

Cordylanthus tenuis ssp. capillaris
(Pennell's Bird's-Beak)

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



Photo Credit: Betty Warne, USFWS

**U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office
Sacramento, California**

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5-YEAR REVIEW

Cordylanthus tenuis ssp. capillaris

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: Pennell's bird's-beak (*Cordylanthus tenuis ssp. capillaris*) was first described as *Cordylanthus capillaris* in 1950 (Pennell 1950). Following subsequent revisions of the genus, Pennell's bird's-beak was reclassified as a subspecies of *Cordylanthus tenuis* in 1986 (Chuang and Heckard 1986). A member of the broomrape family (Orobanchaceae), populations exist below 245 meters (804 ft) above mean sea level within chaparral and closed-pine forest communities of Sonoma County, California (Service 1998, Calflora 2011). Two locations for the species were confirmed to exist at the time of listing – at the Harrison Grade Ecological Reserve, and a few miles to the west along the Bohemian Highway in Camp Meeker (CNDDDB 2011). The species is parasitic on roots of shrubs and possibly Sargent's cypress (*Cupressus sargentii*) trees (Heckard 1977). It is strictly endemic to serpentine soils (Safford et al 2005).

Methodology Used to Complete This Review:

This review was prepared by the Sacramento Fish and Wildlife Office (SFWO), following the Region 8 guidance issued in March 2008. We used information from the Recovery Plan for Serpentine Soils of the San Francisco Bay Area (Recovery Plan) (Service 1998), survey information from experts who have been monitoring various localities of this species, 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 species' status and threats. We received no information from the public in response to our Federal Notice initiating this 5-year review. This 5-year review contains updated information on the species' 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 the species that are attributable to the Act's five

listing factors. The review synthesizes all this information to evaluate the listing status of the species 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:

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Federal Register (FR) Notice Citation Announcing Initiation of This Review: A notice announcing initiation of the 5-year review of Pennell's bird's-beak and the opening of a 60-day period to receive information from the public was published in the Federal Register on March 25, 2009 (74 FR 12878-12883).

Listing History:

Original Listing

FR Notice: 60:6671

Date of Final Listing Rule: February 3, 1995

Entity Listed: *Cordylanthus tenuis* ssp. *capillaris*, a plant subspecies

Classification: Endangered

State Listing

Cordylanthus tenuis ssp. *capillaris* was listed by the State of California as rare in November, 1978.

Review History: No previous 5-Year Reviews or other relevant documents have been written for *Cordylanthus tenuis* ssp. *capillaris*.

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for *Cordylanthus tenuis* ssp. *capillaris* is 6 according to the Service's 2009 Recovery Data Call for the Sacramento Field Office, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a subspecies that faces a high degree of threat and has a low potential for recovery.

Recovery Plan or Outline

Name of Plan: Recovery Plan for Serpentine Soils Species of the San Francisco Bay Area

Date Issued: September 30, 1998

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

Pennell’s bird’s-beak is an herbaceous annual of the broomrape family (Orobanchaceae) (Olmstead *et al.* 2001). Pennell (1950) first described it as *Cordylanthus capillaris* within Scrophulariaceae, yet Chuang and Heckard (1986) revised the genus to consider Pennell’s bird’s-beak one of six subspecies of *Cordylanthus tenuis*. Of the six *C. tenuis* subspecies, only *C. tenuis* ssp. *brunneus* and *C. tenuis* ssp. *capillaris* are known to occur in Sonoma County, California (Chuang and Heckard 1986, CNPS 2011). A high degree of interfertility between the two subspecies demonstrates a close genetic relationship between them (Chuang and Heckard 1975).

Unlike *Cordylanthus tenuis* ssp. *brunneus*, in *C. tenuis* ssp. *capillaris* the outer bracts are three-parted up to two-thirds of their length, and stems are not glandular below the flowers (Chuang and Heckard 1986). Otherwise, *C. tenuis* ssp. *capillaris* is primarily glabrous throughout, yet also minutely pubescent on branchlets. Mature plants grow 30 to 60 centimeters (12 to 24 inches) tall and change from yellow-green to a purplish hue with age (Chuang and Heckard 1986). Leaves are entire, or those of the primary stem three-parted, filiform, complicately folded, and sometimes in part puberulent adaxially. Fine marginal hairs exist on bracts and the calyx, and the tubular corolla is 1.5 centimeters (0.6 inch) long (Chuang and Heckard 1986). It flowers from June through July (Chuang and Heckard 1986), and the corolla is garnet-brown laterally, becoming paler dorsally (Pennell 1950). The fruit are capsules containing 10 to 16 seeds (Chuang and Heckard 1986).

Members of the *Cordylanthus* genus require bees for effective pollination (Chuang and Heckard 1986). In fact, several species of *Cordylanthus* grown in greenhouse conditions, *C. tenuis* ssp. *capillaris* included, were found to be self-incompatible (Chuang and Heckard 1986). Most species of *Cordylanthus*, *C. tenuis* ssp. *capillaris* included, flower in the hottest time of the year, from mid-July through September (Chuang and Heckard 1986). The uncommon flowering period of *Cordylanthus* ssp. in arid climates may be the result over evolutionary time of competition for pollinators (Chuang and Heckard 1986).

It’s likely that the hemiparasitism has allowed the *Cordylanthus* ssp. to exploit a summertime flowering niche (Chuang and Heckard 1986). Like others of the genus, *Cordylanthus tenuis* ssp. *capillaris* is hemiparasitic; although it contains chlorophyll, it collects water, nitrogen, carbon

compounds and other minerals from a host plant (Marvier and Smith 1997). *Cordylanthus* species establish root connections with host plants in the environment by means of haustoria (Chuang and Heckard 1971). Through culture experiments Chuang and Heckard (1971) concluded that *Arctostaphylos bakeri* ssp. *bakeri* (Baker's Manzanita) was the likely host plant for *C. tenuis* ssp. *capillaris*, rather than oaks (*Quercus* spp.), pines (*Pinus* spp.), and toyon (*Heteromeles arbutifolia*). Heckard (1977) identified Sargent's cypress as another possible host. An association with plantain (*Plantago* spp.) also may promote growth of *C. tenuis* ssp. *capillaris* (Chuang and Heckard 1971).

Spatial Distribution

Cordylanthus tenuis ssp. *capillaris* is known solely from records in the Outer North Coast Ranges floristic province of Sonoma County, California (Chuang and Heckard 1986, Hickman 1993, CNDDDB 2011). The known historical range of *C. tenuis* ssp. *capillaris* is less than several square miles (Kruckeberg 1984). Collections among herbaria indicate that over time specimens have been collected most frequently along the Bohemian Highway, between Occidental and Monte Rio, in Sonoma County, California (CCH 2011). At the time of listing, *C. tenuis* ssp. *capillaris* was known from two principal locations: one along Bohemian Highway; and the second partially within the Harrison Grade Ecological Reserve. The two known locations were recorded in the California Natural Diversity Data Base (CNDDDB) as occurrence 1 and occurrence 2. A third location was thought to occur on the private lands adjacent to the first location, yet permission to survey the lands had consistently been refused (Service 1995). These locations are within the Camp Meeker 7.5-minute U.S. Geological Survey quadrangle map (USGS quad).

Presently, *Cordylanthus tenuis* ssp. *capillaris* is recognized to occur in five separate locations (Figure 1). In addition to the two previously known locations, the CNDDDB recognizes two other occurrences. CNDDDB occurrence 4 is located in a roadside ditch along Bohemian Highway, close to CNDDDB occurrence 1. Also, CNDDDB occurrence 5 is located on the privately-owned Twin Valley Ranch near Porter Creek, about 11 km (6.8 miles) northeast of CNDDDB occurrence 2. The Twin Valley Ranch population lies within the Guerneville USGS quad. One additional report, CNDDDB occurrence 6, was recorded in 2004 on Bohemian Club land adjacent to Bohemian Highway, northwest of CNDDDB occurrence 1.

Occurrences range in elevation above mean sea level from 45 to 245 meters (148 to 804 feet) (Calflora 2011, CNPS 2011). It is associated with closed-cone coniferous forests and chaparral on serpentine soils (Chuang and Heckard 1986, Hickman 1993).

Abundance

As is typical of annual species, populations of *Cordylanthus tenuis* ssp. *capillaris* have varied in numbers over time at the two locations known at the time of listing in 1995. At CNDDDB occurrence 1 along Bohemian Highway, 200 plants were reported in 1987, while 10,000 were reported in 1981. In 2011 the habitat and plant numbers along Bohemian Highway were reported to be significantly reduced from recent years (J. Herrick, California Native Plant Society, *in litt.* 2011).



Figure 1. Known CNDDDB occurrences of *Cordylanthus tenuis ssp. capillaris*, all within Sonoma County, California. Occurrence 6 has been reported, but yet to be entered into CNDDDB (Bittman, *in litt.* 2011). No Occurrence 3 exists.

At CNDDDB occurrence 2 around the Harrison Grade Preserve, 1000 plants were noted in 1978, while 10,000 were logged in 1981 over roughly the same acreage (CNDDDB 2011). In 1994, 12 colonies were reported at CNDDDB occurrence 2, and an additional 300-500 plants were reported along Stoetz Lane near CNDDDB occurrence 2 in 2001 (CNDDDB 2011). In 2011, several colonies of 70 to 300 plants, each occupying between 4.6 and 27.9 square meters (50 to 300 square feet), along the road by Harrison Grade Preserve (Herrick, *in litt.* 2011). The populations along both sides of Stoetz Lane were also reported as dense (Herrick, *in litt.* 2011).

Populations confirmed after listing also have shown variations in individual numbers over the past 25 years. Data recorded in 1997 for CNDDDB occurrence 4 noted historic records of 12 plants in 1986 and 113 plants in 1989 (CNDDDB 2011). An unknown number of plants was reported in 1997 at CNDDDB occurrence 5, and likewise an unknown of plants were confirmed at CNDDDB occurrence 6 in 2004 (CNDDDB 2011). Because all occurrences are on private lands (excepting the Harrison Grade Preserve portion of CNDDDB occurrence 2), population estimates have been scant.

Habitat or Ecosystem

Cordylanthus tenuis ssp. *capillaris* grows only on serpentine soils among chaparral and closed pine forests (Chuang and Heckard 1986). Although serpentine soils may vary in chemistry, texture, and water availability at the microsite level (McCarten 1987), favorable conditions are thought to exist within the Geyserville and Healdsburg USGS quads, as well as in additional areas to those known in the Camp Meeker and Guerneville USGS quads (CNPS 2011).

Cordylanthus tenuis ssp. *capillaris* is associated with Sargent's cypress (*Cupressus sargentii*), Baker's manzanita, and coffeeberry (*Rhamnus californica*) (Chuang and Heckard 1986).

Changes in Taxonomic Classification or Nomenclature

Cordylanthus capillaris (Pennell's bird's-beak) was first described by Pennell (1950). Chuang and Heckard (1986) reclassified the *Cordylanthus* genus and considered Pennell's bird's-beak to be a subspecies: *C. tenuis* ssp. *capillaris*. At the time of listing, the genus was considered within the snapdragon family (Scrophulariaceae). Presently, the genus *Cordylanthus* is considered within the broomrape family (Orobanchaceae) (Olmstead et al. 2001).

Genetics

Cordylanthus is a genus of 18 species (Chuang and Heckard 1986). *Cordylanthus tenuis* has 6 subspecies (Chuang and Heckard 1986). Of these subspecies, *C. tenuis* ssp. *brunneus* also occurs on serpentine soils, yet about 30 km (18.6 miles) to the east of the known ssp. *capillaris* occurrences (Chuang and Heckard 1986, Hickman 1993). On specimens of *C. tenuis* ssp. *capillaris* the outer bracts are three-parted, and stems are mostly glabrous and not glandular beneath flowers (Chuang and Heckard 1986). In contrast, specimens of *C. tenuis* ssp. *brunneus* demonstrate outer bracts that are entire, with stems minutely and sparsely glandular and puberulent (Chuang and Heckard 1986). Chuang and Heckard (1975) were able to artificially hybridize ssp. *brunneus* with ssp. *capillaris* to produce vigorous and fertile specimens with both characteristic bract types on the same plant. However, hybridization between these subspecies has not been documented to occur under natural conditions.

Species-specific Research and/or Grant-supported Activities

Since the time of listing, no species-specific research and/or grant supported activities have been performed.

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, development and associated road construction on the private lands containing occurrence 1, which would result in loss, modification, and destruction of *Cordylanthus tenuis* ssp. *capillaris* habitat, were considered potential threats. Development plans had included the donation of 87 hectares (including *C. tenuis* ssp. *capillaris* habitat) to the county for use as a park (Service 1998). However, although some roads were constructed, the development never took place, and the land was subsequently sold. Habitat for *Cordylanthus tenuis* ssp. *capillaris* along Bohemian Highway has been significantly reduced within the past 2-3 years (Herrick, *in litt.* 2011). Parts of the talus and bank have been removed and a windrow has been planted in areas known to be previously colonized by *C. tenuis* ssp. *capillaris* (Herrick, *in litt.* 2011).

The other population of *Cordylanthus tenuis* ssp. *capillaris* known at the time of listing occurs on the Harrison Grade Preserve and adjacent private lands. Unauthorized motor vehicle use, target shooting, and excessive foot traffic were noted as possible threats, modifications, and destruction of *C. tenuis* ssp. *capillaris* habitat. Presently, within the past 5 to 10 years along Stoetz Lane parcels of land have been converted vineyards. The conversion to vineyards of potential *C. tenuis* ssp. *capillaris* habitat continues to threaten populations at CNDDDB occurrence 2 (Herrick, *in litt.* 2011).

The reports of additional occurrences add to the potential threats and modifications to *Cordylanthus tenuis* ssp. *capillaris* habitat. CNDDDB Occurrence 1 is located on property where timber harvesting has occurred since the time of listing (G. Hale, Sonoma Land Trust, *in litt.* 2011). Similarly, timber harvesting has occurred on the property where Occurrence 6 is located, and may continue in the future (Robertson 2011, Zito 2011). Timber harvesting can cause significant changes in the species richness and diversity in the herbaceous plant layer (Battles et al. 2001, Macdonald and Fenniak 2007). Although some effects of canopy removal can be short-lived, many other effects persist over a much longer timeframe (e.g., disturbance-mediated limitations to dispersal) (Gilliam 2007). Such effects could be detrimental to populations of *C. tenuis* ssp. *capillaris*. Roadside maintenance such as mowing has been reported at occurrence 4, and cattle grazing was reported at occurrence 5 (CNDDDB 2011). Mowing and grazing before the plants flower, typically June through July (Chuang and Heckard 1986) would prevent the generation of seeds. As an annual herbaceous plant species, *C. tenuis* ssp. *capillaris* relies on seed banks to maintain population levels.

Due to the hemiparasitic nature of *Cordylanthus tenuis* ssp. *capillaris*, diseases to potential host species may threaten *C. tenuis* ssp. *capillaris* populations. *Phytophthora cinnamomi* is a pathogen causing mortality in a number of native forests and chaparral communities in northern California (Swiecki, *in litt.* 2008, p. 2). *Phytophthora cinnamomi* was identified to be partially responsible for mortality in *Quercus agrifolia* (coast live oak) (Garbelotto *et al.* 2006). Also, *P. cinnamomi* causes root and crown rot and is responsible for killing off large patches of manzanita (Swiecki and Bernhardt 2003). Once infected by this pathogen, the root system of the plant begins to decay until the loss of roots and/or water-conducting tissues causes the plant to desiccate. *P. cinnamomi* can persist in the environment in the absence of susceptible hosts. This pathogen survives in the soil in infected roots, or as long-lived resident spores (Swiecki and Bernhardt 2003). There is no known cure or prevention of disease from *P. cinnamomi* (Swiecki and Bernhardt 2003). Swiecki *et al.* (2005) further noted that although reductions in pathogen populations may occur over time, it is unclear what period of time is needed to allow successful reestablishment of plants without disease.

The pathogenic activity of *Phytophthora cinnamomi* is favored by free moisture and under wet conditions, multiple infection cycles are likely to occur. *P. cinnamomi* is primarily spread to new areas through the movement of infested soil by humans, particularly through the use of vehicles (Swiecki and Bernhardt 2003). Once the disease has been introduced into an area, the movement of the pathogen is facilitated by water flow. Swiecki *et al.* (2005) noted that the local spread of *P. cinnamomi* occurs during the wet season at a cross slope and upslope rate of approximately 0.25 m (0.8 ft) per year. Down slope spread has been calculated at 2 m (6.5 ft) per year, presumably due to transport via flowing water, and under stagnant stream conditions *P. cinnamomi* has been located 10 m (33 ft) from disease-associated mortality centers (Swiecki *et al.* 2005). While it is more likely for *P. cinnamomi* infected soil to be spread over larger distances during the wet season, movement of infected soils can readily occur during dry months as the result of mining operations and excavation (Swiecki *et al.* 2005).

Phytophthora ramorum is another pathogen known to cause sudden oak death in at least four coastal California oak species (Garbelotto *et al.*, 2001; Rizzo and Garbelotto 2003). Moreover, an additional 13 species of coastal California woody plants, from 10 families, have been identified as host species for *P. ramorum* (Garbelotto *et al.*, 2003). Along with main tree species of mixed-conifer forests, understory species such as manzanita, toyon, coffeeberry, and honeysuckle (*Lonicera hispidula*) have been identified as hosts for *P. ramorum* (Garbelotto *et al.*, 2003). The severity and symptoms of *P. ramorum* vary among host species. Because *P. ramorum* has been isolated within the past 15 years, and because the pathogen can result in death in several host species, *P. ramorum* is thought to be invasive to California ecosystems (Garbelotto *et al.*, 2001). As relatively recent phenomena, it is impossible at this time to determine the long-term ecological effects of *P. cinnamomi* and *P. ramorum* on coastal California forests. Thus, we lack adequate information to determine the potential effects of these pathogens on *Cordylanthus tenuis* ssp. *capillaris*.

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

At the time of 1995 listing (60 FR 48136), overutilization was not known to be a factor affecting the existence of *Cordylanthus tenuis* ssp. *capillaris*. However, mentioned within the listing were concerns that unrestricted collecting for scientific or horticultural purposes, or excessive visits by individuals interested in seeing rare plants, could result in increased publicity and ultimately species take as a result of the listing.

Notwithstanding, it has remained that overutilization is not known to be a factor affecting the existence of *Cordylanthus tenuis* ssp. *capillaris*. The species is not spectacular in flower, and therefore may not appeal to general collectors.

FACTOR C: Disease or Predation

In the 1995 listing (60 FR 48136), both horses and deer were reported to browse on *Cordylanthus tenuis* ssp. *capillaris*. The site of occurrence 5 has been used for cattle grazing (CNDDDB 2011). In general, however, the number of plants damaged by grazing continues to be unknown.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

At the time of listing, the California Endangered Species Act (CESA), the Native Plant Protection Act (NPPA), and California Environmental Quality Act (CEQA) were not considered to provide adequate protection to the species in their natural habitats.

California Endangered Species Act and Native Plant Protection Act: The CESA (California Fish and Game Code, section 2080 *et seq.*) prohibits the unauthorized take of State-listed threatened or endangered species. The NPPA (Division 2, Chapter 10, section 1908) prohibits the unauthorized take of State-listed threatened or endangered plant species. The CESA requires State agencies to consult with the California Department of Fish and Game on activities that may affect a State-listed species and mitigate for any adverse impacts to the species or its habitat. Pursuant to CESA, it is unlawful to import or export, take, possess, purchase, or sell any species or part or product of any species listed as endangered or threatened. The State may authorize permits for scientific, educational, or management purposes, and to allow take that is incidental to otherwise lawful activities. *Cordylanthus tenuis* ssp. *capillaris* is listed as rare by CESA.

California Native Plant Protection Act (NPPA): Under NPPA landowners are exempt from CESA for plants to be taken in the process of habitat modification. Where landowners have been notified by the State that a rare or endangered plant is growing on their land, the landowners are required to notify the California Department of Fish and Game 10 days in advance of changing land use in order to allow salvage of listed plants. We do not consider salvage to provide adequate protection for these species because transplanting often results in failure due to unknown reproduction and survival requirements of the species and inappropriate or inadequate reintroduction sites.

California Environmental Quality Act: The CEQA requires full public disclosure of the potential environmental impact of proposed projects. The public agency with primary authority or jurisdiction over the project is designated as the lead agency and is responsible for conducting a review of the project and consulting with other agencies concerned with resources affected by the project. Section 15065 of CEQA guidelines requires a finding of significance if a project has the potential to “reduce the number or restrict the range of a rare or endangered plant or animal”. Species that are eligible for listing as rare, threatened, or endangered but are not so listed are given the same protection as those species that are officially listed with the State. Once significant impacts are identified, the lead agency has the option to require mitigation for effects through changes in the project or to decide that overriding considerations make mitigation infeasible. In the latter case, projects may be approved that cause significant environmental damage, such as destruction of endangered species. Protection of listed species through CEQA is, therefore, at the discretion of the lead agency. CEQA provides that, when overriding social and economic considerations can be demonstrated, project proposals may go forward, even in cases where the continued existence of the species may be jeopardized, or where adverse impacts are not mitigated to the point of insignificance.

California Surface and Mining Reclamation Act of 1975 (SMARA): Evidence of mining activity was reported at the *Cordylanthus tenuis* ssp. *capillaris* Occurrence 5 site, which was confirmed after the 1995 listing of the species (CNDDDB 2011). The SMARA (California Public Resources Code chapter 9 § 2710 et seq.) requires reclaiming mined lands to a useable condition that is readily adaptable for alternative land uses, not necessarily natural conditions. Although SMARA requires reclamation for mining activities, the standards for reclamation and the success of any revegetation is judged on the approved end use of the land. SMARA does not require replacement of the same vegetation type, species, or percentage of vegetation cover as the habitat that is lost. Additionally, mining operations are not required to submit a reclamation plan for operations conducted prior to January 1, 1976.

California Z’berg-Nejedly Forest Practice Act of 1973 (FPA): The FPA encourages prudent and responsible forest resource management, while serving the need for timber and other forest products, and simultaneously giving consideration to the need for watershed protection, fisheries and wildlife, and recreational opportunities (California Public Resources Code §4511 et seq.). The FPA provides that landowners with 2,500 acres or less create a non-industrial timber management plan (NTMP) with objectives of uneven-aged management and sustainable forest products yield. An NTMP is submitted for approval to the California Department of Forestry and Fire Protection (CalFire). Once approved, logging operations as described in an NTMP are permitted for a period of up to 100 years.

Although special-status plants such as *Cordylanthus tenuis* ssp. *capillaris* may be recognized and accounted for when an NTMP is set forth, the fate of individual plants (e.g., new occurrences) is uncertain over the course of timber harvesting operations covered in an NTMP. Changes over time in forest structure, composition, and canopy closure may encourage or discourage the growth and propagation of plants in indeterminable ways (see Gilliam 2007). Furthermore, inadequate NTMPs are at times mistakenly approved. In *Sierra Club and Bohemian Redwood Rescue Club versus CalFire and The Bohemian Club* (2011), California Judge of the Superior Court René A. Chouteau revoked a permitted NTMP on the land where *C. tenuis* ssp. *capillaris*

Occurrence 6 is located. The revocation was based on the unaddressed need to consider harvesting alternatives when drafting an NMTP. It is unclear if scenarios that may be best for listed species, such as *C. tenuis* ssp. *capillaris*, are often overlooked.

Endangered Species Act of 1973, as amended (Act): The Act is the primary Federal law providing protection for these species. The Service's responsibilities include administering the Act, including sections 7, 9, and 10 that address take. Since listing, the Service has analyzed the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 CFR 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project.

Section 9 prohibits the taking of any federally listed endangered or threatened species. Section 3(18) defines "take" to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Service regulations (50 CFR 17.3) define "harm" to include significant habitat modification or degradation which actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. Harassment is defined by the Service as an intentional or negligent action that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. The Act provides for civil and criminal penalties for the unlawful taking of listed species. Incidental take refers to taking of listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 CFR 402.02). For projects without a Federal nexus that would likely result in incidental take of listed species, the Service may issue incidental take permits to non-Federal applicants pursuant to section 10(a)(1)(B). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved Habitat Conservation Plan (HCP) that details measures to minimize and mitigate the project's adverse impacts to listed species. Regional HCPs in some areas now provide an additional layer of regulatory protection for covered species, and many of these HCPs are coordinated with California's related Natural Community Conservation Planning program. Currently, no HCP includes *Cordylanthus tenuis* ssp. *capillaris* as a covered species.

With regard to Federally listed plant species, section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out does not jeopardize a listed plant species. Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the "take" of federally endangered wildlife; however, the take prohibition does not apply to plants. Instead, plants are protected from harm in two particular circumstances. Section 9 prohibits (1) the removal and reduction to possession (i.e., collection) of endangered plants from lands under Federal jurisdiction, and (2) the removal, cutting, digging, damage, or destruction of endangered plants on any other area in knowing violation of a state law or regulation or in the course of any violation of a state criminal trespass law. Federally listed plants may be incidentally protected if they co-occur with federally listed wildlife species.

National Environmental Policy Act (NEPA): NEPA (42 U.S.C. 4371 *et seq.*) provides protection for species that may be affected by activities undertaken, authorized, or funded by Federal action agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the action agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the action agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

Summary of Factor D: In summary, the Endangered Species Act is the primary Federal law that has provided protection for *Cordylanthus tenuis* ssp. *capillaris* since its listing as endangered in 1995. Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent their status under the Act. Therefore, we continue to believe other laws and regulations have limited ability to protect the species in absence of the Endangered Species Act.

Since the 1995 listing, no substantial changes have been made to the above regulations. No additional legal protections are afforded to the species. Accordingly, the threat is the same or similar to the time of listing.

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

At the time of listing in 1995, factors resulting from increasing human populations in central California coastal counties were reported to place a great strain on undeveloped wild-lands, such as those found on the serpentine soils (Service 1995). Listed factors include pedestrian and off-road vehicle traffic, hiking and bicycle trails, and unauthorized garbage dumping. These factors can lead to increased erosion, the establishment of non-native, invasive plants, and the fragmentation of the native plant populations (Service 1995). In turn the native plant populations are increasingly susceptible to natural factors that can negatively affect viability, such as fire and disease (Brigham and Schwartz 2010). The limited number and isolated conditions of the *Cordylanthus tenuis* ssp. *capillaris* populations, resulting from these natural and manmade factors, can render the species susceptible to stochastic extinction (Brigham and Schwartz 2010).

Roadside maintenance, such as mowing and spraying, and vehicular traffic were mentioned as threats to *Cordylanthus tenuis* ssp. *capillaris* in the 1995 listing (Service 1995). Unauthorized dumping of articles ranging from appliances to bottles also was mentioned as factors affecting *C. tenuis* ssp. *capillaris* (Service 1995). Whereas light road grading was thought to facilitate establishment of *C. tenuis* ssp. *capillaris*, heavy road disturbance may increase the invasion of non-native plant species (Service 1995).

Leimu et al. (2006), in meta-analyses of plant studies published between 1987 and 2005, determined that the negative effects of habitat fragmentation (e.g., reduced genetic variation, increased demographic stochasticity) are more common among self-incompatible and rare plant species. *Cordylanthus tenuis* ssp. *capillaris* is not only rare, but also self-incompatible (Chuang and Heckard 1986). Although natural selection pressures have acted over time to create a niche

for *C. tenuis* ssp. *capillaris* on serpentine soils, the fragmented nature of serpentine habitats can leave rare plants dependent upon them susceptible to vagaries of stochastic events. Indeed, populations of *C. tenuis* ssp. *capillaris* vary among years (CNDDDB 2011), and the causes for annual variations are not readily apparent. Reed (2005) suggests that populations of plants should be maintained at 5,000 or more individuals with conservation goals of long-term persistence in mind. Because the results of natural interactions over time are impossible to predict, it is unclear if enough individuals of *C. tenuis* ssp. *capillaris* exist to ensure long-term persistence.

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. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. 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.

Similarly, ozone due to photochemical smog is another potential threat to *Cordylanthus tenuis* ssp. *capillaris*. Several studies have documented harmful effects of increased nitrogen deposition, such as increased foliar injury and growth reduction (e.g., Miller 1992; Grantz and Yang 1996; Bytnerowicz 2002), yet no information exists specifically for *C. tenuis* ssp. *capillaris*.

III. RECOVERY CRITERIA

The approved final Recovery Plan for Serpentine Soil Species contains individual species accounts for 28 federally-listed species, including *Cordylanthus tenuis* ssp. *capillaris* (Service 1998). 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 accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve 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, and assessing a species' degree of recovery is likewise 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.

Measures to Downlist:

1) Protection and management of current known occurrences

Is the criterion valid and has it been addressed: Yes, the criterion is still valid but has not been fully addressed. The Harrison Grade Preserve, managed by the California Department of Fish and Game, affords conservation protection for a portion of occurrence 2. However, much of occurrence 2, as well as the whole populations of all other known occurrences, is on private land. Thus, these populations are not protected or managed for the benefit of *Cordylanthus tenuis* ssp. *capillaris*. The site of occurrence 5 has been used for cattle grazing and mining activities (CNDDDB 2011).

Plans for development on the private land holding *Cordylanthus tenuis* ssp. *capillaris* Occurrence 1 were recognized in the Recovery Plan for Serpentine Species of the San Francisco Bay Area (Service 1998). However, the property was sold in 1997 to Bohemia Ranch LLC and the development plans were dropped (G. Hale, pers. comm., 2010). In June, 2001, the Sonoma Land Trust began the development and implementation of a land management plan for Bohemia Ranch LLC (G. Hale, *in litt.* 2011). As per the Z'berg-Nejedly Forest Practice Act, the management plan included an NTMP for sustainable forest products yield (G. Hale, pers. comm., 2010). In doing so, the management plan provided Bohemia Ranch a conservation easement. The Sonoma Land Trust also has led negotiations to purchase the property from Bohemia Ranch LLC for public use as a park (Cardo 2010). Similarly, although a California court ruling has halted timber harvests on the land where Occurrence 6 is located (Sierra Club, Bohemian Redwood Rescue Club versus California Department of Forestry and Fire Protection, The Bohemian Club 2011), future harvests may be planned.

The listing factors addressed are Factor A (Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range), Factor C (Disease or Predation), and Factor E (Other Natural or Manmade Factors Affecting Its Continued Existence).

2) Collection and banking of seed in Center for Plant Conservation certified botanic garden

Is the criterion valid and has it been addressed: Yes, the criterion is valid and has been addressed. Seeds of *Cordylanthus tenuis* ssp. *capillaris* were collected for banking by the University of California Botanical Garden (Forbes 2005). Seed banks are stored in a manner such that seeds remain viable should restoration efforts become necessary.

The listing factors addressed are Factor A (Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range) and Factor E (Other Natural or Manmade Factors Affecting Its Continued Existence).

3) Survey of serpentine habitats to identify potential habitat

Is the criterion valid and has it been addressed: Yes, the criterion is still valid but has not been fully addressed. A comprehensive and systematic survey of serpentine habitats for the presence of *Cordylanthus tenuis* ssp. *capillaris* is yet to be conducted. The occurrence 5 record was

discovered during a 1997 survey for *Erigeron serpentinus* (serpentine daisy)(CNDDDB 2011). A comprehensive survey also would benefit other species dependent on serpentine soils, such as the state-listed as rare *Arctostaphylos bakeri* ssp. *bakeri* (Baker's Manzanita)(Service 1998).

A comprehensive and systematic survey of serpentine habitats suitable for *Cordylanthus tenuis* ssp. *capillaris* would address listing factors A and E by furthering the understanding of the present habitat and range.

4) Research on seed germination and propagation techniques, demography, and burning as a management strategy

Is the criterion valid and has it been addressed: Yes, the criterion is still valid and but not been fully addressed. Research to date has primarily focused on anatomy and taxonomical differentiation; propagation and demography have received little attention.

Cordylanthus tenuis ssp. *capillaris* has been identified as hemiparasitic, yet the extent to which the species relies on parasitism for subsistence has not been identified. Potential host plants have been inferred from natural occurrences and laboratory tests (Chuang and Heckard 1971), yet no positive identifications have been made. Current occurrences indicate that site disturbance may promulgate colonization, yet the role of fire as a disturbance mechanism is uncertain.

IV. SYNTHESIS

At the time of listing in 1995, two populations of *Cordylanthus tenuis* ssp. *capillaris* were known (Service 1995); currently there are five known populations (CNDDDB 2011). At the time of listing, threats to the global population of *C. tenuis* ssp. *capillaris* included potential development, off-road vehicles, camping, hiking, target-shooting, and dumping (CNDDDB 2011). Timber harvesting, grazing, and mowing have been noted as potential threats to additional populations identified since listing (CNDDDB 2011). The Harrison Grade Preserve protects part of only one of the five known occurrences; most of the global population occurs on private lands. Potential land development continues to threaten the species on the privately-owned lands, as does agricultural conversion of lands to vineyards. Additional new potential threats identified include climate change and increased nitrogen deposition. Also, selection pressures over time have acted to provide *C. tenuis* ssp. *capillaris* with a means to exploit an uncommon niche – a self-incompatible pollinating, annual plant dependent on serpentine soils. Thus, the unique ecological niche *C. tenuis* ssp. *capillaris* has come to occupy may be susceptible to a variety of natural and manmade random effects on the low population numbers. Furthermore, a lack of understanding of the basic demographics, propagation, and general ecology of *C. tenuis* ssp. *capillaris* has persisted since its listing. Therefore, the listing status of *C. tenuis* ssp. *capillaris* as endangered should remain unchanged.

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

New Recovery Priority Number and Brief Rationale:

No change in the recovery priority number or status is recommended.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

1. Protect known occurrences from threats by acquiring the private lands from willing sellers where *Cordylanthus tenuis* ssp. *capillaris* is known to occur.
2. Design and implement a comprehensive survey method for *Cordylanthus tenuis* ssp. *capillaris*. Survey designs should incorporate geographic information systems (G.I.S.) technology to identify additional suitable sites for *C. tenuis* ssp. *capillaris*.
3. Work with land owners and land managers to gain access to known and potential suitable sites for *Cordylanthus tenuis* ssp. *capillaris* populations. Annual population surveys of known occurrences should be reported to the CNDDDB.
4. Scientific studies should be conducted to identify ideal host species. Chuang and Heckard (1971) have inferred suitable host species for *Cordylanthus tenuis* ssp. *capillaris*, yet individual plant fitness varies with host plant relationships. Studies remain to identify decisively the optimal host species.
5. Ascertain the importance of habitat disturbance to *Cordylanthus tenuis* ssp. *capillaris*. Current occurrences are openings among chaparral and conifer woodlands. Management strategies should evaluate the effectiveness of timber removal and fire ecology for the propagation of the species.

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

Cordylanthus tenuis ssp. capillaris

Current Classification: Endangered

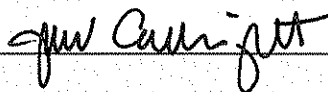
Recommendation Resulting from the 5-Year Review:

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

Review Conducted By: Harry Kahler, Sacramento Fish and Wildlife Office

FIELD OFFICE APPROVAL:

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

Approve  Date 9-8-11

Appendix A. Consortium of California Herbaria specimens of *Cordylanthus tenuis* ssp. *capillaris*, 2011. Data provided by the participants of the Consortium of California Herbaria (ucjeps.berkeley.edu/consortium/; accessed June 27, 2011).

Consortium ID	Herbarium	Collector	Date	Elevation	Locality
JEPS16345	Jepson	H. L. Mason	Jul 4 1946		2 miles e Occidental, Sonoma Co.
JEPS20297	Jepson	Lewis S. Rose	Jul 11 1955	800 ft	2 miles e Occidental
JEPS27994	Jepson	Rimo Bacigalupi (with L. R. Heckard)	Jun 9 1961	750 ft	ca. 0.75 mi nw Occidental School (along Stoetz Lane, ca. 1/2 miles nw of its junction with Harrison Grade road)
JEPS28819	Jepson	L. R. Heckard	Nov 27 1962		3/4 miles nw Occidental School (along Stoetz Lane)
JEPS29842	Jepson	Rimo Bacigalupi and L. Heckard, J. Weiler	Jun 23 1961	750 ft	ca. 3/4 miles nw Occidental School (nw of garbage disposal area, along Stoetz Lane, 0.5 miles nw of its junction with Harrison Grade road.)
JEPS33006	Jepson	Freed W. Hoffman	Aug 14 1946		e Camp Meeker
JEPS33009	Jepson	Freed W. Hoffman	Sep 5 1947		between Tyrone and Camp Meeker (Dutch Bill Creek)
JEPS57382	Jepson	L. R. Heckard and T. I. Chuang	Jun 18 1968		n Occidental (Stoetz Lane about 3/4 miles w of Harris grade road)
JEPS57467	Jepson	L. R. Heckard	Jul 23 1968		n Occidental (Stoetz Lane about 3/4 miles w of Harris grade road)
JEPS62600	Jepson	T. I. Chuang with Fei-Mei Chuang	Jul 25 1970		2.7 miles ne Occidental (Stoetz Road, w of Harrison grade)
JEPS6648	Jepson	Milo S. Baker	Jul 15 1947		2 miles ne Occidental (along Harrison Grade)
JEPS6806	Jepson	R. F. Hoover	Jul 13 1942		3 miles s Monte Rio
JEPS6807	Jepson	R. F. Hoover	Jun 7 1941		2 miles se Monte Rio
JEPS69347	Jepson	T. I. Chuang, F. M. Chuang and Carl Chuang	Jul 22 1972		2 miles n Occidental (on Harrison Grade Road)
JEPS69348	Jepson	Tsan-lang Chuang, F. M. Chuang and Carl Chuang	Jul 22 1972		2 miles nw Camp Meeker (on way to Monte Rio)
JEPS74601	Jepson	L. R. Heckard	Aug 21 1974		about 1 mile n of Camp Meeker (s of Monte Rio)
JEPS74989	Jepson	T. I. and F. M. Chuang	Jul 5 1975		n Occidental (Stoetz Lane, about 3/4 miles w of Harris Grade Road)
JEPS77679	Jepson	Margaret J. Williams	Jul 16 1978		near Occidental
JEPS79414	Jepson	Edward Lee with W. A. Setchell	Jun 7 1936		south ridge fire trail, Bohemian Grove
UC1044679	University of California, Berkeley	Milo S. Baker	Jul 15 1947		2 miles ne Occidental - Harrison Grade
UC1094010	University of California, Berkeley	Lewis S. Rose	Jul 11 1955	800 ft	2 miles e Occidental

UC1096792	University of California, Berkeley	Milo S. Baker	Jul 4 1946		2 miles ne Occidental - Harrison Grade
UC1239007	University of California, Berkeley	Freed W. Hoffman	Aug 14 1946		e Camp Meeker (on "serpentine island") - North Coast Ranges
UC1239008	University of California, Berkeley	Freed W. Hoffman	Sep 5 1947		between Tyrone and Camp Meeker - North Coast Ranges, Dutch Bill Creek
UC727699	University of California, Berkeley	Milo S. Baker	Jul 4 1946		2 miles ne Occidental - Harrison Grade
UC761837	University of California, Berkeley	R. F. Hoover	Jul 13 1942		3 miles s Monte Rio
UC762589	University of California, Berkeley	Robert F. Hoover	Jun 7 1941		2 miles se Monte Rio (on road to Camp Meeker)
JEPS103956	Jepson	Jack and Betty Guggolz	Jul 20 1991		N end of a large serpentine meadow
RSA107417	Rancho Santa Ana Botanic Garden	L. S. Rose	Jul 11 1955	244 m	Northwestern; Outer North Coast Ranges region 2 miles NE of Occidental; elev. 800 ft
RSA537660	Rancho Santa Ana Botanic Garden	T. I. Chuang	Jul 22 1972		Northwestern; Outer North Coast Ranges region 2 miles N of Occidental on Harrison Grade Road
RSA537698	Rancho Santa Ana Botanic Garden	T. I. Chuang	Jul 5 1975		Northwestern; Outer North Coast Ranges region Stoetz Lane, about 3/4 mile west of Harris Grade road, north of Occidental
RSA537704	Rancho Santa Ana Botanic Garden	T. I. Chuang	Jul 25 1970		Northwestern; Outer North Coast Ranges region Stoetz Road, west of Harrison Grade, 2.7 miles east of Occidental
RSA74323	Rancho Santa Ana Botanic Garden	C. F. Baker	Jul 15 1947		Northwestern; Outer North Coast Ranges region 2 miles NE of Occidental, along Harrison Grade
RSA74476	Rancho Santa Ana Botanic Garden	C. F. Baker	Jul 15 1947		Northwestern; Outer North Coast Ranges region 2 miles NE of Occidental, along Harrison Grade
SBBG32336	Santa Barbara Botanic Garden	L. S. Rose	Aug 6 1962	600 ft	2 miles NE of Occidental
UCD67620	University of California, Davis		Aug 09 1996	800 m	Camp Meeker-Monte Rio. Dutch Bill Creek. Open cypress forests (<i>Cupressus sargentii</i>) in serpentine and andesitic rocks
UCD67621	University of California, Davis		Aug 09 1996	800 m	Camp Meeker-Monte Rio. Dutch Bill Creek. Open cypress forests (<i>Cupressus sargentii</i>) in serpentine and andesitic rocks
UCR78363	University of California, Riverside	T. I. Chuang, F. M. Chuang	Aug 25 1970		2.7 miles east of Occidental