Robust spineflower (*Chorizanthe robusta* var. *robusta*)

5-Year Review:
Evaluation and Summary

Photo: Ivan Parr

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

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5-YEAR REVIEW
Robust spineflower (*Chorizanthe robusta* var. *robusta*)

GENERAL INFORMATION

Species: *Chorizanthe robusta* var. *robusta*
FR citation: 59 FR 5499
Date listed: 4 February 1994
Classification: Endangered

BACKGROUND

Most recent status review

U.S. Fish and Wildlife Service. 2010. *Chorizanthe robusta* var. *robusta* (Robust Spineflower) 5-Year Review: Summary and Evaluation. Ventura Fish and Wildlife Office. Ventura, California.

FR Notice citation announcing this status review

Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews of 40 species in California, Nevada, and Oregon; request for information (87 FR 5832), February 2, 2022.

Critical Habitat Designation

Critical habitat for robust spineflower was finalized in 2002 (67 FR 36822). Six critical habitat units were defined within Santa Cruz County (Figure 1). The primary constituent elements for robust spineflower critical habitat include:

1. Sandy soils associated with active coastal dunes and inland sites with sandy soils;
2. Plant communities that support associated species, including coastal dune, coastal scrub, grassland, maritime chaparral, and oak woodland communities, and have a structure such that there are openings between the dominant elements (e.g. scrub, shrub, oak trees, lumps of herbaceous vegetation);
3. Plant communities that contain little or no cover by nonnative species which would compete for resources available for growth and reproduction of *Chorizanthe robusta* var. *robusta*; and
4. Physical processes, such as occasional soil disturbance, that support natural dune dynamics along coastal areas.

State Listing

Not listed under the California Endangered Species Act.

ASSESSMENT

Information acquired since the last status review

This 5-year review was conducted by the U.S. Fish and Wildlife Service (Service), Ventura Fish and Wildlife Office. Initiation of this review was announced through a Federal Register notice on February 2, 2022. We contacted land managers and species experts to request any data or information we should consider in our review, conducted a literature search, and reviewed information from habitat conservation plans, biological opinions, and permit reporting.

Background

Taxonomy

Robust spineflower is closely related to Monterey spineflower (*Chorizanthe pungens* var. *pungens*; federally threatened), Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*, federally endangered), and Scott's Valley spineflower (*Chorizanthe robusta* var. *hartwegii*, federally endangered). A genetic evaluation suggested that Robust spineflower is most closely related to Monterey spineflower rather than the varieties of either of the respective parent taxa (Brinegar and Baron 2009, p. 179). Robust spineflower is known predominantly from Santa Cruz County while Monterey spineflower is known predominantly from Monterey County, although the species cooccur at multiple locations in southern Santa Cruz County. Ben Lomond spineflower and Scotts Valley spineflower are geographically distinct from each other as well as their parent taxa and do not cooccur with other spineflower species. A fifth spineflower, diffuse spineflower (*Chorizanthe diffusa*) is a common species that may be mistaken for robust spineflower, or vice versa. When conducting surveys for Robust spineflower it may be prudent to consult reference populations of robust spineflower, Monterey spineflower, and diffuse spineflower, as well as multiple taxonomic keys (e.g. Jepson Flora Project, Mathews and Mitchell 2015, and Reveal 1989), to ensure accurate identification.

Distribution and Habitat

The distribution of robust spineflower is currently limited to Santa Cruz County. Historically, occurrences were attributed to areas near San Francisco and Alameda to the north, and San Jose and Los Gatos to the northeast, but were extirpated prior to listing because of development. In 2001, populations of a *Chorizanthe* species at Point Reyes National Seashore were identified as robust spineflower. In 2008, the Point Reyes populations were reclassified as a different *Chorizanthe* species based on a genetic evaluation, and those occurrences are now accepted as having been misidentified in 2001 (Service 2010, p. 5). Within Santa Cruz County, robust spineflower is known from coastal and inland areas from Wilder Ranch State Park in the north to Sunset State Beach in the south (Figure 1).

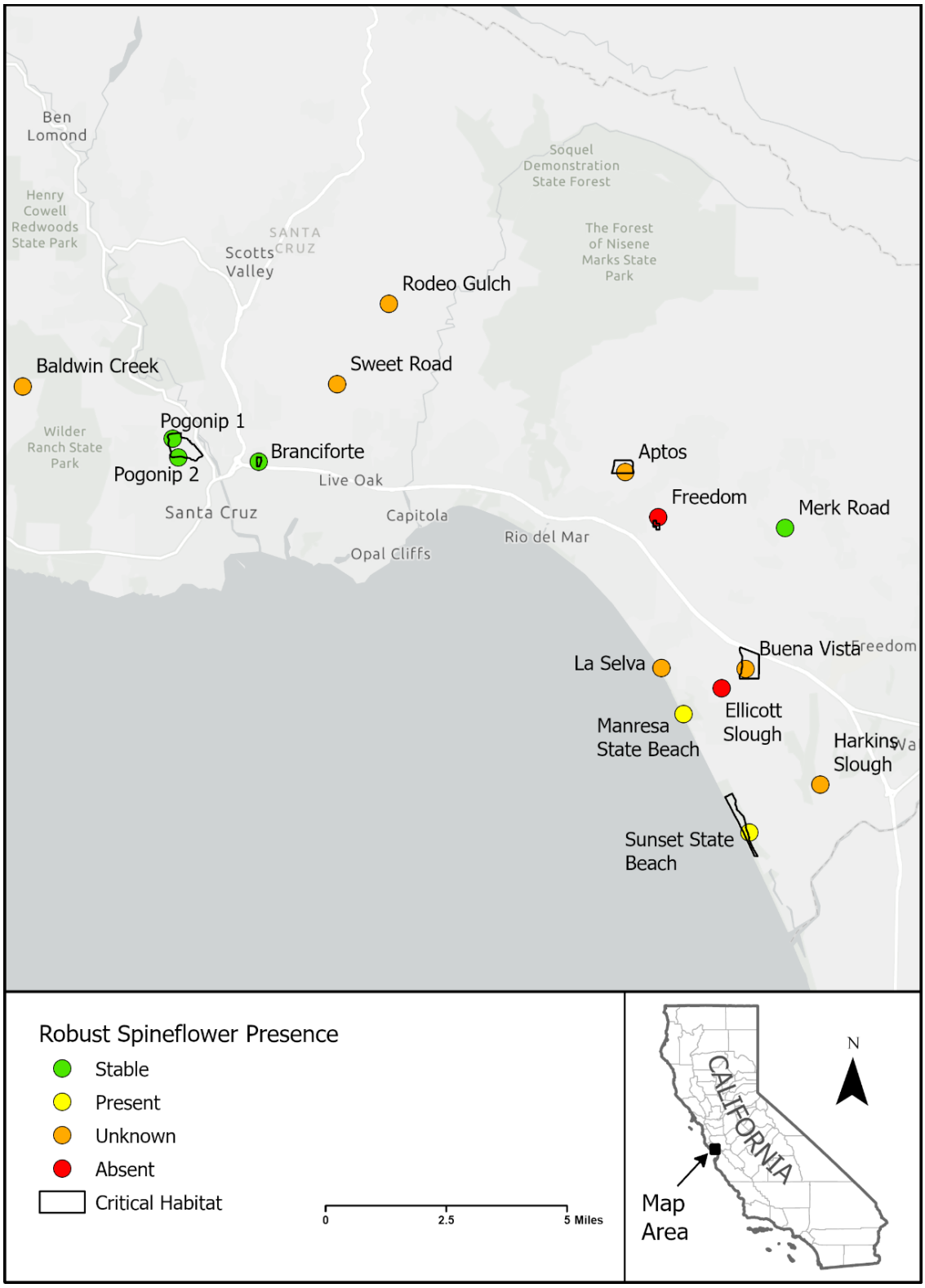

Figure 1. Robust spineflower (*Chorizanthe robusta* var. *robusta*) California Natural Diversity Database (CNDDB) occurrences (CNDDB 2023). Points are centroids of polygons and their size does not represent spatial extent.

Robust spineflower is known to occur primarily in areas of sandy soils with low amounts of competing vegetation. Typical associated plant communities include coastal dunes, coastal scrub, grassland, maritime chaparral, and oak woodland where the species occurs in openings between established vegetation. Robust spineflower is intolerant of shading and is a poor competitor for resources, making it susceptible to invasion by weedy annual species. Disturbance, typically in the form of physical processes, that promote occasional soil disturbance, benefits robust spineflower by reducing competition from annual species and encroachment of shrubs or trees. However, disturbance that is too intense or too frequent results in unsuitable habitat. The Recovery Plan for *Chorizanthe robusta* var. *robusta* (Robust Spineflower) and the 2010 5-year review contain expanded descriptions of habitat and species biology (Service 2004, Service 2010).

Abundance and Population Trends

The California Natural Diversity Database (CNDDB) recognizes 20 occurrences of robust spineflower (CNDDB 2023). Five of these occurrences are considered "possibly extirpated" due to development and were not considered as viable populations or suitable habitat in the listing rule, recovery plan, or 2010 5-year review. Eleven occurrences were considered to support individuals or suitable habitat in the 2010 5-year review (Service 2010, pp. 15-16; Table 1). The remaining four occurrences have very little data associated with them but potentially still have suitable habitat based on a review of publicly available aerial imagery (Table 2).

Continuous data is only available for Pogonip 1 and 2, Branciforte, Merk Road, and Freedom occurrences. Pogonip 1 is a small population and has ranged between 12 and 600 individuals since the previous 5-year review (K. Lyons pers. Com. 2022). Pogonip 2 is a larger population ranging between 900 and 3000 individuals (Service 2010, p. 26). Years with low abundance are typically observed following extended periods of drought. Temporary loss of individuals at Pogonip 1 and 2 occurred in 2019 and 2021 due to the establishment of homeless encampments. Following the removal and remediation of the encampments, the abundance of robust spineflower increased. Both of these populations are managed by the City of Santa Cruz to reduce nonnative species, and site-collected seed is spread to areas with favorable conditions as deemed necessary. The ongoing management of these locations appears successful in maintaining a population that varies in abundance based on climatic conditions and periodic anthropogenic disturbance.

The Branciforte population is protected by a conservation easement and managed according to a mitigation and monitoring plan (Boursier and Hardwicke 2007). Management at this location involves an experimental mowing regime and associated demographic data collection. Population numbers prior to management and monitoring ranged between 200 and 2,000 individuals. With management, the population numbers have increased to between 20,000 and 100,000 individuals (Olberding 2022, p. 11). The methods for estimating the population numbers have changed several times, potentially explaining the large amount of variability that has been recorded. Generally, the observed trend at Branciforte indicates that the population has responded favorably to management with annual abundance estimates ranging between approximately 20,000 to 100,000 individuals since 2012 (Olberding 2022, p. 11). The observed abundance since 2012 greatly exceeds the historical estimates as well as the target population size suggested by the recovery plan (Table 1).

Table 1. List of populations considered in the recovery plan for robust spineflower, their target abundance, and the most current estimated abundance.

Recovery Unit*	Population Name (Occurrence #)	Management	Target Number of Individuals	Most Recent Abundance Estimate (Year)
Northern Santa Cruz	Baldwin Creek (24)	Private	1,000	1,000 (2001)
Northern Santa Cruz	Pogonip 1 (6)	City of Santa Cruz	100	12 (2022)
Northern Santa Cruz	Pogonip 2 (7)	City of Santa Cruz	500	910 (2022)
Northern Santa Cruz	Branciforte (34)	Branciforte Creek Homes Association (Easement)	1,000	>48,000 (2022)
Aptos	Aptos (23)	Private	2,000	3,000 (2000)
Aptos	Freedom (16)	Pajaro Valley Unified School District	2,000	0 (2018)
Aptos	Merk Road (30)	County of Santa Cruz	NA	>144,000 (2022)
Southern Santa Cruz	Buena Vista (15)	CDFW	1,500	>6,000 (2009)
Southern Santa Cruz	Ellicott Slough (31)	USFWS	500	0 (2009)
Southern Santa Cruz	Manresa State Beach (32)	California State Parks	2,000-20,000	1,886 (2021)
Southern Santa Cruz	Sunset State Beach (10)	California State Parks	10,000	583 (2021)

*Species in the Point Reyes recovery unit were found to not be robust spineflower through genetic analysis (Service 2010, pp. 7-8) and are removed from this table. The corresponding table in the Recovery Plan (Service 2004, p. 41) is no longer current and text referencing this recovery unit in the Recovery Plan is no longer applicable.

The Merk Road and Freedom occurrences have both served as reference populations for the Branciforte occurrence. The Freedom occurrence was used from 2012 through 2018 and then discontinued as a reference because the abundance declined from 373 in 2012, to 5 in 2016, and no individuals were observed in 2017 and 2018 (Olberding 2022, p. 12). The loss of individuals at the Freedom occurrence is believed to be due to a decline in habitat suitability resulting from erosion, shrub and tree encroachment, and nonnative species (Olberding 2018, pp. 5-6). The Merk Road occurrence began regular monitoring in 2019 despite a trailer having been illegally

parked within the occurrence that was removed in the same year. The number of individuals has ranged between 28,000 in 2019 to 180,000 in 2022 (Olberding 2022, p. 13). The abundance at the Merk Road occurrence is impressive because there is no known active management occurring. However, this may mean that the disturbance caused by the abandonment and subsequent removal of the trailer temporarily created suitable habitat through the reduction in competing vegetation and without management, abundance may decline as competing vegetation increases.

In 2021 informal surveys of Manresa and Sunset State Beaches were conducted and estimated approximately 1,800 individuals at Manresa State Beach and 580 individuals at Sunset State Beach (Parr 2021, pp. 9-10; Table 1). The estimate at Manresa State Beach is below the previously observed low for the species (the recovery plan estimated a population of 2000 to 20,000 at Manresa State Beach in 2004 and greater than 2,000 individuals in 2009) (Service 2010, p. 24). Without continuous data we do not know if the population is fluctuating but stable, increasing, or decreasing at Manresa State Beach. The 2009 estimate for Sunset State Beach was one million individuals although a previous estimate from 1990 was zero. With very little data and such large differences in abundances, no conclusions can be drawn regarding the Sunset State Beach population except that it is extremely variable.

There is no new data for the remaining populations in Table 1 (Baldwin Creek, Aptos, Buena Vista, and Ellicott Slough). The CNDDB lists four additional populations that were not considered in previous federal documents (Table 2).

Table 2. Additional occurrences listed in the California Natural Diversity Database (CNDDB) not considered in the recovery plan.

Nearest Recovery Unit	Population Name (Occurrence #)	Presence	Last Observation	Notes
Northern Santa Cruz	Sweet Road (5)	Historically Present	1977	CNDDB notes confusion about presence in 1990
Northern Santa Cruz	Rodeo Gulch (8)	Unknown	2007	From 2007 collection
Southern Santa Cruz	La Selva (9)	Historically Present	1979	Area developed to private property but habitat may remain
Southern Santa Cruz	Harkins Slough (33)	Historically Present	2007	Location in CNDDB is incorrect.

There has been no new information regarding the Sweet Road, Rodeo Gulch, or La Selva occurrences but a review of publicly available aerial imagery suggests that suitable habitat could

be present and surveys of these areas is warranted. If habitat is present, but no individuals of robust spineflower are identified, these occurrences would be candidates for reintroduction if the establishment of conservation easements were possible.

The location for the Harkins Slough occurrence is incorrect (S. Baron 2023, pers. com.). The Land Trust of Santa Cruz County conducted rare plant surveys in 2020 and 2021 and found no federally endangered plant species within their property (M. Timmer 2023, pers. com.). The correct location is believed to be located on private property where Galligan Slough and Harkins Slough meet. However, the population was small when it was identified in 2007 and no individuals have been observed recently (S. Baron 2023, pers. com.).

Evaluation of Threats

Habitat loss from development, recreation, and competition with nonnative species were considered threats to robust spineflower at the time of listing (Service 1994, p. 5505). The recovery plan considered stochastic events as an additional threat due to a small number of known occurrences and low abundance within some occurrences (Service 2004, p. 23). The previous 5-year review reevaluated these threats and also considered herbivory and climate change as additional threats (Service 2010, pp. 4-5, 10-12). In this 5-year review, we reevaluate all prior threats with the added threat of vandalism due to events that have occurred since the previous 5-year review.

Development

Development has been the primary cause of extirpation for robust spineflower populations beginning with the loss of occurrences in San Francisco, Alameda, San Jose, and Los Gatos prior to listing. Since listing, development has continued to threaten populations although regulatory mechanisms have had some success in reducing habitat loss while increasing monitoring and management of the Branciforte population. This population is managed and monitored under a mitigation and monitoring plan that was established resulting from an adjacent housing development. The area is now protected from further development while still owned by the Branciforte Creek Homes Association and monitoring has suggested an increasing population size fluctuating between a low of 21,000 plants in 2012 and a high of 106,000 plants in 2020 (Olberding 2021a, p. 11). Conversely, the Freedom population that originally acted as the reference site for the Branciforte population has declined to zero individuals, likely as a result of a combination of factors including expansion of a foot path to accommodate vehicles with an associated increase in use of the path, encroachment of shrub and tree vegetation, and erosion (Service 2010, p. 10; Olberding 2017, Attachment 4; Olberding 2018, pp. 5-6). There are at least six additional occurrences that are located on private land that could be subject to development. No known development plans are known at this time for those locations; however, the threat remains present.

Recreation

Hiking and biking are the most likely forms of recreation to influence populations of robust spineflower. Robust spineflower is disturbance adapted, tolerating disturbance that reduces competing vegetation and reducing shade cover. However, disturbance that is too frequent or too intense will create unsuitable habitat either through direct repeated trampling, resulting in loss of individuals, or the complete loss of all vegetation that may lead to secondary issues such as

erosion or soil compaction. Recreation is expected at all known occurrences with the exception of the Branciforte and Ellicott Slough occurrences because all known populations occur on either public land with established multi-use trails, or on private land where land use is not restricted. The Branciforte population is an exception because it is fenced and actively managed, as well as being too small of a parcel to attract hiking, biking, or other forms of recreation (although it is still subject to vandalism which is evaluated below). The Ellicott Slough National Wildlife Refuge is closed to the public to protect habitat for multiple species, reducing the threat of recreation at that location. The Freedom population is associated with a trail at Aptos High School and is currently the only known population to have declined to zero since the previous 5-year review. The decline is likely due to a combination of trail use, erosion, and encroaching vegetation. The remaining populations on public land, where data is available, have been observed to still support robust spineflower.

Competition

Competition from nonnative species, or native shrub and tree species, can lead to declines in population abundance from shading and competition for resources (Service 2004, pp. 22-23; Service 2010, pp. 10, 12). The Freedom population, as well as the Ellicott Slough population, are believed to have declined to zero at least in part from shrub and tree shading as well as invasion by nonnative annual grasses (Service 2010, pp. 10, 12). Management actions to reduce competing vegetation and reduce canopy shading at the Branciforte and both Pogonip populations have resulted in increasing abundance of robust spineflower at those locations, suggesting that competition remains a threat to the species, but is a threat that can be successfully mitigated with management. The coastal populations at Manresa and Sunset State Beaches are likely persisting in the absence of management due to natural habitat conditions that inhibit establishment of shrub, trees, and nonnative annual species through moderate levels of disturbance. In the absence of natural disturbance processes, or management to reduce competing biomass, competition will remain a threat to robust spineflower.

Stochastic Events

The previous 5-year review considered the threat of stochastic events to have decreased relative to the time of listing because data from known populations indicated greater levels of stability and abundance than previously known (Service 2010, p. 13). Since then, two populations have declined to zero individuals, Ellicott Slough and Freedom. The decline was not due to stochastic events, but the decline at these occurrences reduces redundancy and increases the risk of future stochastic events. The interaction between declines from other threats (e.g. competition, recreation) increase the likelihood that stochastic events may lead to severe declines in abundance or loss of populations. This threat remains current due to the limited number of stable populations and the lack of management throughout most known locations.

Herbivory

Moth larvae and brush rabbits have been observed to decrease plant size and reduce seed output of robust spineflower, but herbivory has not been attributed to the declines observed at the Ellicott Slough and Freedom populations (Baron and Bros 2005). Herbivory is most likely not a severe threat to robust spineflower but is a contributing factor that may be inhibiting recovery or exacerbating the effects of other threats (Service 2010, pp. 4-5, 10-11).

Climate Change

Robust spineflower may be affected by climate change most directly through changes in, and variability of, precipitation, minimum temperature, and maximum temperature. Average precipitation is predicted to increase by 4.1 to 9.8 inches, minimum average temperature by 4.8 to 9.7 degrees Fahrenheit, and maximum average temperature by 4.4 to 7.0 degrees Fahrenheit by 2099 throughout Santa Cruz County (Langridge et al. 2018, pp. 13-17). Despite the predicted increase in precipitation, the areas occupied by robust spineflower may experience fewer total days of precipitation relative to historical averages because of an associated increase in precipitation variability and timing. Current climate models suggest that there will be fewer days of higher-than-average precipitation leading to an increased number of dry days between precipitation events (Langridge et al. 2018, p. 16). Because timing of precipitation impacts germination and survivorship, the changes in variability and timing are likely to have a greater impact on the recovery of robust spineflower than the predicted change in the amount of precipitation, or the increases in average minimum and maximum temperatures.

Robust spineflower may have potential to migrate within Santa Cruz County or to reestablish within the historical range of the species through active reintroduction. Passive migration is possible but unlikely due to the lack of natural dispersal pathways resulting from surrounding development. Robust spineflower is closely related to Monterey spineflower and the climate tolerance for that species may suggest a greater habitable range than is currently realized to the south. However, the reasons for the north-south delineation between the species is not known and there may be a climatic or ecological barrier to southward migration for robust spineflower. In general, the uncertainty of the realization of climate change increases the difficulty in planning and enacting recovery actions as well as identifying best management practices.

Vandalism

There have been four documented instances of vandalism at three different occurrences of robust spineflower since 2019. A trailer was moved onto the Merk Road occurrence and abandoned in 2019 (Olberding 2019, pp. 20-21). This resulted in a broken fence and rutting, although the population appeared to rebound without management upon the removal of the trailer (Olberding 2021b, p. 13). In both 2019 and 2021, a homeless encampment was established at the Pogonip 1 occurrence which resulted in trampling and trash accumulation. Remediation in both years involved removing debris and the population appeared to rebound without additional management (K. Lyons *pers. com*. 2022). At the Branciforte population, a firebreak was established outside of the timeframe established in the Mitigation and Monitoring Plan (Olberding 2021a, pp. 20-21, 24; Olberding 2021b pp. 21, 24-25). The effect to the population is likely low since the disturbance was confined to the margin of the preserve area used as a buffer zone. Enforcement of the timing of establishing fire breaks has proven difficult because the action is being undertaken by an unknown entity. The prohibited actions are not believed to have resulted in a significant decline of individuals due to the estimated abundance observed during annual monitoring relative to the comparatively small loss of individuals. However, the repeated nature of the events shows that enforcement has been unsuccessful and future, more destructive vandalism is possible at this location.

Each of these vandalism events were not purposeful actions to remove robust spineflower. The Pogonip occurrence appears to have a location that is attractive to the establishment of homeless

encampments, and this may continue to occur as this societal problem persists. The Merk Road location is along a road lending itself towards vehicle or other refuse abandonment. The vandalism at the Branciforte occurrence was conducted for perceived safety reasons and not to intentionally remove robust spineflower. Fortunately, none of these actions have been observed to have resulted in sustained declines of individuals and monitoring at all locations is planned for future years.

Summary of Threats

Development and competition from nonnative species or trees and shrubs remain the most severe threats to the persistence of robust spineflower throughout its current range. The occurrences on private land are most susceptible to development and without management, all occurrences are subject to the negative effects of competition. Recreation, stochastic events, herbivory, climate change, and vandalism all continue to inhibit recovery of robust spineflower. The management at the Pogonip occurrences and Branciforte suggest that these threats can be managed so that robust spineflower populations remain stable or increase. However, without funding for management, the current threats are likely to lead to declines in abundance.

DOWNLISTING AND DELISTING CRITERIA

The following downlisting criteria were developed in the recovery plan for robust spineflower and are paraphrased below (Service 2004, pp. iv, 40-42):

1) Eleven populations of robust spineflower across four (now three with the removal of Point Reyes) recovery units distributed through the species' range have been protected, either through an approved and implemented management plan, or through a conservation easement. The recovery plan delineates target acreages and abundance for each of the populations considered when the plan was written.
2) Habitat in each protected population has been appropriately managed and restored; and
3) Population monitoring shows a stable or increasing trend in population size or density over 10 years.

Delisting criteria may be considered when the downlisting criteria for a species has been met. The delisting criterion for robust spineflower is (Service 2004, pp. iv, 41-42):

1. The total number of populations has increased to at least 18, at least 15 of which have an average population of 1,000 individuals in a normal rainfall year over at least 10 years beyond the downlisting monitoring period. This could be achieved by a combination of the following:

    a) discovering additional populations, and/or

    b) establishing new populations through an outplanting program. The populations would need to be self-sustaining, and be protected through conservation measures equivalent to those in the downlisting criteria above.

The downlisting and delisting criteria were created when robust spineflower was thought to occur at Point Reyes. The Point Reyes occurrences are no longer identified as *Chorizanthe robusta* var. *robusta* so the number of recovery units has changed from four to three (removal of the Point Reyes recovery unit). The target number of populations (11) remains unchanged since a new population (Merk Road) was identified within the Aptos recovery unit. It should be noted that the recovery units are loose geographic designations and have no established boundaries.

Evaluation

Currently, there are 11 robust spineflower occurrences. Of these 11 occurrences, four occurrences (within two of three recovery units) have data that suggest that the populations may be stable with a mean population number equal to or greater than the recovery criteria goal (Pogonip 1 and 2, Branciforte, and Merk Road). Each of these four occurrences are on land that is protected from development, but all have been subject to vandalism. Successful management has been demonstrated to increase abundance at Pogonip 1 and 2, and Branciforte, highlighting the need to secure funding and target robust spineflower for management in order to recover the species. The remaining occurrences have no data, or too little data, from which to draw conclusions regarding the stability of the populations. Additionally, there is no funding secured for management by which to improve or manage habitat to ensure the continued persistence of robust spineflower. At this time no recovery criteria for downlisting have been met and therefore delisting criteria are not considered.

CONCLUSION

The evaluation of threats affecting the species under the factors in 4(a)(1) of the Act and the analysis of the recovery criteria and current understanding of population trends were conducted using the best available scientific information. All threats considered in previous reviews remain present with the addition of vandalism as an emerging threat. Since the previous review, the abundance of a previously occupied population has declined to zero. The available data suggest no recovery criteria have been met. Therefore, we conclude that robust spineflower remains an endangered species.

RECOMMENDATIONS FOR FUTURE ACTIONS

1. All occurrences should be revisited to evaluate presence and suitable habitat.
2. Occurrences currently protected from development should be managed to reduce competing vegetation using the Pogonip occurrences or Branciforte as an example of successful methodologies.
3. Reintroductions within the current and historical range should be considered to evaluate techniques for population establishment and specific ecological site conditions.

APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approved STEPHEN HENRY Digitally signed by STEPHEN HENRY Date: 2023.01.24 12:11:29 -08'00' _____

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