5-YEAR REVIEW
Fountain thistle (*Cirsium fontinale* var. *fontinale*)

GENERAL INFORMATION:

Species: Fountain thistle (*Cirsium fontinale* var. *fontinale*)
Date listed: February 3, 1995
Federal Register (FR) citation: 60 FR 6671
Classification: Endangered

State Listing:
Fountain thistle was listed by the State of California as endangered in 1979.

BACKGROUND:

Most recent status review:

(Service) U.S. Fish and Wildlife Service. 2010. *Acanthomintha obovata* ssp. *duttonii* (San Mateo thornmint), *Cirsium fontinale* ssp. *fontinale* (fountain thistle), *Pentachaeta bellidiflora* (white-rayed pentachaeta) 5- Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Sacramento, California. 35 pp.

We did not recommend a status change in the 2010 status review.

FR notice citation announcing this status review:

U.S. Fish and Wildlife Service. 2020. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 66 Species in California and Nevada. Federal Register 85:4692-4694.

We did not receive any information from the public in response to the Federal Register Notice announcing this 5-year review.

ASSESSMENT:

Information acquired since the last status review:

This 5-year review was conducted by the U.S. Fish and Wildlife Service's (Service) Sacramento Fish and Wildlife Office. We solicited data for this review from interested parties through a Federal Register notice announcing this review on January 27, 2020 (Service 2020). We also contacted subspecies experts, performed a literature search, reviewed information from our own files, and obtained data from an occurrence search of the California Natural Diversity Database (Diversity Database) maintained by the California Department of Fish and Wildlife.

Since the last 5-year review, new information has become available related to species management, a reintroduction effort, and habitat restoration. The San Francisco Public Utilities Commission (SFPUC) has implemented a management plan for fountain thistle at the Crystal Springs population to compensate for fountain thistle that will be inundated by raising the Crystal Springs Reservoir (SFPUC 2013, Appendix C). More information related to the raising of Crystal Springs Reservoir

can be found in the **Threats** section below. SFPUC has also undertaken efforts to reestablish a fountain thistle population on a property called the Triangle (Simono *in litt.* 2021a, p. 2) (see **Distribution and Abundance**). The Triangle was one of three population locations at the time of listing, but that original population had been extirpated by the time of our last status review (Service 2010, p. 7). Finally, habitat restoration work completed at two population locations in 2012 (Niederer and Elliott 2012, p. 2) resulted in an increase of fountain thistle numbers at both locations (Service 2019, p. 21).

Distribution and Abundance

At the time of listing in 1995, three occupied locations of fountain thistle were known, all in San Mateo County, California (Service 1995, p. 6674). One population with 1,000 to 2,800 plants was just east of Crystal Springs Reservoir; another with 100 to 200 plants was in a property called "the Triangle," just west of the Edgewood County Park and Natural Reserve ("Edgewood Park"); and a third, consisting of a single plant, was in Edgewood County Park itself. In this status review, we may refer to such occupied locations as "occurrences," which is a term the Diversity Database has defined to mean a group of the species of interest, separated from other such groups by at least 0.25 mile (mi) (Diversity Database 2020, p. 11). We consider separate fountain thistle occurrences to be separate populations for purposes of meeting recovery goals.

By the time of our last status review in 2010, the populations at the Triangle and Edgewood Park had been extirpated, but new populations had been found farther south in San Mateo County at Stulsaft Park in Redwood City, and near Woodside Glens, a neighborhood in the town of Woodside (Service 2010, p. 7). At that time, the Crystal Springs population consisted of about 25,000 plants (Service 2010, pp. 6–7) and based on counts from 2007 and 2003, respectively, Stulsaft Park was considered to have about 50 plants, while Woodside Glens was considered to have about 20 (Service 2010, p. 7; Diversity Database 2021, pp. 7–8). More accurate counts, published slightly after our 2010 5-year review, showed Stulsaft Park had 261 adult plants and 301 seedlings in 2010 (Niederer and Elliott 2012, p. 2). The same source also reported 13 plants at Woodside Glens in 2010, but did not provide separate counts of adults and seedlings.

The three populations in existence at the time of our 2010 review remain extant today, in addition to the reintroduction at the Triangle (Service 2019, p. 6). The Crystal Springs population consisted of 26,778 plants in 2020 (37 acres divided among several subpopulations) (Diversity Database 2021, p.1; SFPUC 2021, p. 1; Simono *in litt.* 2021a, p. 2), which is roughly the same as the 25,000 we reported in our last review (Service 2010, pp. 6–7;). However, the population increased to 32,499 in 2018 before falling again to the current total (SFPUC 2021, p. 1). We note that all these counts are much higher than any of the counts provided by the Diversity Database for several years from 1994 to 2014, but those counts only include subpopulations east of Highway 280 (Diversity Database 2021, p. 1). The higher, more recent counts include the large "Boat Ramp" subpopulation to the west of Highway 280, which was discovered around 2010 (Service 2010, pp. 6–7; Diversity Database 2021, p. 1).

In 2010 through 2012, two nonprofit environmental groups, Acterra and the Creekside Center for Earth Observation, conducted a Service-funded project to help restore fountain thistle habitat at Stulsaft Park and Woodside Glens, by removing invasive vegetation. At Stulsaft Park, the project helped increase the number of adult plants from 261 to 478, and increased overall occupied area from 82 to 131 square meters (sq m) (Niederer and Elliott 2012, p. 2). Seedling numbers also

increased from 301 to 614. Adult plants continued to increase in 2013 to 983, although the number of seedlings decreased to 233 (Diversity Database 2021, p. 7). We are not aware of estimates of the Stulsaft Park population more recent than 2013.

The Woodside Glens population also increased, from 13 adult plants in 2010 to 38 in 2012 (Niederer and Elliott 2012, p. 2). We are not aware of additional censuses of the population conducted after that time.

SFPUC has recently attempted to establish a new population in the Triangle by seeding an area with promising hydrology southwest of the original Triangle population site (Simono *in litt.* 2021a, p. 2; Simono *in litt.* 2021b, p. 1). The seeding resulted in about 300 to 400 plants by the winter of 2020/2021 (Simono *in litt.* 2021b, p. 1). The area was seeded a second time in early 2021, but hot, dry spring weather is putting stress on the plants, so it remains unclear whether they will be able to establish a self-supporting population.

Threats

Threats to the fountain thistle described at the time of listing include: highway improvement projects (such as a planned widening of Highway 92) at the Crystal Springs location; proposals for recreational trail construction at the Crystal Springs and Triangle locations; and drainage maintenance at the Edgewood Park location (where the single plant of that population was located in a drainage ditch) (Service 1995, p. 6679). Additional threats included roadside maintenance activities such as weed spraying; competition with invasive plants; dumping of garden debris; and small population sizes that increased vulnerability to chance events such as fire or drought (Service 1995, p. 6682). Seed predation by beetles was also known to occur, but it was unclear whether it resulted in population-level impacts (Service 1995, p. 6680).

In our 2010 status review, we noted that the Triangle and Edgewood Park populations had been extirpated, although we were unable to identify a cause (Service 2010, pp. 7, 12). We also indicated a lack of information regarding impacts at the Crystal Springs population from the widening of Highway 92 (Service 2010, p. 12). However, we noted that the large "Boat ramp" subpopulation at Crystal Springs, which had been found after the fountain thistle was listed, had become threatened by a proposal from SFPUC to raise the surface elevation of the Crystal Springs Reservoir, thereby flooding 0.30 acre of the population, which consisted at the time of 21 total acres of occupied habitat spread among several subpopulations (Service 2021, p. 1).

Currently, plans remain to raise the maximum normal surface elevation of Crystal Springs Reservoir by 4 feet (ft) (to 287.8 ft) (SFPUC 2013, p. 9). Occasional elevation increases of up to 4 additional feet would also be allowed for up to 14 days during exceptionally rainy seasons. This would inundate about half of the Boat Ramp subpopulation (also referred to as L1), and a small portion of a smaller subpopulation (also referred to as L8) to the southeast (SFPUC 2013, Appendix A, Figures 1a, 1b, 1c, 3). In 2011, we completed a biological opinion on the project in which we concluded that the proposed actions would not jeopardize fountain thistle or other threatened and endangered species in the area if an approved compensation plan were prepared to minimize overall impacts (Service 2011, pp. 29, 72–74; SFPUC 2013, p. 103). The Fountain Thistle Compensation Plan (SFPUC 2013, Appendix C) has been approved by both CDFW and the Service (Service 2015, p. 2; Simono *in litt.* 2021d, p. 1) and is currently being implemented. The plan effectively addresses the threat of increased reservoir levels, reduces additional threats

discussed below such as encroachment by woody plants, and considers the achievement of recovery criteria.

Under the terms of the Fountain Thistle Compensation Plan, the authorized surface level ("operating limit") of the reservoir may be raised by either 6 inches (in) or 1 ft in any given year, but only if several requirements are met (SFPUC. 2013, pp. 104–108). Those requirements involve establishing additional thistle plants above the maximum water surface level to compensate for those lost to inundation. The number of extra plants must equal the number being inundated by the given rise in water level, plus the number that would be inundated if it were to rise an extra foot, except that no compensation is required for plants above the highest operating limit of 291.8 ft. The required number of compensating plants must be maintained for either three or six years (three if recruitment of additional plants was natural) prior to raising the water surface level. In addition to these census and temporal requirements; (1) at least thirty percent of the compensating plants must be located in or near the Boat Ramp subpopulation; (2) non-native invasive plant cover must be kept to specific limits; and (3) seeded areas must meet certain limits on plant density and percentage of seedlings (Simono *in litt.*2021c, p. 2).

This plan has enabled protection and management in perpetuity for the Crystal Springs subpopulations above the maximum planned reservoir height (SFPUC. 2013, p. 103), and has also led to the seeding and potential reestablishment of a population at the Triangle property (Simono *in litt.* 2021a, p. 2). The number of plants above maximum reservoir height in the Crystal Springs population in 2020 (26,778 plants) has also increased considerably compared to the number that were above that elevation in 2010 (15,417 plants) (SFPUC 2021, p. 1). However, the total number of plants in 2010 both above and below the planned maximum reservoir height was 35,917, so the current numbers above maximum elevation still represent only about 75 percent of the total original baseline. Additionally, SFPUC has so far been unable to meet all the requirements mentioned above for at least three consecutive years (Simono *in litt.* 2021c, p. 2). Consequently, the water level at Crystal Springs Reservoir has not yet been raised by any increment (Simono *in litt.* 2021c, p. 2). Impediments to meeting the various requirements include: (1) limits on the available acreage of areas with the correct serpentine soils, moisture regimen and native plant associates; and (2) difficulties finding sufficient habitat in and around the Boat Ramp subpopulation to accommodate 30 percent of the compensating plants. However, the most pressing issues restricting fountain thistle population growth (and thus preventing incremental water level increases) appear to be reduced water availability, and encroachment by various native and nonnative plants (Simono *in litt.* 2021a, p. 1). Water availability is important because fountain thistle is restricted to perpetually moist serpentine springs and seeps (Service 2010, p. 3). Reductions in available water have occurred in recent years due to drought; due to concentration of total yearly precipitation into fewer rainfalls; and due to increased summer temperatures (Simono *in litt.* 2021a, p. 1; Simono 2019, p. 2). All of these have likely been exacerbated by climate change.

Changes to water availability also impact the growth of tufted hairgrass (*Deschampsia caespitosa*), an important associate of fountain thistle with a growth pattern that typically leaves interstitial spaces on the ground in which fountain thistle can germinate and grow (Service 2019, p. 8; Simono *in litt.* 2021a, p. 1). At many of the fountain thistle subpopulations, native sedges (*Carex spp.*) and couch grass (*Elymus spp.*) have almost completely displaced the tufted hairgrass, leaving it scarce at these locations. This reduction of the tufted hairgrass associate further reduces the amount of available habitat for fountain thistle (Simono 2019, p. 2).

Other species encroaching on fountain thistle habitat include native woody shrubs such as coyote brush (*Baccharis pilularis*); nonnative trees such as pines; and nonnative herbaceous plants including teasel (*Dipsacus spp.*), Jubata grass (*Cortaderia jubata*), tall fescue (*Festuca arundinacea*), and various annuals in the daisy family (Asteraceae) (Simono *in litt.* 2021a, p. 1). In the Crystal Springs population this encroachment is continuously managed in accordance with the management plan (Simono *in litt.* 2021a, p. 1).

The displacement of native ant species by Argentine ants (*Linepithema humile*) poses another potential threat (Service 2019, p. 7; Simono *in litt.* 2021a, p. 1). Fountain thistle may have relied largely on native ants to disperse their seeds and the Argentine ants that have replaced them do not carry the seeds away from under the parent plant. The ability of fountain thistle to colonize new areas (unaided by human management actions) is thus likely reduced.

Finally, a 2012 genetics study found that the Stulsaft Park and Woodside Glens populations have low genetic diversity and a high inbreeding coefficient, thereby indicating a possible risk from inbreeding depression (Fant *et al.* 2012, pp. 1, 4). Inbreeding depression involves lowered reproductive success, often accompanied by congenital defects and lowered resistance to disease (Soulé 1980, pp. 157–158; Gilpin 1987, p. 132; O'Brien 2003, pp. 62–63). The study also analyzed fountain thistle plants near the Crystal Springs Reservoir, but did not find any indication of high inbreeding risk in that population.

Recovery Criteria

Revised recovery criteria for downlisting and delisting are described in Service 2019 (pp. 19-21, 36–38). Downlisting criteria for fountain thistle have not been met (Table 1), thus delisting criteria are not assessed here.

Table 1. Downlisting criteria for fountain thistle provided in Service 2019, pp. 20–21. Table shows status for 2010 (based on Service 2010, pp. 21–22) and 2020 (based on Niederer and Elliott 2012; SFPUC 2013, Appendix C; SFPUC 2021; Simono in litt. 2021a; Simono in litt. 2021b).

Downlisting criteria	Criterion still valid?	2010 Status	2020 Status
At least five populations (including a population at Crystal Springs), protected and managed in perpetuity; each with adjacent unoccupied habitat and a 150-meter (500-foot) buffer where possible.	Yes	Not met	Partially met. A fourth population at the Triangle property was reestablished in 2019, but its resilience is unclear. The Crystal Springs population is protected and managed. The Triangle population will be as well if it becomes established.
Service-approved management plans are implemented for the populations and essential adjacent areas. The plans must include provisions for standardized annual monitoring of populations.	Yes	Partially met. A 2002 SFPUC watershed management plan requires protection of endangered plants.	Partially met. A management plan is being implemented for the Crystal Springs population. It will apply to the Triangle population as well if it becomes established.
At least 20,000 reproductive adult plants in the Crystal Springs population. At least 2,000	Yes	Partially met. Crystal Springs population had 25,000 plants.	Partially met. The Crystal Springs population has maintained over 20,000 plants since counts began in 2016.

Downlisting criteria	Criterion still valid?	2010 Status	2020 Status
reproductive adult plants in the other populations. All populations and subpopulations have sufficient plants to ensure self-perpetuation.			Other populations have less than half the goal of 2,000 plants, and we lack recent population counts for the Stulsaft Park and Woodside Glens populations.
Each population exhibits a stable or increasing population trend, with evidence of natural recruitment, for 20 years and 2 normal precipitation cycles.	Yes	Not met.	Partially met. The Crystal Springs population has been relatively stable since counts began in 2016. We lack abundance trend data for the other populations.
Seeds are stored in at least 2 certified facilities, and reliable germination and propagation techniques are understood.	Yes	Largely met. Seed has been stored at two Center for Plant Conservation-certified facilities. Seeds only need water to germinate.	Largely met (as per 2010 status). Seeding is commonly used to replenish or establish subpopulations at Crystal Springs and the Triangle.

Conclusion:

After reviewing the best available scientific information, we conclude that fountain thistle remains an endangered species. Although the Crystal Springs population is currently being managed and the number of plants there has increased in order to compensate for the loss of fountain thistle expected when the reservoir surface height is raised, none of the downlisting criteria for the other populations have been met, and the total number of populations remains below five. Therefore, the evaluation of threats affecting the species under the factors in 4(a)(1) of the Act presented in the 2010 status review (Service 2010, pp. 11–19) remains an accurate reflection of the species' current status with additional increased threats from reduced water availability, encroachment by various native and nonnative plants, and the displacement of native ant species by Argentine ants. Furthermore, the Stulsaft Park and Woodside Glens may be at risk of inbreeding depression.

RECOMMENDATIONS FOR FUTURE ACTIONS:

Here we propose several habitat conservation and ecological research recommendations that will aid in the recovery and conservation of the fountain thistle:

1. Conduct surveys and habitat maintenance at the Stulsaft Park and Woodside Glens populations with the goal of raising population numbers to 2,000 adult plants.

2. Continue monitoring of the recently reseeded Triangle population. Manage threats if the population becomes established.

3. Attempt to establish a fifth population, possibly at the former Edgewood location.

4. Collect and store seeds at two certified facilities as recommended by the recovery plan.

Field Supervisor, Sacramento Fish and Wildlife Office

Approve MICHAEL FRIS Digitally signed by MICHAEL FRIS Date: 2022.03.31 12:16:09 -07'00' Date _____

LITERATURE CITED

[Diversity Database] California Natural Diversity Database (government version). 2020. California Natural Diversity Database (CNDDB) management framework. Dated July 28, 2020. Accessed March 12, 2021 from https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=181808&inline. 31 pp. plus cover.

[Diversity Database] California Natural Diversity Database (government version). 2021. Occurrence report – *Cirsium fontinale* var. *fontinale*. Accessed Jan 21, 2021 via Rarefind (https://apps.wildlife.ca.gov/rarefind/view/RareFind.aspx). 8 pp.

Fant JB, Keller J, Hernandez J, Buiser A, Knight. 2012. Genetic structure of the endemic thistle *Cirsium fontinale* var. *fontinale* populations Cirsium pitcheri (Asteraceae). 17 pp.

Gilpen ME. 1987. Spatial structure and population vulnerability. In: Soulé M editor: Viable populations for conservation. New York: Cambridge Univ Press. Pp. 125–139.

Niederer C and Elliott C. 2012. Fountain thistle (*Cirsium fontinale* var. *fontinale*) restoration project, final report. FWS Agreement Number 81420-A-J514. Dated September 17, 2012. 20 pp.

O'Brien SJ. 2003. A run for its life – the Florida panther. In: Tears of the cheetah: the genetic secrets of our animal ancestors. New York: St. Martin's Press. Pp. 56–75.

[SFPUC] San Francisco Public Utilities Commission. 2013. Lower Crystal Springs dam improvement project. Application to California Department of Fish and Wildlife for incidental take of endangered species, threatened and candidate species. Dated September 2013. 117 pp.

[SFPUC] San Francisco Public Utilities Commission. 2021. Census of the Crystal Springs fountain thistle population. 1 p.

[Service] US Fish and Wildlife Service. 1995. Determination of endangered status for ten plants and threatened status for two plants from serpentine habitats in the San Francisco Bay region of California. Dated February 3, 1995. 60 FR 6671–6685.

[Service] US Fish and Wildlife Service. 2010. *Acanthomintha obovata* ssp. *duttonii* (San Mateo thornmint), *Cirsium fontinale* var. *fontinale* (fountain thistle), *Pentachaeta bellidiflora* (white-rayed pentachaeta) 5-Year Review: Summary and Evaluation. Dated August 2010. Accessed November 16, 2020. Available at: https://ecos.fws.gov/docs/five_year_review/doc3564.pdf. 35 pp.

[Service] US Fish and Wildlife Service. 2011. Biological opinion on the San Francisco Public Utilities Commission (SFPUC) Lower Crystal Springs dam improvements project, San Mateo County, California. File no 81420-2010-F-0079. Dated January 24, 2011. 87 pp.

[Service] US Fish and Wildlife Service. 2015. Reinitiation of Formal Consultation on the San Francisco Public Utilities Commission's (SFPUC) Lower Crystal Springs Dam

Improvements Project in San Mateo County, California. File no 08ESMF00-2010-F-0079. Dated Sept 15, 2014. 24 pp.

[Service] US Fish and Wildlife Service. 2019. Recovery plan for serpentine soil species of the San Francisco Bay Area, Recovery plan amendment. Dated September 2019. Accessed March 23, 2021. Available at: https://ecos.fws.gov/docs/recovery_plan/APG%20amendment%20seven%20serpentine%20species.pdf. 71 pp.

[Service] US Fish and Wildlife Service. 2021. Map showing Crystal Springs population extent in 2010, 2021. Includes attribute table showing occupied square meters in 2010. Map constructed by the Service using Diversity Database shapefiles from both years. 1 p.

Soule' ME. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. In: Soule' ME, Wilcox BA eds. Conservation biology, and evolutionary–ecological perspective. Sinaur Assoc. Sunderland MA. pp. 151–169.

Personal Communication

Simono, S. 2019. Biologist, SFPUC. Peer review comments to the Sacramento Fish and Wildlife Office, April 11, 2019. Subject: Peer review request from USFWS.

In Litteris

Simono S. Biologist, San Francisco Public Utilities Commission. 2021a. Re Seeking info on San Mateo thornmint, fountain thistle, white-rayed pentachaeta. Email to G Tarr, US Fish and Wildlife Service. March 9, 2021. 5 pp.

Simono S. Biologist, San Francisco Public Utilities Commission. 2021b. Re Seeking info on San Mateo thornmint, fountain thistle, white-rayed pentachaeta. Email to G Tarr, US Fish and Wildlife Service. March 31, 2021. 3 pp.

Simono S. Biologist, San Francisco Public Utilities Commission. 2021c. Re Seeking info on San Mateo thornmint, fountain thistle, white-rayed pentachaeta. Email to G Tarr, US Fish and Wildlife Service. March 31, 2021. 4 pp.

Simono S. Biologist, San Francisco Public Utilities Commission. 2021d. Question re Lower Crystal Springs dam improvement project document. Email to G Tarr, US Fish and Wildlife Service. Sept 24, 2021. 2 pp.