

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

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



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**U.S. Fish and Wildlife Service  
Ventura Fish and Wildlife Office  
Ventura, California  
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## **5-YEAR REVIEW**

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

### **I. GENERAL INFORMATION**

#### **Purpose of 5-Year Reviews:**

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

#### **Species Overview:**

As summarized in the recovery plan for this variety, *Chorizanthe robusta* var. *robusta* (robust spineflower) is a short-lived annual spineflower in the *Pungentes* section of the genus *Chorizanthe* in the buckwheat family (Polygonaceae). Primary threats to *C. robusta* var. *robusta* include but are not limited to: development, recreation, encroachment (and/or shade-out) by invasive non-native and native species, road maintenance, vegetation management, human disturbance, and random events. Limited in both population size and range, *C. robusta* var. *robusta* occurs in 11 populations over a range of approximately 21 miles (33.8 kilometers (km)), and is restricted to sandy soils along the coast and near-coastal areas in Santa Cruz County, California (Service 2004).

#### **Methodology Used to Complete This Review:**

This review was prepared by the Ventura Fish and Wildlife Office (VFWO), following the Region 8 guidance issued in March 2008. We used information from the recovery plan, survey information from experts who have been monitoring various localities of this variety, and the California Natural Diversity Database (CNDDDB) maintained by the California Department of Fish and Game. The recovery plan and personal communications with experts were our primary sources of information used to update the status and threats for *Chorizanthe robusta* var. *robusta*. We received no information from the public in response to our Federal Register Notice initiating this 5-year review. This 5-year review contains updated information on the taxon's biology and threats, and an assessment of that information compared to that known at the time of listing or since the last 5-year review. We focus on current threats to *C. robusta* var. *robusta* that are

attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of *C. robusta* var. *robusta*, and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

**Contact Information:**

**Lead Regional Office:** Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, Region 8, Pacific Southwest, (916) 414-6464.

**Lead Field Office:** Lena Chang, Biologist, (805) 644-1766 ext. 302; Connie Rutherford, Listing and Recovery Program Coordinator for Plants, (805) 644-1766 ext. 306; Ventura Fish and Wildlife Office.

**Federal Register (FR) Notice Citation Announcing Initiation of This Review:** A notice announcing initiation of the 5-year review of *Chorizanthe robusta* var. *robusta* and the opening of a 60-day period to receive information from the public was published in the Federal Register on March 25, 2009 (Service 2009).

**Listing History:**

**Original Listing**

**FR Notice:** 59 FR 5499

**Date of Final Listing Rule:** February 4, 1994

**Entity Listed:** *Chorizanthe robusta* var. *robusta*, (the species *Chorizanthe robusta* was listed, inclusive of 2 varieties)

**Classification:** Endangered

**Associated Rulemakings:**

**Critical Habitat**

**FR Notice:** 67 FR 36822

**Date Designated:** June 27, 2002

**Area Designated:** 469 acres (190 hectares)

**Review History:** none

**Species' Recovery Priority Number at Start of 5-Year Review:** The recovery priority number for *Chorizanthe robusta* var. *robusta* is 9 according to the Service's 2008 Recovery Data Call for the Ventura Fish and Wildlife Office based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Service 1983). This number indicates that *Chorizanthe robusta* var. *robusta* is a variety that faces a moderate degree of threat and has a high potential for recovery.

## Recovery Plan or Outline

**Name of Plan or Outline:** Recovery Plan for *Chorizanthe robusta* var. *robusta* (Robust Spineflower)

**Date Issued:** August 23, 2004

**Dates of Previous Revisions:** None

## II. REVIEW ANALYSIS

### Application of the 1996 Distinct Population Segment (DPS) Policy

The Endangered Species Act defines “species” as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. Because the species under review is a plant, the DPS policy is not applicable, and the application of the DPS policy to the species’ listing is not addressed further in this review.

### Information on the Species and its Status

#### Species Biology and Life History

*Chorizanthe robusta* var. *robusta* is a short-lived annual spineflower in the *Pungentes* section of the genus *Chorizanthe*, in the buckwheat family (Polygonaceae). This taxon is restricted to the sandy soils of coastal and near coastal areas of Santa Cruz County, California.

*Chorizanthe robusta* var. *robusta* is pollinated by a variety of insects and is also capable of self pollination. A study by Murphy (2003) revealed that insect pollination significantly increased seed set for *C. robusta* var. *robusta*, suggesting that pollinators may enhance its overall fitness. Understanding plant-pollinator relationships is important for threatened and endangered plants, given that they often consist of small populations that are vulnerable to change. Inadequate pollination may affect a plant’s ability to reproduce and decrease the amount of genetic exchange within populations, ultimately threatening its survival. These results suggest that protection of pollinator habitat and diversity may be a necessary component of survival for *C. robusta* var. *robusta* (Schemske et al. 1994; Murphy 2003).

Germination of *Chorizanthe robusta* var. *robusta* occurs during winter months; flowering occurs from April through June, and in some cases throughout the summer. A study by Baron (1998) determined the seedling survival rate of *C. robusta* var. *robusta* is approximately 42 percent. Causes of mortality for seedlings included desiccation prior to flowering, herbivory, and uprooting by gophers. Plants that survived to flowering showed a positive correlation between basal diameter and flower production, with larger plants producing more flowers (Service 2004).

In 2005, Baron and Bros published a study investigating the effects of insect herbivory on *Chorizanthe robusta* var. *robusta*. They concluded that insect herbivores (in this case, the larvae of an undescribed moth species of the genus *Aroga* (Gelechiidae)) reduced plant size and significantly decreased seed production of *C. robusta* var. *robusta*. Leaf removal by insects also compromises *C. robusta* var. *robusta*’s ability to obtain resources (Louda 1984; Louda et al.

1990, as cited in Baron and Bros, 2005), potentially affecting the plant's ability to grow and reproduce. In addition, brush rabbits (*Sylvilagus bachmani*) browsing on *C. robusta* var. *robusta* removed mature seed heads from 11 percent of the study plants, eliminating their reproductive potential. Additional watering increased seed output, but only when insect herbivores were excluded. This study suggests that ecological factors combined with loss of habitat due to anthropogenic causes may intensify effects of herbivory and potentially cause greater threats to rare plant populations (Baron and Bros 2005).

Plants dry through the summer months, eventually breaking apart in the fall. Seeds disperse when the involucrel spines attach to passing animals. Small mammals and birds are the most likely seed dispersers of *Chorizanthe robusta* var. *robusta*; though wind also plays a part in the dispersal of seeds (Service 2004).

### Spatial Distribution

Occurrences of *Chorizanthe robusta* var. *robusta* populations have been recorded since the late 1800s, occurring as far north as San Francisco and Alameda Counties, and south into Monterey County. Inland occurrences were documented in and around San Jose and Los Gatos in Santa Clara County. Coastal and near coastal occurrences have been documented in San Mateo County and Santa Cruz County where it is found today (CNDDDB). At the time of listing in 1994, *C. robusta* var. *robusta* was found in 3 populations over a 12-mile (19.3 km) range in southern Santa Cruz County (Service 1994). Currently, there are 11 populations in Santa Cruz County over a range of approximately 21 miles (33.8 km). Appendix A illustrates the current and historic range of *C. robusta* var. *robusta* populations.

In 2004, the recovery plan for *Chorizanthe robusta* var. *robusta* listed 12 populations; 10 in Santa Cruz County, and 2 in Marin County at the Point Reyes National Seashore. The report of *C. robusta* var. *robusta* at Point Reyes was puzzling because it was located outside of its historical range, and 100 miles (161 km) away from populations in Santa Cruz County (Service 2004). Recently, new information on this population was gained during a 4-year genetic study conducted by Brinegar and Baron (2008) on the molecular phylogeny of the *Pungentes* subsection of *Chorizanthe*. Brinegar and Baron determined that the population at Point Reyes is not *Chorizanthe robusta* var. *robusta*, but an inland form of the morphologically similar *Chorizanthe cuspidata* var. *villosa* (woolly-headed spineflower). This clarification eliminates Marin County from *C. robusta* var. *robusta*'s range. In 2007, a new population of *C. robusta* var. *robusta* was discovered along Merk Road in the city of Watsonville on land owned by Santa Cruz County Parks and Recreation (S. Baron, botanical consultant, in litt. 2009a).

Table 2 in the 2004 recovery plan refers to two locations of *Chorizanthe robusta* var. *robusta* populations at Sunset State Beach (Sunset State Beach and South End of Sunset State Beach). Tim Hyland, State Parks Environmental Scientist, advised that at present, there is no clear line to separate the populations (in litt. 2009b). For clarity, in this review and unless determined otherwise, this population will be considered as one location, and referred to as Sunset State Beach.

## Abundance

Like many annual species, the number of individuals in any given population may fluctuate widely from one year to another. When *Chorizanthe robusta* var. *robusta* was listed as endangered in 1994, the final listing rule identified Sunset State Beach as having the largest population of 5,000 individuals. Smaller populations of a few hundred were known at Manresa State Beach and on property owned by the City of Santa Cruz (Service 1994). In 2000, the draft recovery plan named populations in 4 locations, with the largest continuing to be the Sunset State Beach population, then reaching 100,000 individuals (Service 2000). The increase in numbers is likely a reflection of more detailed censusing over time, rather than a real increase in population size.

When the final recovery plan for *Chorizanthe robusta* var. *robusta* was published in 2004, populations were known from 12 locations (including the two populations at Point Reyes National Seashore, which have now been omitted), with the largest population at Sunset State Beach then reaching approximately 1,000,000 individuals.

Brinegar and Baron's 2008 study clarifying the identity of the Point Reyes populations as *Chorizanthe cuspidata* var. *villosa* reduced what was considered to be known numbers of *C. robusta* var. *robusta* at the time, by approximately 10,000+ plants.

Appendix B summarizes population status data outlined in the 2004 recovery plan and current population data for *C. robusta* var. *robusta*.

## Habitat or Ecosystem

There are specific biological and physical habitat components that are essential to the conservation of *Chorizanthe robusta* var. *robusta*. These components include sandy soils associated with active coastal dunes and inland sites with sandy soils; 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, clumps of herbaceous vegetation); plant communities that contain little or no cover by nonnative species that would compete for resources available for growth and reproduction of *C. robusta* var. *robusta*; and physical processes, such as occasional soil disturbance, that support natural dune dynamics along coastal areas (Service 2004).

## Land Ownership and Management

Appendix C outlines land ownership of *Chorizanthe robusta* var. *robusta* on private, park, and refuge lands, including current threats and conservation and management efforts.

Certain habitat management actions have proven to be effective for increasing the size of the Pogonip populations of *Chorizanthe robusta* var. *robusta*. In 2009, these populations had an almost five-fold increase in plant numbers from the previous year. Baron attributes the large increase in numbers in 2009 to the management actions performed in 2006, 2007, and particularly 2008, when areas adjacent to the populations were scraped using a McLeod (a

combination hoe and rake). Baron's work at the Pogonip sites and the resulting increase in plant numbers demonstrate the benefits of regular, long-term management and monitoring.

Effective management actions included:

- Removal of small firs (*Abies* sp.) threatening to encroach into the populated area;
- Removal of a few small trees shading the population;
- Scraping adjacent to the population, opening up the area to light and heat, and creating edges (spineflowers did very well in these areas); and
- Hand weeding within the population.

Baron recommends these actions be repeated in the winter of 2009 or 2010 to further benefit the population. Baron advises to consider climate extremes when planning management and does not recommend scraping within small populations of *Chorizanthe robusta* var. *robusta* (Baron 2009).

Management at Sunset and Manresa State Beaches performed by California State Parks includes dune habitat restoration, annual monitoring, removal of weeds and/or other plants or trees threatening to encroach into populations, and mapping. These actions have benefited *Chorizanthe robusta* var. *robusta*, as these populations have continued to flourish.

### Genetics

In 2003, a genetic study was initiated and funded by the Service to investigate two listed *Chorizanthe* taxa, *C. pungens* var. *pungens* and *C. robusta* var. *robusta*. The study answered questions regarding whether populations identified as robust spineflower at Point Reyes National Seashore held the true *robusta* genotype, given that the populations were outside the historic range and 100 miles (161 km) from the other known populations; and whether *C. pungens* var. *pungens* and *C. robusta* var. *robusta* are hybridizing in adjacent populations at Sunset State Beach. Internal transcribed spacer (ITS) sequences and chloroplast DNA (cpDNA) were used to evaluate the entire *Pungentes* subsection of *Chorizanthe*, with emphasis on the *C. pungens*/*C. robusta* complex. The *C. pungens*/*C. robusta* complex includes four listed taxa: *C. pungens* var. *hartwegiana* (Ben Lomond spineflower), *C. pungens* var. *pungens* (Monterey spineflower), *C. robusta* var. *hartwegii* (Scotts Valley spineflower), and *C. robusta* var. *robusta* (robust spineflower).

Morphological characteristics between some closely related species in the genus *Chorizanthe* are difficult to differentiate. The populations at the two Point Reyes sites described in the 2004 recovery plan were misidentified as *C. robusta* var. *robusta* due to morphological similarities between them and another *Chorizanthe* variety, an inland version of *Chorizanthe cuspidata* var. *villosa* (woolly-headed spineflower). The study by Brinegar and Baron (2008) confirmed the identity of this population as *C. cuspidata* var. *villosa*, subsequently eliminating a large number of plants that were considered as robust spineflowers at the time.

Regarding hybridization between *Chorizanthe pungens* var. *pungens* and *C. robusta* var. *robusta*, an unanticipated discovery revealed that the two species are nearly identical in genetic make-up and as a result, determination of whether hybridization occurs between them was difficult. This

study compared ITS sequences of 11 species of *Chorizanthe*. One of the significant findings of the study revealed the homogeneity of ITS sequences between *C. robusta* var. *robusta* and *C. pungens* var. *pungens*, and significant sharing of their cpDNA haplotypes. Brinegar and Baron determined that the two are indistinguishable from each other with any certainty, based on the ITS sequences alone. Furthermore, they documented an instance where a robust spineflower from the backdune of Sunset State Beach had an identical ITS sequence as a Monterey spineflower taken from the foredune. These data suggest that the *C. pungens/C. robusta* complex has only recently evolved and may not yet merit division into two separate species (Brinegar and Baron 2008).

Brinegar and Baron (2008) conclude that the results of the study support a high degree of evolutionary adaptation and recent change for the *Pungentes* subsection of *Chorizanthe*. They suggest that the minor morphological and genetic differences between plants are helpful in adapting to changing environments, emphasizing the importance of protecting multiple, small, and sometimes genetically diverse populations. Further deterioration of genetic composition through the loss of habitat or introduction of outside genetic material should be avoided (Brinegar and Baron 2008).

#### Species-specific Research and/or Grant-supported Activities

The 2003 genetic study described above was conducted by Dr. Chris Brinegar and Sandra Baron. Funding for this research was provided by the Service (contracts #101813Q101 and #801017M276).

Sandra Baron has also applied management actions and conducted annual plant censuses for the two Pogonip populations of *Chorizanthe robusta* var. *robusta*. Baron's population estimate for 2009 was 4,000+ plants, a more than 5-fold increase from the previous year (Baron 2009). Funding has been provided by the City of Santa Cruz and a Partners for Fish and Wildlife grant. Although these management actions have proven to be beneficial for the Pogonip *C. robusta* var. *robusta* populations, the future of continued work at this site is uncertain (Baron, in litt. 2009b).

#### **Five-Factor Analysis**

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

#### **FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range**

At the time of listing, *Chorizanthe robusta* var. *robusta* in coastal dune habitats was affected by recreational use, residential development, and the introduction of non-native species (Service 1994). Historically, many populations of *C. robusta* var. *robusta* were extirpated by urbanization or conversion of native habitat to agriculture. Populations may have relied on natural disturbances such as dune erosion and formation in the coastal sites, and fires that created openings in native habitats inland. Where native habitat remains, natural succession of native



herbaceous and shrubby vegetation may shade out *C. robusta* var. *robusta*. Invasive, nonnative species may encroach on habitat, reducing or eliminating *C. robusta* var. *robusta* populations (Service 2004).

In the various park units at Pogonip and Sunset and Manresa State Beaches, recreational activities can have an impact on *Chorizanthe robusta* var. *robusta*, although low to moderate levels of impacts may be beneficial. At the time the recovery plan was written, no research had been conducted to confirm this. Recent management actions performed by Baron and Eidam at the Pogonip sites may prove that slight disturbance (in this case, scraping with a McLeod) can be beneficial for populations of *C. robusta* var. *robusta*. The disturbance can create necessary open areas that increase light, heat, and water, and may improve conditions for ground nesting pollinators (at Pogonip, *Steniolia elegans* (digger wasp) and an undescribed wasp species of the genus *Tachysphex* (Murphy 2003)). These populations at Pogonip showed a large increase in numbers after management actions were implemented (Baron and Eidam 2008). Conversely, without proper management, high levels of recreational impact at these park sites (i.e., horseback riding and mountain biking) may eliminate the taxon altogether (Service 2004).

Populations of *Chorizanthe robusta* var. *robusta* on private lands are subject to additional and sometimes more serious threats. The Branciforte site has been approved by the City of Santa Cruz for a housing development project, though it is unknown when construction activities will begin. The Service and the California Native Plant Society (CNPS) submitted comments recommending larger buffer areas for *C. robusta* var. *robusta* populations, as described in the final Environmental Impact Report (EIR) for the Branciforte Creek Residential Development project (RBF Consulting 2007).

The CNPS was able to negotiate larger buffer zones (60 vs. 30 feet (18.3 m vs. 9.1 m)) for populations at this site to reduce secondary impacts associated with adjacent human occupancy. The “Branciforte Creek Residential Development Robust Spineflower (*Chorizanthe robusta* var. *robusta*) Management and Monitoring Plan” (MMP) (Boursier and Hardwicke 2007) incorporated these and other protective measures. The MMP describes specific instructions to ensure that these building constraints are enforced (Cheap, in litt. 2009b).

An observation in 2009 reported that the Branciforte population appears healthy; however, the presence of a chain link fence for excluding off-highway vehicles is barring fire safety mowing that had previously helped control invasive trees from encroaching into the population. As a result, the population is now also being threatened by invasives, particularly *Ailanthus altissima* (tree of heaven) (Cheap, in litt. 2009a). Upon further observation at the Branciforte site, it is clear that *Chorizanthe robusta* var. *robusta* is well established there and has the potential to flourish. However, *Ailanthus altissima* is prolific and abundant within the *C. robusta* var. *robusta* population and is an even more imminent threat than originally considered (Chang and Glenn, Service biologists, pers. obs. 2009b). The shade created by this non-native tree will inevitably eliminate *C. robusta* var. *robusta* from the site. In addition to *Ailanthus altissima*, other species that have been identified as threats to the Branciforte population are *Rubis ursinus* (Pacific blackberry), *Rubis discolor* (Himalayan blackberry), *Carpobrotus edulis* (iceplant), *Lathyrus latifolius* (sweet pea), *Genista monspessulana* (French broom), *Lobularia maritima* (sweet alysium), and *Lotus scoparius* var. *scoparius* (deerweed) (Boursier and Hardwicke 2007).

The future of the Branciforte site and implementation of the MMP are uncertain. Due to economic setbacks, it is possible that the planned development may not go forward, and the population would be left unmanaged (Ferry, City Planner, City of Santa Cruz, in litt. 2009). Little is known at this time regarding the future of the site.

In the early 1990s, the Freedom population at Aptos High School suffered losses of *Chorizanthe robusta* var. *robusta* individuals when land was modified in preparation for lot divisions. Additionally, in the late 1990s, the school widened a foot path running through the population in order to accommodate vehicles (Service 2004). An observation made in 2004 recorded in the CNDDDB reported that a large colony east of the school baseball field remained intact, but that plants below the parking lot were eliminated by construction. Upon subsequent observation at this site, *C. robusta* var. *robusta* was visible along a foot trail southeast of the baseball field, growing on the edges of the trail, where the sandy soil is loose and there is less growth of other plants (Chang and Glenn, pers. obs. 2009a).

A 2009 survey of the Ellicott Slough population found no *Chorizanthe robusta* var. *robusta* plants. This absence may be a result of an increase of grassland weeds in the open areas where *C. robusta* var. *robusta* could potentially grow. The lack of plants could have also been due to the survey being conducted late in the season, although nearby populations at Buena Vista and Merk Road were large and appeared to be doing well (Baron, in litt. 2009c).

In summary, recreation, development, and encroachment and/or shading by both native and nonnative plant species continue to pose a threat to *Chorizanthe robusta* var. *robusta* and its habitat. The recovery plan lists additional threats such as restoration activities, road maintenance, vegetation management, and human disturbance (Service 2004). Management actions and monitoring have proven to be beneficial for this variety.

Appendix C outlines the percentage of *Chorizanthe robusta* var. *robusta* populations and critical habitat on private, park, and refuge lands. In addition, it describes threats, conservation and management efforts, and the results of these efforts.

### **FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes**

Overutilization for commercial purposes was not known to be a factor in the 1994 final listing rule (Service 1994) and does not appear to be a threat at this time.

### **FACTOR C: Disease or Predation**

Disease or predation was not known to be a factor in the 1994 final listing rule (Service 1994); however, as mentioned in the life history section of this review, the Baron and Bros (2005) investigation of insect herbivory on *Chorizanthe robusta* var. *robusta* concluded that insect herbivores reduced plant size, significantly decreasing both size and lifetime seed production of *C. robusta* var. *robusta*, subsequently compromising the plant's ability to obtain resources. In addition, rabbits browsing on *C. robusta* var. *robusta* removed mature seed heads from 11 percent of the study plants. The results of this study suggest that effects of herbivory can

potentially be a threat to *C. robusta* var. *robusta*, or exacerbate other threats to *C. robusta* var. *robusta* populations (Baron and Bros 2005).

#### **FACTOR D: Inadequacy of Existing Regulatory Mechanisms**

At the time of listing (Service 1994), we did not discuss any particular concerns regarding the inadequacy of existing regulatory mechanisms for *Chorizanthe robusta* var. *robusta*.

There are several State and Federal laws and regulations that are pertinent to federally listed taxa, each of which may contribute in varying degrees to the conservation of federally listed and non-listed taxa. These laws, most of which have been enacted in the past 30 to 40 years, have greatly reduced or eliminated the threat of wholesale habitat destruction. However, because most of the populations of *Chorizanthe robusta* var. *robusta* occur on lands that are being managed in part for the conservation of sensitive resources, these laws have rarely been needed. However, see discussion of the Branciforte population below.

#### **State Protections**

California State Parks: According to the Park's general management plan, rare and endangered plants found within Sunset State Beach (and Manresa State Beach) will be protected and managed for their perpetuation. Systematic surveys for rare and endangered plants will be made throughout these units. If any rare or endangered species is found, all populations will be mapped, and management plans developed for their protection and perpetuation. Prior to any site-specific development or heavy use activities, additional surveys will be made during the flowering season for rare or endangered plants in the areas that will be impacted (Keck et al. 1990).

California Environmental Quality Act (CEQA): The CEQA requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency, and is the primary mechanism for ensuring that impacts to sensitive species on private lands are minimized. If significant effects to sensitive resources (including List 1B taxa<sup>a</sup>) are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Therefore, protection of sensitive species through CEQA is dependent upon the discretion of the lead agency involved. For the Branciforte population, which is being threatened by development, the Branciforte Creek MMP outlines specific mitigation requirements under CEQA, in the event the proposed development project commences. A few of the management goals described in the MMP are: reduction of invasive plant species; retention of associate species within the population area; yearly monitoring; and education (Boursier and Hardwicke 2007); however, as mentioned in Factor A, management at Branciforte will not be initiated until plans for this site are definite and set into motion.

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<sup>a</sup>According to the California Native Plant Society's ranking system for rare plants, a List 1B plant meets the definitions of Sec. 1901, Chapter 10 of the Native Plant Protection Act, or Secs. 2062 and 2067 of the California Endangered Species Act, and is eligible for State listing (CNPS 2009). *Chorizanthe robusta* var. *robusta* is currently not a State listed taxon.

## **Federal Protections**

National Wildlife Refuge System Improvement Act of 1997: This act establishes the protection of biodiversity as the primary purpose of the National Wildlife Refuge system. This has led to various management actions to benefit the federally listed species. The Ellicott and Buena Vista populations of *Chorizanthe robusta* var. *robusta* are managed by the Ellicott Slough National Wildlife Refuge.

## **FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence**

Under Factor E, threats to *Chorizanthe robusta* var. *robusta* at the time of listing (Service 1994) were the introduction of non-native species to coastal dunes for the purpose of sand stabilization, random fluctuations or variation (stochasticity) in annual weather patterns and other environmental factors, and stochastic extinction due to a small number of isolated populations.

### Invasive Species

The recovery plan lists additional threats such as shading from both native and non-native species and random events (Service 2004). As mentioned in Factor A, the presence of invasive species shading and/or encroaching into areas where *Chorizanthe robusta* var. *robusta* occurs also continues to pose a threat. Invasive plants are actively managed for a few of the populations; however the majority of populations continue to be threatened by invasive plants. For example, *Ailanthus altissima* (tree of heaven) at the Branciforte site will eventually shade out the entire population of *C. robusta* var. *robusta* if management is not implemented, and grassland weeds at the Ellicott site may have eliminated the *C. robusta* var. *robusta* population in 2009.

### Variation in Annual Weather Patterns

Annuals and other monocarpic plants (individuals that die after flowering and fruiting), such as *Chorizanthe robusta* var. *robusta*, are typically vulnerable to random fluctuations or variation in annual weather patterns and other environmental factors (Service 1994).

### Climate Change

At the time of listing, we did not discuss the potential effects of climate change on the long-term persistence of *Chorizanthe robusta* var. *robusta*. Impacts to *C. robusta* var. *robusta* under predicted future climate change are unclear. Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999; Cayan et al. 2005; IPCC 2007). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. While it appears reasonable to assume that both plant and animal species may be affected, we lack sufficient certainty on knowing how and how soon climate change will affect species, the extent of average temperature increases in California, or potential changes to the level of threat posed by drought or fire. While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular species at this time.

### Stochastic Extinction

The conservation biology literature commonly notes the vulnerability of taxa known from one or very few locations and/or from small and highly variable populations (e.g., Shaffer 1981, 1987; Primack 2006; Groom et al. 2006). A small population size may make it difficult for a species to persist while sustaining other impacts such as habitat alteration that favors non-native species. Although *Chorizanthe robusta* var. *robusta* is self-compatible and capable of self-fertilization, seed set was demonstrated to be higher in individuals that were insect pollinated. Small populations may also have a more difficult time attracting pollinators and therefore may experience lower seed viability rates. Many of the populations appear to be stable or support a larger number of individuals than we knew of at the time of listing. While we believe stochastic extinction is less of a threat now for *C. robusta* var. *robusta* than at the time of listing, it is still a concern for several of the smaller-sized populations.

### **III. RECOVERY CRITERIA**

The final recovery plan, Recovery Plan for *Chorizanthe robusta* var. *robusta* (Robust Spineflower), was issued on August 23, 2004. Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been met. In that instance, we may determine that overall, the threats have been minimized sufficiently, and the species is healthy enough to downlist or delist. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate for achieving recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management. Assessing a species' degree of recovery is also an adaptive process that may or may not fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

“The recovery goal for *Chorizanthe robusta* var. *robusta* is to conserve viable and self-sustaining populations in its natural habitat such that protection of the Endangered Species Act is no longer necessary” (Service 2004, p. iv).

Downlisting Criterion 1: Eleven populations of *Chorizanthe robusta* var. *robusta* in four recovery units distributed through the species' range have been protected, either through an approved and implemented management plan, or through a conservation easement.

This criterion addresses listing factors A, D, and E. Management and/or monitoring implemented by the Service in conjunction with the City of Santa Cruz, California State Parks, and the Ellicott Slough National Wildlife Refuge has overall been beneficial for their associated populations (Pogonip 1 and 2, Sunset and Manresa State Beaches, Ellicott and Buena Vista, respectively). This comprises 6 out of the 11 known

populations; however, with the exception of the populations managed by the Refuge and State Parks, the future of management and/or monitoring for these populations is not certain. The remaining 5 populations (Freedom, Aptos, Branciforte, Baldwin Creek, and Merk Road) are currently not associated with any approved management plans or conservation easements. As stated in the Factor A section of this review, management actions and monitoring have proven beneficial for *C. robusta* var. *robusta* populations and should continue to be supported.

At the time this recovery criterion was written, we knew of 12 populations of *Chorizanthe robusta* var. *robusta*, clustered into 4 Recovery Units. Currently, there are 11 known populations. The intention of identifying recovery units was to ensure that populations were conserved and recovered in each of the geographic locations it occurs. To accurately determine that this criterion is met in the future, this recovery criterion should be refined as appropriate based on recent information.

We believe that this criterion is relevant to both the current status and current threats of *Chorizanthe robusta* var. *robusta*. Because only 6 of the 11 populations have undergone management and/or monitoring, and the future of these actions is uncertain, we believe this criterion has been partially, but not fully met.

Downlisting Criterion 2: Habitat in each protected population has been appropriately managed and restored.

This criterion addresses listing factors A and E. Long-term management and restoration has proven to be beneficial for *Chorizanthe robusta* var. *robusta* populations. Therefore, we believe that this criterion is relevant to both the current status and current threats of *C. robusta* var. *robusta*. In the abovementioned populations that have undergone management and monitoring, the increase in numbers and/or stability of these plants and populations indicates that proper management and restoration of the sites or habitats has been implemented. However, the future of these actions is uncertain, and 5 out of 11 populations remain unprotected. As a result, we believe this criterion has been partially, but not fully met.

Downlisting Criterion 3: Population monitoring shows a stable or increasing trend in population size or density during favorable precipitation years over at least 10 years.

3a: For populations under 4 hectares (10 acres) and below 10,000 individuals, the average number of individuals in favorable (non-drought) precipitation years should meet or exceed the target population levels given in Table 5 during a period of at least 10 years that encompass a normal rainfall cycle (including periods of drought and wet years). Zedler and Black (1989) analyzed historical precipitation records for San Diego and calculated the minimum monitoring period that would be needed to expect a range of annual rainfall that includes 50 percent of the total range in variation of annual rainfall. An analogous period should be calculated for the central coastal California area where *Chorizanthe robusta* var. *robusta* occurs, and the 10-year monitoring period should be reassessed if it would not adequately capture the range of precipitation in the region (as cited in Service 2004).

3b: For populations over 10,000 individuals or 4 hectares (10 acres), monitoring based on density or frequency may be more appropriate. Currently, this would apply to populations at Sunset State Beach, Abbott’s Lagoon, South Kehoe Creek, and possibly Aptos and Buena Vista.

This criterion addresses listing factor A. Section 3a of this criterion refers to Table 5, which was originally published in the 2004 recovery plan. An abbreviated version of this table, including the most recent population numbers is outlined in Table 1 below. Although some of the target numbers have been met since 2004, the recovery criterion specifies that these numbers need to be maintained during a period of at least 10 years, encompassing a normal rainfall cycle.

**Table 1. Target numbers of individuals from the 2004 recovery plan, and recent population numbers for *C. robusta* var. *robusta*.**

| Population          | Target Number of Individuals to be maintained from the 2004 recovery plan <sup>c</sup> | Current (or most recent) Numbers of Individuals | Target Numbers Met since 2004 |
|---------------------|--|---|-------------------------------|
| Baldwin Creek       | 1,000  | N/D <sup>b</sup>                                | N/D                           |
| Pogonip 1           | 100  | 523   | yes                           |
| Pogonip 2           | 500  | 3,500+  | yes                           |
| Branciforte         | 1,000  | 600+  | no                            |
| Aptos               | 2,000  | N/D   | N/D                           |
| Freedom             | 2,000  | 500   | no                            |
| Merk Road           | N/A  | 5,000+  | yes                           |
| Buena Vista         | 1,500  | 6,000+  | yes                           |
| Ellicott Slough     | 500  | 0   | no                            |
| Manresa State Beach | 2,000-20,000   | 2,000+  | yes                           |
| Sunset State Beach  | 10,000   | 1 million <sup>c</sup>                          | yes                           |

Section 3b of this criterion reflects the 2004 recovery plan’s assessment of known populations at the time. To accurately determine that this criterion is met in the future, this recovery criterion should be refined as appropriate based on recent information.

Though numbers of individuals in the majority of populations of *Chorizanthe robusta* var. *robusta* have shown an increase over time, the range has decreased from historical occurrences in at least six counties, to currently known populations in only one county. It is important to consider that past and current population numbers may not be completely indicative of the status of *C. robusta* var. *robusta*, as population survey methods and frequency may have improved over the years, contributing to apparent increases in numbers.

We believe that this criterion is relevant to both the current status and current threats of *C. robusta* var. *robusta*. The Pogonip populations have been monitored regularly and are the only populations for which we have long term data. The trends for both of these populations show an increase in numbers over time, as shown in Appendix D.

<sup>b</sup> N/D = no data

<sup>c</sup> Service 2004

The 2009 Pogonip Rare Plant Census (Baron 2009) includes population data in Appendix D along with the management actions described in the Land Ownership/Management section of this review. Populations on State Parks and National Wildlife Refuge lands have also implemented ongoing management and monitoring. Management for the populations on Sunset and Manresa State Beaches in recent years includes the removal of weeds, non-native species, and species threatening to encroach into the population. The population at Sunset State Beach remains the largest of the *Chorizanthe robusta* var. *robusta* populations, and both populations have been observed to be stable and doing well (Hyland, pers. comm. 2009). Looking at recent population increases of the Buena Vista population and the stability of the State Beach populations, it is reasonable to conclude that adaptive management of *C. robusta* var. *robusta* has been successful for these populations.

We do not have continuous, long-term data for populations of *Chorizanthe robusta* var. *robusta* on private lands. We have informal surveys of the Freedom and Branciforte populations, giving a very rough estimate of plant numbers in 2009, and no new data for Aptos or Baldwin Creek since 2000-2001.

While some populations have improved and appear stable, there has been no continuous, long-term monitoring for the majority of *Chorizanthe robusta* var. *robusta* populations; therefore, we believe that this criterion has not been met.

#### Delisting Criterion

The delisting criterion for *Chorizanthe robusta* var. *robusta* as written in the 2004 recovery plan is as follows:

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 favorable (non-drought) rainfall years over at least 10 years (beyond the downlisting monitoring period). This criterion could be achieved by a combination of the following:
  - a. Discovering additional populations and achieving an equivalent level of conservation for them as above; and
  - b. Establishing new populations through an outplanting program. The populations would need to be self-sustaining, and be protected through conservation measures equivalent to above. Surveys should be conducted within *C. robusta* var. *robusta*'s historical range to determine the availability and defensibility of suitable habitat.

This criterion addresses listing factors A and E. We believe that this criterion is relevant to both the current status and current threats of *Chorizanthe robusta* var. *robusta*. Although some progress has been made toward the discovery of new populations and implementation of conservation measures, we believe that this criterion has not been met.



#### IV. SYNTHESIS

Since the late 1800s, populations of *Chorizanthe robusta* var. *robusta* have occurred as far north as San Francisco and Alameda Counties, south into Monterey County, inland to Santa Clara County, and coastally in San Mateo and Santa Cruz Counties. At the time of listing in 1994, *C. robusta* var. *robusta* was found in 3 populations over a 12-mile (19.3 km) range in southern Santa Cruz County. Currently, there are 11 populations over a range of approximately 21 miles (33.8 km). While the current range is larger than it was at the time of listing, it is still only a portion of the range that *C. robusta* var. *robusta* historically occupied.

As described in the Land Ownership/Management section of this review, protection and management of *Chorizanthe robusta* var. *robusta* at the Pogonip and State Beach sites has proven beneficial. At Pogonip, these activities include the removal of small trees shading and threatening to encroach into the populated area, scraping adjacent to the population, and hand weeding within the population. At the State Beach sites, activities have included dune habitat restoration, annual monitoring, removal of weeds and/or other plants or trees threatening to encroach into populations, and mapping. Populations at these locations have continued to flourish, particularly following the implementation of management actions and protection from threats. Threats such as development, recreation, encroachment (and/or shade-out) by invasive non-native and native species, road maintenance, vegetation management, human disturbance, and random events all remain valid threats to *C. robusta* var. *robusta* and its habitat, particularly for populations that are under little or no management. In addition, with the exception of the large population at Sunset State Beach, *C. robusta* var. *robusta* is limited in both population size and range. Therefore, we believe that *C. robusta* var. *robusta* should remain classified as endangered, and do not recommend a status change at this time.

#### V. RESULTS

##### Recommended Listing Action:

- Downlist to Threatened
- Uplist to Endangered
- Delist (indicate reason for delisting according to 50 CFR 424.11):
  - Extinction*
  - Recovery*
  - Original data for classification in error*
- No Change

#### VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

The highest priority recovery actions that should be initiated and/or completed over the next 5 years for *Chorizanthe robusta* var. *robusta* are listed as follows:

1. Establish and/or continue long-term management and monitoring programs for *Chorizanthe robusta* var. *robusta* populations, particularly those on park and refuge lands.

2. Continue genetic research to clarify uncertainties within the *Chorizanthe robusta*/*Chorizanthe pungens* complex.
3. Investigate opportunities for conservation of the Branciforte population, and remove *Ailanthus altissima* (tree of heaven) and other invasive species at the site, in accordance with the “Branciforte Creek Residential Development Robust Spineflower (*Chorizanthe robusta* var. *robusta*) Management and Monitoring Plan,” whether or not planned development goes forth.
4. Conduct surveys on suitable habitat and within the historical range to locate new populations, in conjunction with examination of genetic information to ensure the plant’s identity. Discovery of additional new populations such as the population at Merk Road will broaden our understanding of *Chorizanthe robusta* var. *robusta*’s status, its habitat, and range.
5. Initiate an outplanting program to establish new *Chorizanthe robusta* var. *robusta* populations in appropriate habitat within its historical range by:
  - a. Locating appropriate habitat for outplanting;
  - b. Conducting experimental habitat enhancement;
  - c. Applying appropriate habitat enhancement techniques;
  - d. Conducting propagation experiments to determine the best techniques for developing material to use in introductions;
  - e. Conducting experimental introductions;
  - f. Developing a protocol to guide introductions;
  - g. Conducting large-scale introductions on appropriate sites; and
  - h. Monitoring newly established populations (Service 2004).
6. Establish an outreach program to increase public awareness for populations on both public and private lands, particularly on park lands, refuges, and at Aptos High School.

On our recent visit to Aptos High School, we were able to meet with a biology teacher regarding the robust spineflower population on the school grounds. He was enthusiastic about learning more, and hopes to incorporate aspects of the recovery of *Chorizanthe robusta* var. *robusta* into his curriculum, as well as assist the Service in gaining information about the population over time.

7. Revise the recovery plan and recovery criteria as appropriate based on new information and/or research.

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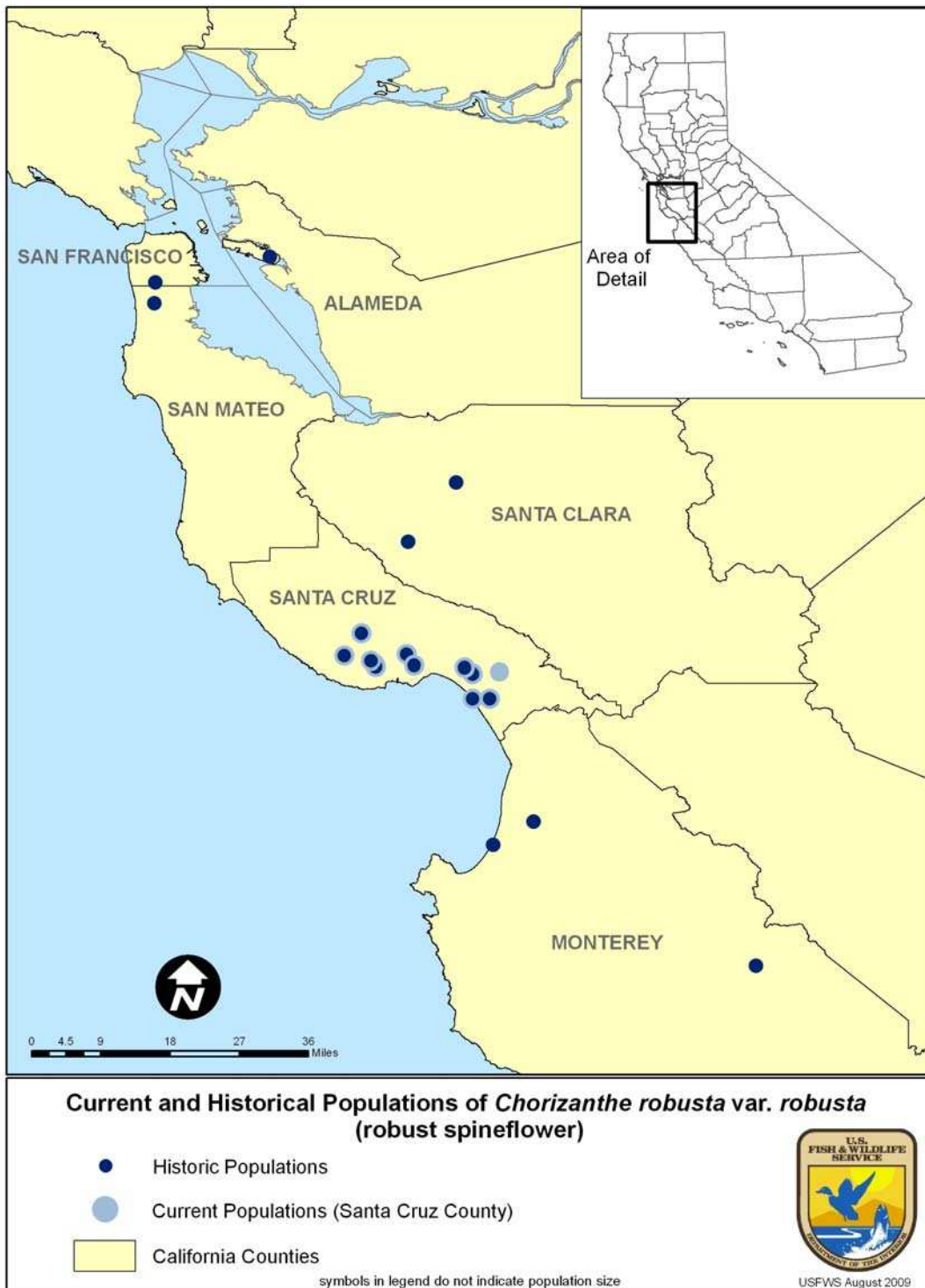
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## VIII. APPENDICES

### APPENDIX A. Map of current and historical populations of *C. robusta* var. *robusta*



**APPENDIX B. Summary of population numbers of *Chorizanthe robusta* var. *robusta*, from the 2004 recovery plan and the present (Point Reyes populations omitted).**

| 2004 Recovery Plan Population Numbers <sup>e</sup> |   |                 |      | Current Population Numbers |   |                       |      |
|--|---|-----------------|------|----------------------------|---|-----------------------|------|
| Population   |   | Number          | Year | Population                 |   | Number/Status         | Year |
| 1  | Pogonip Park, south of Brayshaw trail   | 271             | 2004 | 1                          | Pogonip Park, south of Brayshaw trail   | 523 <sup>d</sup>      | 2009 |
| 2  | Pogonip Park, west of Nature Look trail | 595             | 2004 | 2                          | Pogonip Park, west of Nature Look trail | >3,500 <sup>d</sup>   | 2009 |
| 3  | Sunset Beach State Park                 | 1 million       | 1998 | 3                          | Sunset Beach State Park                 | 1million <sup>c</sup> | 2009 |
|  | Sunset Beach State Park, south end      | 0               | 1990 |                            |   |                       |      |
| 4  | Freedom (Aptos High School)             | 2,200           | 2001 | 4                          | Freedom (Aptos High School)             | 500 <sup>f</sup>      | 2009 |
| 5  | Buena Vista                             | 3,700           | 2003 | 5                          | Buena Vista                             | >6,000 <sup>g</sup>   | 2009 |
| 6  | Ellicott Slough                         | ?               | 2003 | 6                          | Ellicott Slough                         | 0 <sup>h</sup>        | 2009 |
| 7  | Aptos                                   | 3,000           | 2000 | 7                          | Aptos                                   | N/D                   | N/D  |
| 8  | Branciforte                             | 1,000           | 2002 | 8                          | Branciforte                             | >650 <sup>i</sup>     | 2009 |
| 9  | Baldwin Creek                           | 1,000           | 2001 | 9                          | Baldwin Creek                           | N/D                   | N/D  |
| 10   | Manresa State Beach                     | 2,000 to 20,000 | 2002 | 10                         | Manresa State Beach                     | >2,000 <sup>j</sup>   | 2009 |
|  |   |                 |      | 11                         | Merk Road                               | >5,000 <sup>k</sup>   | 2009 |

<sup>d</sup> Baron 2009

<sup>e</sup> Service 2004

<sup>f</sup> Chang, pers. obs. 2009a

<sup>g</sup> S. Baron, in litt. 2009d

<sup>h</sup> S. Baron, in litt. 2009c

<sup>i</sup> V. Cheap, in litt. 2009b

<sup>j</sup> T. Hyland, pers. comm. 2009

<sup>k</sup> S. Baron, in litt. 2009a

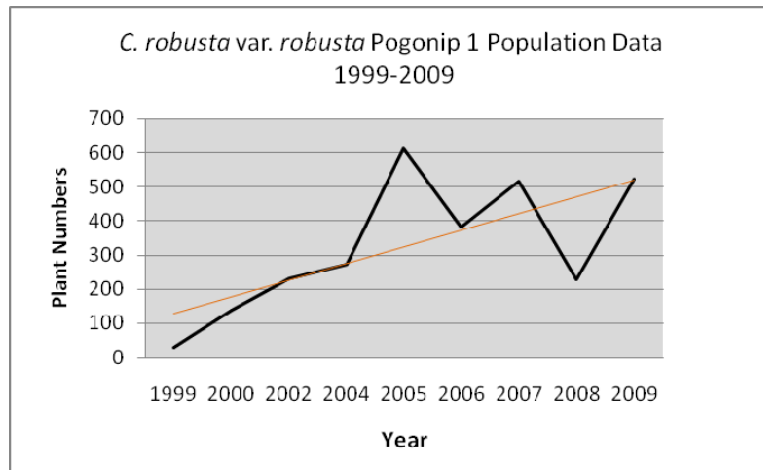
N/D = no data



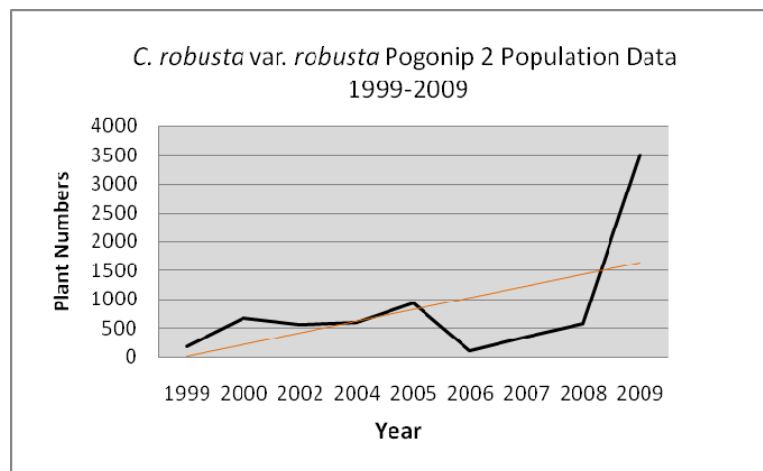
**APPENDIX C. A summary of populations, land ownership, and critical habitat of *C. robusta* var. *robusta* on private, park, and refuge lands, including current threats and conservation efforts.**

| <b>Percentage of <i>C. robusta</i> var. <i>robusta</i> Populations and Critical Habitat on Private, Park, and Refuge Lands</b> | <b>Populations and Ownership</b>                 | <b>Current threats: Listing Factors A and E</b>  | <b>Conservation/ Management Efforts</b>  | <b>Result of Conservation Efforts</b>   |
|--|--|--|--|---|
| <b>Private</b><br><br>36% of total populations<br><br>19% of critical habitat  | Branciforte/Private                              | development, recreation, invasive species        | --   | --  |
|  | Aptos/Private                                    | recreation, vegetation management, random events | --   | --  |
|  | Baldwin Creek/Private                            | road maintenance, random events                  | --   | --  |
|  | Freedom/Pajaro School District and Private       | human disturbance                                | --   | --  |
| <b>Park Lands</b><br>(city, county and state)<br><br>45% of total populations<br><br>52% of critical habitat                   | Pogonip 1 and 2/City of Santa Cruz               | recreation, random events                        | Annual census and management actions   | In 2009, a 5-fold increase in plant numbers from the previous year, a 20-fold increase since 1999 |
|  | Sunset State Beach/California State Parks        | recreation, random events, weeds                 | Dune habitat restoration, annual monitoring, removal of invasives, mapping, and management | Populations are stable and doing well   |
|  | Manresa State Beach/California State Parks       | recreation, random events                        | Dune habitat restoration, annual monitoring, removal of invasives, mapping, and management | Populations are stable and doing well   |
|  | Merk Road/Santa Cruz County Parks and Recreation | --   | --   | --  |
| <b>Refuge</b><br><br>18% of total populations<br><br>29% of critical habitat   | Ellicott Slough/National Wildlife Refuge         | vegetation management, recreation                | Refuge management  | --  |
|  | Buena Vista/National Wildlife Refuge             | random events                                    | Refuge management  | Population has nearly doubled since 2003  |

**APPENDIX D. Population data graphs of the Pogonip populations of *C. robusta* var. *robusta*.**



**Figure 1. *C. robusta* var. *robusta* at Pogonip 1 from 1999-2009**



**Figure 2. *C. robusta* var. *robusta* at Pogonip 2 from 1999-2009**

**U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW**

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

**Current Classification:**

**Recommendation Resulting from the 5-Year Review:**

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

**Review Conducted By:** Lena Chang

**FIELD OFFICE APPROVAL:**

**Lead Field Supervisor, U.S. Fish and Wildlife Service**

Approve Diane K. Woods Date 2/9/10