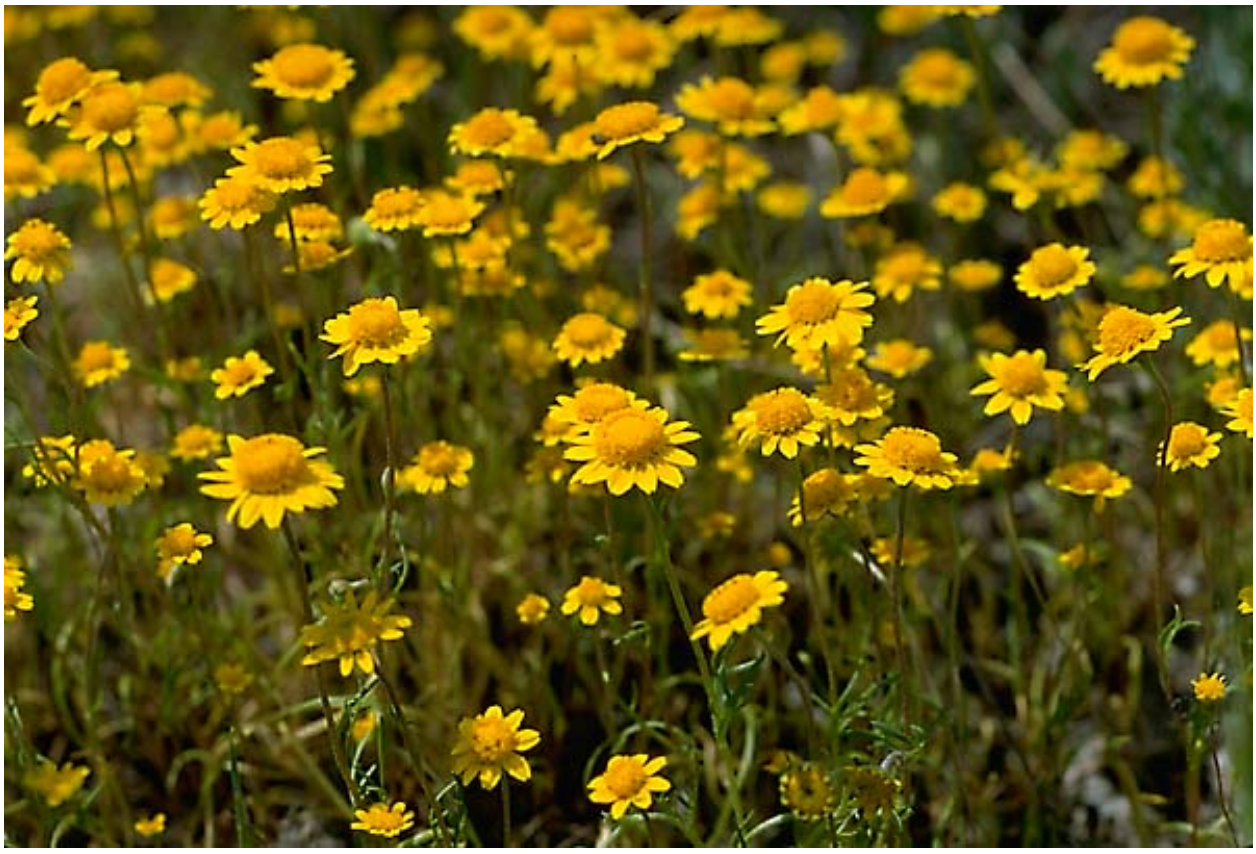
Lasthenia conjugens
(Contra Costa Goldfields)

5-Year Review:
Summary and Evaluation



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

January 2013

5-YEAR REVIEW

Lasthenia conjugens (Contra Costa Goldfields)

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 described in the Recovery Plan for Vernal Pools Ecosystems of California and Southern Oregon (Recovery Plan; Service 2005a), *Lasthenia conjugens* is an annual flowering plant in the aster family (Asteraceae) that grows 10 to 30 centimeters (4 to 12 inches) tall and usually has a branched stem. The leaves are opposite, light green, and hairless. The lower leaves have smooth margins, but stem leaves have one or two pair of narrow lobes. The daisy-like flower heads are terminal, solitary, and all disk and ray flowers are golden-yellow (Greene 1888; Ornduff 1993). The phyllaries (bracts below the flower head in the aster family) are one-quarter to one-half fused; where all other species of *Lasthenia* have either free phyllaries or phyllaries fused more than two thirds of their length. The achenes (fruit) of *L. conjugens* are less than 1.5 millimeters (0.06 inch) long and always lack a pappus (the hair-like or scale-like structures attached to an achene, which assist in dispersal; Ornduff 1969, Ornduff 1993). *L. conjugens* has been reported in ten counties within California: Alameda, Contra Costa, Marin, Mendocino, Monterey, Napa, Santa Barbara, Santa Clara, Solano, and Sonoma (CNDDB 2012). *L. conjugens* flowers from March to June (Ornduff 1966, Ornduff 1976) and is self-incompatible.

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 2005 Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (Service 2005a), survey information from experts who have been monitoring various localities of this species, and the California Natural Diversity Database (CNDDB) maintained by the California Department of

Fish and Game (CDFG). The Recovery Plan and personal communications with experts were our primary sources of information used to update the species' status and threats sections of this review. 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 this 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 recover. 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 this taxon and the opening of a 60-day period to receive information from the public was published in the Federal Register on April 27, 2012 (77 FR 25112) . The Service received no additional information during the comment period.

Listing History:

Original Listing
FR Notice: 62 FR 33029
Date of Final Listing Rule: June 18, 1997
Entity Listed: *Lasthenia conjugens*, a plant species
Classification: Endangered

Associated Rulemakings: Critical habitat for this species was proposed on September 24, 2002 (67 FR 59884). The final rule to designate critical habitat for *Lasthenia conjugens* was published on August 6, 2003 (68 FR 46684). A re-evaluation of non-economic exclusions from the August 2003 final designation was published on March 8, 2005 (70 FR 11140). An evaluation of economic exclusions from the August 2003 final designation was published on August 11, 2005 (70 FR 46924). Administrative revisions were published on February 10, 2006 (71 FR 7118). Clarifications on the economic and non-economic exclusions for the final designation of critical habitat were published on May 31, 2007 (72 FR 30279).

Review History: Updated information on the status of and threats to *Lasthenia conjugens* was included in the 2005 Recovery Plan (Service 2005a). A 5-year review of *L. conjugens* was completed on March 25, 2009; we recommended no change to the status of this species (74 FR 12878).

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for *Lasthenia conjugens* is 5C according to the Service's 2012 Recovery Data Call for the SFWO 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 species that faces a high threat level and has low potential for recovery. The "C" indicates conflict with construction or other development projects.

Recovery Plan or Outline

> **Name of Plan or Outline:** Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon
> **Date Issued:** December 15, 2005

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

Spatial Distribution *Lasthenia conjugens* has historically occurred in seven vernal pool regions: Central Coast, Lake-Napa, Livermore, Mendocino, Santa Barbara, Santa Rosa, and Solano-Colusa (Keeler-Wolf *et al*. 1998). In addition, several historical occurrences in Contra Costa County are outside of the defined vernal pool regions (Keeler-Wolf *et al*. 1998). Ornduff (1966) reported collections from 13 sites in Alameda, Contra Costa, Mendocino, Napa, Santa Barbara, Santa Clara and Solano counties. Although he cited three specimens each from Contra Costa and Santa Barbara Counties, Ornduff (1966; 1979) noted that the species was most common in Solano County. One additional site in Alameda County was documented in 1959 by G. Thomas Robbins, who collected a specimen (# 3963, housed at the Jepson Herbarium) on the "shore of the San Francisco Bay" south of Russell (Service 2005a).

The majority of the location information used in this review is from the California Natural Diversity Database (CNDDB) that reports species locations as "occurrences" rather than populations. An "occurrence", that may represent a documented collection, observation, or museum specimen of a species, is defined by the CNDDB as a location occupied by a species separated from other locations by at least 0.25 mile, and may contain multiple records. At the time of listing, there were only 13 known occurrences of *Lasthenia conjugens* in four counties:

Napa, Contra Costa, Alameda, and Solano. At the time when the Recovery Plan (Service 2005a) and the first 5-year review (74 FR 12878) were written, 32 occurrences of *L. conjugens* were catalogued in ten counties in CNDDB: Alameda, Contra Costa, Marin, Mendocino, Monterey, Napa, Santa Barbara, Santa Clara, Solano, and Sonoma.

The CNDDB now reports 34 occurrences of *Lasthenia conjugens*. The two additional localities noted since the last 5-year review are found in Solano County. Both of these occurrences are located on private land and are not protected (CNDDB 2012; R. Elliott, CNDDB, pers. comm. 2012). Of the 34 listed occurrences, seven are extirpated and four are potentially extirpated (CNDDB 2012). The species is believed to be completely extirpated from Santa Clara and Santa Barbara Counties (CNDDB 2012). These extirpations occurred primarily from habitat conversion to urbanization and agriculture (CNDDB 2012). The majority of the presumed extant localities are located in Solano County, where 11 localities are presumed extant (CNDDB 2012). The next largest concentrations of populations are in Monterey County and Alameda County, each with three occurrences (CNDDB 2012). Of the 23 presumed extant records, four occurrences may now be extirpated: (1) an occurrence in Mendocino County has not been observed since 1937; (2) an occurrence in Alameda County has not been observed since 1959; (3) in 1987, a single plant was observed in Napa County and has not been documented since; (4) an occurrence in Solano County was noted on a field checklist in1996 and the location is unknown (CNDDB 2012). The status and distribution of the *L. conjugens* is uncertain due in part to the difficulty of relocating sites and also because this species may reappear on a site after several years, even if it is absent during a given survey. Additionally, CNDDB occurrences have in some cases either been deleted or lumped, making tracking of the number of occurrences difficult.

Abundance

Sonoma County

One occurrence of *Lasthenia conjugens* is located on private lands east of the City of Petaluma, south of Stage Gulch Road, near the Sonoma Mountains (CNDDB 2012). This locality is within the Santa Rosa vernal pool region and was not yet discovered at the time of listing. The population was first observed by Sarah Lynch, Monk & Associates, during a protocol level special status plant survey at the site in 2003 when approximately 15 plants were noted. While population trends are unknown, approximately 1,500 plants were observed in 2008 while hundreds were observed in 2011 (S. Lynch, Monk & Associates, pers. comm. 2012) and the population is presumed extant.

Marin County

One occurrence of *Lasthenia conjugens* is located on along Highway 1 and south of Americano Creek (owner unknown; CNDDB 2012). This locality is within the Santa Rosa vernal pool region and was initially discovered by Betty Guggolz and later rediscovered by Randy Morgan in 2002 (CNDDB 2012). This occurrence was undiscovered at the time of listing. In 2011, hundreds of plants as well as unusual masses of flowers were observed at this location so the

occurrence is presumed extant (D. Smith, CNPS, pers. comm. 2012) however population trends are unknown.

Monterey County

Three occurrences of *Lasthenia conjugens* are found in Monterey County and all are found within the Fort Ord core area and Central Coast Vernal pool region; no occurrences in Monterey County were known at the time of listing. All occurrences are on land currently administered by the U.S. Bureau of Reclamation. This land has a Habitat Management Plan and will be managed and preserved in perpetuity (U.S. Army Corps of Engineers 1997). Approximately 2,779 hectares (6,868 acres) of the former Fort Ord are designated as critical habitat for *L. conjugens* (Service 2003). An unknown number of plants were most recently observed at all three locations as part of an informal survey conducted in 2009 (D. Tannourji, CH2M Hill, pers. comm. 2012); the population trend of each occurrence is also unknown.

Napa County

Two occurrences of *Lasthenia conjugens* are found in Napa County and occur in the Lake-Napa vernal pool region both of which were identified at the time of listing. One occurrence, described above (Spatial Distribution section), is adjacent to the Berryessa core area with one plant observed in 1987 which may now be extirpated; the status of this occurrence is unknown (CNDDB 2012). The second population occurs within the Napa River core area near Soscol Creek on private land. The population is currently declining and has been affected by vineyards, changing hydrology, isolation, and lack of invasive species management (CNDDB 2012; J. Ruygt, CNPS, pers. comm. 2012). Historically, 5 to 15,000 plants were reported annually, however no plants were found in two of the last five years (Ruygt, pers. comm. 2012). Individual plant counts for the last five years are: 0 (2008), 17 (2009), 400 to 500 (2010), 0 (2011), and 3 (2012; Ruygt, pers. comm. 2012).

Contra Costa County

One known extant occurrence of *Lasthenia conjugens* is found in Contra Costa County and was known at the time of listing. This occurrence is within the Rodeo Creek core area within the Solano-Colusa vernal pool region. The population is within the State Route 4 Preserve which was designated as preservation land as part of compensation for the State Route 4 Gap Closure Project. The preserve is currently being managed by the Muir Heritage Land Trust in Contra Costa County. Population counts at the time of listing or any time before 1998 are unknown (CNDDB 2012; G. Lewis, Muir Heritage Land Trust, pers. comm. 2012). While present population trends are also unknown, population counts have increased over the last five years, likely owing to proper grazing management and sufficient rainfall. The numbers of individual plants observed over the last five years are: 577 (2008), 4,517 (2009), 5,271 (2010), 6,932 (2011), and 15,137 (2012; Lewis, pers. comm. 2012).

Alameda County

Three presumed extant occurrences of *Lasthenia conjugens* are found in Alameda County. All three occurrences are located within the Central Coast vernal pool region. One occurrence, described above (Spatial Distribution section), is documented near Russell City and presumed extant, but has not been surveyed since 1959. The other two occurrences are located within the S.E. San Francisco Bay core area and the Don Edwards San Francisco Bay National Wildlife Refuge (NWR), one at the Warm Springs Seasonal Wetland Unit that had been discovered at the time of listing and one at the Pacific Commons Preserve. *L. conjugens* cover in the Warm Springs Unit has been similar among years since 2006, however abundance was not captured in these measurements and was noticeably greater in 2010 and 2011 likely due to above average rainfall (Loredo 2010; 2011). Quantitative surveys for *L. conjugens* have been performed at the Pacific Commons Preserve since 1999 (WRA 2009). During the period of 1999-2009, both the distribution and abundance of *L. conjugens* in this area expanded likely owing to mitigation wetland construction activities such as seeding and monitoring of grazing that promoted a decrease in non-native annual grasses and weed species (WRA 2009). Both 2007 and 2008 showed robust population numbers of *L. conjugens* at this location (5,353 and 4,893 individual plants, respectively) but a slight decline in 2009 (1,485 plants) as a result of below average rainfall and an early warm winter (WRA 2009).

Solano County

Eleven presumed extant occurrences of *Lasthenia conjugens* are found within the Solano-Colusa Vernal pool region in Solano County, however only nine were known at the time of listing. One occurrence, described above (Spatial Distribution section), located on Rush Ranch in the Suisun Marsh has only been documented once on a field checklist in1996 and the location is unknown (CNDDB 2012). Of the remaining ten occurrences, two are located within the Suisun Marsh Core Area: one is along Cordelia Road, east of Pitman Road, and southwest of Fairfield on private land, and the other is on the privately owned Gentry property, also on Cordelia Road, west of Suisun City (CNDDB 2012). The eight other occurrences are located within the Jepson Prairie Core Area. Of these eight, two occurrences are protected: one at Travis Air Force Base (AFB) owned by the Department of Defense and the other at the North Suisun Mitigation Bank Property on private land owned by Wildlands Inc (CNDDB 2012). The six other occurrences found in the Jepson Prairie Core Area include: one south of Travis ABF and east of Branscombe Road, one northeast of Fairfield and south of the summit at Cement Hill, one west of Travis AFB and south of Cement Hill Road, one east of Fairfield and along Scally Road, one northwest of Travis AFB and east of Peabody Road, and one west of the south gate entrance to Travis AFB (CNDDB 2012). In 2006, the U.S. Fish and Wildlife Service awarded an Endangered Species Act Section 6 grant to the Solano County Water Agency to perform studies regarding the status of *L. conjugens*; the results of this work will be used in the development of the Solano Habitat Conservation Plan (LSA 2010). As a result, select monitoring of many of the ten extant occurrences has been conducted every year from 2006 to present (Table 1), however population trends are still unknown (LSA 2010; 2011; 2012).

Table 1. Locations monitored in Solano from 2006 to present and corresponding abundance data (LSA 2010; 2011; 2012).

CNDDB EO #	Location	Study Site	Number of Plants in Census Year					
			2006	2007	2008	2009	2010	2011
42506	Cordelia Rd	Not included						
16733	Gentry property	Barnfield	7,029,826	7,344,760	6,096,661	8,211,165		
30303	Travis Air Force Base	Goldfield Conservation Bank	296,276	9,390,342	3,680,084	47,924,387		
43586	North Suisun Mitigation Bank	Not included						
16731	South of Travis AFB	Not included						
541	South of Cement Hill summit	McCoy Basin	521,790	1,475,980	630,870	2,513,018		
21918	West of Travis AFB	Not included						
17769	Scally Rd	Director's Guild Study Site	15,672,891	33,939,707	28,682,308	164,065,994		
568	East of Peabody Rd	Noonan Ranch Conservation Bank				14,815,539	35,922,682	2,718,443
77028	South gate Travis AFB	Not included						

Habitat or Ecosystem

Lasthenia conjugens typically grows in vernal pools, swales, and low depressions in open valley and foothill grasslands and have been found in three types of vernal pools: Northern Basalt Flow, Northern Claypan, and Northern Volcanic Ashflow (Sawyer and Keeler-Wolf 1995). Landforms and geologic formations for sites where *L. conjugens* occur have not been identified. This species is commonly found at elevations less than 61 meters (m) (200 feet (ft)) but has been documented at 445 m (1465ft) in Napa County and at 137 m (450ft) in Monterey County (CNDDB 2012). The most commonly reported *L. conjugens* associates are *Lolium multiflorum* (Italian ryegrass), *Plagiobothrys* spp. (popcorn flower), *Eryngium* spp. (coyote thistle, *Lasthenia* spp. (other goldfields), and *Downingia* spp. (calicoflowers; CNDDB 2012).

Changes in Taxonomic Classification or Nomenclature

The taxonomy of *Lasthenia conjugens* has remained unchanged since the seminal work of Ornduff (1966; B. Baldwin, UC Berkeley Jepson Herbarium, pers. comm, 2012).

Genetics

Ramp Neale *et al*. (2008) conducted a study that examined the genetic diversity both within and among populations of *Lasthenia conjugens* throughout a large portion of its range using microsatellite or intersimple sequence repeat markers, short DNA sequence motifs that are repeated in tandem and whose length may vary among individuals within a population. Samples were collected from eight populations in Napa, Solano (four sampling sites), Contra Costa, Alameda, and Monterey Counties (n=250) in 1994 (Napa County) or 1999 (all other counties). The authors found high levels of genetic diversity and moderate levels of differentiation among populations. A positive, statistically significant relationship was also observed between geographical distance and pairwise genetic differentiation. The results likely indicate that *L. conjugens* populations were historically connected but recently became fragmented by geological and climatic events, and agricultural practices or that gene flow presently exists among these populations; however, the latter scenario is unlikely. The study suggests that because genetic variation is broadly distributed among populations, it is prudent to preserve all remaining

populations and to collect samples from multiple pools within a population and widely across each pool to capture potential genetic variation as part of conservation or restoration efforts. Finally, the authors also recommend a sampling scheme that will detect and include rare alleles (genetic fragments) and in addition to a high total number of fragments.

In 2010, LSA Associates Inc. published a report on the status and distribution of *Lasthenia conjugens* in Solano County for 2006-2009 (LSA 2010) to aid in the development of a Solano Habitat Conservation Plan. An assessment of genetic diversity and structure of *L. conjugens* populations in Solano County using microsatellite markers was included in the report as a means to inform management and restoration decisions. Samples (n=341) were obtained from 14 study sites in 2006 and/or 2007 and analyzed by property (i.e. study site), sub-property, and pool. The study showed that while a high level of genetic diversity was present among populations overall, there was no correlation with geographical distance (i.e. distance between populations); low to moderate levels of inbreeding were also observed within properties and within pools. In accordance with Ramp Neale et al. (2008), these results point to recent population fragmentation or on-going gene flow among populations, however, the detection of inbreeding indicates that gene flow is not a plausible explanation. The report reinforces recommendations made by Ramp Neal et al. (2008) and suggests that because genetic diversity is greater among pools of a single property than among properties, conservation plans should aim to preserve the greatest number of individual pools.

Species-specific Research and/or Grant-supported Activities

In 1999, 256 experimental vernal pool basins were created on either side of a landing strip at Travis Air Force Base in Solano County, California as part of an endangered species mitigation plan (Collinge 1999; T N & Associates 2000). Since their construction, the pools have been utilized in multiple studies of vernal pool ecology and restoration, the results of which have been published since the time of the last 5-year review. Studies by Collinge and Ray (2009) on patterns of vernal pool community assembly at this site showed that *Lasthenia conjugens* occur at a higher frequency in seeded versus unseeded pools indicating that the species experiences dispersal limitation. The same study also found *L. conjugens* abundance to be significantly greater in experimental pools seeded across multiple years rather than a single year, a result that is important for vernal pool restoration projects. Collinge et al. (2011) examined resistance of vernal pool plant communities to exotic species invasion at this same location. The authors found that pools sown with a greater number of native species (including *L. conjugens*) and seed showed a lower frequency of exotic plants over time. However, after severe flooding and drought, exotic species eventually encroached upon and dominated all pools suggesting that extreme climatic events facilitate exotic species invasion of created vernal pools. Collinge et al. (unpublished data; S. Collinge, University of Colorado, pers. comm. 2012) evaluated the hydrological and vegetative features of the experimental pools at Travis AFB compared to nearby naturally occurring vernal pools and determined that environmental conditions were similar between the two pool types but natural pools were deeper and inundated for a longer time period than experimental pools. This study also showed that seeding encourages the establishment of native plants and that native plant cover is positively correlated with water depth and nature of the seeding regiment.

A master's thesis (Tannourji 2009) used linear regression to identify the biotic and abiotic factors significantly associated with *Lasthenia conjugens* cover of the three known occurrences at former Fort Ord in Monterey County. Increased *L. conjugens* abundance was correlated with long inundation periods, warm water temperatures, neutral water pH, and high native species richness suggesting that these factors are important for *L. conjugens* restoration and introduction efforts.

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

According to the 1997 listing rule, *Lasthenia conjugens* was threatened by direct destruction of the plants and their habitats or hydrologic changes in their vernal pool habitats. Such activities include urbanization, wetland drainage, industrial development, agricultural land conversion, ditch construction, off highway vehicle use, road widening, and trampling by cattle. Other threats to the species include vineyards, intensive grazing practices, insufficient grazing, and competition from invasive plants. All of these threats were noted in the last five-year review and are still imminent.

Sonoma County

The landowner whose property contains the single occurrence of *Lasthenia conjugens* in Sonoma County was using the site for grazing and is now in the planning stage with the county to build a vineyard on the property (Lynch pers. comm. 2012). Presently, the landowner has agreed to avoid construction where *L. conjugens* is found as well as the entire watershed surrounding this large wetland (Lynch pers. comm. 2012). However, this population is not protected, is not within the vernal pool regions covered by the Recovery Plan, and is potentially threatened by future development within the watershed (CNDDB 2012).

Marin County

According to the Marin Chapter of the California Native Plant Society, the occurrence at the Marin County site has been historically and is currently sheep-grazed, a practice that is a potential threat to *Lasthenia conjugens* (CNDDB 2012). However, the grazing does not appear to negatively affect the *L. conjugens* and may mitigate the growth of non-native weedy grasses (Smith, pers. comm. 2012). This occurrence is not currently protected, and is not within the vernal pool regions covered by the Recovery Plan.

Monterey County

While protected, *Lasthenia conjugens* at the three localities in Monterey County are potentially threatened by site degradation via soil compaction as the result of equestrian, bike, and off-highway vehicle trespass as well as pig activity (CNDDB 2012; Tannourji, pers. comm. 2012).

Napa County

The *Lasthenia conjugens* occurrence in Napa County is privately owned and not protected but located within the Napa River core area and is threatened by vineyards, changing hydrology, isolation, and lack of invasive species management (CNDDB 2012; Ruygt, pers. comm. 2012). However, a fence was installed in 2011 and cattle are seasonally grazed on the property to control the growth of invasive plant species (Ruygt, pers. comm. 2012).

Contra Costa County

The occurrence in Contra Costa County is protected and located within the State Route 4 Preserve but is threatened by competition with non-native grasses (CNDDB 2012) including *Dittrichia graveolens* (stinkwort) and *Lepidium latifolium* (pepperweed; Lewis, pers. comm. 2012). The site is grazed by cattle in the wet season and the spraying of herbicides has been performed in an effort to control this threat (Elliott, pers. comm. 2012; Lewis, pers. comm. 2012).

Alameda County

The two extant occurrences of *Lasthenia conjugens* in Alameda County are located in the Don Edwards San Francisco Bay National Wildlife Refuge and are protected. However, these occurrences are threatened by the invasion of *Lolium multiflorum* (Italian ryegrass) and *Lactuca serriola* (prickly lettuce; CNDDB 2012). A monitoring and management plan was completed for the Warm Springs Unit in 2004 (Loredo 2011). This plan outlines a seasonal livestock grazing regime that is supplemented with mowing, the application of herbicide, and controlled burning; all of these actions are meant to support the vernal pool habitat and also promote the persistence of *L. conjugens* (Loredo 2011).

Solano County

Solano County contains 48% of all known presumed extant occurrences of *Lasthenia conjugens* (CNDDB 2012). With the exception of the Travis AFB and North Suisun Mitigation Bank Property, the remaining occurrences of *L. conjugens* in Solano County are subject to high development pressure and habitat loss. There are seven known occurrences *L. conjugens* that are unprotected and threatened by development. Proposed projects that are near known occurrences of *L. conjugens* or may impact known occurrences are: Gentry-Suisun, Hawthorne Mill, and Jepson Parkway which include residential development, drainage, landfill expansion, highway projects, road expansions, and industrial development (Service 2006b; 2006c; 2007b). Additionally, all occurrences are threatened by inadequate habitat management and grazing, invasive non-native plant species, and climate change (CNDDB 2012; LSA 2010).

The Gentry-Suisun Project is a proposed commercial and residential development on 95.02 acres south of State Route 12 in an unincorporated portion of the county in Suisun City (Huffman-Broadway Group, Inc. 2007). Development of this site has stalled due to lack of interest in the residential housing market, however commercial development may still proceed according to the original Gentry-Suisun Project plan (S. Bragdon, Suisun City, pers. comm. 2012). While development is not presently underway, the loss of 0.023 acres of habitat and 35.93 acres of potential habitat outlined in the proposal is likely to adversely affect *L. conjugens* (Huffman-Broadway Group, Inc. 2007).

The Hawthorne Mill Development Projects consists of two development projects (Hawthorne Mill East and West) in the City of Fairfield in Solano County. Hawthorne Mill East includes residential and commercial development, associated infrastructure, and parks and is planned in conjunction with the construction of the Fairfield Train Station located at the southeast corner of Peabody Road and Vanden Road. Hawthorne Mill West is also a proposed residential development but is not associated with the Fairfield Train Station. The two sites are located south of Cement Hill Road, separated by the McCoy Basin, and are independent developments that are being considered together for analysis under the California Environmental Quality Act (CEQA). The proposed project in its current state is not believed to adversely affect *L. conjugens* (D. Riggs, WRA Inc., pers. comm. 2012).

The Jepson Parkway Project concept was developed to improve roadways in mid-Solano County between Interstate 80 (I-80) in Vacaville and State Route 12 in Suisun City. The project will upgrade and link a series of existing local two and four lane roadways to a four to six lane north-south travel route and improve numerous roads as well as medians, signals, shoulders, turn lanes, railroad grade separations, and bike lanes. While construction has not yet been initiated (J. Adams, Solano Transportation Authority, pers. comm. 2012), the biological assessment prepared for the Solano Transportation Authority determined that the proposed project is likely to adversely affect and result in the loss of 2.70 acres of designated critical habitat for *L. conjugens* (PBS&J 2009).

In summary, 65% of presumed extant *Lasthenia conjugens* occurrences throughout the species range are on private land and are not protected (CNDDB 2012). Protected localities of this species include three occurrences within the former Fort Ord in Monterey County, one at Travis AFB and one at the North Suisun Mitigation bank in Solano County, one at the State Route 4 Preserve in Contra Costa County, as well as two occurrences at the Don Edwards San Francisco Bay National Wildlife Refuge. The primary threats to *L. conjugens* continue to be habitat loss, industrial development, and modification of vernal pool habitat as well as invasion of non-native plant species. Even in areas where habitat is protected, the urbanization of surrounding lands may indirectly affect *L. conjugens* by increased presence of deleterious substances (i.e., fertilizers, herbicides, and oil based products), human intrusion, habitat fragmentation, and modification of hydrology. Other threats to presumed extant occurrences of this species include wetland drainage, agricultural land conversion, ditch construction, off-highway vehicle use, road widening, trampling by cattle, vineyards, inappropriate livestock grazing, elimination of grazing, and drainage (Service 2005a; CNDDB 2012).

Table 2. *Lasthenia conjugens* occurrences, known threats, and conservation efforts.

OCCURRENCE (1) *Rarefind EO number	**KNOWN AT LISTING (2)**	**CURRENT THREATS (3)**	**CURRENT CONSERVATION (4)**
Sonoma County EO 52830	No. First noted in CNDDB (2012) in 2003 by S. Lynch and G. Monk.	Factor A: prospective vineyard construction and development within the watershed (Lynch, per. comm. 2012).	Landowner has agreed to avoid construction in *L. conjugens* habitat and watershed (Lynch, pers. comm. 2012).
Marin County EO 51673	No. Discovered by B. Guggolz and re-discovered by R. Morgan in 2002 (CNDDB 2012).	Factor A: sheep grazing (Smith, pers. comm. 2012).	Sheep grazing may prevent growth of non-native weedy grasses (Smith, pers. comm. 2012).
Monterey County EO 42498 EO 42499 EO 69970	No. EO 42498 first noted in CNDDB (2012) in 1998 by V. Yadon. EO 42499 first noted in CNDDB (2012) in 1998 by B. Delgado. EO 69970 first noted in CNDDB (2012) in 1999 by H. Forbes and B. Keller.	Factor A: soil compaction from equestrian, bike, and off-highway vehicle activity (CNDDB 2012; Tannourji, pers. comm. 2012)	2,779 hectares (6,868 acres) of the former Fort Ord are designated as critical habitat (Service 2003).
Napa County EO 9584	Soscol Ridge. Occurrence first noted in CNDDB (2012) in 1979 by J. Ruygt.	Factor A: vineyards, changing hydrology, isolation, and lack of invasive species management (Ruygt, pers. comm. 2012).	Seasonal cattle grazing and fence construction have been introduced to control invasive plant growth (Ruygt, pers. comm. 2012)
Contra Costa EO 29059	Headwaters of Rodeo Creek. Occurrence first noted in CNDDB (2012) in 1995 by J. Sherar.	Factor A: competition with non-native grasses: *Dittrichia graveolens* (stinkwort) and *Lepidium latifolium* (pepperweed; Lewis, pers. comm. 2012)	Occurrence located within the State 4 Route Preserve and is managed by the Muir Heritage Land Trust. Cattle grazing and the application of heribicides have been performed to control invasive plant growth (Elliott, pers. comm. 2012; Lewis, pers. comm. 2012).

Alameda County EO 30917 EO 31468	EO 30917 located in the Warm Springs Seasonal Wetland Unit was first noted in CNDDB (2012) in 1996 by J. Sherar and was known at the time of listing. Occurrence EO 31468 at Pacific Commons was first noted in CNDDB (2012) in 1997 by B. Anderson.	Factor A: invasion by *Lolium multiflorum* (Italian ryegrass) and *Lactuca serriola* (prickly lettuce), grazing, and gravel yards (CNDDB 2012).	Occurrences are located within the Don Edwards San Francisco Bay National Wildlife Refuge. A 2004 monitoring and management plan for the Warm Springs Unit incorporates grazing, mowing, controlled burns, and the application of herbicides to support the persistence of *L. conjugens* occurrences (Loredo 2011).
Solano County EO 16733 EO 16731 EO 21918 EO 17769 EO 21933 EO 568 EO 541 EO 42506 EO 43586 EO 77028 EO 84517	Eight occurrences were known at the time of listing according in CNDDB (2012): EO 16733, EO 21918 (R. Ornduff 1958), EO 16731 (R. Ornduff 1960), EO 17769 (1986 J. Lacey and S. Morey), 21933 (1993 A. Howald), EO 568 and EO541 (1994 S. Lafer & Associates), and EO 42506 (1996 R. Chan). Three occurrences were noted in CNDDB (2012) after listing: EO 43586 (1999 State Lands Commission), EO 77028 (R. Huddleston 2008), and EO 84517 (B. Grewell 1996).	Factor A: loss of habitat to urban development, inadequate habitat management and grazing, invasive non-native plant species, and climate change (CNDDB 2012; LSA 2010). The EO 21933 site is regularly bladed for annual fair parking (CNDDB 2012). The habitat west of EO 77028 is leveled irrigated pasture (CNDDB 2012).	An Endangered Species Section 6 grant supports the continued annual monitoring of *L. conjugens* occurrences in Solano County (LSA 2010).

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

Overutilization for commercial purposes was not known to be a factor in the 1997 final listing rule (Service 1997). Overutilization for any purpose does not appear to be a threat at this time.

FACTOR C: Disease or Predation

Disease or predation was not known to be a threat to this species at the time of listing (Service 1997), and is not known to be a threat at this time.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

In the final rule, we identified the inadequacies of the Federal Clean Water Act and the California Environmental Quality Act.

Federal Laws

The Endangered Species Act: The Endangered Species Act of 1973, as amended (Act), is the primary Federal law that provides protection for *Lasthenia conjugens*. 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 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, plants are not protected against take. 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. The protection of section 9 afforded to endangered species is extended to threatened wildlife and plants by regulation. Federally listed plants may be incidentally protected if they co-occur with federally listed wildlife species.

Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of an incidental take statement. Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species because take of plants in not prohibited. However, limited protection of listed plants from take is provided to the extent that the Act and the implementing regulations prohibit the removal and reduction to possession of federally listed threatened or endangered plants or the malicious damage of endangered plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas when in violation of state law or regulation or in the course of any violation of a State criminal trespass law.

National Environmental Policy Act: The National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq.*) may afford some protection to populations affected by Federal activities. The NEPA requires all Federal agencies to formally document, consider, and publicly disclose the environmental impacts of Federal actions and management decisions affecting the human

environment. NEPA requires agencies to consider mitigation alternatives, but does not require or guide the actual implementation of mitigation for impacts.

Federal Clean Water Act: The Section 404 of the Clean Water Act (CWA) may afford some protection to *Lasthenia conjugens*. The U.S. Army Corps of Engineers (Corps) issues permits for the discharge of dredged or fill material into navigable waters of the United States. The Corps interprets "the waters of the United States" expansively to include not only traditional navigable waters, but also other defined waters that are adjacent or hydrologically connected to traditional navigable waters. Before issuing a 404 permit for a project that may affect federally listed species, the Corps is required under section 7 of the Act to consult with the Service. Thus, wetland protections under CWA that would benefit this species may be dependent upon its status under the Act.

However, recent Supreme Court rulings have called into question the Corps' definition of Waters of the U.S. On June 19, 2006, the U.S. Supreme Court vacated two district court judgments that upheld this interpretation as it applied to two cases involving "isolated" wetlands. Currently, the Corps regulatory oversight of vernal pools is in doubt because of their "isolated" nature. In response to the Supreme Court decision, the Corps and the U.S. Environmental Protection Agency (USEPA) have recently released a memorandum providing guidelines for determining jurisdiction under the CWA. The guidelines provide for a case-by-case determination of a "significant nexus" standard that may protect some, but not all, vernal pool habitat (USEPA and USACE 2007). The 2007 guidelines were revised in 2008 (USEPA and USACE 2008) and are currently used in this form to address issues of jurisdiction over waters of the United States under the Clean Water Act (M. Finan, USACE, pers. comm. 2012). The overall effect of the new permit guidelines on loss of vernal pool habitat is not known at this time however confusion surrounding jurisdiction has made enforcement of protection of endangered species under the Clean Water Act problematic (Finan, pers. comm. 2012). If the Corps loses their regulatory authority over vernal pools, unmitigated destruction of potential habitat for *Lasthenia conjugens* may increase over the range of the species.

California State Laws

California Endangered Species Act: The State's authority to conserve wildlife includes the California Endangered Species Act (CESA) and the California Environmental Quality Act (CEQA). While *Lasthenia conjugens* are not listed under CESA, it must be considered under CEQA as a rare species (Section 15380, Public Resources Code). CEQA (chapter 2, section 21050 *et seq.* of the California Public Resources Code) requires government agencies to consider and disclose environmental impacts of projects and to avoid or mitigate them where possible. Under CEQA, public agencies must prepare environmental documents to disclose environmental impacts of a project and to identify conservation measures and project alternatives. Through this process, the public can review proposed project plans and influence the process through public comment. However, CEQA does not guarantee that such conservation measures will be implemented.

In summary, the Endangered Species Act is the primary Federal law that provides protection for this species since its listing as endangered in 1997. 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 its 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.

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

The 1997 listing rule states that restricted habitats/ranges and small population size are a threat to *Lasthenia conjugens*. Current threats include those discussed in the 1997 final rule, as well as competition from invasive plant species, improper or lack of grazing regimes, and climate change/drought.

Invasive Plant Species:

Competition from invasive plant species poses a primary threat to this species. Non-native grasses occur commonly in vernal pool complexes and have become a threat to native vernal pool species through their capacity to change pool hydrology. Non-native grasses maintain dominance at pool edges, sequestering light and soil moisture. *Lolium multiflorum* and *Glyceria declinata* (waxy mannagrass) increase thatch buildup, which leads to increased oxygen depletion in the pools (Dunne and Leopold 1978) and contributes to the shortening of inundation periods through increased evapotranspiration (Marty 2005). As vernal pool complexes become surrounded by residential development and disturbed habitat, the likelihood of invasion by non-native plants increases (Zedler and Black 2004). Residential and municipal landscaping provides a constant seedsource of non-native plants. Urban runoff, combined with the urban seedsource, is likely to convert the vernal pools to patches of nonnative weeds and grasses. Activities such as deep-ripping (breaking up the clay pan by thrusting metal prongs into the soil and dragging them with heavy machinery so water can drain from the area) and gravel mining disturb the habitat and allow non-native species to become more easily established (Service 2005a). Small reserves may be particularly susceptible to degradation by non-native species, particularly when the reserves are located in a matrix of development and are associated with chronically disturbed transportation corridors (Zedler and Black 2004).

The CNDDB (2012) reports six extant *Lasthenia conjugens* occurrences that are threatened by competition from invasive plants such as *Lolium multiflorum* and *Lactuca serriola*. *Lolium* spp. threaten occurrences in Alameda County and a Napa County occurrence that is within the Napa River core area (CNDDB 2012). Grazing ceased on the Napa County site in 2005, off road vehicle use has occurred, and *Lolium* spp. have been invading (CNDDB 2012). Invasive non-native plants such as *Dittrichia graveolens* and *Lepidium latifolium* (Lewis, pers. comm. 2012) have also become a concern for the State Route 4 preserve in Contra Costa County since grazing was discontinued from 1999-2002 to allow for road construction (Lewis, pers. comm. 2012; CNDDB 2012). Non-native grasses such as *L. multiflorum* not only shade out short-statured plants like *L. conjugens* but can also negatively impact vernal pool hydrology by decreasing inundation periods in pools (Marty 2004). In addition, encroachment of non-native plants often follows surface disturbing activities such as disking, grading, filling, and off-road vehicle use (Service 2005a).

Grazing:

Intensive grazing and lack of grazing are significant threats to *Lasthenia conjugens* (Service 2005a; CNDDB 2012). Heavy grazing is cited as a threat for the *L. conjugens* occurrence at Pacific Commons Preserve in Alameda County, and for four occurrences in Solano County including the Gentry property (CNDDB 2012). Additionally, lack of grazing is cited as a threat for the *L. conjugens* occurrence at Soscol Ridge in Napa County (CNDDB 2012). Both lack of grazing and excessive grazing may cause an increase in organic matter in the habitat that can eliminate the natural vernal pool invertebrate community and promote opportunistic and invasive nonnative species, such as *Lolium* spp., that outcompete the obligate vernal pool species (Rogers 1998; Rogers 2006). The cessation of cattle grazing has been found to exacerbate the negative effects of invasive non-native plants on vernal pool inundation period. Appropriate levels of grazing may help maintain soil conditions and limit the amount of thatch accumulation near vernal pools (Rogers 2006). Increased grass cover in and around ungrazed pools may lead to an increase in evapotranspiration rates, resulting in a decreased hydroperiod (Marty 2005). In areas where long-term grazing has been in effect, moderate grazing (in both stocking numbers and amount of time) may be an important tool in combating non-native plant species, when burning is not an option. Moderate grazing may be a necessary tool to maintain the species diversity of the natural vernal pool ecosystem (Marty 2005).

In 1992 upon its purchase by the U.S. Fish and Wildlife Service, grazing was suspended at the Warm Springs Seasonal Wetland Unit in Alameda County (Loredo 2010; 2011). However, this practice encouraged the accumulation of non-native grasses in vernal pools and so in 2004, a seasonal grazing program was adopted to prevent annual grass biomass and litter build-up in sensitive areas (Loredo 2010; 2011). Appropriate grazing management at the Warm Springs Seasonal Wetland Unit increased native species cover and promoted the growth and maintenance of the *Lasthenia conjugens* occurrence located therein (Loredo 2010; 2011). While listed as a threat in CNDDB (2012), grazing activities are also known to increase the cover of native plant species including *L. conjugens* at the other Alameda County occurrence in the Pacific Commons Preserve (WRA 2009). Grazing has also been utilized as a means to limit invasive grass competition and remove thatch around *L. conjugens* at the Goldfield Conservation Bank study site in Solano County since 2009 (LSA 2010).

Climate Change/Drought:

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; Pyke 2005). However, climatic conditions for smaller sub-regions such as California remain uncertain (Pyke 2005). It is unknown at this time if climate change in California will result in a localized, relatively small cooling and drying trend, or a warmer trend with higher precipitation events (Pyke 2005). *Lasthenia conjugens* is dependent upon vernal pool wetlands that signify the importance of water availability on the survival and recovery for this species. If California receives more rainfall through intense precipitation events, suitable vernal pool habitat for *L. conjugens* may increase, which would benefit the species. However, if California enters into a drying trend, the resulting droughts could adversely affect *L. conjugens*.

While drought conditions are a normal part of environmental variability in California, a severe drought would exacerbate adverse effects associated with small, disjunct populations of *Lasthenia conjugens*, and would place additional strains on vernal pool ecosystems. Where populations persist on only marginal habitat, the increase in the severity and frequency of drought conditions is likely to result in high rates of mortality in the short term, with the effects of low reproductive output and survivorship persisting after the drought has ceased (Griggs and Jain 1983). However, a severe drought, if compounded by other factors such as improper grazing regimes, invasive plant species, and other unforeseen circumstances, could contribute to the local extirpation of this species.

III. RECOVERY CRITERIA

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.

General recovery criteria for *Lasthenia conjugens* and 19 other listed plants and animals are described in the Recovery Plan (Service 2005a). This Recovery Plan uses an ecosystem-level approach because many of the listed species and species of concern co-occur in the same natural ecosystem and share the same threats. The over-arching recovery strategy for *L. conjugens* is habitat protection and management. The five key elements that comprise this ecosystem-level recovery and conservation strategy are: (1) habitat protection; (2) adaptive management, restoration, and monitoring; (3) status surveys; (4) research; and (5) public participation and outreach.

The Recovery Plan describes the geographic distribution of vernal pool taxa according to the vernal pool regions defined by the California Department of Fish and Game (CDFG; Keeler-Wolf *et al.* 1998). Vernal pool regions are discrete geographic regions identified largely on the basis of endemic species, with soils and geomorphology as secondary elements. Within the vernal pool regions, the Recovery Plan identifies core areas that support high concentrations of federally listed vernal pool species, are representative of a given species' range, and are

generally where recovery actions are focused. Core areas are distinct areas that provide the features, populations, and distinct geographic and/or genetic diversity necessary to the recovery of a species. More than one federally listed vernal pool species may be found within a single core area, and the core areas encompass areas larger that just the location of any single species. Within each core area, the Recovery Plan identifies specific percentages of suitable habitat that should be protected to achieve recovery for listed species. Core areas are ranked as Zone 1, 2, or 3 in order of their overall priority for recovery, with Zone 1 reflecting the highest priority areas. Protection of the majority of suitable habitat within Zone 1 core areas, and Zone 2 and 3 core areas where appropriate, is recommended to provide corridors and dispersal habitat, support metapopulation dynamics, provide for reintroduction or introduction sites, and to protect currently undiscovered populations.

The Recovery Plan provides recovery criteria that either directly or implicitly address three of the listing factors noted in the final rule to list the species: destruction, modification, or curtailment of habitat or range (Factor A), inadequacy of existing regulatory mechanisms (Factor D), and other man-made or natural factors affecting its continued existence (Factor E). Factor B, overutilization for commercial, recreational, scientific, or education purposes, and Factor C, disease or predation, were not included as threats in the listing rule and are not addressed in the Recovery Plan for *Lasthenia conjugens*. Since the Recovery Plan has only recently begun to be implemented, species surveys and monitoring efforts that will provide data to evaluate progress towards recovery have not yet occurred.

Downlisting/delisting criteria for *Lasthenia conjugens* include:

1. Habitat protection: Accomplish habitat protection that promotes vernal pool ecosystem function sufficient to contribute to population viability of the covered species.

This criterion addresses Factor A1.

1A. Suitable vernal pool habitat within each prioritized core area for the species is protected.

Core areas support high concentrations of federally listed vernal pool species and are representative of a given species' range, and are generally where recovery actions are focused. Core areas support viable populations, and possibly even source populations of vernal pool species for larger metapopulations, that will contribute to the connectivity of habitat and thus increase dispersal opportunities between populations. More than one federally listed vernal pool species may be found within a single core area, and the core areas encompass an area larger than just the location of *Lasthenia conjugens*. In the Recovery Plan, the core areas that pertain to *L. conjugens* include: (1) Fort Ord; (2) SE San Francisco Bay; (3) Berryessa; (4) Napa River; (5) Jepson Prairie; (6) Suisun Marsh; (7) Rodeo Creek; (8) Altamont; and (9) Manchester. These nine core areas are distributed among five vernal pool regions: (1) Central Coast; (2) Lake-Napa; (3) Solano-Colusa (4) Livermore; and (5) Mendocino. Additionally, the Santa Barbara Vernal Pool Region is identified as a region for reintroduction of *L. conjugens*.

The Recovery Plan identifies specific percentages of suitable habitat to be protected in each of the nine core areas. Core areas are ranked as Zone 1, 2, or 3 in order of their overall priority for

recovery. Core areas pertaining to *Lasthenia conjugens* are included as Zones 1, 2, and 3 in the Recovery Plan. Table 3 provides a summary of the six vernal pool regions that pertain to *L. conjugens* (including Santa Barbara), and the Zone designations for each of the nine core areas.

To downlist *Lasthenia conjugens*, the Recovery Plan recommends that 95 percent of suitable *L. conjugens* habitat in Zone 1 and 85 percent of suitable *L. conjugens* habitat in Zone 2 core areas be protected. In addition, the Recovery Plan recommends that 90 percent of known localities be protected. Neither of these criteria has been met. To delist *L. conjugens*, the Recovery Plan recommends that 100 percent of all reintroduced populations be protected. At this time, new populations have not been reintroduced. Therefore, this criterion has not been met.

The Service does not yet have sufficient information to quantify either the acreage of suitable habitat within each core area or the acreage of protected habitat that is suitable for *Lasthenia conjugens*. The amount of suitable habitat that exists range-wide has not yet been estimated; therefore, the percent that has been protected range wide is still unknown. However, the vast majority of localities of this species are not protected. The protected populations of this species include: (1) three populations at Fort Ord in Monterey County, (2) one population at the Travis Air Force Base (AFB) in Solano County, (3) one at the Wildlands North Suisun Mitigation Bank, in Solano County (4) one on the State Route 4 preserve managed by the Muir Heritage Land Trust in Contra Costa County (land has yet to have easement), and (5) two populations within the Don Edwards San Francisco Bay National Wildlife Refuge (NWR) in Alameda County, one at the Warm Springs Seasonal Wetland Unit and one in the Pacific Commons Preserve.

Table 3. *Lasthenia conjugens* core areas.

Regions/Core Areas	**Presumed Extant Occurrences Within Core Areas**
Central Coast Vernal Pool Region:	
Core Areas: Fort Ord (Zone 2)	3
SE San Francisco Bay (Zone 2)	2
Lake-Napa Vernal Pool Region:	
Core Areas: Berryessa (Zone 2)	0
Napa River (Zone 2)	1
Solano-Colusa Vernal Pool Region	
Core Areas: Jepson Prairie (Zone 1)	9
Suisun Marsh (Zone 2)	2
Rodeo Creek (Zone 2)	1
Livermore Vernal Pool Region	
Core Area: Altamont Hills (Zone 1)	0
Mendocino Vernal Pool Region	
Core Area: Manchester (Zone 3)	0
Santa Barbara Vernal Pool Region	0
	18 Total presumed extant within core areas

1B. Species localities distributed across the species' geographic range and genetic range are protected. Protection of extreme edges of populations protects the genetic differences that occur there.

This criterion has been partially met. *Lasthenia conjugens* is still known to occur in the following vernal pool regions (from west to east): Central Coast; Lake-Napa; and Solano-Colusa. There are five protected localities in the Central Coast region, three at former Fort Ord in Monterey County, and two the Don Edwards San Francisco Bay NWR in Alameda County. Two protected localities occur within the Solano-Colusa region, one within the North Suisun Mitigation Bank, in Solano County, and one within Travis AFB, Solano County. There are no known protected localities of *L. conjugens* in the Lake-Napa vernal pool region.

The extreme edges of this species range are not protected. The northernmost presumed extant locality occurs in Napa County and this locality is on private land and not protected. An extirpated locality in Mendocino County once represented the northern extent of this species range. The southernmost presumed extant localities occur in Monterey County and are protected on public land. An extirpated locality in Santa Barbara County once represented the southern extent of this species' range, and reintroduction efforts have yet to be undertaken in this area.

1C. Reintroduction and introductions must be carried out and meet success criteria.

This recovery criterion has not been met. The Recovery Plan recommends introduction of *Lasthenia conjugens* to vernal pool regions and soil types from which status surveys indicate the species has been extirpated. This species has been extirpated from Santa Barbara, Santa Clara, and Mendocino Counties (Service 1997; CNDDB 2012). The Recovery Plan states that seven reintroductions should occur throughout the current and historic range of the species.

Four of these seven reintroductions will occur in the Berryessa core area, specifically Milliken canyon in Napa County; the Altamont Hills Core area in Alameda County; the Manchester Core area in Mendocino County; and a locality in Santa Barbara County, with no specific area determined. The other three introductions are recommended to be situated on appropriate soil types to replace extirpated occurrences.

1D. Additional localities that are detected (and determined essential to recovery goals) are permanently protected.

This recovery criterion has not been met. Two additional localities in Solano County have been noted in CNDDB (2012) since the time of the last five-year review but both are on private land and neither are protected

1E. Habitat protection results in protection of hydrology essential to vernal pool ecosystem function, and monitoring indicates that hydrology that contributes to population viability has been maintained through at least one multi-year period that includes above average, average, and below average local rainfall as defined above, a multi-year drought, and a minimum of 5 years of post-drought monitoring.

This recovery criterion has not been met. Inundation, aquatic environment, and pool parameters were measured at the three extant occurrences in Monterey County between October 2006 and May 2008 (Tannourji 2009) but the study did not meet the monitoring criteria described in the Recovery Plan. Precipitation and inundation as well as physical and chemical properties including depth, pH, conductivity, temperature, and salinity of vernal pools at the Warm Springs Seasonal Wetland Unit in the Don Edwards San Francisco Bay NWR in Alameda County have been taken from 2002 to present (Loredo 2009; 2010; 2011); however the monitoring criteria described in the Recovery Plan have not been met. Rainfall and water quality data have been collected from vernal pools in Solano County since 2006 (LSA 2010; 2011; 2012) but do not meet Recovery Plan criteria. Monitoring of hydrology has not occurred at any other of the known presumed extant populations; therefore, the Service is unable to determine whether the hydrology at presumed extant locations has supported viable populations through a variety of hydrologic conditions.

2. Adaptive Habitat Management and Monitoring:

This criterion implicitly addresses Factors A, D, and E.

2A. Habitat management and monitoring plans that facilitate maintenance of vernal pool ecosystem function and population viability have been developed and implemented for all habitat protected, as previously discussed in sections 1A-E.

This criterion has been partially met. Although several Contra Costa goldfield occurrences are protected within conservation banks, preserves, or sites that have management and monitoring plans in place, in most cases the plans are too new to determine whether they adequately facilitate maintenance of vernal pool ecosystem function, such as controlling invasive plant species or managing site hydrology. The Ford Ord occurrences are managed under the Habitat Management Plan (USACE 1997). The State Route 4 Preserve occurrence is managed under the Draft Contra Costa goldfields Management Plan (Entrix, Inc. and Muir Heritage Land Trust, 2004). The Draft Contra Costa goldfields Management Plan mentions that if invasive species become a problem appropriate measures will be implemented to control such species. Formal management plans for the Warm Springs Seasonal Wetland Unit and the Pacific Commons Preserve of the Don Edwards San Francisco Bay NWR occurrence do not exist; however, both will be covered under the Comprehensive Conservation Plan (CCP) for the Refuge that was initiated in 2010 (Service 2010) and will be completed in 2012 (draft available now; Service 2012b) as outlined by the National Wildlife Refuge System Improvement Act of 1997. The Travis AFB occurrence is managed under the Travis AFB Land Management Plan. The North Suisun Mitigation Bank is adaptively managed under the *North Suisun Special Status Species Management Plan* (Wildlands, Inc. 2006).

2B. Mechanisms are in place to provide for management in perpetuity and long-term monitoring of 1A-E, as previously discussed (funding, personnel, etc.).

This criterion has been partially met. The occurrences at former Fort Ord are on land within the Habitat Management Plan Habitat Reserve Lands and will be conserved and managed in perpetuity (USACE 1997). The State Route 4 Preserve does not have an endowment fund or

other mechanism to provide for management in perpetuity and long-term monitoring at this time. The occurrences at the San Francisco Bay NWR are the recipients of funding for management and protection of vernal pool species that are allocated to NWR annually. The CCP is expected to include long-term management guidance and goals for protection, maintenance, and monitoring of vernal pool ecosystems on the Refuge. The occurrence at Travis AFB is protected as an ecological preserve, with protective measures and appropriate management for the species provided in the Travis AFB Land Management Plan (Service 2005a). The North Suisun Mitigation Bank has an endowment fund to ensure management in perpetuity and long-term monitoring.

2C. Monitoring indicates that ecosystem function has been maintained in areas protected under 1A-D for at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring.

Monitoring of ecosystem function has not occurred for any of the known populations of this species; therefore, the Service is unable to determine if the ecosystem function has been maintained at presumed extant locations that have supported viable populations through a variety of hydrological conditions. It is probable that many of the protected sites have functional ecosystems that would meet the requirements of specified in this recovery criterion.

2D. Seed banking actions have been completed for species that would require it as insurance against risk of stochastic extirpations or that will require reintroductions or introductions to contribute to meeting recovery criteria.

This criterion has not been met. The recovery plan recommends that *Lasthenia conjugens* seed be collected in each vernal pool region and core area. Seed collection from each population should be stored in at least two sites, including the National Center for Genetic Resources Preservation in Fort Collins, Colorado, and a facility certified by the Center for Plant Conservation (Service 2005a).

3. Status Surveys:

This criterion implicitly addresses Factors A, D, and E.

3A. Status surveys, 5-year reviews, and population monitoring show populations within each vernal pool region where the species occur are viable (e.g., evidence of reproduction and recruitment) and have been maintained (stable or increasing) for at least one multi-year period that includes above average, average, and below average local rainfall, a multi-year drought, and a minimum of 5 years of post-drought monitoring.

To our knowledge, monitoring has not occurred for a duration that meets the requirements specified in the Recovery Plan at any of the sites with known occurrences. Therefore, the Service is unable to determine if this criterion has been met at this time. Informal status surveys have occurred at former Fort Ord, Soscol Creek in Napa County, the State Route 4 Preserve, at both the Wet Springs Unit and Pacific Commons Preserve at the San Francisco NWR, Travis

AFB, and the North Suisun Mitigation Bank Property. For these sites, biologists have noted the number of plants observed, but either no standardized annual site assessments exist for any of the sites, or monitoring protocols have just recently been established.

3B. Status surveys, status reviews, and habitat monitoring show that threats identified during and since the listing process have been ameliorated or eliminated. Site-specific threats identified through standardized site assessments and habitat management planning also must be ameliorated or eliminated.

This criterion has not been met. Systematic habitat monitoring that demonstrates the amelioration or elimination of threats identified since the listing process has not occurred at any of the known localities of *Lasthenia conjugens* since the listing of the species. Informal status surveys have occurred at former Fort Ord, Soscol Creek in Napa County, the State Route 4 Preserve, at both the Wet Springs Unit and Pacific Commons Preserve at the San Francisco NWR, Travis AFB, and the North Suisun Mitigation Bank Property. While some long-term data is available, threats to this species described in the 1997 listing rule are still present, including impacts from agriculture practices, inappropriate grazing practices, and competition from invasive weed species (CNDDB 2012; Lewis, pers. comm. 2012; LSA 2010; Lynch pers. comm. 2012; Ruygt, pers. comm. 2012).

4. Research:

Research implicitly addresses all five listing factors.

4A. Research actions necessary for recovery and conservation of the covered species have been identified (these are research actions that have not been specifically identified in the recovery actions but for which a process to develop them has been identified). Research actions (both specifically identified in the recovery actions and determined through the process) on species biology and ecology, habitat management and restoration, and methods to eliminate or ameliorate threats have been completed and incorporated into habitat protection, habitat management and monitoring, and species monitoring plans, and refinement of recovery criteria and actions.

The Recovery Plan discusses a variety of research that would be beneficial to help refine recovery actions and criteria and guide overall recovery and long-term conservation efforts (pages IV-53 to IV-63). The Recovery Plan recommends research on genetics, taxonomy, biology of vernal pool species, the effects of habitat management practices on vernal pool species and their habitat, and threats to vernal pool species and ecosystems. Currently, this criterion has been initiated, although the majority of information needs discussed in the Recovery Plan are still outstanding.

For results of recent research in these areas, see section II: Genetics; Species-specific Research and/or Grant-supported Activities.

Loredo (2009; 2010; 2011) conducted studies on vernal pool biology in the Warm Springs Unit in the San Francisco NWR and determined that rainfall patterns influence pool inundation

periods, timing, and depths, which in turn affects the reproductive success of organisms that breed in this environment and vernal pool plant germination. As part of the same study, several plots of land known to contain *Lasthenia conjugens* were selected for a grazing study: half were enclosed by a fence to exclude seasonal cattle grazing while the rest remained open. The percentage cover of *L. conjugens* and other native grasses was shown to be greater in grazed plots than in exclosure plots. Additionally, abundance of non-native grasses and hydroperiod of vernal pools were higher in exclosure plots. Annual surveys of rare plants performed by WRA (2009) in the Pacific Commons Preserve in the San Francisco NWR similarly indicated that numbers of *L. conjugens* decreased during periods of heavy rainfall and extended periods of inundation and that cover increased in wetland areas that were grazed at high intensity for longer periods of time.

LSA (2010) researched methods for sampling *Lasthenia conjugens* at the Director's Guild (Table 1) property in Solano County that provide repeatable and valid density estimates and found that visual estimates of plant density are unreliable and often underestimate true plant numbers. A survey program that involves mapping parcel boundaries and measuring *L. conjugens* density within quadrats along a wide belt transect is recommended for repeatable and statistically valid estimates of *L. conjugens* cover among sites and across years. Furthermore, *L. conjugens* population data collected by the authors during the same study period (annually from 2006 to 2009) indicate that rainfall is the biggest factor that affects year-to-year variation in plant abundance and distribution. In general, *L. conjugens* cover was found to be lower in shallow pools that experienced short-duration hydroperiods (e.g. low rainfall and drought years). Additionally, the greatest densities and cover of *L. conjugens* were found in pools with moderately high soil alkalinity. LSA (2010) also extracted soil cores from and established removal plots at the same location to determine if *L. conjugens* maintains an interannual seed bank. These experiments indicated that *L. conjugens* maintains a robust seed bank; however, the distribution and density of the seed bank can vary greatly from year to year depending upon environmental conditions.

4B. Research on genetic structure has been completed (for species where necessary - for reintroduction and introduction, seed banking) and results incorporated into a habitat protection plan to ensure that within- and among-population genetic variation is fully representative by populations protected in the Habitat Protection section of this document, described previously in sections 1A-E.

See 4A above.

4C. Research necessary to determine appropriate parameters to measure population viability for each species has been completed.

See 4A above.

5. Participation and Outreach:

Public participation and outreach implicitly address all relevant listing factors.

5A. Recovery Implementation Team is established and functioning to oversee rangewide recovery efforts.

The Recovery Plan discusses a variety of participation programs to achieve the goals of recovering listed species in the plan. An essential component of this collaborative approach is the formation of a single recovery implementation team overseeing the formation and function of multiple working groups formed at the vernal pool region level. This criterion has been initiated and has been partially met.

5B. Vernal pool regional working groups are established and functioning to oversee regional recovery efforts.

See 5A above.

5C. Participation plans for each vernal pool region have been completed and implemented.

A participation plan was developed and is being implemented by the Butte Working Group. This plan is generally appropriate for other future working groups.

5D. Vernal pool region working groups have developed and implemented outreach incentive programs that develop partnerships contributing to achieving recovery criteria 1-4.

This action has not been initiated.

IV. SYNTHESIS

When *Lasthenia conjugens* was listed as endangered in 1997, the primary threats to its survival and recovery were activities that result in the direct destruction of the plants and their habitats or hydrologic changes in their vernal pool habitats. Such activities include urbanization, wetland drainage, industrial development, agricultural land conversion, ditch construction, off highway vehicle use, road widening, and trampling by cattle. We have no new information to suggest that these threats to the species have substantially changed since the time of listing in 1997. In addition, other factors, such as drought, vineyard conversion, competition from weedy invasive plants, inappropriate livestock grazing, and elimination of grazing may also threaten this species. The majority of the localities of *L. conjugens* do not have management plans, monitoring programs, or adequate funding to ensure that these localities are sustainable in perpetuity. Lack of management, monitoring, and funding are not, in themselves, threats to *L. conjugens*; however, without these components, the potential threats described above may not be identified and eliminated.

There are eight occurrences within the range of this species that are protected from development (i.e. land conversion). Ten occurrences of this species remain unprotected and all of these sites are on private lands. Other than habitat preservation, other criteria discussed within the Recovery Plan have not been met, and in some instances, not initiated, including research, monitoring, management, and public participation and outreach. Based on the continuing threat

of habitat loss due to urbanization, agriculture practices, invasive weeds, intensive cattle grazing, we conclude that *L. conjugens* still meets the ESA definition of endangered. No status change is recommended 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*
_X_ No Change

New Recovery Priority Number and Brief Rationale: No change.

We recommend that the recovery priority number remain 5C.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

The following recommendations for future actions are from the 2005 Recovery Plan and the results of discussions on the status of the species and the species' needs with several recognized *Lasthenia conjugens* experts:

1. *L. conjugens* occurrences that are currently protected and managed for the benefit of the species include: (1) the North Suisun Mitigation Bank, in Solano County, (2) Travis AFB, in Solano County, (3) the State Route 4 Preserve, in Contra Costa County, (4) Don Edwards San Francisco Bay NWR, in Alameda County, and (5) the former Fort Ord, in Monterey County. Protection of additional localities of this species is necessary to recover this species. Protecting occurrences in Sonoma, Marin, and Napa Counties should be a priority over the next five years, as this is the northwestern edge of the species' range, and no occurrences in these counties are protected at this time.

2. Once additional sites are protected, management plans should be prepared. Results from standardized monitoring discussed in item 3, below, should be included in the management plans for these protected sites. Grazing management and invasive weed control should be primary components of these management plans.

3. Conduct research at as many of the presumed extant localities as possible to incorporate research recommendations outlined in the Recovery Plan. The following research should be prioritized over the next five years:
   a. Develop a standardized method to monitor species status and population trends at all known locations. This will better our understanding of potential threats to the species, and will aid in the development of methods to ameliorate these threats.

b. Conduct research on invasive weedy plant species to determine the most appropriate methods to control these plants and increase population numbers of *L. conjugens* and other listed vernal pools plants.
c. Conduct further research on the genetic structure of the species to determine the feasibility of introducing *L. conjugens* to biologically appropriate vernal pool regions and soil types from which status surveys indicate the species has been extirpated.

4. Regional vernal pool working groups should be created in regions where *L. conjugens* is known to occur to aid with monitoring and management efforts.

5. Conduct additional research on how *L. conjugens* is pollinated. If certain insects are found to be important to pollination, and therefore to seed production, their habitat must be protected in each core area to contribute to the recovery of *L. conjugens*.

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

***Lasthenia conjugens* (Contra Costa goldfields)**

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

Review Conducted By: _Daphne Gille, Sacramento Fish and Wildlife Office____

Date Submitted to Region 8: _____

FIELD OFFICE APPROVAL:

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

Approve _____ Date 21 Feb 2013