrophilum* var. *hydrophilum* described in Service (2013) would promote relatively high resilience, redundancy, and representation for this variety, especially if three or more populations are maintained and each of these populations consists of a reasonably high number of individuals. Downlist criteria specify that there should be at least three separate populations (or one large population) of *Cirsium hydrophilum* var. *hydrophilum*, with a 5-year average of 3,000 or more individuals (or 5,000 or more individuals if there is one large population) with no less than 800 individuals in a population. Currently, there are no populations of *Cirsium hydrophilum* var. *hydrophilum* with a 5-year average of over 800 individual plants, and the total population count has not exceeded the downlist threshold of 3,000 plants since 2003.

Survey work in the early 2000s suggest that *Cirsium hydrophilum* var. *hydrophilum* populations at Suisun Marsh have the potential to exhibit population sizes well above 3,000 individuals (L. C. Lee & Associates 2003). The Tidal Marsh Recovery Implementation Team is continuing to work on restoring habitat at Suisun Marsh and improve the resiliency, redundancy, and representation of *Cirsium hydrophilum* var. *hydrophilum* populations. However, it remains unclear how *Cirsium hydrophilum* var. *hydrophilum* populations will respond to these restoration efforts and there remains a long road to recovery for this plant. It appears likely that *Cirsium hydrophilum* var. *hydrophilum* will require several more decades of concerted conservation and recovery efforts to meet or exceed the recovery criteria and exhibit the resilience, redundancy, and representation needed to consider downlisting to Threatened status (or, ultimately, delisting).

Thus, after reviewing the best available scientific information, the Service concludes that *Cirsium hydrophilum* var. *hydrophilum* remains an endangered species. The evaluation of threats affecting *Cirsium hydrophilum* var. *hydrophilum* under the factors in 4(a)(1) of the Act and analysis of the status of this plant variety in our most-recent 5-year review (Service 2009) remains an accurate reflection of the current status of *Cirsium hydrophilum* var. *hydrophilum*.

RECOMMENDATIONS FOR FUTURE ACTIONS:

Several areas of future action over the next five years are suggested, which build on the actions articulated in Service (2013) and the tidal marsh ecosystem sections of Service (2019a, 2019b).

Consider developing, reviewing and implementing the following survey and monitoring plans:

- A range-wide *Cirsium hydrophilum* var. *hydrophilum* survey and monitoring plan. This plan would include locations to be surveyed; the group(s) responsible for coordinating surveys; survey timing including the month(s) surveys are to be conducted; and the frequency of surveys (e.g., annually vs. every three years). These surveys should be conducted by well-trained individuals capable of reliably identifying *Cirsium hydrophilum* var. *hydrophilum*, should be reproducible, and should provide at a minimum the following information: an estimated population size with confidence interval(s); the number and locations of known populations; an estimate of the area inhabited by *Cirsium hydrophilum* var. *hydrophilum* (acres); and an estimate of the area inhabited by *Cirsium hydrophilum* var. *hydrophilum* that occurs on preserved properties (acres).
- A *Lepidium latifolium* survey and monitoring plan for areas occupied by *Cirsium hydrophilum* var. *hydrophilum*. This would include locations to be surveyed; the group(s) responsible for coordinating surveys; survey timing including the month(s) surveys are to be conducted; and the frequency of surveys. These surveys should be reliable and reproducible and at a minimum provide an estimate of the percent of the total distribution of *Cirsium hydrophilum* var. *hydrophilum* in which *Lepidium latifolium* also occurs.
- A range-wide thistle weevil predation pressure monitoring plan for *Cirsium hydrophilum* var. *hydrophilum*. This plan would include information about how predation pressure will be estimated, the group(s) responsible for coordinating monitoring, and locations to be monitored including the timing and frequency of predation pressure surveys.
- A feral pig and cattle damage monitoring plan to evaluate the extent of feral pig and cattle damage to *Cirsium hydrophilum* var. *hydrophilum* populations. This plan would include information about how feral pig and cattle activity and damage will be monitored, the group(s) responsible for coordinating surveys, locations to be surveyed for damage including survey timing, and the frequency of damage surveys.

Consider developing and implementing the following *Cirsium hydrophilum* var. *hydrophilum* restoration actions:

- A tidal marsh restoration plan for *Cirsium hydrophilum* var. *hydrophilum*, and complete the actions that are achievable within 5 years.
- An upland marsh restoration plan for *Cirsium hydrophilum* var. *hydrophilum*, and complete the actions that are achievable within 5 years.
- A propagation and reintroduction plan for *Cirsium hydrophilum* var. *hydrophilum*, and complete the actions that are achievable within 5 years.
- A seed banking plan for *Cirsium hydrophilum* var. *hydrophilum*, and complete the actions that are achievable within 5 years.

Other future actions to consider include continued research on the habitat requirements and seed bank dynamics of *Cirsium hydrophilum* var. *hydrophilum*, which may lead to helpful information and insights in guiding long-term recovery efforts, including identifying areas for possible development of new populations of *Cirsium hydrophilum* var. *hydrophilum* within Suisun Marsh. This future work could include an analysis of how environmental variables, such as precipitation and temperature patterns, and seeding and out-planting influence population dynamics in currently occupied areas and colonization of newly restored areas. A study of the current pollinators of *Cirsium hydrophilum* var. *hydrophilum* would help add to the Service's understanding of the natural history of this plant and identify which potential pollinators, or groups of pollinators, to monitor to ensure that healthy and diverse pollinator populations continue to occur.

Statistical and numerical modeling, such as with habitat suitability analysis and population dynamics modeling, can provide insights into possible locations to search for unknown populations of *Cirsium hydrophilum* var. *hydrophilum* and for identifying future locations for development of new populations, and future dynamics of these populations. Vasey *et al.* (2020) began developing a species distribution model for *Cirsium hydrophilum* var. *hydrophilum*. It is possible that a continuation of this line of investigation will lead to improved insights into where and how to develop additional areas that will support the recovery of *Cirsium hydrophilum* var. *hydrophilum*. It may also be useful to consider developing population viability analyses (PVA) that are specifically developed for *Cirsium hydrophilum* var. *hydrophilum*. For example, it is possible that a stage-structured matrix population model similar to the model developed by Thomson (2005; also see Gotelli 2001, Kéry and Schaub 2012) could be used to form a foundation for PVA analysis. It is also possible that building and parameterizing such a model, and then projecting this model into various possible futures, including under the influence of changing climate and hydrology conditions, could help provide useful insights. As part of efforts to improve statistical analysis and modeling, creating a well-vetted and archived dataset of all *Cirsium hydrophilum* var. *hydrophilum* surveys, and resolving any discrepancies in counts identified during this review will be critical to progressing on this objective.

The San Francisco Bay-Delta Fish and Wildlife Office has convened a recovery implementation team (RIT) to focus on the listed tidal marsh species described in Service (2013), including *Cirsium hydrophilum* var. *hydrophilum*. The primary goal of this group is to encourage Service biologists, managers and external experts to collectively consider recovery priorities for these species and tidal marsh ecosystems in northern and central California, and continue to stay abreast of emerging research related to *Cirsium hydrophilum* var. *hydrophilum* and related tidal marsh taxa, tidal marsh ecology, and other relevant topics. This group could help develop a recovery implementation strategy for *Cirsium hydrophilum* var. *hydrophilum*, which would strive to articulate relatively short-term recovery goals (e.g., on a 2-3 year time horizon) related to the long-term recovery criteria discussed in detail above and in Service (2013).

Donald Ratcliff, Project Leader, San Francisco Bay-Delta Fish and Wildlife Office, U.S. Fish and Wildlife Service

Approve _____

LITERATURE CITED:

- Bjerke, J. 2018. Suisun Marsh thistle summary of site visits. California Department of Fish and Wildlife (CDFW) file report, Native Plant Program.
- Bjerke, J. 2019. Suisun Marsh thistle summary of site visits. California Department of Fish and Wildlife (CDFW) file report, Native Plant Program.
- Fiedler, P. L., M. E. Keever, B. J. Grewell, and D. J. Partridge. 2007. Rare plants in the Golden Gate Estuary (California): the relationship between scale and understanding. *Australian Journal of Botany* 55:206-220.
- Gilless, F. K., and R. C. Smith. 2012. Management response to eroding wildland buffers between developed and protected areas through education and collaborative planning efforts. *The George Wright Forum* 29:236–245.
- Gotelli, N. J. *A primer of ecology*, third edition. Sinauer Associates, Inc., Sunderland, Massachusetts.
- Greene, E.L., 1892. *Eclogæ botanicæ*, No. 1. Proceedings of the Academy of Natural Sciences of Philadelphia, 357–365.
- Herr, J. C. 2004. Non-target impact of the weed biological control agent *Rhinocyllus conicus* on rare native California thistles in the genus *Cirsium*. PhD dissertation, University of California, Berkeley.
- Keil, D. J. 2012, *Cirsium hydrophilum* var. *hydrophilum*, in Jepson Flora Project (eds.) Jepson eFlora, https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=7061, accessed on July 08, 2021.
- Kéry, M., and M. Schaub. 2012. Bayesian population analysis using WinBUGS: a hierarchical perspective. Academic Press, Boston, Massachusetts.
- L. C. Lee & Associates [LCLA]. 2003. Geographic distribution and population parameters of the endangered Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*) at Rush Ranch in Solano County, California, Final Report. Prepared for Solano County Water Agency.
- Lund, J., E. Hanak, W. Fleenor, R. Howitt, J. Mount, and P. Moyle. 2007. Envisioning futures for the Sacramento-San Joaquin Delta. Public Policy Institute of California, San Francisco.
- Moyle, P. B., A. D. Manfree, and P. L. Fielder, editors. 2014. Suisun Marsh: ecological history and possible futures. University of California Press, Berkeley.
- Schneider, R.S. 2013. Investigating rarity in an endemic wetland thistle. Master's thesis, San Francisco State University, San Francisco, CA.

- Smith, D. R., N. L. Allan, C. P. McGowan, J. A. Szymanski, S. R. Oetker, and H. M. Bell. 2018. Development of a species status assessment process for decisions under the U.S. Endangered Species Act. *Journal of Fish and Wildlife Management* 9:1–19.
- Thomson, D. M. 2005. Matrix models as a tool for understanding invasive plant and native plant interactions. *Conservation Biology* 19:917–928.
- U.S. Department of Interior [DOI]. 2018. Department of Interior’s Strategic Plan for Fiscal Years 2018-2022. Washington, D.C.
- U.S. Fish and Wildlife Service [Service]. 1997. Endangered and threatened wildlife and plants; determination of endangered status for two tidal marsh plants—*Cirsium hydrophilum* var. *hydrophilum* (Suisun Thistle) and *Cordylanthus mollis* ssp. *mollis* (Soft Bird’s-Beak) from the San Francisco Bay area of California. *Federal Register* Volume 62, number 224:16916–16925.
- U.S. Fish and Wildlife Service [Service]. 2009. *Cirsium hydrophilum* var. *hydrophilum* (Suisun thistle), 5-year review: summary and evaluation. Sacramento Fish and Wildlife Office, California. https://ecos.fws.gov/docs/five_year_review/doc5789.pdf
- U.S. Fish and Wildlife Service [Service]. 2013. Recovery plan for tidal marsh ecosystems of northern and central California. Region 8, Sacramento, California.
- U.S. Fish and Wildlife Service [Service]. 2019a. Natural resource management plan for the San Francisco Bay National Wildlife Refuge Complex. Pacific Southwest Region, Sacramento, California.
- U.S. Fish and Wildlife Service [Service]. 2019b. San Francisco Bay National Wildlife Refuge Complex inventory and monitoring plan. Pacific Southwest Region, Sacramento, California.
- Vasey, M., *et al.* 2020. A preliminary evaluation of reintroduction potential for the endangered Suisun Thistle (*Cirsium hydrophilum* var. *hydrophilum*). Report submitted to San Francisco Bay-Delta Fish and Wildlife Office, Sacramento, California.

Personal communication:

- Bloom, V. 2021. San Francisco Bay-Delta Fish and Wildlife Office, U.S. Fish and Wildlife Service, Sacramento, California. March 25, 2021.