CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

California Endangered Species Act

Five-Year Species Review and Recommendation to List as Endangered: Calistoga Popcornflower (*Plagiobothrys strictus*)

Report to the California Fish and Game Commission
August 2026

Cover banner (Alternative text: San Joaquin Valley habitat image overlaid by CDFW shield and text "California Department of Fish and Wildlife [line break] California Endangered Species Act")

Cover page photo by Jake Ruygt (Alternative text: A closeup photograph of small, green plants with multiple white flowers along a raceme. Each flower has five separate petals).

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List of Abbreviations, Acronyms, and Terms

ABAG – Association of Bay Area Governments
CAL FIRE – California Department of Forestry and Fire Protection
Cal-IPC – California Invasive Plant Council
CCH2 – Consortium of California Herbaria
CDC – California Department of Conservation
CDFG – California Department of Fish and Game
CDFW – California Department of Fish and Wildlife
CEQA – California Environmental Quality Act
CESA – California Endangered Species Act
CNDDB – California Natural Diversity Database
CNPS – California Native Plant Society
Commission – California Fish and Game Commission
CRPR – California Rare Plant Rank
Department – California Department of Fish and Wildlife
EO – CNDDB Element Occurrence
ESA – Federal Endangered Species Act
et al. – "and others"
FONSI – Finding of No Significance
MND – Mitigated Negative Declaration
MTC – Metropolitan Transportation Commission
NAHC – Native American Heritage Commission
PCA – Priority Conservation Area
PUC – Pacific Union College
sp. – one species
spp. – more than one species
TEK – Traditional Ecological Knowledge
USFWS – U.S. Fish and Wildlife Service
var. – variety

Executive Summary

In 1990, the California Fish and Game Commission (Commission) listed Calistoga popcornflower (*Plagiobothrys strictus*) as threatened under the California Endangered Species Act (CESA). This five-year species review for Calistoga popcornflower was prepared by the California Department of Fish and Wildlife (Department) for the Commission pursuant to the requirements of CESA (Fish & G. Code, § 2077, subd. (a)). This five-year species review is based on the best scientific information currently available to the Department regarding each of the components listed under section 2072.3 of the Fish and Game Code, and Section 670.1, subdivisions (d) and (i)(1)(A), of Title 14 of the California Code of Regulations. The Department prepared this five-year species review to evaluate whether conditions that led to the original listing of Calistoga popcornflower are still present or have changed. In addition, this document includes the identification of habitat that may be essential to the continued existence of the species, and the Department's recommendations for management activities and for recovery of the species (Fish & G. Code, §§ 2072.3 & 2077, subd. (a)).

Calistoga popcornflower is a small, annual plant with an extremely limited range and distribution. Only two extant populations remain. Both are on private property in Calistoga, California, and together occupied less than 84 sq m (900 sq ft) at the time of listing. The species is found in alkaline wetland habitat which is essential to its survival due to the habitat's distinct mineral-concentrated soils, formed from volcanic activity and fed by geothermal waters over thousands of years. At the time of listing, the most immediate threats to the species were present or threatened modification or destruction of habitat, and stochastic (chance) events due to small population size. Since listing, Calistoga popcornflower's population size and occupied habitat have significantly reduced from habitat modification and altered hydrology. The species is currently in serious danger of extinction by these factors in addition to competition, and genetic drift, introgression, and inbreeding depression. Development is an ongoing, immediate threat to the species. There have never been specific management efforts for the conservation of Calistoga popcornflower. Coordination with various partners is ongoing to find solutions for aiding in the species conservation and recovery.

The Department finds there is sufficient scientific information to indicate that the conditions that led to the listing of Calistoga popcornflower as threatened have changed and recommends a change in status to endangered. The Department is submitting this five-year species review to comply with Fish and Game Code section 2077 and as a recommendation pursuant to Fish and Game Code sections 2077, subdivision (e) and 2072.7 to list Calistoga popcornflower as endangered (Fish and G. Code § 2072.7 & 2077, subd. (e)).

1 Introduction

A. Five-Year Species Review Overview

The California Department of Fish and Wildlife (Department) prepares five-year species reviews to determine whether the conditions that led to the listing of a species as threatened or endangered under the California Endangered Species Act (CESA) are still present or have changed. A five-year species review serves as the basis for a recommendation to the California Fish and Game Commission (Commission) on whether a change to the status of a species listed under CESA is warranted (Fish and G. Code § 2077, subd. (a); Cal. Code Regs. tit. 14 § 670.2 & 670.5). Fish and Game Code section 2077 directs the Commission to treat any five-year species review that contains a recommendation to add a species to or remove a species from the list of endangered species or the list of threatened species as a recommendation and petition from the Department submitted pursuant to Fish and Game Code section 2072.7. A five-year species review is based upon the best scientific information available to the Department. It is not intended to be an exhaustive review of all published scientific literature on the species; rather, it is intended to summarize key points relevant to the status of the species and address regulatory report requirements (Fish & G. Code, §§ 2072.3, 2072.7, & 2077, subd. (a), (e); Cal. Code Regs. tit. 14, 670.1, subd. (d)).

A five-year species review must include "information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information" (Fish & G. Code, §§ 2072.3, 2077). A five-year species review shall also include information regarding the habitat necessary for the continued existence of the species, a detailed distribution map, the Department's recommendations for management activities and other recommendations for recovery of the species, and any other factors that are deemed relevant (Fish & G. Code, §§ 2072.3 & 2077, subd. (a); Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)). Additionally, a five-year species review addresses the following factors as they pertain to the species: "present or threatened modification or destruction of its habitat, overexploitation, predation, competition, disease, or other natural occurrences or human-related activities" (Cal. Code Regs., tit. 14, § 670.1, subd. (i)(1)(A)). In some instances, the Department has grouped similar components together and renamed components, described where applicable, to create a more cohesive and readable report.

Receipt by the Commission of a five-year species review is to be placed on the agenda for the next available Commission meeting after delivery. At that time, the species

review will be available to the public for at least 30 days before the Department presents the results of the species review and its recommendation at a Commission meeting. When the Department provides a recommendation in a five-year species review to the Commission to uplist (threatened to endangered), downlist (endangered to threatened), or delist, the Department's five-year species review fulfills the requirements of Fish and Game Code section 2077, and also serves as a petition to change the listing status of the species (Fish & G. Code, §§ 2072.7 & 2077, subd. (e)).

B. Listing and Review History

i. California Endangered Species Act History

In July 1988, The California Native Plant Society (CNPS) submitted to the Commission a petition to list Calistoga popcornflower (*Plagiobothrys strictus*) as endangered under CESA. In August 1989, the Department recommended to the Commission to list Calistoga popcornflower as endangered and also provided three alternatives to the petitioned action which included: listing the species as threatened, listing the species as rare under the Native Plant Protection Act, and no listing (CDFG 1989). In November 1990, the Commission listed Calistoga popcornflower as threatened under CESA (Fish and G. Code § 2050 et seq.; Cal. Code Regs. tit. 14 § 670.2, subd. (b)(3)(A)). The Department has not written a five-year species review for Calistoga popcornflower since listing.

ii. Federal Endangered Species Act History

The United States Department of the Interior, U.S. Fish and Wildlife Service (USFWS) listed Calistoga popcornflower as endangered in 1997 under the Federal Endangered Species Act (ESA). The USFWS completed two five-year reviews in 2010 and 2023 (USFWS 2010, 2023).

C. Additional Species Status Designations

i. California Rare Plant Rank

The California Native Plant Society works in collaboration with botanical experts throughout the state, including Department biologists, to assign rare plants a California Rare Plant Rank (CRPR) reflective of their rarity status (CNDDB and CNPS 2020). Calistoga popcornflower has been assigned a CRPR of 1B.1 (CNPS 2025). Plants with a CRPR of "1B" are considered rare, threatened, or endangered throughout their range with the majority endemic to California (CNDDB and CNPS 2020). The threat code extension of ".1" indicates that the species is seriously threatened in California, with over

80 percent of occurrences threatened and a high degree and immediacy of threat (CNDDB and CNPS 2020).

ii. NatureServe Conservation Status Rank

NatureServe's conservation status ranks consist of a global conservation status rank (global rank, G rank) describing the status of a given species over its entire distribution, and a subnational conservation status rank (subnational rank, S rank) describing the status of a given species over its state distribution (Master et al. 2012; NatureServe 2025). Calistoga popcornflower has been assigned a global rank of G1 and a subnational rank of S1 (NatureServe Explorer 2025), both indicating that the species is critically imperiled and at very high risk of extinction due to a very restricted range, very few populations, very steep declines, severe threats, or other factors (CNDDB 2020, 2025).

D. California Native American Tribes and Traditional Ecological Knowledge

Since time immemorial, California Native American tribes have lived alongside the native fish, wildlife, and plants of California, including Calistoga popcornflower and the geothermal waters the species relies on. California Native American people have collected a growing body of knowledge of the environment over thousands of years. This body of knowledge is often referred to as Traditional Ecological Knowledge (TEK) and encompasses the world view where ecology, spirituality, and human-animal relationships, are all interconnected. TEK and related practices support a deeper understanding of a species' life history and inform its management.

Through our tribal engagement process, the Department sought to understand how tribes would like to engage with the development of this five-year species review and how TEK and tribal practices of stewardship, restoration, and conservation relate to and affect Calistoga popcornflower and its habitat. While the Department did not receive any tribal comments or information to be included in this five-year species review, the Department recognizes how geothermal waters across North America, including in California, are known to be sacred, spiritual, communal spaces, and important cultural touchstones to Native Americans (Menefee 1873; Lund 1995; Miller 2013; Pascual et al. 2024; Native Land Digital 2025; NAHC 2025). Published sources indicate that geothermal waters may hold cultural significance in some contexts (Menefee 1873; Lund 1995; Milliken 2009; Grossinger and Askevold 2012; Pinoleville Pomo Nation 2020; Pascual et al. 2024; Native Land Digital 2025; Suscol Intertribal Council 2025), but such information cannot substitute for direct tribal input and should not be generalized. The Department invites and will continue to seek tribal engagement to determine site-specific relevance and to co-develop stewardship and conservation approaches that reflect tribal priorities.

E. Notifications and Information Received

Calistoga popcornflower and Napa bluegrass (*Poa napensis*), both listed under CESA, co-occur. Since multiple factors affect both species, the Department's outreach requested information for both species for their respective five-year species review. The following is a summary of notifications sent to inform partners, including California Native American tribes, of the Department's initiation of a five-year species review for Calistoga popcornflower, and information received in response to the notifications:

- February 1, 2024—the Department notified in writing to the Commission of a list of species that the Department expects to initiate or continue five-year species reviews on, including Calistoga popcornflower (CDFG, personal communication, Feb 1, 2024). The Commission then notified people who have expressed interest in CESA actions of this information. The e-mail notification included a link to the Department's dedicated web page for five-year species reviews of threatened and endangered species at https://www.wildlife.ca.gov/Conservation/CESA/Five-Year-Reviews.

- January 15, 2025 – The Department contacted USFWS to coordinate and exchange information for the Department's five-year species reviews of Calistoga popcornflower and Napa bluegrass (F. Bowman and L. Kong, personal communication, Jan 10, 2025) with their five-year review process last completed in 2023 for both species (Fish & G. Code, § 2077, subd. (b)). Prior to this exchange, the Department and the USFWS coordinated updates on these species in 2023 and 2024 (F. Bowman et al., personal communication, Sep 4 2024 to Oct 21 2024). The Department and USFWS coordination for conservation, management, and recovery are ongoing. The Department included information provided by USFWS in this five-year species review.

- February 11, 2025—The Department sent seven tribal notification letters (paper and electronic) to the list of tribes provided by the Native American Heritage Commission (NAHC) as having a cultural or traditional affiliation with the geographic area of Calistoga popcornflower and Napa bluegrass.

- February 14, 2025—The Department sent an email bulletin through GovDelivery to subscribers in the CESA 5-year Species Reviews and CESA Plants groups (CDFW, personal communication, Feb 14, 2025). People may voluntarily opt-in to GovDelivery notifications at https://public.govdelivery.com/accounts/CNRA/signup/35821.

- February 18, 2025—The Department posted a call for data for Calistoga popcornflower and Napa bluegrass on the California Natural Diversity

Database's (CNDDB) Blog, available at https://wildlife.ca.gov/Data/CNDDB/News/calistoga-popcornflower-and-napa-bluegrass-species-reviews-how-you-can-help.

- April 7, 2025—The Department mailed notifications of the Department's initiation of this five-year species review to private landowners where the species are known to grow.
- April 11, 2025—The Department followed up via email and phone calls with the tribes that had not yet responded to the Tribal Notification letters. A second follow up was sent via email on May 9, 2025. No information related to Calistoga popcornflower was received from tribes for this five-year species review.
- May 6, 2025—The Commission sent an email bulletin, containing the same information as the Department's bulletin dated February 14, 2025, through the Commission's GovDelivery subscribers to CESA alerts (CFGC, personal communication, May 6, 2025).

The Department also conducted a literature review and individually contacted and coordinated efforts with the USFWS, Department Bay Delta Region staff, City of Calistoga, Napa County, Land Trust of Napa County, Pacific Union College, Santa Barbara Botanic Gardens, Green Biome Institute, the Napa Valley Chapter of CNPS, local botanists and naturalists, and others with relevant experience or expertise concerning Calistoga popcornflower.

2 Species Description and Taxonomy

A. Species Description

Calistoga popcornflower is a small, upright, herbaceous plant in the borage family (Boraginaceae). Stems are slender and green with narrow leaves. When blooming, the species has small, white flowers. The species' fruits are egg-shaped nutlets with small projections on the back that contain no prickles (Kelley and Guilliams 2021). Characteristics of the fruits are the most important features for identification of the species, which are typical of plants in the borage family. Individual plant height ranges from 3 cm (1.2 in) to over 20 cm (8 in) (A. Wyrick-Brownworth, personal communication, Jan 18, 2023).

B. Species Taxonomy

Calistoga popcornflower was first collected in 1892 and described by Edward Lee Greene as *Allocarya stricta.* Greene first proposed the *Allocarya* genus in the borage

family in 1887 to include borages that were uniquely described to have lower leaves along the stem that were opposite and fused to one another while clasping the stem (i.e., connate-perfoliate). In 1923, Ivan M. Johnston merged *Allocarya* with *Plagiobothrys*, and changed the name of Calistoga popcornflower to *Plagiobothrys strictus* (Johnston 1923). Johnston reaffirmed his own findings almost a decade later (Johnston 1932) but taxonomic differences between *Allocarya* and *Plagiobothrys* were argued well into the century until genetic work in 2015 clarified relatedness among the species (Guilliams 2015). An extensive phylogenetic project for Boraginaceae confirmed the genetic taxonomic relationship of Calistoga popcornflower and definitively placed it into the genus *Plagiobothrys* (Guilliams 2015; Simpson et al. 2017).

C. Similar Taxa

Calistoga popcornflower shares a common ancestor (~6 million years ago) and is most closely related to four other *Plagiobothrys* spp. found in California, including Choris' popcornflower (*Plagiobothrys chorisianus* var. *chorisianus*), Hickman's popcornflower (*Plagiobothrys chorisianus* var. *hickmanii*), sculptured-nut popcornflower (*Plagiobothrys glyptocarpus*), soft popcornflower (*Plagiobothrys mollis* var. *mollis*), and Parish's popcornflower (*Plagiobothrys parishii*) (Guilliams 2015; M. Guilliams, personal communication, Aug 8, 2025). The data identifies close genetic relationships based on gene sequencing and similarities of the linear ventral scar on the seeds (M. Guilliams, personal communication, Aug 8, 2025), but none of these species overlap with Calistoga popcornflower's range. There are 13 other *Plagiobothrys* taxa documented in Napa County, and 7 of them are plants of seasonal wetlands, like Calistoga popcornflower (Ruygt 2020). Calistoga popcornflower has hairless stems and leaves when viewed under magnification, whereas the other seven wetland *Plagiobothrys* spp. are sparsely to very hairy.

3 Life History and Ecology

This section considers the best available scientific information regarding the species' life history (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

Calistoga popcornflower is an annual plant which means the species completes its lifecycle within one growing season, before its habitat completely dries for the summer and fall. Calistoga popcornflower seeds germinate in moist soils with high mineral (e.g., boron) concentrations beginning in winter, that are in part fed by alkaline springs and seasonal precipitation (CDFG 1989; Wyrick-Brownworth et al. 2021). Calistoga popcornflower generally blooms for several weeks between March and April (sometimes, but rarely, through June) (CDFG 2005; Kelley and Guilliams 2021), and each plant produces an estimated average of 9 flowers (Wyrick-Brownworth and Maxam

2014; Wyrick-Brownworth et al. 2021). Calistoga popcornflower's pollinators may include flies and bees according to an herbarium specimen collection (Brane and Malloch 1985), but nothing else is known about the species' pollination. Once the flowers develop fruits, the species will form seeds in each fruit. Given the estimations for average seed production per plant (36 seeds/plant), about one flower is produced for every 1 cm of growth per plant and each flower produces about four seeds (Wyrick-Brownworth et al. 2021). Shortly after setting seed, the species dries up, senesces, and shrivels away. Outside of the growing season, the species is very difficult to find.

4 Range and Distribution

This section considers the species' range and distribution and provides a detailed distribution map (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)). A species' range for the purposes of CESA and a five-year species review is the species' California range (*Cal. Forestry Assn. v. Cal. Fish and Game Com.* (2007) 156 Cal.App.4th 1535, 1551). Range describes the general geographical area in which a species occurs. Distribution describes the actual sites where individuals and populations of the species occur within the species' range.

Calistoga popcornflower is extremely limited in its range and distribution because the species is highly dependent on geothermal resources. The species' entire known range is within a 5 km (3 mi) radius from the city of Calistoga, Napa County, California (Figure 1). The range of Calistoga popcornflower was likely larger prior to development and destruction of the species' preferred habitat based on four specimen collections from before the 1960s near the "Old Faithful Geyser" and Myrtledale Hot Springs (west of Calistoga city limits), which may indicate a broader historical distribution (CCH2 2025). Just two miles east of the "Old Faithful Geyser," a mobile home park was constructed in 1965 directly north of an extant locality in Calistoga. Prior to this construction, various geothermal wells, fumaroles (hot vents), and streams flowed through this area, but were eventually diverted to bypass the mobile home park and channeled to the Napa River. Although much of Calistoga's development and geothermal resource extraction occurred before listing, the species' distribution continues to decline because of these factors.

There are three Element Occurrences (EOs), which are mapped areas of species presence that are at least 0.4 km (0.25 mi) apart, in the Department's California Natural Diversity Database (CNDDB). Occurrences are not always numerically consecutive due to being combined with other EOs, new EO additions, or for other reasons. One of these EOs (EO4) was based on a specimen that was later determined to be bracted popcornflower (*Plagiobothrys bracteatus*), and therefore is no longer considered valid, and is not discussed further in this five-year species review (CCH2 2007). The two

presumed extant occurrences (EOs 2 and 3) are distributed at each location in one to several areas. Combined, both occurrences occupied less than 84 sq m (900 sq ft) at the time of listing (CDFG 1989; USFWS 2010; Wyrick-Brownworth et al. 2021; USFWS 2023). Overall, the species' distribution has been significantly reduced. EO 2 has been limited to a small parcel on Tubbs Lane and EO 3 has been reduced from three areas to two small patches within one area. EOs 2 and 3 are discussed further below.

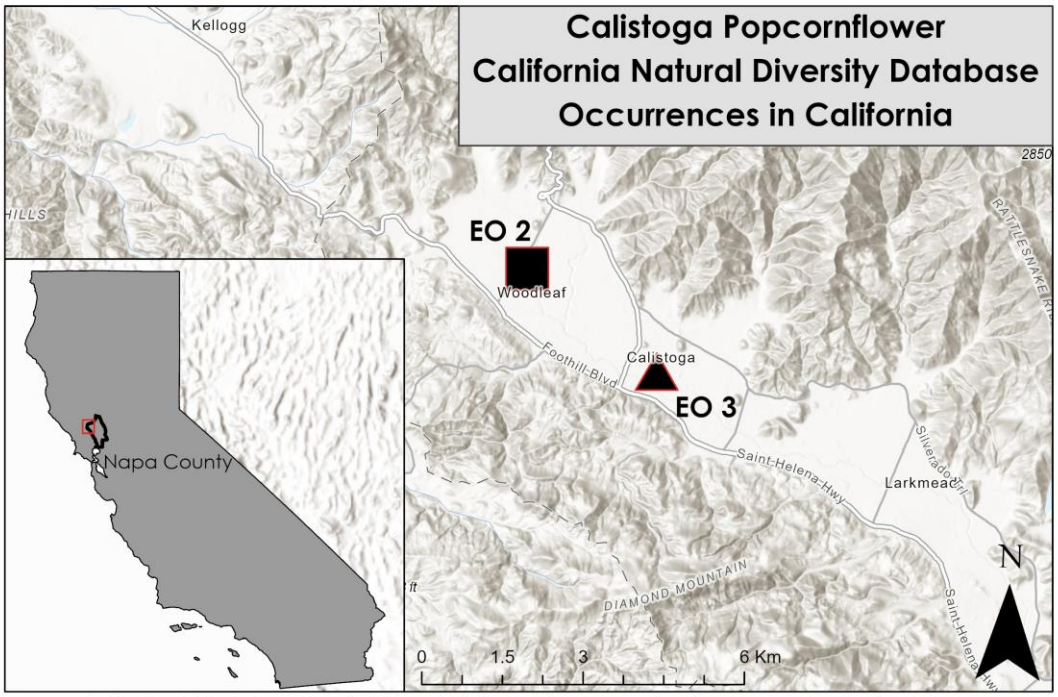


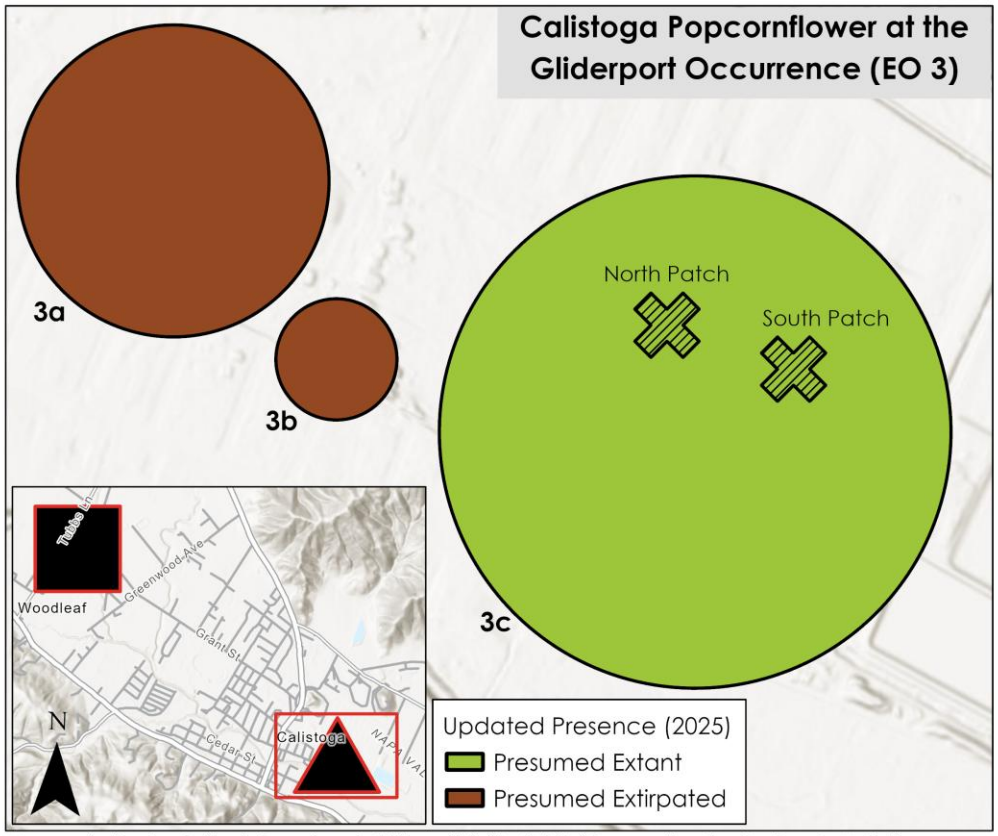
Figure 1. Range and distribution map of Calistoga popcornflower.

A. Tubbs Lane (EO 2)

Minimal information is known about the Tubbs Lane occurrence (EO 2), located in Napa County outside of Calistoga city limits. EO 2 was likely first documented from a specimen collection sometime between 1955 and 1980 (CCH2 2025). The species exists as scattered plants over a 4 ha (10 ac) area on a 8 ha (20 ac) property that is bisected by an asphalt road and concentrated towards the middle of the field (USFWS 2010; CNDDB 2025). In 2008, the USFWS reported Calistoga popcornflower growing on the edge of the fence line and observed the species growing at the edge of a vernal pool (Symonds 2008; USFWS 2010). A site visit in 2025 indicated the species was found in vernal pools that are 4.5 m (15 ft) or more in diameter (Ruygt 2025). Overall, there is not enough data to make any conclusions on whether distribution of the species at EO 2 has changed since listing.

B. Gliderport (EO 3)

The Gliderport occurrence (EO 3) is in Calistoga at the now defunct Calistoga Airfield, and adjacent to the Indian Springs Resort to the northwest and a mobile home park to the north. The occurrence is mapped into three areas at the airfield, designated as 3a, 3b, and 3c (Figure 2). The only source of information available for 3a is from a map that shows the species' locations (Brane and Malloch 1985). Area 3b was mapped in 2008; however, the data informing the species distribution may have been an erroneous data point (Glenn Lukos Associates 2009; R. Powell, personal communication, Sep 15, 2025). The species was never found again in areas 3a and 3b despite multiple attempts to find the species (EcoSystems West Consulting Group 2009; Glenn Lukos Associates 2009; USFWS 2010; Wyrick-Brownworth 2013a, 2017; Wyrick-Brownworth and Maxam 2014; Wyrick-Brownworth et al. 2018, 2021), and are presumed extirpated from loss of habitat.



Map created by the California Department of Fish and Wildlife, Habitat Conservation Planning Branch, M. Smith. 20251223. California Natural Diversity Database (CNDDB) element occurrence (EO) features and population patches are generalized on this map for visual purposes and are not representative of the actual population boundaries to protect specific location data per CNDDB data sharing guidelines: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=27285&inline. Basemap Source: ESRI USGS Terrain.

Figure 2. Calistoga popcornflower presence at the Gliderport occurrence (EO 3). The species is regularly found in only two patches (North Patch and South Patch) within 3c. This map is generalized for visual purposes and is not to scale to protect species' data.

Within area 3c, there are only two patches (North Patch and South Patch) where Calistoga popcornflower is restricted to and where plants have been found regularly since 2005. There is also a known water leak, that predominately feeds the South Patch, from geothermal pipes that run below the mobile home park (Wyrick-Brownworth 2013a). The patches are separated by an area that is 69 m (225 ft) wide where no Calistoga popcornflower occurs (EcoSystems West Consulting Group 2009). The total area occupied by the species in these two patches has fluctuated between 180 sq m (1,938 sq ft) and 2,200 sq m (23,680 sq ft), which is as small as about 12 standard parking spaces and as large as the size of 4.5 basketball courts. Additional information on these patches is discussed further below.

i. North and South Patches

In 2005, Calistoga popcornflower was found across 2,200 sq m (23,680 sq ft) (Northwest Biosurvey 2005; USFWS 2010). A 2008 survey confirmed the same locations mapped in 2005, but the species occupied only an estimated 500 sq m (5,382 sq ft) of habitat, in 10 clusters (Glenn Lukos Associates 2009; USFWS 2010). These clusters ranged in size from about 6 sq m (65 sq ft) up to 198 sq m (2,131 sq ft) (Glenn Lukos Associates 2009). A third mapping effort in 2009 also confirmed the same locations mapped in 2005 but estimated a further decline in distribution with only 200 sq m (2,178 sq ft) of occupied habitat (EcoSystems West Consulting Group 2009). Although densities remained the same as in 2008, the species was found in smaller clusters (0.1-69 sq m (1 to 743 sq ft)) (EcoSystems West Consulting Group 2009).

Annual monitoring for Calistoga popcornflower in 2013-2020 tracked how plant distribution shifted each year within the patches (Wyrick-Brownworth 2013a, 2017; Wyrick-Brownworth and Maxam 2014; Wyrick-Brownworth et al. 2018, 2021). Over the monitoring period, the species' distribution expanded about 10 m (33 ft) total (A. Wyrick-Brownworth, personal communication, Jan 18, 2023), which could have been influenced by the known water leak from pipes beneath the mobile home park directly north of these patches. No surveys were conducted from 2021 to 2024 due to restricted access by the landowner. The species was mapped in 2025 and observed in the South Patch only, with no plants observed in the North Patch (Monk & Associates Inc. 2026). Overall, the distribution of the species at EO 3 has declined since listing.

In conclusion, the range of Calistoga popcornflower has likely been reduced due to historical habitat destruction and modification. The distribution of Calistoga popcornflower within its range has also been reduced since the species was listed. While it is unknown if the distribution of the population at EO 2 has changed, the occupied area at EO 3 has been reduced to just two patches. In addition, no new

populations have been found since the species was listed in 1990. This reduction in area occupied by Calistoga popcornflower puts the species in extreme danger of extinction.

5 Abundance and Population Trend

This section considers the species' abundance and population trends (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)). Since listing, Calistoga popcornflower's population size has continued to decline from loss of habitat. The population sizes of the species have fluctuated from fewer than 50 plants to over 300,000 plants. Additional information on the species abundance is provided below. Overall, Calistoga popcornflower's abundance has reduced significantly and suggests a declining trend.

A. Tubbs Lane (EO 2)

The population size at the Tubbs Lane occurrence (EO 2) fluctuated from approximately 1,000 to 10,000 plants between 1983 and 1990 (CDFG 1989; CNDDB 2025). Since then, lack of annual access to the property has prevented any regular surveys or monitoring. The USFWS collected plant specimens of Calistoga popcornflower from this location (and at EO 3) in 2008, but did not estimate population size (Symonds 2008). Estimates in 2009 indicated the population contained several hundred plants (USFWS 2010). The species was fully censused in 2013 with fewer than a thousand plants observed across four, isolated pools (2 dry, 2 inundated) (Wyrick-Brownworth 2013a). Inundated pools contained more plants that were much taller than in the dry pools (Wyrick-Brownworth 2013a). In spring 2025, members of the Napa Valley Chapter of CNPS were permitted access to the property to search for Calistoga popcornflower (J. Ruygt, personal communication, Aug 7, 2025) and estimated a little over a thousand plants at the site (Ruygt 2025). Overall, the abundance and population size of Calistoga popcornflower at EO 2 appears to have declined since listing; however, there is not enough continuous abundance data to infer a population trend at this occurrence.

B. Gliderport (EO 3)

At the time of listing, fewer than 50 plants were recorded at the Gliderport occurrence (EO 3) (CDFG 1989). Periodic observations (1983-2009; 2021-2025), and annual monitoring (2013-2020) provide abundance data for EO 3 (0 to 340,000+ plants) that is informative of species presence but does not provide enough information to evaluate a population trend (Table 1). Most of the population-level data available is specified for the North and South patches within area 3c (Figure 2).

In 2008, there was an average 13 plants/sq m (1 plant/sq ft) observed (Glenn Lukos Associates 2009). Average densities were similar in 2009 with 15-22 plants/sq m (1-2

plants/sq ft), despite occupying a smaller amount of area than in 2008 (EcoSystems West Consulting Group 2009; Glenn Lukos Associates 2009). Annual monitoring for Calistoga popcornflower (2013-2020) indicated the species to be intermittently sparse or dense within the patches (Wyrick-Brownworth 2013a, 2017; Wyrick-Brownworth and Maxam 2014; Wyrick-Brownworth et al. 2018, 2021). Plants within the South Patch tend to be taller and more robust than in the North Patch, likely because the South Patch is nearest a known water leak from the geothermal pipes beneath the mobile home park that is adjacent to these patches (Wyrick-Brownworth 2013a).

*Table 1. Observations and census information for Calistoga popcornflower at the Gliderport occurrence (EO 3) from 1983 to 2025. An * indicates incomplete survey years.*

Year	Plant Counts	Notes on occurrence (if applicable)	Source
1978	350	Southern end of airstrip in five pools	(Brane and Malloch 1985)
1983	<100		(CNDDB 2025)
1989	>10,000		(CNDDB 2025)
1994	>5,000		(USFWS 2010; CNDDB 2025)
1996	No data	Unknown numbers observed	(CNDDB 2025)
2005	No data	Mapping did not estimate counts	(Northwest Biosurvey 2005; USFWS 2010)
2008	6,250	Mapped; Specimens collected	(Symonds 2008; Glenn Lukos Associates 2009)
2009	~3,310 to 5,000	Mapped estimates	(EcoSystems West Consulting Group 2009; CNDDB 2025)
2013	5,706	North and South Patches only	(Wyrick-Brownworth et al. 2021)
2014	20,000	North and South Patches only	(Wyrick-Brownworth et al. 2021)
2015	345,560	North and South Patches only	(Wyrick-Brownworth et al. 2021)
2016	318,130	North and South Patches only	(Wyrick-Brownworth et al. 2021)
2017	74,797	North and South Patches only	(Wyrick-Brownworth et al. 2021)
2018	8,052	Partial survey completed	(Wyrick-Brownworth et al. 2021)
2019	297,963	North and South Patches only	(Wyrick-Brownworth et al. 2021)
2020*	No data	Partial survey completed	(Wyrick-Brownworth et al. 2021)
2021	No data	Species is present	(iNaturalist 2025)
2024	No data	Many plants; locally common near scalds	(iNaturalist 2025; T. Van Loon, personal communication, Aug 3, 2025)
2025	198	Plants found in South Patch only; most plants were dry by April	(iNaturalist 2025; J. Liu, personal communication, Aug 4, 2025; Monk & Associates Inc. 2026)

The average density of plants over the entire monitoring period ranged from 250 to 1,500 plants/sq m (23 to 139 plants/sq ft) (Wyrick-Brownworth et al. 2021). Population counts in 2018 were lower due to surveying late in the growing season when most plants were drying or senesced (Wyrick-Brownworth et al. 2021). Survey results for the species in 2020 were incomplete due to unforeseen circumstances, but the species' presence was confirmed in the North Patch (Wyrick-Brownworth et al. 2021). There are also some observations recorded in iNaturalist (a global community science platform) where Department staff confirmed that the location data matches CNDDB occurrence records (Table 1). A survey effort in 2025 mapped 198 individuals, found in the South Patch only (Monk & Associates Inc. 2026). Complete abundance estimates at EO 3 between 2020 and 2024 are unknown due to restricted access by the landowner.

Available abundance data for Calistoga popcornflower at EO 3 shows the variability in population sizes over the years, which can be expected for an annual plant species, but assessing population size alone is not a sufficient indicator to guarantee stability against extinction (Nunney 2002; Flather et al. 2011; NatureServe 2025). Additional information on weather and habitat conditions at EO 3 each year, as well as additional survey data, is needed to put this data into context and determine possible population trends.

In conclusion, the species remains critically vulnerable to extinction since listing due to extreme fluctuations in abundance and small population extents. While extreme fluctuations in abundance can be expected for an annual plant species, the overall extent of the occurrences have contracted for Calistoga popcornflower. This decline in extent likely requires a higher minimum population size for the species to recover from low abundance years to ensure the long-term persistence of the species (Nunney 2002).

6 Habitat

This section considers the best available scientific information regarding the kind of habitat necessary for the species survival (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)), and a review of the identification of the habitat that may be essential to the continued existence of the species (Fish & G. Code, § 2077, subd. (a)).

Calistoga popcornflower has specialized habitat requirements that include alkaline soils near or adjacent to geothermal water sources or geysers in seasonal vernal pools (Figure 3). The species' grows in wet depressions that are adjacent to or growing on conspicuous, bare alkaline crusts (scalds; Figure 4) with high concentrations of manganese, potassium, boron, sulfate, and sodium, that at similar levels, would be

severely toxic to most agricultural crops (Northwest Biosurvey 2005; EcoSystems West Consulting Group 2009; USFWS 2010; Wyrick-Brownworth et al. 2021).

Figure 3. Calistoga popcornflower at the Tubbs Lane occurrence (EO 2) in Spring 2025. (Top Left) A dense patch of the species in a dry alkaline pool. (Top Right) Single individual of the species surrounded by flowering seep monkeyflower (Erythranthe guttata). (Bottom left) Scattered individuals of the species in damp clay soil. (Bottom right) A patch of the species with a 6-in ruler for scale. Photos source: Ruygt (2025).

Figure 4. Calistoga popcornflower near alkaline crusts at the Gliderport occurrence (EO 3). Flags show where the species is growing in 2009 (top) and in 2013 (bottom). Photo sources: EcoSystems West Consulting Group (2009), p. A-10; Wyrick-Brownworth (2013a), p. 8.

A. Vegetation Communities

The plant diversity where Calistoga popcornflower occurs is a mix of other rare and native plant species, and some invasive species. Calistoga popcornflower is most closely associated with the state-endangered Napa bluegrass, Brewer's milkvetch (*Astragalus breweri*), California goldfields (*Lasthenia californica* ssp. *californica*), and large flowered sand-spurrey (*Spergularia macrotheca*) (G. Cooley, personal communication, Nov 10, 2005; EcoSystems West Consulting Group 2009; Wyrick-Brownworth 2013a; CNDDB 2025). Table 2 includes a combined general list of native plant species (including rare species) from various sources that have been documented at both extant occurrences of Calistoga popcornflower. Appendix A includes a more extensive list of plants observed on the entire property where the Tubbs Lane occurrence (EO 2) is found (Ruygt ND).

Non-native plant species, including some that are also considered invasive, are present at both occurrences. Invasive plants are considered non-native and cause harm to the environment (e.g., alter soil chemistry) by displacing native species (Cal-IPC 2025). Their abundance and distribution vary annually but they have been observed at least once within the vicinity of Calistoga popcornflower, and some have been observed spreading throughout the surrounding habitat in the summer and fall. These species include the following which were provided by various sources (Brane and Malloch 1985; Symonds 2008; USFWS 2010; J. Ruygt and A. Wyrick-Brownworth, personal communication, Jul 23, 2013; Wyrick-Brownworth et al. 2021; CNDDB 2025):

- Wild oat (*Avena fatua*)
- Yellow star-thistle (*Centaurea solstitialis*)
- Common teasel (*Dipsacus fullonum*)
- Tall fescue (*Festuca arundinacea*)
- Italian ryegrass (*Festuca perennis*)
- Meadow fescue (*Festuca pratensis*)
- Mouse barley (*Hordeum murinum*)
- Prickly lettuce (*Lactuca serriola*)
- Perennial pepperweed (*Lepidium latifolium*)
- Spring vetch (*Vicia sativa*)
- Hairy vetch (*Vicia villosa*)

Table 2. Combined list of rare and other native plant species that occur in Calistoga popcornflower habitat. Superscripts: [1]CESA-listed plant, CRPR 1B.1 or 1B.2.

Common Name	Scientific Name	Tubbs Lane	Gliderport	Source of Information
Brewer's milkvetch	*Astragalus breweri*	X		(G. Cooley, personal communication, Nov 10, 2005; CNDDB 2025)
Pink star-tulip	*Calochortus uniflorus*		X	(G. Cooley, personal communication, Nov 10, 2005; Wyrick-Brownworth et al. 2021; CNDDB 2025)
Pappose tarplant[2]	*Centromadia parryi* ssp. *parryi*	X	X	(G. Cooley, personal communication, Nov 10, 2005; EcoSystems West Consulting Group 2009; CNDDB 2025; Ruygt 2025)
Annual hairgrass	*Deschampsia danthonioides*	X	X	(EcoSystems West Consulting Group 2009; Ruygt 2025)
Saltgrass	*Distichlis spicata*	X	X	(EcoSystems West Consulting Group 2009; Ruygt 2025)
Button-celery	*Eryngium* sp.		X	(Brane and Malloch 1985)
Seep monkeyflower	*Erythranthe guttata*	X	X	(Brane and Malloch 1985; CDFG 1989; Ruygt 2025)
Low barley	*Hordeum depressum*	X	X	(EcoSystems West Consulting Group 2009; Ruygt 2025)
Toad rush	*Juncus bufonius*	X	X	(CNDDB 2025; Ruygt ND)
Rush	*Juncus* spp.	X	X	(CDFG 1989)
California goldfields	*Lasthenia californica* ssp. *californica*	X	X	(Brane and Malloch 1985; EcoSystems West Consulting Group 2009; Wyrick-Brownworth et al. 2021; Ruygt ND)
Wooly-headed lessingia	*Lessingia hololeuca*	X	X	(G. Cooley, personal communication, Nov 10, 2005; Ruygt ND)
California loosestrife	*Lythrum californicum*	X		(G. Cooley, personal communication, Nov 10, 2005; Ruygt ND)
Douglas' microseris	*Microseris douglasii*		X	(CNDDB 2025)
Common muilla	*Muilla maritima*	X	X	(Brane and Malloch 1985; EcoSystems West Consulting Group 2009; Ruygt ND)
Napa bluegrass[1]	*Poa napensis*	X	X	(CNDDB 2025)
Bluegrass	*Poa* spp.		X	(Wyrick-Brownworth et al. 2021)
Clustered goldenweed	*Pyrrocoma racemosa* var. *racemosa*	X	X	(G. Cooley, personal communication, Nov 10, 2005)
Sticky sandspurry	*Spergularia macrotheca* var. *leucantha*	X		(Ruygt 2025)
Large-flowered sand-spurrey	*Spergularia macrotheca* var. *longistyla*		X	(EcoSystems West Consulting Group 2009; Wyrick-Brownworth et al. 2021; CNDDB 2025)
Sun cup	*Taraxia ovata*		X	(Brane and Malloch 1985)
Saline clover[2]	*Trifolium depauperatum* var. *hydrophilum*	X	X	(G. Cooley, personal communication, Nov 10, 2005)
Tomcat clover	*Trifolium willdenovii*		X	(Brane and Malloch 1985)
Triple lilies	*Triteleia* spp.		X	(Wyrick-Brownworth et al. 2021)

B. Climate and Hydrology

Calistoga popcornflower grows in the wet depressions of barren, alkaline crusts (or scalds) indicative of alkaline vernal pool habitat that is highly dependent on belowground geothermal water activity and seasonal precipitation (Figure 4). These alkaline crusts are formed from geothermal hot springs (historic or active) that deposit water-soluble minerals at high levels that are not normally tolerated by plants (i.e., boron, manganese, sulphates). However, Calistoga popcornflower is adapted to and depends on the high mineral concentrations to thrive (CDFG 1989; CDFG 2005; Wyrick-Brownworth et al. 2021). Over time, higher and higher concentrations of minerals and salts are left behind as water evaporates from the hot spring overflows (Northwest Biosurvey 2005; EcoSystems West Consulting Group 2009; Grossinger and Askevold 2012). Any remaining alkaline crusts are usually indicators of where historic outflow of hot springs once surfaced (Northwest Biosurvey 2005; EcoSystems West Consulting Group 2009), and are unique habitat features important to Calistoga popcornflower.

The Tubbs Lane occurrence (EO 2) is about 188 m (0.1 mi) east of Calistoga's "Old Faithful Geyser," which is a likely source of water for EO 2. At the Gliderport occurrence (EO 3), both patches are likely fed by seasonal precipitation and by a known water leak from geothermal pipes below the adjacent mobile home park (Wyrick-Brownworth 2013a). Anecdotal data and observations suggest that winter precipitation from October to December impacts plant distribution and abundance, while spring precipitation from January to April impacts plant size and plant longevity (seed production) (Wyrick-Brownworth et al. 2021). For example, at the Gliderport occurrence (EO 3), more plants in 2015 and 2016 than in previous years were correlated with higher total precipitation in November/December. Calistoga popcornflower's population size, distribution, and morphological differences over the years may be partially explained by temporary increases in water availability by precipitation inputs or the depth to water table (A. Wyrick, personal communication, Jan 8, 2023), but more research is needed to better understand what additional factors may be influencing this species' variation in morphology and reproduction.

C. Geology and Soils

Calistoga, as part of the Napa Valley, was formed about 3 million years ago from colliding tectonic plates that formed the surrounding mountains and volcanic activity (ash, lava, magma) that created the unique hydrothermal character of the lowland valley of the Calistoga area (Enderlin 1995; Grossinger and Askevold 2012). Historical evidence also suggests this unique geology allowed for volcanic sediments at higher elevations to dissipate into multiple branched streams and settle in layers over existing marine sedimentary deposits, developing wetlands and the valley's vernal pools

(Grossinger and Askevold 2012). Calistoga popcornflower occurs in soils mapped as Bale loam or Bale clay loam (Soil Survey Staff 2025). Soils in the Bale series are very deep and poorly drained, and formed when flowing water deposited igneous rocks such as rhyolite and andesite (volcanic sediments rich in silica) (USDA-NRCS 1997; Soil Survey Staff 2025), which makes these soils generally desirable for wine grape growing. Calistoga popcornflower's habitat contains poorly draining soils (gravelly loam with dark, adobe-like clay) that are also rich in minerals which would be toxic to most plants. The mineral composition of the soils at the Gliderport occurrence (EO 3) contain manganese, potassium, boron, sulfate, and sodium in extremely high concentrations, while copper, iron, and phosphate are in low concentrations (Wyrick-Brownworth et al. 2021). The soils of Tubbs Lane (EO 2) have not been tested; however, they are likely similar to the soils at EO 3 due to the biological and ecological needs of the species and the area's geologic and geothermal history.

7 Threats

This section considers the factors affecting the ability of the species to survive and reproduce, and the degree and immediacy of threat (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)). In addition, this section addresses the six listing factors identified in title 14 of the California Code of Regulations section 670.1, subdivision (i)(1)(A):

- Present or threatened modification or destruction of habitat
- Overexploitation
- Predation
- Competition
- Disease
- Other natural occurrences or human-related activities

The sixth listing factor, "other natural occurrences or human-related activities", is addressed under the following subsections: hydrologic changes, small population size; chance events; and genetic drift, introgression, and inbreeding depression. Compounding factors, such as climate change, likely amplify the degree (intensity) of the more immediate threats mentioned above that impact the species. At the time of listing, the threats to Calistoga popcornflower were predominately stochastic (chance) events due to small population size, and habitat modification and destruction from grass mowing, air traffic, and vehicle parking (CDFG 1989). The following outlines how threats within each listing factor have changed.

A. Present or Threatened Modification or Destruction of Habitat

At the time of listing, modification or destruction of habitat were identified as one of the immediate threats to Calistoga popcornflower. The two five-year reviews by USFWS also indicated potential future development as a threat of extirpation of the species (USFWS 2010, 2023). The Status Review indicated that urbanization and viticulture (i.e., wine grape cultivation) extirpated a historic population and had already converted 70% of potential habitat across its range (CDFG 1989). Viticulture is still a major industry in Calistoga. By 2012, about 14 sq km (5.5 sq mi) within an approximately 26 sq km (10 sq mi) area that includes the city of Calistoga and surrounding area were already under intensive agricultural cultivation (City of Calistoga 2012). Over the years, development and other human activities have further fragmented the species' distribution and reduced the population size. Since listing, present or threatened modification or destruction of habitat continues to put the species in danger of extinction and is described in more detail below.

i. Potential Development

The Gliderport occurrence (EO 3) is located on private property that is divided into 14 separate parcels under an umbrella of the same ownership. These parcels are mixed in zoning (LightBox 2025a), but generally allow for commercial activities of existing, approved uses (e.g., airport), and any future development of other uses would require zoning reclassification (City of Calistoga 2020a). An estimated 62 properties under various ownership and zoning are neighboring or near the Gliderport property; however, none of the parcels are protected from future development (Figure 5). Most of the neighboring properties to the south and east of the Gliderport property are owned by the City of Calistoga.

In October 2023, the City of Calistoga updated zoning for some areas to meet State mandates for affordable housing in the Housing Element of the City's General Plan (2023-2031) (City of Calistoga 2020a, 2023a). Two parcels (sites F and G) were included in the rezoning (Figure 6) and are across the road of the Gliderport property containing EO 3 (City of Calistoga 2023a). Sites F and G are owned by the City of Calistoga and re-zoning would allow for developing affordable housing on both parcels (Figure 6). The Department provided comments expressing concern that the re-zoning would open up potential development to these sites, which would jeopardize the existence of Calistoga popcornflower (CDFW, personal communication, Sep 15, 2022). The Department also requested to remove sites F and G from the re-zoning to fully ensure no future impacts to Calistoga popcornflower.

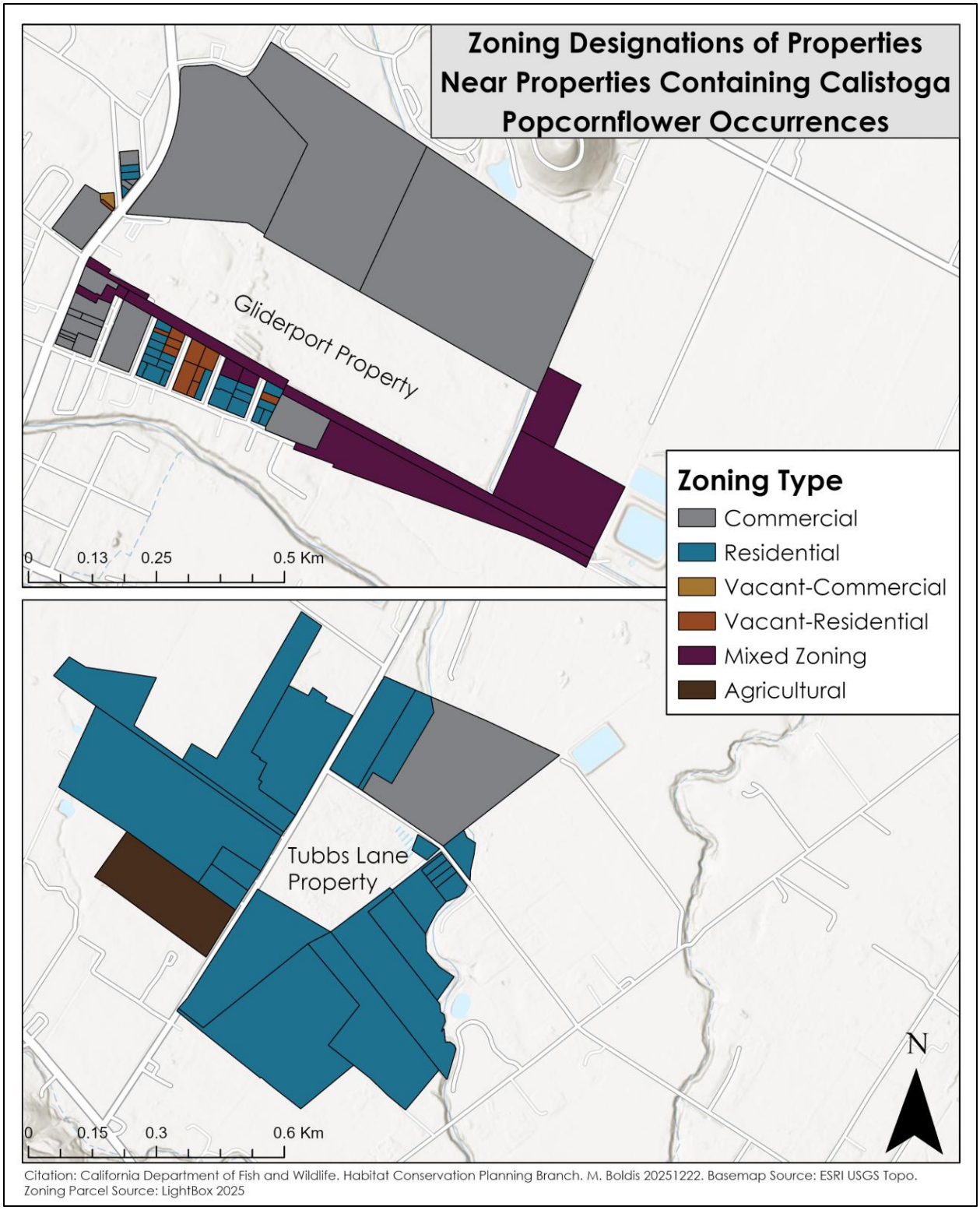


Figure 5. Zoning for properties near the locations of Calistoga popcornflower.

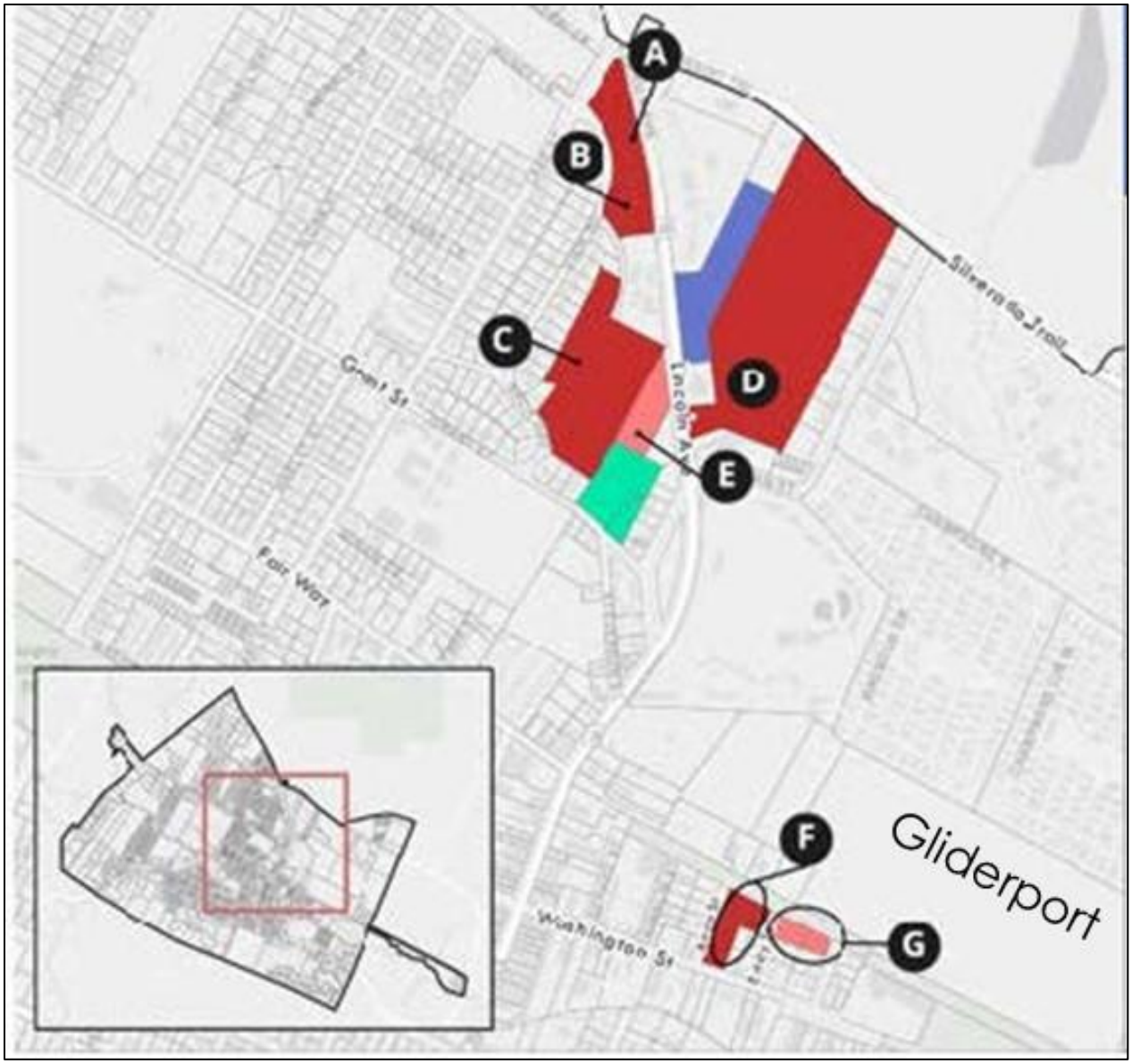


Figure 6. Sites re-zoned near the Gliderport occurrence (EO 3) to allow for the development of affordable housing. Map sourced from 2023 City of Calistoga Housing Element, p. 5-23 (City of Calistoga 2023a).

The City of Calistoga's response provided that the re-zoning of these sites included sufficient mitigation measures for any future proposed development to ensure the species' continued existence (City of Calistoga 2023b). The City also indicated they would notify the Department for additional recommendations to avoid or minimize impacts to the species if development on sites F and G were to be proposed (City of Calistoga 2023b).

The private property containing the Tubbs Lane occurrence (EO 2) is currently designated as "vacant rural land" that permits uses such as agriculture, a communications tower, and single-unit housing and accessory structures (LightBox 2025b). This parcel once contained a house, a barn, and ancillary structures, but were torn down in recent years. Prior to vacating the property (sometime before 2011), the landowner mentioned they were potentially selling the land to commercial developers (Callizzo 1985, 1989). An estimated 22 parcels neighbor or are near the property containing EO 2 and are all zoned with some form of development allowed (Figure 5), which includes mixed residential use, commercial, and agricultural (LightBox 2025b). Currently, a local land trust is pursuing the conservation of the Tubbs Lane property (L. Pollastro and J. Ruygt, personal communication, Jul 16, 2025 to Sep 8, 2025), which would remove the ability to develop the property if conservation is successful.

ii. Resort Expansion

Since the mid to late 2000s, development of the Gliderport property to expand the existing Indian Springs Resort (originally built between 1912 and 1920) has been proposed several times (Goude 2009; J. Bjerke, personal communication, Oct 22, 2013; Merchant N.D.). Based on observations from one growing season of Calistoga popcornflower at EO 3, it was presumed that the species could benefit from higher soil saturation (A. Wyrick Brownworth, personal communication, Dec 10, 2013). Subsequently, a stormwater discharge project was proposed but ultimately did not take place. The stormwater discharge project would have altered the hydrology and inadvertently introduced harmful pollutants into the species' habitat (City of Calistoga, personal communication, Dec 10, 2013; CDFW, personal communication, Feb 5, 2014).

Monitoring from 2013 to 2020 at the Gliderport occurrence (EO 3) included management recommendations for the landowner (Wyrick-Brownworth et al. 2021), which were adapted into the Veranda at Indian Springs Project (City of Calistoga 2020c). In January 2025, the City of Calistoga approved the Veranda at Indian Springs Project, a hotel expansion that includes a 2-story building with 96 hotel rooms and additional amenities (City of Calistoga 2020c; Z. Tusinger, personal communication, Aug 26, 2020 to Sep 17, 2020; G. Desmond, personal communication, Jul 17, 2025). This expansion is located at the western end of the Gliderport (Figure 7), which contains the buildings for the former airport and where the two smaller areas of EO 3 (3a and 3b) occur (Figure 2), but are now extirpated.

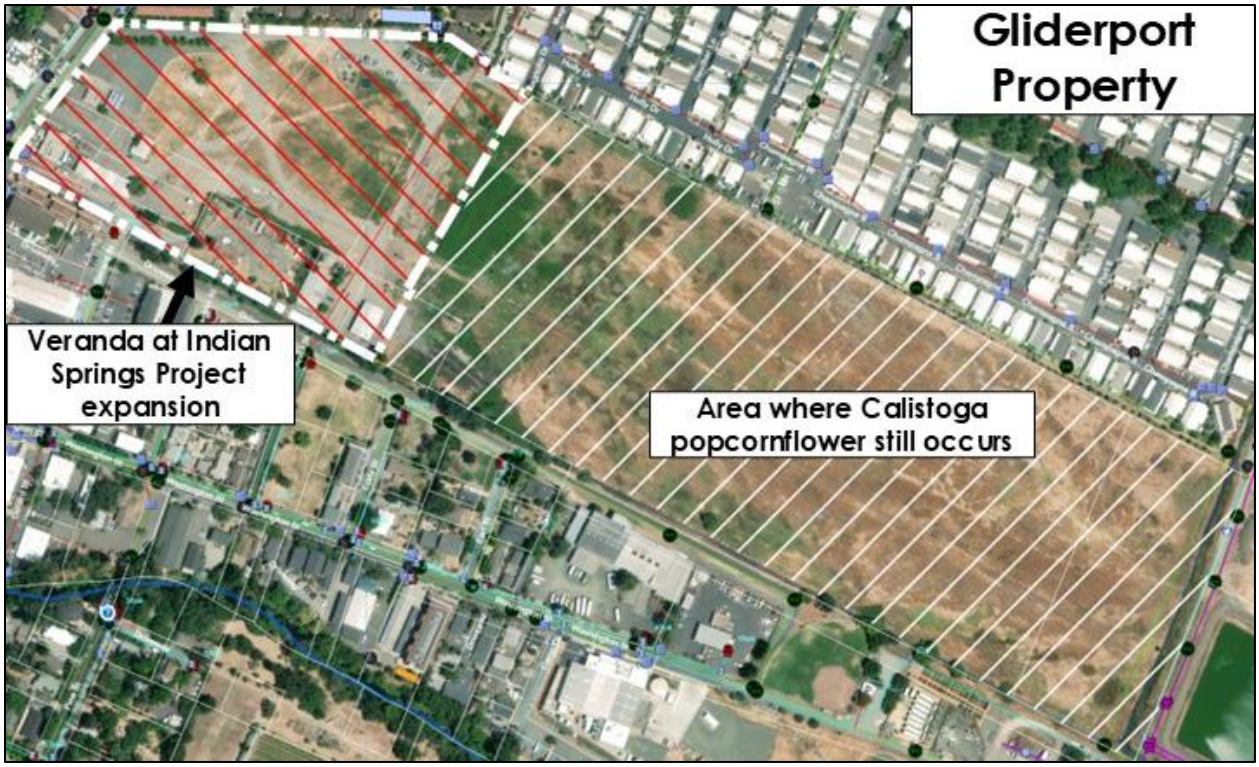


Figure 7. Outline of the area approved for development to expand the existing Indian Springs Resort on the western end of the Gliderport property. Source of image (G. Desmond, personal communication, Jul 17, 2025).

iii. Altered Geothermal Hydrology

Altered geothermal hydrology from drilling water wells, historical and ongoing water extraction, and water diversions have contributed to the decline of Calistoga popcornflower, resulting in just two extant and isolated occurrences left in the world. A decrease in ground water flow feeding lowland habitat from hot springs, water diversions from springs, complete drying of springs, or any other further change could lead to further population declines or complete extinction of Calistoga popcornflower.

The changes in the geothermal hydrology and land use in Calistoga, especially near and within extant Calistoga popcornflower occurrences (e.g., mobile home park development), suggests that the species' habitat was once likely more extensive and could have occupied a much larger area (Glenn Lukos Associates 2009). Calistoga was once characterized as a riverine wetland complex (bodies of water connected by various small and large streams) that was eventually channelized to feed into the present day Napa River that runs through the city (Grossinger and Askevold 2012). Since the late 1860s, drilling wells and water extraction activities have been an important aspect for developing Calistoga's hot spring resorts, residential homes, and mineral

water companies (Youngs and Higgins 1981; Digitale 2015; Napa County Historical Society 2015), especially in the valley (also called "Springs Ground") (Figure 8). Between 1910 and 1920, "Springs Ground's" depth to water table decreased more than 30 m (100 ft) due to excess water extraction (Allen and Day 1927). The shallowest areas completely dried by 1924 (Allen and Day 1927). Today, the Gliderport occurrence (EO 3) is located within the portion of old "Springs Ground" that remains intact from seasonal flooding from precipitation and from an underground leak closest to the South Patch from the geothermal pipes that run below the mobile home park (Wyrick-Brownworth 2013a).

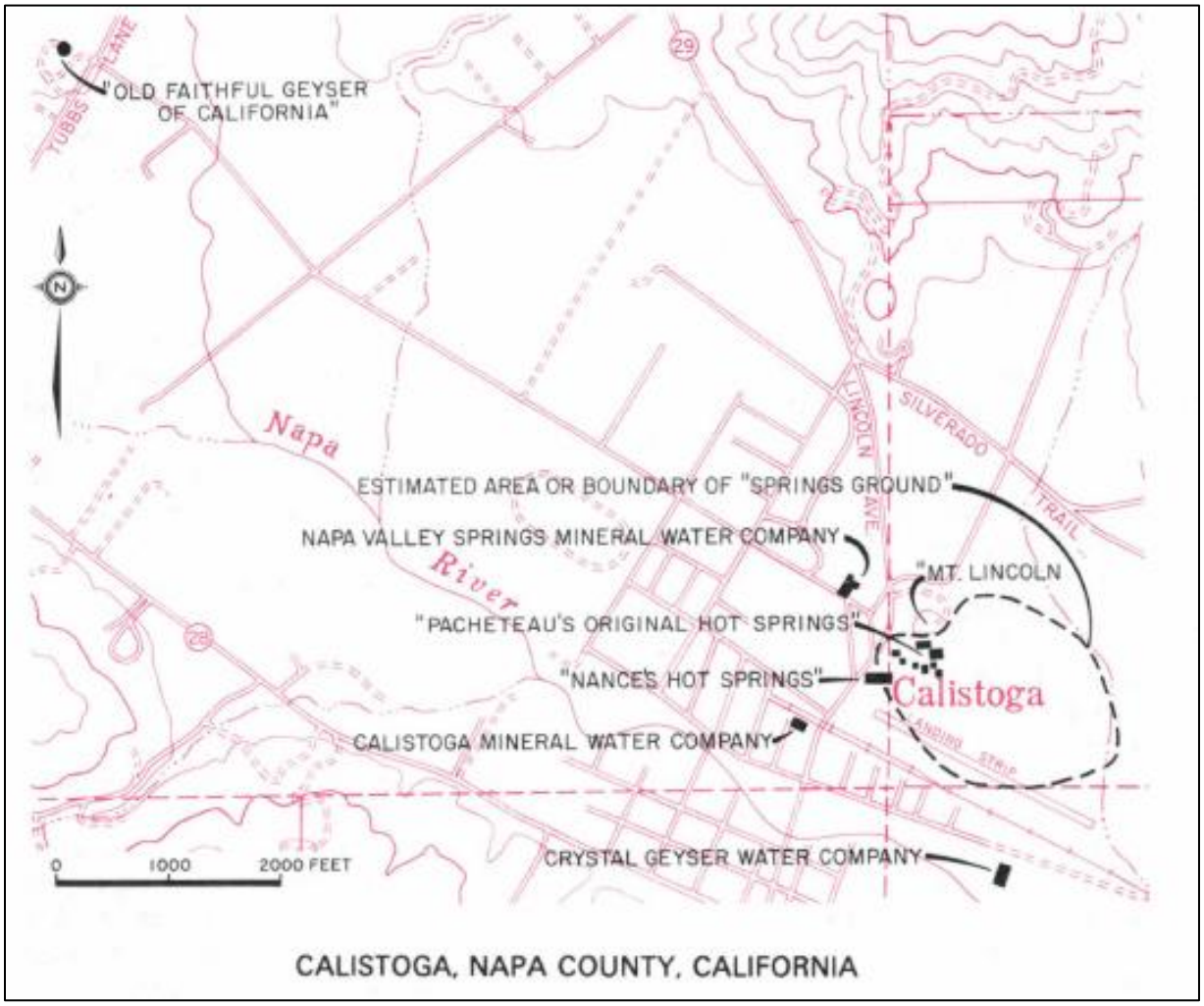


Figure 8. Map of Calistoga where geothermal waters were extracted in the valley ("Springs Ground") beginning in the 1860s. The "Pacheteau's original hot springs" referenced on the map is known as Indian Springs Resort. Source: Allen and Day (1927).

In 1980 and 1981, the California Geological Survey (formerly the California Division of Mines and Geology), conducted a study to assess all the wells and geothermal activity

in California for additional potential development opportunities, which included the evaluation of over 100 wells in Calistoga (Youngs et al. 1980; Taylor et al. 1981; Youngs and Higgins 1981). At present, about 136 wells are within 4 km (2.5 mi) of extant Calistoga popcornflower occurrences (CDC 2025). There are 102 wells currently permitted to be supplying water (active) or remain operable but are not currently supplying water (idle), and the remaining 34 are closed and no longer supplying water (non-active) (Figure 9).

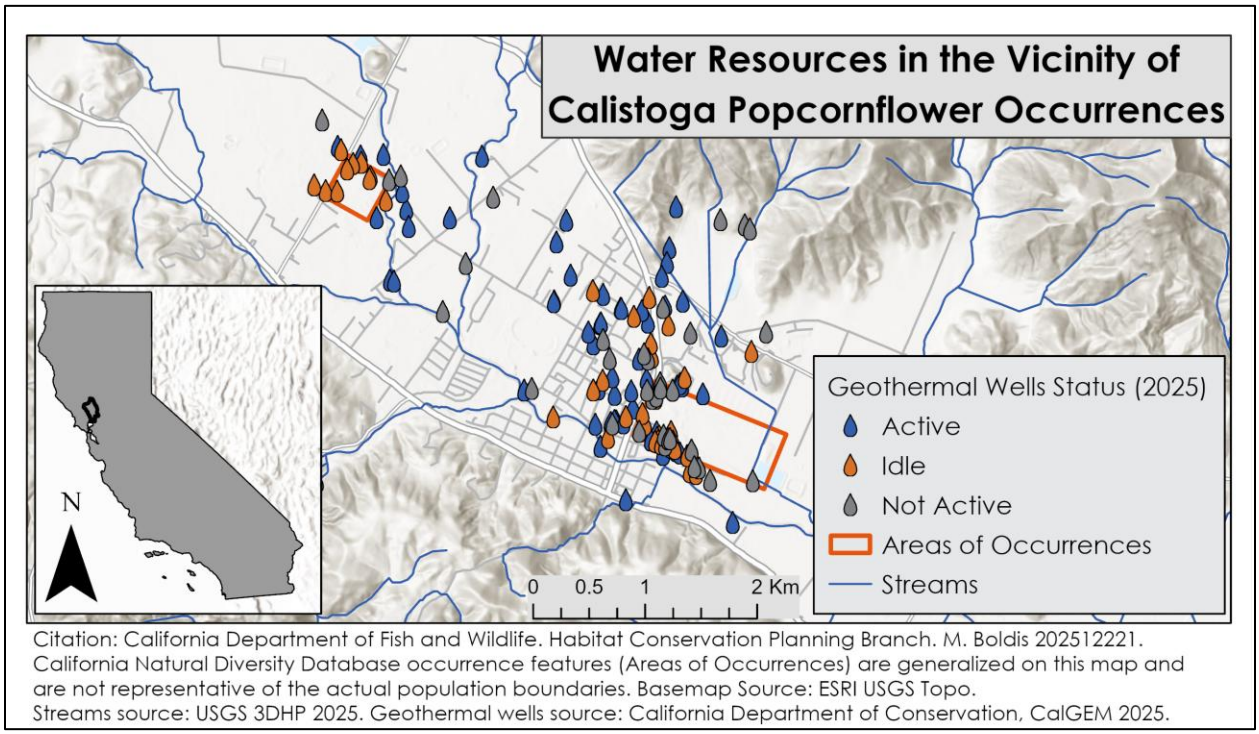


Figure 9. Geothermal well status and streams in the vicinity where Calistoga popcornflower occurrences are found. 102 wells are active or idle.

By 1912, 13 geyser wells within the vicinity of the Tubbs Lane occurrence (EO 2) were drilled for commercial or residential use (Allen and Day 1927). EO 2 likely shares a water source with the "Old Faithful" Geyser (drilled in 1915) due to their relative proximity to each other and proximity to surrounding wells (Youngs and Higgins 1981). Historical imagery from 1952, 1965, 1998, and 2024 at EO 2 shows how the land changed (Figure 10). It appears that the focus of land use shifted from water extraction for the geothermal properties to developing vineyards, wineries, and residences nearby. This may be due to the slightly higher elevations (±18 m (60 ft)) that make it more expensive to drill deeper wells for hot spring development and because the volcanic soils are also desirable for wine-grape growing (Youngs and Higgins 1981).

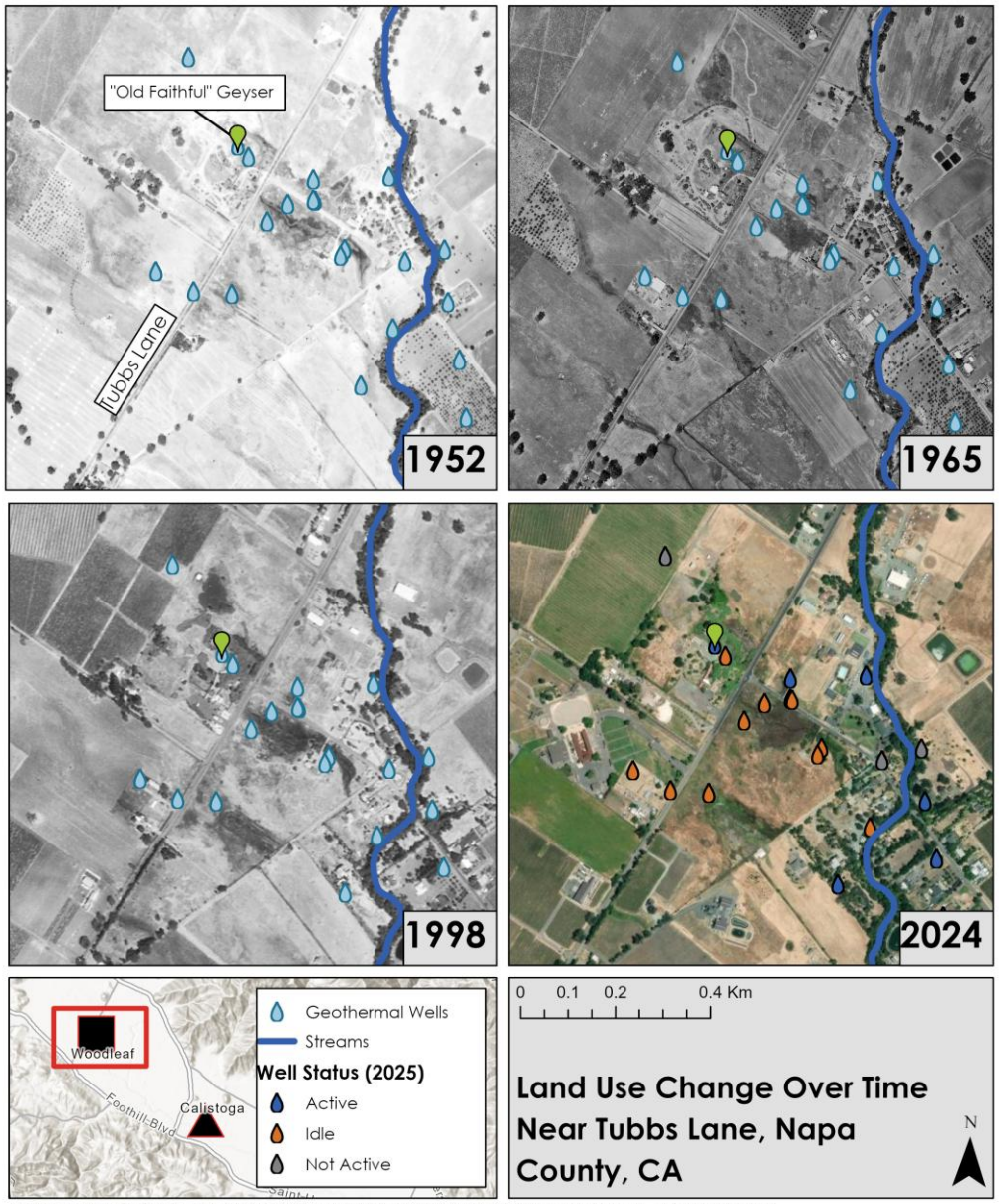
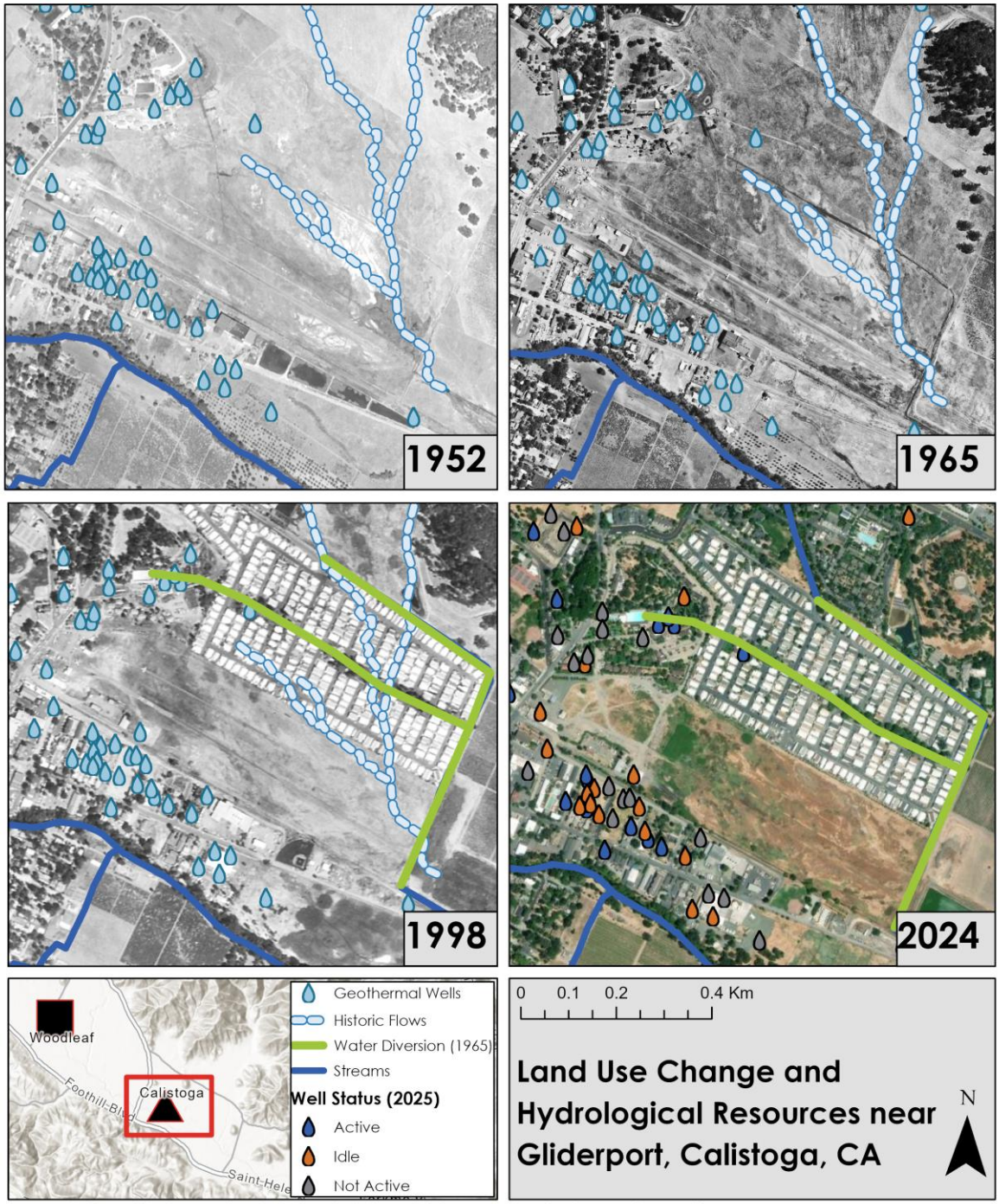


Figure 10. Hydrological resources and land use change over time near the Tubbs Lane occurrence (EO 2).

Historical imagery at the Gliderport occurrence (EO 3) from 1952, 1957, and 1965 shows where surface water flowed, before those areas became developed (Figure 11). In 1965, geothermal hot spring water from Indian Springs Resort and surface waters directly north of EO 3, were diverted beath and around a newly constructed mobile home park (Figure 11) and emptied into the Napa River. Prior to developing the mobile home park, you can view patterns of dry and wet vegetation and alkaline crusts (scalds) that once existed in this area (Figure 12).



Map created by California Department of Fish and Wildlife, Habitat Conservation Planning Branch, M. Smith 20251223. Basemap Sources: ESRI USGS Topo, UC Santa Barbara Frame Finder Library of Historical Aerial Photos. Water Diversion (1965) Source: Glenn Lukos Associates 2009. Streams Source: USGS 3DHP 2025. Wells Source: California Department of Conservation, CalGEM.

Figure 11. Hydrological resources and land use change near the Gliderport occurrence (EO 3). Geothermal water from Indian Springs Resort and other water were channeled into pipes beneath the mobile home park in 1965 to runoff into the Napa River.

Figure 12. Alkaline crusts (bare scalds) and meadows north of the Gliderport occurrence (EO 3) before 1965. Adjacent to the Indian Springs Resort (in foreground), an alkaline meadow interspersed with bare scalds once existed in the location where at present day a mobile home park stands. Bare scalds are considered locations of historical outflow of hot springs and are indicators for Calistoga popcornflower habitat. Image source (Grossinger and Askevold 2012, p. 77, courtesy of the California Historical Society).

From the early 2000s to present day, various developmental plans were proposed for the Gliderport property which raised concerns over impacts to the hydrology of EO 3 (USFWS, personal communication, Dec 22, 2009; J. Bjerke, personal communication, Oct 22, 2013; City of Calistoga, personal communication, Dec 10, 2013; CDFW, personal communication, Aug 26, 2020; Merchant N.D.). In 2013, a proposal was submitted for a project that would discharge stormwater into Calistoga popcornflower habitat (City of Calistoga, personal communication, Dec 10, 2013), but was not implemented since it was unknown how Calistoga popcornflower would be affected by year-round inundation and possible pollutants being discharged into its habitat (City of Calistoga, personal communication, Dec 10, 2013; Cooley 2013; CDFW, personal communication, Feb 5, 2014). As part of the Veranda at Indian Springs Project proposed in subsequent years (City of Calistoga 2020b), stormwater discharge infrastructure was integrated into the design. Communications between the Department and the City of Calistoga

ultimately led to changes in stormwater infrastructure design to address runoff from being released east into Gliderport that could cause adverse impacts to listed species including Calistoga popcornflower (CDFW, personal communication, Aug 26, 2020; City of Calistoga 2020b, c; Z. Tusinger, personal communication, Aug 26, 2020 to Sep 17, 2020). Stormwater would now runoff into an onsite 100-year rainfall-rated detention chamber located on the western edge of the emergency vehicle access road and then be discharged via percolation through a rock layer below the chamber as a form of filtering pollutants or chemicals (City of Calistoga 2020b, c). If the chamber fills beyond its capacity and soils become fully saturated, the overflow would release adjacent to and immediately south of the proposed parking lot (City of Calistoga 2020b). The Department suggested that the project also relocate the emergency vehicle access road (Figure 13) away from the Gliderport property, which as designed, would be approximately 200 m (700 ft) from Calistoga popcornflower habitat (G. Allen and K. Weiss, personal communication, Sep 8, 2020).

Figure 13. Site Plan of the Veranda at Indian Springs Project. Source: City of Calistoga (2020c), Figure 5, p. 16.

However, the City of Calistoga indicated relocation would not be possible and provided a mitigated alternative where the road would be sloped to direct runoff to the west (away from the Gliderport) (CDFW, personal communication, Aug 26, 2020; City of Calistoga 2020b). In January 2025, the City of Calistoga finalized the Veranda at Indian Springs Project which also requires preparing a final stormwater control plan (City of Calistoga 2020b, 2025). Despite these design changes to avoid all impacts to Calistoga popcornflower, the risk remains for altered hydrological connectivity to the species. Specifically, stormwater detention and percolation, and changes to local topography to direct water flow (which includes precipitation) may increase localized saturation, potentially affecting seasonal flooding that Calistoga popcornflower relies upon. Any modifications to the project and additional development into Gliderport could negatively impact what remains of Calistoga popcornflower at the Gliderport property. Given the small extent of remaining occupied patches and their proximity to the footprint of the Veranda at Indian Springs Project, even subtle hydrologic or chemical shifts (e.g., pollutants) can change plant size, reproductive capacity, distribution, and abundance, which impact species persistence.

iv. Other Disturbance

The site of the Gliderport occurrence (EO 3) used to be a small airport originally known as the Calistoga Airfield; however, all flying operations ceased in 1999 (Freeman 2024). Sometime between 2000 and 2003, the current landowner removed the asphalt of the runway and piled the gravel at the north end of the runway (Freeman 2024). The outlines of the runways are still discernable and free of large debris (Figure 14).

Figure 14. View looking north at the end of a formerly paved runway at the Gliderport (Calistoga Airfield) in 2003. Photo source: Jonathan Westerling (Freeman 2024).

Grass mowing occurred frequently at EO 3 before the airport ceased operations (CDFG 1989), but mowing has been minimized since 2013, likely due to the landowner being made aware of the status and impacts to the species (Wyrick-Brownworth et al. 2021). Unfortunately, as mowing intensity has decreased, overgrown and invasive vegetation surrounds the species' habitat (Wyrick-Brownworth et al. 2021; Monk & Associates Inc. 2026) and the threat of competition from invasive species has become a greater threat to Calistoga popcornflower. Trampling from grazing animals threatened the species at the time of listing (CDFG 1989). For decades, horses and goats grazed the property of the Tubbs Lane occurrence (EO 2), but grazing was removed from the site sometime before 2011 and is no longer a threat (Shaw 1984; Doran 1988; Callizzo 1989; Rancho Santa Ana Botanic Garden (RSABG) 2012).

In conclusion, present or threatened modification or destruction of habitat where the species occurs have increased since listing. The remaining habitat is on land that is not permanently protected from future development. The resort expansion at EO 3 reduced the extent of the population from three areas to two small patches within one area, which increases the magnitude of how severe threat impacts are on the species. The altered geothermal hydrology (e.g., water diversions, water well supply) continues to impact water availability for the species and its habitat and any changes (e.g., decrease in water supply) can be detrimental to Calistoga popcornflower. Additionally, as the threats of mowing and grazing have decreased, the threat of competition from invasive vegetation has significantly increased which contributes to the displacement of the species. Overall, the risk of extinction from present or threatened modification or destruction of habitat to the species has continued, and in some cases increased, since the species was first listed.

B. Overexploitation

Overexploitation was not considered a threat at the time of listing, and there is no information to suggest that it has since become a threat.

C. Predation

In 2012, a study investigated whether threatened and endangered species in the Boraginaceae family (including Calistoga popcornflower) may be at risk of herbivory by a non-native root-feeding weevil (*Mogulones cruciger*) that has recently been found in the northern US (Park et al. 2011, 2024). The researchers found one case of feeding on Calistoga popcornflower, but determined it unlikely that the root-feeding weevil would feed the listed species in their natural setting (Park et al. 2024). At the moment, predation appears to not be a threat to the species.

D. Competition

At the time of listing, competition was not identified as a threat to Calistoga popcornflower (CDFG 1989). For this five-year species review, competition by vegetation encroaching into the species' habitat appears to threaten Calistoga popcornflower. With an increase in urbanization and agricultural land conversion, introduction of non-native plants that can also become invasive species is often a secondary impact from development. Non-native, invasive plants diminish native plant biodiversity, compete for the same resources as native plants, and block light to smaller annuals like Calistoga popcornflower, especially when the invasive plants become dry and overgrown (i.e., thatch).

At the Tubbs Lane occurrence (EO 2), tall fescue has been known to be an encroaching species that appears to tolerate a lot of moisture (Ruygt and Wyrick-Brownworth pers. comm. 2013). Tall fescue is rated as moderate for invasiveness by the California Invasive Plant Council (Cal-IPC), which indicates that the species has a substantial and apparent ecological impact on habitat, plant and animal communities (Cal-IPC 2004b). At the Gliderport property, the approved resort expansion (City of Calistoga 2025) may facilitate the unintentional introduction and spread of invasive plant species east of the expansion towards the Gliderport occurrence (EO 3) (CDFW, personal communication, Aug 26, 2020; City of Calistoga 2020b). The area where the emergency vehicle access road would be located (Figure 13) consists of Bermuda grass (*Cynodon dactylon*), large patches of Himalayan blackberry (*Rubus armeniacus*), field brome (*Bromus arvensis*), prickly lettuce, spring vetch, and hairy vetch, which has the potential to significantly impact Calistoga popcornflower nearby (City of Calistoga 2020b, c). Bermuda grass (moderately invasive) and Himalayan blackberry (highly invasive) are not species currently encroaching Calistoga popcornflower habitat, likely because they may not do as well in toxic soils. However, they both have the potential to indirectly displace Calistoga popcornflower by reducing access to light or reducing access to water (Cal-IPC 2004a, d). To mitigate invasive plant impacts, the project added vehicle washing stations and associated mitigation measures for the duration of the construction period to minimize non-native plant introductions (City of Calistoga 2020b). The project also added in perpetuity, removal invasive plants and development of a Habitat Protection and Management Plan (G. Allen, personal communication, Sep 8, 2020; City of Calistoga 2020b).

At both occurrences, wild oat, yellow star-thistle, Italian ryegrass, perennial pepperweed, meadow fescue, and common teasel have been commonly observed (Symonds 2008). Meadow fescue has no rating for invasiveness, but wild oat, Italian ryegrass, and common teasel are rated as moderately invasive by Cal-IPC. Yellow star-thistle and perennial pepperweed are rated as highly invasive by Cal-IPC which

increases concern for spread due to their high rates of establishment and severe impacts to ecological processes, which can shift the health and biodiversity of entire plant communities (Cal-IPC 2003, 2004c). Yellow star-thistle and perennial pepperweed are known to encroach into both dry and wet habitats, but yellow star-thistle significantly depletes soil moisture and perennial pepperweed is known to deplete soil salinity (Cal-IPC 2003, 2004c). The high mineral concentrations in soil are tolerated by Calistoga popcornflower which gives the species a competitive advantage since these conditions are not tolerated by most plants including non-native invasive species. However, these non-native invasive species grow in tall, dense patches near and adjacent to these mineral pools that cover habitat and block light from reaching Calistoga popcornflower. Dense areas of non-native invasive species also likely use available soil-water resources that are upland from the pools, before being able to reach Calistoga popcornflower. In conclusion, competition by non-native, invasive vegetation has become a new threat since listing.

E. Disease

Disease was not considered a threat at the time of listing, and there is no information to suggest that it has since become a threat.

F. Small Population Size

Plants with small population sizes that also occupy relatively small areas are inherently more vulnerable to extinction than plants with larger population sizes that also occupy larger areas. Calistoga popcornflower occupies an extremely small area and its population sizes are extremely low, making it highly vulnerable to extinction. Since listing, no additional occurrences have ever been found, and the species' distribution and abundance within each occurrence have fluctuated but have generally reduced. Years when no plants are found or when plants are small (having only one or two flowers) also indicates a poor reproductive year, especially when one flower can only produce four seeds at most. The Gliderport occurrence (EO 3) specifically has been fragmented due to heavy disturbance in the area over the years, reducing from three areas to only two small patches within one area. The species may have been extirpated within areas 3a and 3b by early 2025 (Figure 2), but the planned resort expansion will guarantee this extirpation. There is not much abundance data for the Tubbs Lane occurrence (EO 2), but its current low numbers (<1,000 individuals) put it at high risk of extirpation based on the NatureServe risk assessment (Master et al. 2012). In conclusion, the risk of extinction has been intensified by small population size. The overall extent of the range and distribution of the occurrences have reduced, which diminishes the species' ability to recover from years where the species experiences low abundance.

G. Stochastic (Chance) Events

At the time of listing, stochastic events were identified as a predominate threat to the small population size and restricted distribution of the species (CDFG 1989), and they continue to be a threat to the species. Stochastic events are random or occur by chance (e.g., wildfire, flood). For Calistoga popcornflower, any event can be detrimental since it is an annual which allows only one opportunity in a growing season for the species to reproduce successfully. For example, mowing overgrown invasive vegetation before Calistoga popcornflower can reproduce viable seeds, especially when mowing multiple years in a row, can potentially cause extinction. The intensity of a stochastic event does not have to be great to be existential when a species' population size is extremely small and its distribution is highly restricted. Invasive species (e.g., yellow star-thistle) present in areas surrounding Calistoga popcornflower occurrences can pose an increased fire risk, especially in late summer when vegetation is overgrown and dry and wildfire risk is high. Historical and recent wildfire fire data (1950 – 2025) in the area (CAL FIRE 2025c) shows the expansive footprint of wildfire over the years near the two Calistoga popcornflower occurrences (Figure 15).

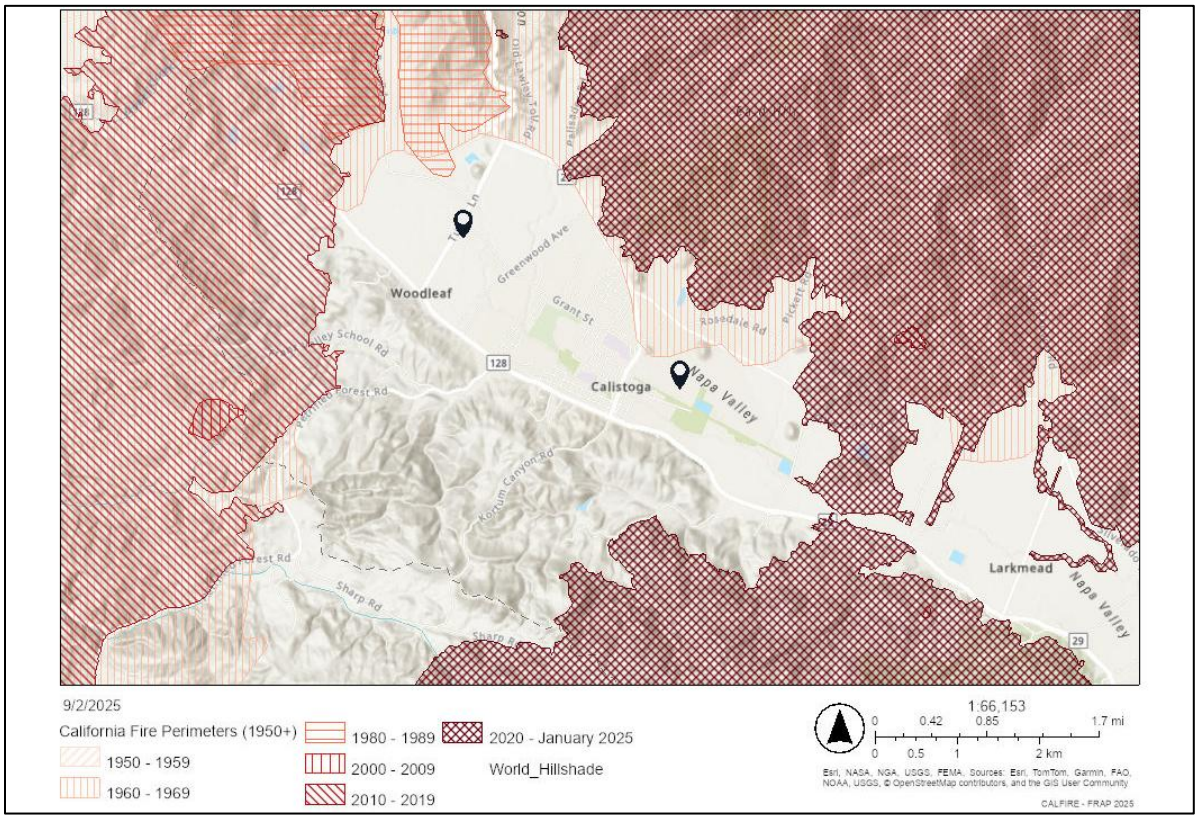


Figure 15. Fire perimeters (1950-2025) surrounding the Calistoga area near the two Calistoga popcornflower occurrences. The pins on the map show the approximate locations of the occurrences relative to the fire perimeters.

In 2016, a local fire that started at the "Old Faithful Geyser" (Bay City News 2016) also burned part of the property where the Tubbs Lane occurrence (EO 2) is found (Figure 16). Despite the fire, Calistoga popcornflower has been found at EO 2 in subsequent years. However, it is unknown how fire, especially high intensity fire, impacts Calistoga popcornflower. In conclusion, stochastic events remain a threat to the species.

Figure 16. Burned areas from a local fire in 2016 that include burned habitat where the Tubbs Lane occurrence (EO 2) is found. Source: Napa Valley Register (2016).

H. Genetic Drift, Introgression, and Inbreeding Depression

Genetic drift, introgression (hybridity), and inbreeding depression are some of the risks to a species with a small population size (Nunney 2002). These risks may further fragment a population and reduce genetic variation, which lessens the ability of a species to adapt to environmental changes, especially in the face of climate change. Previous genomic sequencing for *Plagiobothrys* (Guilliams 2015) provided limited conclusions for genetic relationships at the species level (M. Guilliams, personal communication, Aug 7, 2025) and it remains unanswered if or how genetic drift, introgression, and inbreeding depression could affect Calistoga popcornflower. While no additional genetic or demographic studies on this species have been conducted, a genomics sequencing study for Calistoga popcornflower is in the planning stage; and if successful, would inform the species' genetic diversity including if the species is experiencing any genetic drift, introgression or inbreeding depression (C. Baysdorfer, personal communication,

Sep 10, 2025; C. Baysdorfer et. al., personal communication, Sep 3, 2025; M. Guilliams, personal communication, No 18, 2025; J. Heraty, personal communication, Oct 8, 2025; J. Ruygt, A. Wyrick-Brownworth, personal communication, Oct 17, 2025). In conclusion, genetic drift, introgression, and inbreeding depression have been identified as new threats to the species since listing due to small population size, declining distribution and restricted range.

8 Existing Management

This section considers the impact of existing management efforts on the species (Fish & G. Code, § 2072.3; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)).

Just as indicated in the original status review (CDFG 1989), there are currently no existing or past management efforts for the direct conservation of Calistoga popcornflower. Both occurrences occur on private property, which can make implementing management more complex. Although there is no existing management, the following provides insight on existing efforts to minimize impacts on the species and seek solutions for conserving Calistoga popcornflower.

A. Habitat Mitigation and Monitoring Plan at Gliderport

The resort expansion (Veranda at Indian Springs Project) was approved in January 2025 (City of Calistoga 2025). As a result, the landowner is required to prepare a Habitat Protection and Management Plan in coordination with the City of Calistoga and reviewed and approved by the Department (City of Calistoga 2020b, c; Z. Tusinger, personal communication, Aug 26, 2020 to Sep 17, 2020). The Habitat Protection and Management Plan expects to include monitoring for Calistoga popcornflower, management for the species' benefit, management of invasive species in perpetuity, and recommendations for designating the remaining Gliderport property as a Natural Resource Preservation Area (G. Allen, personal communication, Sep 10, 2020; City of Calistoga 2020a, b). It is important to note that this plan does not protect the remaining Gliderport habitat from future development and does not protect and conserve Calistoga popcornflower from possible extirpation.

B. Conservation Seed Storage

In 2008, USFWS staff collected four plant specimens and an unrecorded number of seeds between the fence and road edge of the Tubbs Lane occurrence (EO 2) and from the southwestern edge of the Gliderport occurrence (EO 3) (Symonds 2008). The purpose of this collection was for conservation and long-term seed storage at California Botanic Garden (Symonds 2008).

C. Local Jurisdictions

The importance of protecting critical habitat resources for Calistoga popcornflower are mentioned within the Open Space and Conservation Element of the General Plan for the City of Calistoga (City of Calistoga 2012, 2020a), and within the Managed Production of Resources in the Napa County General Plan (Napa County 2009). The General Plan for the City of Calistoga identifies wetland resources at the Gliderport property that should not be developed, along with identifying a site within the Gliderport property itself for new park planning. Some of the goals and objectives recognize the value in protecting sensitive resources (e.g., Calistoga popcornflower) to the extent possible on the Gliderport property and outlines objectives that encourage the city to explore designating parcels as Natural Resource Preservation Areas. The Napa County General Plan provides goals and objectives that focus on agricultural sustainability while balancing the need to protect important biological resources that include Calistoga popcornflower.

Both occurrences are located within a Local Responsibility Area, meaning the financial responsibility of wildfire prevention is with Napa County for the Tubbs Lane occurrence (EO 2) and with the City of Calistoga for the Gliderport occurrence (EO 3). Part of where EO 2 is found falls within a moderate fire hazard severity zone (CAL FIRE 2025b). The Gliderport property is not currently within an identified fire hazard severity zone, but these maps could change in the future (CAL FIRE 2025a).

EO 2 and EO 3 are also located within locally and regionally designated Priority Conservation Areas (MTC 2025a), which are separate from local land use zoning as designated by the city and county. Priority Conservation Areas are lands recognized by the Association of Bay Area Governments (ABAG) as being important for conservation, enhancement, restoration, or public access in the face of climate change (MTC 2025b). Each Priority Conservation Area is defined under one of five types of land designations. Each land designation has their own goals and objectives to determine the type of conservation actions preferred to be implemented (MTC 2024b). EO 2 was designated as a Working Lands type (Napa County Agricultural Lands) in 2008, which offers both protection and enhancement opportunities within the definition. and EO 3 was designated as a Recreation Type (Vine Trail) in 2025, which is not focused on protection like the other designation because it occurs within an urban setting (MTC 2024a). While a Priority Conservation Area does not change or affect local land use, zoning, or a landowner's ability to develop in the future, these designations streamline assessments and provide grant opportunities for projects that focus on conservation, enhancement, restoration, or public access (MTC 2025c).

D. Ongoing Communication

Over the last two decades, the landowners have periodically been made aware of recommendations for conserving Calistoga popcornflower at the Gliderport occurrence (EO 3) (USFWS, personal communication, Dec 22, 2009; J. Bjerke, personal communication, Oct 22, 2013; Z. Tusinger, personal communication, Aug 26, 2020 to Sep 17, 2020; CDFW, personal communication, Sep 30, 2024). The Department has regularly communicated with interagency partners and individuals since 2024 to collaborate and exchange information on monitoring, research, and potential management for the species (F. Bowman et. al., personal communication, Nov 22, 2024; CDFW, personal communication, Sep 30, 2024; M. Day, personal communication, Jul 10, 2025; USFWS and J. Ruygt, personal communication, Jul 31, 2025). As of publication of this five-year species review a local land trust was pursuing the conservation of the property containing the Tubbs Lane occurrence (EO 2) with support from the Department and collaborating partners (CDFW and partners et. al., personal communication, Jul 16 to Oct 17, 2025). The Department has also been coordinating and planning with the Santa Barbara Botanic Garden and relevant partners to collect seed and tissue samples for a genomics study on the species (C. Baysdorfer, personal communication, Sep 10, 2025; C. Baysdorfer et al., personal communication, Sep 3, 2025; M. Guilliams, personal communication, Aug 7, 2025; M. Guilliams, personal communication, Aug 8, 2025; M. Guilliams, personal communication, Nov 18, 2025; J. Heraty, personal communication, Oct 8, 2025; J. Ruygt and A. Wyrick-Brownworth, personal communication, Oct 17, 2025).

9 Management Recommendations

This section considers suggestions and recommendations for future management activities and other recommendations for recovery of the species (Fish & G. Code, §§ 2072.3 & 2077; Cal. Code Regs., tit. 14, § 670.1, subd. (d)(1)). The following actions are not a detailed conservation strategy; however, they outline management actions which are likely to aid in recovery and prevent the extinction of the species. The Department recommends that the following actions be conducted in coordination with partners and interested parties, consistent with California's goals of preventing the extinction of rare, threatened, and endangered species. Protecting any remaining and extremely rare habitat is vital to prevent Calistoga popcornflower from going extinct.

A. Recommended Management Actions

Below is a table of recommended actions that may be used to aid in recovery and to prevent extinction of Calistoga popcornflower. Each action is accompanied by the threats it addresses and how it may contribute to the species' recovery.

Table 3. Recommended actions to aid in the recovery of Calistoga popcornflower.

Actions	Threat(s) Addressed	Contributions to aid Recovery
1. Conserve remaining habitat permanently	Present or threatened modification or destruction of habitat	Conserves population(s) by removing the potential for habitat elimination or destruction due to development and associated activities
2. Avoid negative impacts to species and habitat through outreach and cooperation	Present or threatened modification or destruction of habitat; Competition	Increases awareness of the species' imperiled status and enables potential coordination to manage for and protect the species from threats of extinction
3. Stabilize and expand populations	Small population size; Stochastic (chance) events; Genetic drift, introgression, and inbreeding depression	Preserves existing genetic diversity important for species resiliency and supports the potential for reintroducing or outplanting the species to increase population size
4. Remove or minimize competition from invasive plants	Present or threatened modification or destruction of habitat; Competition	Maintains critical habitat essential to the continued existence of the species
5. Re-establish and/or promote existing hydrologic connectivity from springs	Present or threatened modification or destruction of habitat; Small population size	Ensures remaining occurrence(s) can rely on connectivity to geothermal resources that seasonally feed their habitat and improve species' survival
6. Establish research and long-term monitoring to build understanding of the species' needs, tolerances, and population trends	Present or threatened modification or destruction of habitat; Small population size; Stochastic (chance) events; Genetic drift, introgression, and inbreeding depression	Supports scientific understanding of the species' ecology and biology to create an informed conservation strategy for the species' recovery
7. Engage with tribes to raise awareness of the species' need for increased protection and provide opportunities for tribes to express priorities	Present or threatened modification or destruction of habitat; Competition	Supports transparency of the species' imperiled status, and enables opportunities for collaborative problem solving and integration of tribal priorities into decision making processes needed for the species' survival

B. Recommended Tasks to Implement Management Actions

To prevent extinction and facilitate recovery of Calistoga popcornflower, cooperation of partners and stakeholders in the species' area is needed. To aid in the recovery of the species, recommended tasks for each management action from Table 3 are provided below.

1. Conserve remaining habitat permanently.

    a. Acquire and permanently protect any land containing Calistoga popcornflower. All remaining habitat is considered essential (CDFG 1989). Support acquisition efforts by conservation-focused non-profits (e.g., land trusts) or tribes.

    b. Update the Priority Conservation Area land designations maintained by the Association of Bay Area Governments (ABAG) for both occurrences to recognize the importance of protecting and preserving critical habitat. Change designations at the Tubbs Lane occurrence (EO 2) from Working Lands to Natural Lands, and at the Gliderport occurrence (EO 3) from Recreation to Natural Lands (MTC 2024b). Working Lands designation supports activities and projects that enhance or protect and preserve habitat, but the main objectives for these lands are to support the region's agricultural economy. Recreation designation provides opportunities for habitat enhancement, but not for protection and preservation (MTC 2024a). Natural Lands designation support activities that protect, enhance, or maintain regional biodiversity and ecological function of terrestrial and aquatic ecosystems.

    c. Implement the goals and objectives for protecting significant biological resources outlined in the general plans for the City of Calistoga and for Napa County to protect Calistoga popcornflower and its habitat (Napa County 2009; City of Calistoga 2020a).

    d. Suggest changing the local land use type at the Gliderport occurrence (EO 3) from "Airport Commercial" to "Open Space for the Preservation of Natural Resources" in a future amendment of the General Plan for the City of Calistoga. This change would aid in minimizing the possibility of developing the species' habitat in the future and would be consistent as a Priority Conservation Area that the land is designated as by the ABAG.

e. Promote acquisition projects in Priority Conservation Areas that focus on protecting Calistoga popcornflower for the benefit of the species and other rare plants. The Priority Conservation Area Grant Program may provide funding to support acquisition: https://mtc.ca.gov/funding/funding-opportunities/priority-conservation-area-pca-grants. Additional funding sources may include the Endangered Species Recovery Land Acquisition Grant Program (Non-traditional Section 6): https://wildlife.ca.gov/Grants/Land-Acquisition; the Land Acquisition Program: https://wcb.ca.gov/Programs/Acquisitions; and the Sustainable Agricultural Lands Conservation Program: https://www.conservation.ca.gov/dlrp/grant-programs/SALCP/Pages/Program-Guidelines.aspx.

2. Avoid negative impacts to species and habitat through outreach and cooperation.

    a. Reach out to landowners periodically to encourage avoidance of impacts to the species, and establishment of management plans that may help avoid impacts in the future. Landowners can explore partnering with USFWS's Partners for Fish and Wildlife Program to implement a shared-cost conservation project: https://www.fws.gov/program/partners-fish-and-wildlife.

    b. Work with Napa County and the City of Calistoga when they are updating their General Plans' goals and objectives concerning Calistoga popcornflower habitat to ensure the protection and management of open spaces coincides with preventing extinction of the species.

    c. Meet periodically with relevant partners such as Department staff in region, USFWS, Napa County Flood Control and Water Conservation District, California Native Plant Society, Pacific Union College, and others to discuss Calistoga popcornflower conservation and engagement with the landowners.

    d. Develop a formal management and recovery plan for the species in collaboration with federal and state agency partners, local government, tribal partners, non-profit organizations, landowners, and other interested parties.

    e. Encourage the application of laws and regulations (e.g., CESA, CEQA) through permitting pathways for projects near Calistoga popcornflower to protect the species and its essential habitat.

3. Stabilize and expand populations.

    a. Establish redundant seed collections that represent the genetic diversity of the species and store at accredited seed banking institutions for long-term conservation storage.

    b. Test viability of seeds collected periodically to ensure reproductive capacity.

    c. Develop propagation techniques for Calistoga popcornflower.

    d. Collaborate with local partners to plan and implement an experimental propagation and outplanting project to expand the population at existing sites or to establish populations at new sites.

4. Remove or minimize competition from invasive plants.

    a. Implement an annual assessment of invasive species (e.g., tall fescue, yellow star-thistle) at both occurrence locations.

    b. Encourage collaboration to develop and implement an invasive species management plan in coordination with the Department, USFWS, City of Calistoga, Napa County, CAL FIRE, tribes, landowners, and other interested parties to minimize habitat encroachment and mitigate fire risk.

5. Re-establish and/or promote existing hydrologic connectivity from springs.

    a. Measure changes in groundwater recharge annually at both occurrences to monitor changes in hydrology.

    b. Install a weather station in Calistoga to collect precise precipitation data for the localities and to provide redundancy for the collection of long-term weather data by the National Oceanic and Atmospheric Administration California Nevada River Forecast Center. Currently, the nearest weather station is Napa State Hospital 48 km (30 mi) away.

    c. Assess ways to improve hydrology to expand the species' distribution in coordination with Department regional staff, USFWS, City of Calistoga, Napa County, tribes, landowners, and other interested parties.

6. Establish research and long-term monitoring to build understanding of the species' needs, tolerances, and population trends.

a. Evaluate how factors such as soil nutrient concentrations, precipitation, soil water availability, and depth to water table relate to the distribution of Calistoga popcornflower and the species' overall size.

b. Examine how soil nutrient concentrations in patches the species grows in relate to the nutrient concentrations found in the species' plant tissue.

c. Assess the species' genomic diversity through seed and plant tissue collection, and look for evidence of genetic drift, introgression, and inbreeding depression.

d. Evaluate how local hydrology (e.g., weather patterns, surface water, groundwater) influences the species' ecology, including abundance, distribution, reproductive output, size, longevity, and root length.

e. Identify the primary pollinators of Calistoga popcornflower.

f. Study seed viability under various moisture regimes and fire intensities to better understand survival tolerances in the face of climate change.

g. Conduct habitat modeling to identify areas of possible suitable habitat outside the urban areas of Calistoga that could be potential future outplanting sites.

h. Implement annual population surveys for both occurrences.

7. Engage with tribes to raise awareness of the species' need for increased protection and provide opportunities for tribes to express priorities.

    a. Share with tribes any new and pertinent information the Department receives related to the species, including recommended management actions to support informed decision-making by a tribe.

    b. Ensure tribal interests are sought out when any future management or conservation efforts for the species are proposed by the Department.

    c. Strive for collaborative problem solving and integration of tribal priorities (e.g., stewardship, research, co-management, etc.) into recommended management actions 1 through 6 and any other efforts that enhance the species' survival and habitat. Any conservation efforts applied to the species' habitat would benefit from tribal involvement and co-management.

10 Recommendation to the Commission

CESA requires the Department to prepare this five-year species review to 1) assess the status of Calistoga popcornflower in California based on the best scientific information available to the Department, 2) determine if the conditions that led to the original listing are still present, and 3) indicate to the Commission the results of its five-year species review (Fish & G. Code, § 2077).

Under CESA, an endangered species is defined as "a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species is defined as "a native species or subspecies…that although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by CESA" (Fish and G. Code § 2067).

Prior to the 1990 decision to list the species as threatened, the Department recommended in its status review to list the species as endangered, consistent with the recommendation by CNPS in its listing petition. Based on the criteria described above and the best scientific information available today, the Department submits the following recommendation to the Commission:

CHANGE IN STATUS FROM THREATENED TO ENDANGERED

In completing this five-year species review for Calistoga popcornflower, the Department finds there is sufficient scientific information to indicate that the conditions that led to the listing of Calistoga popcornflower as threatened have changed and recommends a change in status to endangered. The Department evaluated the components set forth in Fish and Game Code section 2072.3 and California Code of Regulations, title 14, section 670.1, subdivision (d)(1) for sufficiency of information pursuant to Fish and Game Code section 2077 and sections 2072.7 and 2077, subdivision (e)). Based upon the information contained in this five-year species review, the Department determined there has been a decline in the conditions of the species since being listed as threatened in 1990. As outlined in this document, the distribution of Calistoga popcornflower within its range has reduced since listing due to continued modification and destruction of habitat. Additionally, the reduction in overall extent of the occurrences for Calistoga popcornflower likely requires a higher minimum population size than when the species was first listed, to ensure persistence. The most immediate threat to the species is modification or destruction of habitat, which has continued or increased since listing. The following have become new threat factors

impacting the species since listing: competition by non-native, invasive vegetation, and genetic drift, introgression, and inbreeding depression. Small population size and stochastic events remain ongoing threats since listing, amplifying the species vulnerability to extinction. The Department's five-year species review is submitted to the Commission not only in compliance with Fish and Game Code section 2077, but also as a Departmental recommendation and petition to list the species as endangered (Fish and G. Code § 2072.7 & 2077, subd. (e)). The species' change in CESA status may prompt increased interagency coordination specific to Calistoga popcornflower's conservation and protection. The species' change in CESA status may also increase the likelihood that state and federal resource management agencies will allocate funds toward monitoring, research, protection, and recovery actions.

Acknowledgements

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Appendix A. Vascular Plants Observed on the Property Containing the Tubbs Lane Occurrence (EO 2)

Table of species is unmodified from the original unpublished PDF (Ruygt ND). Common names followed by an asterisk were identified as non-native plants.

Scientific Name	Common Name	Status	Habitat
Acmispon americanus var. *americanus*	American Trefoil		
Astragalus breweri	Brewer's Milkvetch	CNPS List 4.2	
Atriplex triangularis	Fat hen		
Avena barbata	Wild Oats *		
Briza minor	Small Quaking Grass *		
Brodiaea terrestris subsp. *terrestris*	Dwarf Brodiaea	Napa Co. rare	
Bromus diandrus	Ripgut Grass *		
Bromus hordeaceus	Soft Chess *		
Calltriche sp.	Water Starwort		wetland
Cardamine oligosperma	Few-seeded Bitter Cress		
Centromadia parryi subsp. *parryi*	Pappose Spikeweed	CNPS List 1B.2	wetland
Cerastium vulgare	Mouse-eared Chickweed *		
Daucus carota	Queen Anne's Lace *		
Deschampsia danthonioides	Annual Hair Grass		wetland
Dipsacus fullonum	Wild Teasel *		
Distichlis spicata	Salt Grass		
Eleocharis rostellata	Beaked Spikerush	Napa Co. rare	wetland
Epilobium ciliatum	Northern Willow Herb		
Eryngium jepsonii ?	Coyote Thistle	(CNPS 1B)	
Erythranthe guttata	Seep-spring Monkeyflower		
Festuca arundinacea	Meadow Fescue *		
Festuca perenne	Italian Rye *		
Galium aparine	Cleavers		
Geranium dissectum	Cut-leaved Geranium *		
Hainardia cylindrica	Thin Tail *		
Hordeum depressum	Low Barley		wetland
Hordeum marinum subsp. *gussoneanum*	Mediterranean Barley *		wetland
Iris sp.	Iris *		

Scientific Name	Common Name	Status	Habitat
Juncus balticus	Baltic Rush		wetland
Juncus bufonius	Toad Rush		wetland
Lasthenia californica subsp. *californica*	California Goldfields		
Lathyrus angulatus	Angled Pea *		
Lathyrus odoratus	Common Sweet Pea *		
Leontodon saxatilis subsp. *longirostris*	Lesser Hawkbit *		
Lepidium acutidens	Alkali Peppergrass *	Napa Co. rare	wetland
Lepidium latifolium	Broad-leaved Peppergrass *		
Lessingia hololeuca	Woolly-headed Lessingia	CNPS List 3	
Lotus corniculatus	Bird's Foot Trefoil *		
Lupinus bicolor	Miniature Lupine		
Lythrum californicum	California Loosestrife	Napa Co. rare	wetland
Lythrum hyssopifolia	Hyssop Loosestrife *		wetland
Muilla maritima	Common Muilla	Napa Co. rare	wetland
(Palm)			
Perideridia kelloggii	Kellogg's Yampah		
Plagiobothrys strictus	Calistoga Popcornflower	FE	wetland
Pleuropogon californicus	Semaphore Grass		wetland
Poa napensis	Napa Bluegrass	FE	wetland
Rumex acetosella	Sheep Sorrel *		
Rumex crispus	Curly Dock *		wetland
Shoenoplectus americanus	Olney's Bulrush		
Senecio vulgaris	Common Grounsel *		
Sisyrinchium bellum	Blue Eyed Grass		
Spergularia marcotheca var. *leucophylla*	Long-styled Sand Spurry	CNPS List 1B.2	wetland
Tamarix parviflora	Small-flowered Tamarisk *		
Triglochin scilloides	Flowering Quillwort		wetland
Trifolium depauperatum var. *trunacatum*	Pale Sack Clover *		
Trifolium hirtum	Rose Clover *		
Trifolium variegatum	White-topped Clover		wetland
Triphysaria versicolor subsp. *faucibarbata*	Smooth Owl's Clover		
Vicia sativa subsp. *sativa*	Spring Vetch *		
Vicia villosa subsp. *varia*	Woolly-podded Vetch *		