

Blennosperma bakeri
(Sonoma Sunshine)

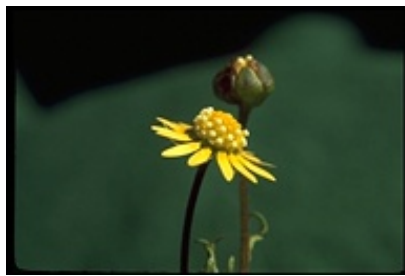
Lasthenia burkei
(Burke's Goldfields)

Limnanthes vinculans
(Sebastopol Meadowfoam)

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



Lasthenia burkei
Jo-Ann Ordano
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Sciences



Blennosperma bakeri
J. E. (Jed) and Bonnie McClellan
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Limnanthes vinculans
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**Sacramento Fish and Wildlife Field Office
U.S. Fish and Wildlife Service
Sacramento, California
September 2008**

5-YEAR REVIEW
***Blennosperma bakeri* (Sonoma Sunshine),**
***Lasthenia burkei* (Burke's Goldfields) and**
***Limnanthes vinculans* (Sebastopol Meadowfoam)**

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional or Headquarters Office – Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist, California and Nevada Region Office, 916-414-6464

Lead Field Office – Kirsten Tarp, Recovery Branch, Sacramento Fish and Wildlife Office, 916-414-6600

1.2 Methodology used to complete the review:

This review was prepared by the Sacramento Fish and Wildlife Office (SFWO) of the U.S. Fish and Wildlife Service (Service) using information from the *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects that May Affect Four Endangered Plant Species on the Santa Rosa Plain, California, July 17, 1998* (1998 Programmatic), *Santa Rosa Plain Conservation Strategy* (Conservation Strategy) (Conservation Strategy Team 2005), California Natural Diversity Database (CNDDDB), and survey information from experts who have been monitoring various localities of these species.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: 72 FR 7064, February 14, 2007. We received no information from the public in response to this notice.

1.3.2 Listing history

Original Listing

FR notice: 56 FR 61173

Date listed: December 2, 1991

Entity listed: *Blennosperma bakeri* (Sonoma sunshine), *Lasthenia burkei* (Burke's goldfields) and *Limnanthes vinculans* (Sebastopol meadowfoam), three plant species

Classification: Endangered

1.3.3 Associated rulemakings

No associated rule makings have been made for these three species.

1.3.4 Review History

No formal status reviews have been conducted for these species. However, since the original listing in 1991, we have assessed certain aspects of the species' conservation status in the following documents.

1. *Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects that May Affect Four Endangered Plant Species on the Santa Rosa Plain, California, July 17, 1998* (1998 Programmatic) (Service 1998).
2. *Santa Rosa Plain Conservation Strategy, December 2005* (Conservation Strategy Team 2005).
3. *Programmatic Biological Opinion for U.S. Army Corps of Engineers Permitted Projects that May Affect California Tiger Salamander and Three Endangered Plant Species on the Santa Rosa Plain, California* (2007 Programmatic) (Service 2007).

1.3.5 Species' Recovery Priority Number at start of 5-year review

Blennosperma bakeri is ranked as 5C. This species is considered to be confronted by a high degree of threat and to have a low potential for recovery. The "C" indicates there is a conflict with construction or other development projects or other forms of economic activity.

Lasthenia burkei and *Limnanthes vinculans* are ranked as 2C. These two species are considered to be confronted with a high degree of threats and to have a high potential for recovery. The "C" indicates there is a conflict with construction or other development projects or other forms of economic activity.

Recovery priority numbers are determined based on a 1 to 18 ranking system where 1 represents the highest ranked recovery priority and 18 represents the lowest ranked recovery priority.

1.3.6 Recovery Plan or Outline

Name of plan or outline: *Administrative Draft Recovery Plan For Three Vernal Pool Plants of California's Santa Rosa Plain*

Date issued: N/A

2.0 REVIEW ANALYSIS

Species Overview

Blennosperma bakeri:

Blennosperma bakeri is a small (up to 30.5 centimeters (12.0 inches) in height), annual herb in the aster family (Asteraceae). The plant has alternate, narrow, hairless leaves 5.1 centimeters (2.0 inches) to 15.2 centimeters (6.0 inches) long. The upper ones have 1 to 3 lobes, the lower ones none. From March through April, the species produces yellow daisy-like flowers. The yellow disk flowers have white pollen and stigmas. Sterile ray flowers, which are yellow or sometimes white, have red stigmas. The lobe pattern of the leaves and the color of ray stigmas separate this species from others in the genus.

Blennosperma bakeri grows in vernal pools and wet grasslands below 100 meters (330 feet) (Ornduff 1993a). *Blennosperma bakeri* occurs in vernal pools on nearly level to slightly sloping loams, clay loams, and clays. The flowers of *B. bakeri* are self-incompatible, meaning that they can set seed only when fertilized by pollen from a different plant.

Blennosperma bakeri occurs only in Sonoma County, California, and ranges in the Santa Rosa Plain from near the community of Fulton in the north to Scenic Avenue between Santa Rosa and Cotati in the south. Additionally, the species extends from near Glen Ellen to near the junction of State Routes 116 and 121 in the Sonoma Valley. In addition, *B. bakeri* has been introduced to at least one site on Alton Lane during mitigation activities.

Lasthenia burkei:

Lasthenia burkei is a small, slender annual herb in the aster family (Asteraceae). It has narrow, opposite leaves. Flowers bloom from April until June. Both the ray and disk flowers are yellow, while the pappus (seed appendage that aids dispersal by acting like a little parachute) usually consists of one long bristle and several short bristles. The flowers of *L. burkei* are self-incompatible (Ornduff 1966; Crawford and Ornduff 1989) and insect-pollinated. *Lasthenia burkei* grow in vernal pools and swales below 500 meters (1,640 feet) (Ornduff 1993b). In Sonoma County, California, the vernal pools containing *L. burkei* are on nearly level to slightly sloping loams, clay loams, and clays. *Lasthenia burkei* sometimes occurs along with *Blennosperma bakeri* and *Limnanthes vinculans*.

Lasthenia burkei is known only from southern portions of Lake and Mendocino Counties and from the Cotati Valley (locally known as the Santa Rosa Plain) in Sonoma County. Historically, 39 sites were known from the Santa Rosa Plain in Sonoma County, 2 sites in Lake County, and one site in Mendocino County. The type locality of *L. burkei* is the only known occurrence from Mendocino County and is possibly extirpated. Both Lake County occurrences are presumed extant. Within Sonoma County, one occurrence is known from north of Healdsburg (Patterson *et al.* 1994) and the core of the current range

of *L. burkei* is in the Santa Rosa Plain from the community of Windsor to east of the city of Sebastopol.

Limnanthes vinculans:

Limnanthes vinculans is a small (up to 30.48-centimeter (12.00-inch tall)), multi-stemmed herb of the false meadowfoam family (Limnanthaceae). Although the first leaves are narrow and undivided, leaves on the mature plant have three to five undivided leaflets along each side of a long stalk (petiole). The shape of the leaves distinguishes *L. vinculans* from other members of the *Limnanthes* genus. Small, bowl-shaped, white flowers appear April through May. The white flowers are born singly at the end of stems. The seeds of *L. vinculans* germinate after the first significant rains in fall. Repeated drying and filling of pools in the spring favors development of large plants with many branches and long stems. This species grows in Northern Basalt Flow and Northern Hardpan vernal pools (Sawyer and Keeler-Wolf 1995), wet swales and meadows, on the banks of streams, and in artificial habitats such as ditches (Wainwright 1984; CNDDDB 2002).

Historically, *Limnanthes vinculans* was known from 40 occurrences (as defined in CNDDDB) in Sonoma County and one occurrence (occurrence #39) in Napa County, at the Napa River Ecological Reserve. In Sonoma County, all but two occurrences were found in the central and southern portions of the Santa Rosa Plain. Occurrence #20 occurred at Atascadero Creek Marsh west of Sebastopol, and the second (#40) occurred in the vicinity of Knights Valley northeast of Windsor (CNDDDB 2001). In the Santa Rosa Plain, the southern cluster of occurrences extends 5 kilometers (3 miles) from Stoney Point Road to the Laguna de Santa Rosa, and is bounded by Occidental Road to the north and Cotati to the south. The central cluster stretches 1.5 miles (2.4 kilometers) on either side of Fulton Road extending northwards from Occidental Road to River Road. Patterson et al. (1994) estimated that the Santa Rosa Plain occurrences represent only 10 hydrologically separate populations of *L. vinculans*.

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

Yes
 No

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

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Figure 1 (on page 33) is a map showing the current distribution of occurrences for *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* (Table 1). All three species are endemic to California vernal pool ecosystems.

Populations of *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* can vary greatly in size from year to year. Seed banks are of particular importance to annual plant species which are subject to uncertain or variable environmental conditions (Cohen 1966, 1967; Templeton and Levin 1979; Parker et al. 1989). These three listed plants fit this criterion (Hickman 1993); they are annual species living in California's highly variable Mediterranean climate (Holland and Jain 1977). These plants are adapted to a variable Mediterranean climate, where precipitation varies a great deal from one year to another, and there is a pronounced dry season – they are annuals with a high degree of variation in the numbers and extent of above-ground plants from one year to the next and they form long-lived seedbanks in the soil. To date, there is no known scientifically reliable method to sample the seed bank.

Blennosperma bakeri. Patterson *et al.* (1994) estimated less than 12 biologically separate populations remain. Of the sites they examined, 17 percent had been extirpated, and 17 percent had not been confirmed recently. An additional 17 percent were believed to be extant but threatened by development as of 1994 (Patterson *et al.* 1994). A site, as defined by Patterson *et al.* (1994), may be all or part of a CNDDDB occurrence. At one CNDDDB occurrence, 12 *B. bakeri* colonies were observed in 1989. By 1993, only six remained (CNDDDB 1998). The CNDDDB defines occurrence as a location separated from other locations of the species by at least one-fourth mile that may contain populations, individuals, or colonies. For the purposes of this review, “element occurrence” or “occurrence” refers to a report contained in the CNDDDB.

The Service used data from 1994 (Patterson *et al.* 1994) to examine how numbers of *B. bakeri* plants at particular sites changed between the time of listing and the most current surveys that had been performed after listing. After listing, the number of sites with many individuals decreased, and the number with less than 10 individuals increased. The percentage of sites with fewer than 10 individuals increased by 15 percent between the time of listing and 1994.

Lasthenia burkei. Since the time *L. burkei* was listed in 1991, the species has continued to experience dramatic loss. Patterson *et al.* (1994) evaluated known *L. burkei* sites on the Santa Rosa Plain. Their data indicate that 33 percent of the acreage of known Santa Rosa Plain *L. burkei* sites has been severely degraded or extirpated.

The Service used data from Patterson *et al.* (1994) to examine how numbers of *L. burkei* plants changed at particular sites between the time of listing and the most recent surveys that had been conducted after listing. A site, as defined by Patterson *et al.* (1994), may be all or part of a CNDDDB occurrence. After listing, the number of sites with many individuals decreased, and the number with very few individuals increased. Fifteen of the 28 sites for which they had both pre- and post-listing surveys decreased in size after the species was listed. The percentage of sites with fewer than 10 individuals increased by 30 percent, and the percentage of sites with 10,000 to 100,000 individuals decreased by 7 percent. As of 1994, no sites were recorded with more than 100,000 plants. Data from Patterson *et al.* (1994) also indicate that between the time of listing and 1994, 12 different sites were extirpated or largely destroyed. The data indicate large populations of *L. burkei* are diminishing and nearly half of the sites may have populations either extirpated or are highly vulnerable to extirpation due to small population numbers (less than 10 individuals) (calculated from Patterson *et al.* 1994; CH2M Hill 1995).

Limnanthes vinculans. Patterson *et al.* (1994) estimated only 10 hydrologically separate populations of *L. vinculans* exist. A site, as defined by Patterson *et al.* (1994), may be all or part of a CNDDDB occurrence. Of the sites they examined, nearly 10 percent were considered erroneous, 18 percent were extirpated, 18 percent were extant but threatened by development, and 36 percent were extant but may not be large enough to qualify as high-quality preserve lands (Patterson *et al.* 1994).

At the time of listing of these three species in 1991 and as described in the Service's Federal Register notice (56 FR 61173), *Blennosperma bakeri* was documented from no more than 35 sites in the Cotati Valley and 7 sites from the Sonoma Valley. *Lasthenia burkei* was recorded from no more than 39 sites in the Cotati Valley, 2 sites in Lake County, and 1 site in Mendocino County. *Limnanthes vinculans* documented from 29 locations. The CNDDDB (2008) reports there to be 26 occurrences of *B. bakeri* (3 extirpated, 1 potentially extirpated and 22 presumed extant), 32 occurrences of *L. burkei*

Table 1: *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* CNDDDB 2008 occurrences.

Species	Occurrence Number	Status	Ownership Type	Trend
<i>Blennosperma bakeri</i>	2	Extirpated	UNKNOWN	Unknown
<i>Blennosperma bakeri</i>	3	Extirpated	PVT	Unknown
<i>Blennosperma bakeri</i>	5	Presumed Extant	SON COUNTY	Fluctuating
<i>Blennosperma bakeri</i>	6	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	7	Presumed Extant	PVT, DFG-LAGUNA WA	Unknown
<i>Blennosperma bakeri</i>	8	Presumed Extant	DFG-LAGUNA DE SANTA ROSA ER	Decreasing
<i>Blennosperma bakeri</i>	9	Presumed Extant	PVT	Decreasing
<i>Blennosperma bakeri</i>	10	Presumed Extant	PVT	Decreasing
<i>Blennosperma bakeri</i>	11	Presumed Extant	PVT	Decreasing
<i>Blennosperma bakeri</i>	12	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	13	Possibly Extirpated	PVT	Unknown
<i>Blennosperma bakeri</i>	15	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	16	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	17	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	18	Extirpated	PVT	Unknown
<i>Blennosperma bakeri</i>	20	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	22	Presumed Extant	PVT	Decreasing
<i>Blennosperma bakeri</i>	23	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	24	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	25	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	26	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	27	Presumed Extant	PVT-COBBLESTONE DEVELOPMENT	Unknown
<i>Blennosperma bakeri</i>	28	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	29	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	30	Presumed Extant	PVT	Unknown
<i>Blennosperma bakeri</i>	31	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	1	Possibly Extirpated	DFG-LAGUNA DE SANTA ROSA ER	Decreasing
<i>Lasthenia burkei</i>	2	Extirpated	PVT	Unknown
<i>Lasthenia burkei</i>	3	Extirpated	PVT	Unknown
<i>Lasthenia burkei</i>	4	Extirpated	UNKNOWN	Unknown
<i>Lasthenia burkei</i>	5	Possibly Extirpated	UNKNOWN	Unknown
<i>Lasthenia burkei</i>	6	Presumed Extant	PVT	Decreasing
<i>Lasthenia burkei</i>	7	Presumed Extant	SON COUNTY	Unknown
<i>Lasthenia burkei</i>	8	Presumed Extant	PVT	Decreasing
<i>Lasthenia burkei</i>	10	Presumed Extant	PVT	Decreasing
<i>Lasthenia burkei</i>	11	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	12	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	13	Presumed Extant	PVT	Decreasing
<i>Lasthenia burkei</i>	14	Presumed Extant	PVT, DFG	Unknown

Species	Occurrence Number	Status	Ownership Type	Trend
<i>Lasthenia burkei</i>	15	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	16	Possibly Extirpated	PVT	Unknown
<i>Lasthenia burkei</i>	17	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	18	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	19	Presumed Extant	PVT	Decreasing
<i>Lasthenia burkei</i>	21	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	22	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	23	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	24	Presumed Extant	PVT	Increasing
<i>Lasthenia burkei</i>	25	Presumed Extant	PVT- COBBLESTONE DEVELOPMENT	Unknown
<i>Lasthenia burkei</i>	26	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	27	Presumed Extant	PVT, PINER- OLIVET SCHOOL DIST	Unknown
<i>Lasthenia burkei</i>	28	Presumed Extant	DFG, PVT	Unknown
<i>Lasthenia burkei</i>	29	Extirpated	PVT	Unknown
<i>Lasthenia burkei</i>	30	Presumed Extant	PVT	Unknown
<i>Lasthenia burkei</i>	31	Presumed Extant	DFG	Unknown
<i>Lasthenia burkei</i>	32	Presumed Extant	UNKNOWN	Unknown
<i>Lasthenia burkei</i>	33	Presumed Extant	UNKNOWN	Unknown
<i>Lasthenia burkei</i>	34	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	1	Presumed Extant	DFG, PVT	Fluctuating
<i>Limnanthes vinculans</i>	2	Presumed Extant	DOD-SANTA ROSA AIR CENTER	Unknown
<i>Limnanthes vinculans</i>	3	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	5	Presumed Extant	PVT, DOD-ARMY	Unknown
<i>Limnanthes vinculans</i>	6	Presumed Extant	PVT, DFG- LAGUNA WA	Unknown
<i>Limnanthes vinculans</i>	7	Possibly Extirpated	PVT	Unknown
<i>Limnanthes vinculans</i>	9	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	10	Presumed Extant	CITY OF SANTA ROSA	Unknown
<i>Limnanthes vinculans</i>	12	Extirpated	PVT	Unknown
<i>Limnanthes vinculans</i>	14	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	15	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	16	Presumed Extant	PVT	Decreasing
<i>Limnanthes vinculans</i>	17	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	18	Possibly Extirpated	UNKNOWN	Unknown
<i>Limnanthes vinculans</i>	20	Possibly Extirpated	PVT	Unknown
<i>Limnanthes vinculans</i>	21	Presumed Extant	PVT- COBBLESTONE DEVELOPMENT	Unknown
<i>Limnanthes vinculans</i>	22	Presumed Extant	SONOMA COUNTY, PVT	Decreasing

Species	Occurrence Number	Status	Ownership Type	Trend
<i>Limnanthes vinculans</i>	24	Presumed Extant	CALTRANS	Unknown
<i>Limnanthes vinculans</i>	25	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	26	Presumed Extant	PVT	Decreasing
<i>Limnanthes vinculans</i>	27	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	28	Presumed Extant	UNKNOWN	Unknown
<i>Limnanthes vinculans</i>	29	Presumed Extant	CITY OF SANTA ROSA	Unknown
<i>Limnanthes vinculans</i>	30	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	31	Possibly Extirpated	PVT	Unknown
<i>Limnanthes vinculans</i>	33	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	34	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	35	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	36	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	38	Extirpated	PVT	Unknown
<i>Limnanthes vinculans</i>	39	Presumed Extant	DFG-NAPA RIVER	Unknown
<i>Limnanthes vinculans</i>	40	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	42	Presumed Extant	SON COUNTY AG PRES/OPEN SPACE	Unknown
<i>Limnanthes vinculans</i>	43	Presumed Extant	CITY OF SANTA ROSA	Unknown
<i>Limnanthes vinculans</i>	46	Extirpated	SON COUNTY	Unknown
<i>Limnanthes vinculans</i>	47	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	48	Presumed Extant	UNKNOWN	Unknown
<i>Limnanthes vinculans</i>	49	Presumed Extant	PVT	Unknown
<i>Limnanthes vinculans</i>	50	Presumed Extant	SON COUNTY	Unknown

(4 extirpated, 3 potentially extirpated, and 25 presumed extant), and 39 occurrences of *L. vinculans* (3 extirpated, 4 potentially extirpated, and 32 presumed extant). The trend for most of the occurrences for all three species are identified as either unknown or decreasing (CNDDDB 2008).

2.3.1.2 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Lasthenia burkei

Genetic variation for thirteen *Lasthenia burkei* populations in Lake and Sonoma County was assessed in 2007 using 42 nuclear genetic markers (Sloop *et al.* unpublished manuscript, 2007). Eleven of the thirteen populations between the two counties are naturally occurring, while the Alton Lane and Santa Rosa Airport (SRA) Preserve populations are seeded. The study included the investigation of genetic variation at thirteen different population sites including thirty individual plants from each population (except one); DNA was extracted;

and genetic differentiation was analyzed including using standard statistical methods (Hoelzel 1992).

Two *Lasthenia burkei* populations in Lake County (Manning Flat and Ployez Winery), which are geographically the most isolated from the eleven Sonoma County populations, were genetically distinct from each other and the Sonoma County populations. Population distinctions are significant between Sonoma County populations except for those from Santa Rosa Airport Preserve, where there is a distinct northern (Winsor Garcia, Wood Road, SRA Preserve) and southern group (Dawson, Pellagrini/Wilkinson, Piner/Marlow, Wood/Fulton, Preakness Court, and Alton Lane). In Sonoma County, the Dawson Ranch and Pellagrini populations were genetically distinct. Though the Maggi and Wood Road populations are geographically close to one another, they are genetically distinct suggesting a lack of gene flow between these groups. The Alton Lane and Santa Rosa Airport Preserve populations show a degree of similarity though they are not geographically close to one another.

All thirteen *Lasthenia burkei* populations in Lake and Sonoma Counties are genetically distinct despite showing some gene flow between them. It is unclear whether gene flow is historical or contemporary as vernal pool seed banks can persist for many decades. The Alton Lane and Santa Rosa Airport Preserve populations may show genetic similarities because they were once seeded simultaneously and from the same stock population that previously existed (now extinct) along Fulton Road, Santa Rosa (Sloop *et al.* unpublished manuscript, 2007).

Limnanthes vinculans

The genetic variability of *Limnanthes vinculans* is low compared to other *Limnanthes* species (Jain 1984). However, populations of this species do differ in genetic makeup (Jain *in litt.* 1980).

A genetic survey of *Limnanthes vinculans* leaf-tissues from locations within the Santa Rosa Plain and Napa Valley was completed in 2006 (Sloop and Ayres, unpublished data, 2007) using the same methodology as described for *Lasthenia burkei* above. Approximately 640 individuals were genotyped from 21 populations. Among the Santa Rosa Plain populations, gene flow seems less restricted indicating adequate pollen and/or seed movement. High genetic diversity was observed in *L. vinculans* suggesting effective population sizes are large with low inbreeding and low or no genetic drift.

2.3.1.3 Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range, etc.):

The ranges of *Blennosperma bakeri* and *Limnanthes vinculans* have not increased. Two new *L. burkei* colonies were found in Lake County (Northwest Biosurvey, 2006; Golden Bear Biostudies, 2007). *Lasthenia burkei* and *B. bakeri* populations continue to become increasingly fragmented in the area of the Town of Windsor since the time of listing (P. Chamberlin, Town of Windsor, pers. comm., 2008b). It is unknown to what extent colonies have been lost entirely due to development or other human-caused, ground-disturbing activities.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Factor A, Present or threatened destruction, modification or curtailment of its habitat or range:

The reduction and fragmentation of habitat due to urban development, agriculture-land conversion, and habitat degradation from overgrazing, agriculture, and other human-related changes to vernal pool hydrology are listed as the primary threats to these species in the 1991 listing rule (56 FR 61173). Additional threats identified in the 1991 rule include off-road vehicles and erosion. Consistent with the 1991 rule, the largest continuing threat to these species are urban development and land conversion to viticulture or other intense agriculture activities.

Urban and Rural Development and Conversion to Agriculture: The most severely impacted portion of the range of *Lasthenia burkei* has been the northwestern portion of the Santa Rosa Plain. The majority of the known sites severely degraded or extirpated are in the Windsor area (Patterson *et al.* 1994, CH2M Hill 1995). Two of the largest known populations in Sonoma County occurred in this area and were considered extirpated by Patterson *et al.* (1994). The extirpations were thought to have resulted from urban and commercial development or agricultural land use changes. For example, one CNDDDB occurrence in the area contained 11 colonies in 1984; by 1993, only two were extant (CNDDDB 1998). A second occurrence had more than 20 vernal pools in 1985, but by 1994, only one colony of *L. burkei* was present (CNDDDB 1998). This property once contained 50,000 plants, but after repeated disking only about 100 plants remain (B. Guggolz, California Native Plant Society, pers. comm., 1998). Only a few stable *L. burkei* sites still exist in the Windsor area, and these are threatened by development (Patterson *et al.* 1994). The City of Windsor has already developed, or designated development, on every *L. burkei* site within their general planning area (B. Guggolz, pers. comm., 1998). Only a few stable *L. burkei* sites still exist in the Windsor area, and these are threatened by development (Patterson *et al.* 1994). Development in the Windsor area continues to impact the limited amount of remaining *L. burkei* habitat in this area (P. Chamberlin, Town of Windsor, pers. comm., 2008b). Similar to *Lasthenia burkei*, *Blennosperma bakeri* and *Limnanthes vinculans* are experiencing similar threats throughout their ranges as a result of activities related to urban and rural development and conversion to

agriculture. CNDDDB (2008) identifies at least 19 of the 26 occurrences for *Blennosperma bakeri* and 26 of the 39 occurrences for *Limnanthes vinculans* are being threatened, partially extirpated, or extirpated as a result.

The population of California is expected to increase to 58 million, almost double the 1990 State population, by 2040 (Field *et al.* 1999). Between 1994 and 2005, the Sacramento Fish and Wildlife Office engaged in Endangered Species Act section 7 consultations for projects with impacts to approximately 20,250 hectares (50,000 acres) of vernal pool habitat, including the loss of 10,125 hectares (25,000 acres) to residential, commercial, and industrial development (Service 2005). The Cities of Santa Rosa, Cotati, and Rohnert Park assisted in the preparation of the Santa Rosa Plain Conservation Strategy (Conservation Strategy Team 2005) and identified the areas expected to be proposed for development by the year 2015. The threat of urban development to these species in the Santa Rosa Plain is expected to continue (Conservation Strategy Team 2005).

Alteration of Hydrology: More subtle threats have the ability to change habitat suitability in natural lands remaining within the developed landscape. For example, loss of vernal pool habitat to residential, commercial, and industrial development can also lead to changing or removing the hydrological connections that sustain the remnant vernal pools. Vernal pool plants such as these three species are sensitive to variations in the period of vernal pool inundations (Bauder 2000).

Alteration of the hydrological regime as a result of breaking the clay hard pan (e.g., disking or deep ripping) and draining the pools can change the composition of plant species by facilitating the invasion of non-native upland species. Conversely, if water from urban or agricultural run-off continues to fill pools during spring and summer months, invasion by plant species adapted to permanent inundation can be expected. Disking appears to be a common activity for fire prevention. Some sites are disked in entirety and others only the perimeter (V. Griego. U.S. Fish and Wildlife Service, personal observations, 2003-2007). Regular disking has resulted in “smearing” (flattening the landscape) and has changed the natural hydrology of the area. Some landowners purposefully changed the hydrology to “get rid” of the listed plants (P. Chamberlin, Town of Windsor, pers. comm., 2008a). In addition, the hydrology of the seasonal wetland habitat of these three listed plants in many areas throughout the Santa Rosa Plain has been altered by human activity. This resulted in the loss of hydrologic connectivity to neighboring wetlands, to an extent that conditions may not be suitable for germination and flowering in many years. However, the plants can still persist in the seedbank and have been known to “reappear” once more appropriate hydrologic conditions are reestablished (Rosburg, 2001; Kivilaan *et al.* 1981; Zedler *et al.* 2004).

Changes to vernal pool habitat associated with residential development include facilitation of the introduction of non-native plants to vernal pool habitats (Zedler

and Black 2004). Non-native grasses occur commonly in vernal pool complexes and have become a threat to native vernal pool plants through their capacity to change pool hydrology and competition with native plants. Non-native grasses maintain dominance at pool edges, sequestering light and soil moisture, promoting thatch build-up, and shortening inundation periods. Although the mechanism responsible for the change in inundation is not documented, reduction in inundation period is thought to be due to increased evapo-transpiration associated with dense cover of nonnative plants at the vernal pools (Marty 2005).

Wastewater Irrigation: Wastewater irrigation is a recently established factor affecting vernal pools on the Santa Rosa Plain. This practice began in the 1970s and has continued, which has resulted in changing seasonal wetland plant composition. While the native seasonal wetland species are adapted to a summer-dry Mediterranean climate, summer irrigation results in perennial wetland conditions that are intolerable by native seasonal wetland species (Patterson *et al.* 1994). Patterson *et al.* (1994) stated that the ongoing need to expand effluent irrigation acreage to keep pace with population growth would continue to jeopardize the existence of oak woodlands and vernal pools on the Santa Rosa Plain unless other, less sensitive lands are found for irrigation or other means of disposal are found.

The City of Santa Rosa has recently developed a draft Environmental Impact Report (Winzler & Kelly, 2008) to look at additional wastewater storage and irrigation in the Santa Rosa Plain. The City of Santa Rosa is pursuing agreements with other wastewater facilities (Sonoma County Water Agency and Town of Windsor) to share irrigation and storage. The City of Santa Rosa is permitted to apply wastewater biosolids to lands within the Santa Rosa Plain. The California Regional Water Quality Control Board recently issued a renewed permit to Santa Rosa for wastewater discharges (J. Short, pers. comm., 2007). The permit requires the City of Santa Rosa to study wastewater land application rates to ensure users are not over-irrigating. The permit recognizes the presence of specific pollutants (including toxic pollutants) in the treated wastewater. The permit sets time schedules for these pollutants to be addressed prior to discharge to surface waters. Technically, the California Regional Water Quality Control Board regulations (Water Quality Control Plan for the North Coast Region) prohibit wastewater discharge to surface waters during the summer. The regulations, however, did not contemplate that wastewater would be used to irrigate vernal pools and other types of seasonal wetlands (J. Short, pers. comm., 2007). Based on these observations, we believe that unchecked wastewater irrigation may alter the normal hydrology of vernal pools in the Santa Rosa Plain and adversely affect *B. bakeri*, *L. burkei*, and *L. vinculans*.

Off-Highway Vehicles: The use of off-highway vehicles continues to degrade some vernal pool habitat in the Santa Rosa Plain. For example, there is one location where motocross tracks were created for recreation (CNDDDB 2008). There was one incidence where a vehicle entered private property and drove

through a population of *Blennosperma bakeri* and got stuck. At another location, a locked gate was broken into at a California Department of Fish and Game Preserve that is protected for these species (T. Love, pers. comm., 2008). It is reasonable to expect activities of this sort to increase as urban development and rural development continue to increase. The level of this threat is likely to be variable and is difficult to predict or monitor.

Conservation Efforts

1. Sonoma County Vernal Pool Task Force

The Sonoma County Vernal Pool Task Force (Task Force) was formed in 1991 to address human-caused impacts to threatened vernal pool plant taxa within the Santa Rosa Plain, and to address the concerns of the Santa Rosa community regarding issuance of permits for fill of seasonal wetland in light of the pending Federal listing of *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans*. Under the auspices of the Task Force, Federal, State, and local agencies entered into a memorandum of understanding to formally establish cooperative relationships for the development of a Santa Rosa Plain Vernal Pool Ecosystem Preservation Plan (Ecosystem Preservation Plan) (CH2M Hill, 1995). This plan summarized existing biological and land-use information in a comprehensive regional framework known as Phase I. Phase II tasks were also identified, including the need to develop an overall preserve design, to determine factors affecting habitat quality, and to establish a procedure to rank sites for acquisition (CH2M Hill, 1995).

2. Santa Rosa Vernal Reserve System

The initial planning phase represented by the Ecosystem Preservation Plan was followed up 6 years later by the establishment of the Santa Rosa Vernal Reserve System (Pavlik *et al.* 1998). This reserve system was created to integrate properties owned or controlled by the California Department of Fish and Game on the Santa Rosa Plain into a scientifically based planning, management, and public service system (Pavlik *et al.* 1998). Acquisition of properties supporting vernal pools and swales and their rare inhabitants has continued, where feasible, since the establishment of the Laguna de Santa Rosa Ecological Reserve on Todd Road in 1980. More than 18 separate properties, ranging in size from 0.4 hectare to 70 hectares (1 to 174 acres), have been placed under the regulatory auspices of the California Department of Fish and Game, either by purchase, mitigation agreements, or the establishment of conservation easements with private landowners. These properties extend from Windsor to Cotati.

The establishment of the Santa Rosa Reserve System was the first attempt to create a coordinated reserve system, to specify how research could identify essential habitat factors, and to develop appropriate management prescriptions for improving the quality of vernal pool habitat. A long-term research program was

subsequently initiated on three Santa Rosa Vernal Reserve System properties to determine those management prescriptions (Pavlik *et al.* 2000, 2001). The second phase of the Ecosystem Preservation Plan, the implementation phase, has been addressed partially through the creation of the Santa Rosa Vernal Reserve System and by the establishment of two mitigation banks in 1997, the Southwest Santa Rosa Preservation Bank and the Wright Preservation Bank. The intent of the Ecosystem Preservation Plan was to assess the current status of the remaining populations of *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* on the Santa Rosa Plain, and to propose recovery and management strategies to increase the number and size of population, and total acreage of protected vernal pool habitat (CH2M Hill 1995).

3. The 1998 Programmatic

On July 17, 1998, we provided the U.S. Army Corps of Engineers with a programmatic biological opinion for an Endangered Species Act section 7 consultation for all Clean Water Act-permitted activities on the Santa Rosa Plain that might affect *Blennosperma bakeri*, *Lasthenia burkei*, *Limnanthes vinculans*, and *Navarretia leucocephala ssp. plieantha* (Service 1998). The consultation document had two purposes: (1) to expedite formal consultations, on a project-by-project basis, for limited effects to listed species in “low-quality” seasonal wetlands under specifically defined circumstances; and (2) to outline a comprehensive conservation program that would address effects to the listed species resulting from Clean Water Act Section 404 permit issuance for fill of seasonal wetlands throughout the Santa Rosa Plain.

To expedite consultations, the 1998 Programmatic set limits on the amount of vernal pool and swale habitat that could be permitted to be filled. It also provided guidelines for the amount of existing vernal habitat that needed to be preserved, and the amount of new vernal pools that needed to be created, to mitigate for each acre filled.

The 1998 Programmatic was designed to allow up to 20.23 hectares (50 acres) of low-quality seasonal wetlands (suitable habitat without flowering plants) to be filled, to include no more than 12.14 hectares (30.00 acres) occupied (or presumed to be occupied) by *Blennosperma bakeri*, *Lasthenia burkei* and *Limnanthes vinculans* or *Navarretia leucocephala ssp. plieantha*. Of the 12.14 impacted hectares (30 acres) which are occupied or presumed occupied, no more than 2.43 hectares (6 acres) could include sites for which there are known records of the listed plants. Between the period of the 1998 Programmatic consultation and the date of the subsequent 2007 Programmatic (discussed below), less than 12.14 hectares (30 acres) of low-quality seasonal wetlands were authorized to be filled under the 1998 Programmatic. At this time, it is unknown how many of the 12.14 hectares (30 acres) impacted wetland acres were occupied with one or more of the listed plants. The low-quality seasonal wetlands were to be mitigated by

preservation and creation of listed plant habitat as outlined in the 1998 Programmatic, and likely include some of the Preserves summarized in Table 2.

4. Santa Rosa Plain Conservation Strategy

The listing of various populations of the California tiger salamander (*Ambystoma californiense*) as endangered (2003) or threatened (2004) caused a level of uncertainty for local jurisdictions, landowners, and developers about how the listing would affect their activities. Private and local public interests met with the Service to discuss possible cooperative approaches to protecting the species, while allowing planned land uses to occur within the range of the animal. The result of those discussions was the formation of the Santa Rosa Plain Conservation Strategy Team (Team). The Team included the following members: Service, California Department of Fish and Game, U.S. Army Corps of Engineers, Environmental Protection Agency, North Coast Regional Water Quality Control Board, local governments, the Laguna de Santa Rosa Foundation, the environmental community, and the private landowner community. It was agreed that the Team would develop a conservation strategy for the Santa Rosa Plain that conserves and enhances the habitat for the California tiger salamander, *Blennosperma bakeri*, *Lasthenia burkei*, *Limnanthes vinculans*, and *Navarretia leucocephala* ssp. *plieantha*), while considering the need for development pursuant to the general plans of the local jurisdictions. The Team held its first meeting on March 30, 2004, and continued to meet through August 2005, to prepare a Draft Santa Rosa Plain Conservation Strategy. The Team held a public meeting on September 12, 2005, and received numerous comments on the draft through September 16, 2005. In addition, the Draft Santa Rosa Plain Conservation Strategy was peer-reviewed. The Team reviewed and considered all comments received, made modifications to the Draft Santa Rosa Plain Conservation Strategy where appropriate, and produced the Final Santa Rosa Plain Conservation Strategy in December of 2005 (Conservation Strategy Team 2005).

The purpose of the Conservation Strategy is threefold: (1) to establish a long-term conservation program sufficient to compensate potential adverse effects of future development on the Santa Rosa Plain, and to conserve and contribute to the recovery of the California tiger salamander and a select group of listed plants (*Blennosperma bakeri*, *Lasthenia burkei*, *Limnanthes vinculans*, and *Navarretia leucocephala* ssp. *plieantha*) and the conservation of their sensitive habitat; (2) to accomplish the preceding in a fashion that protects stakeholders' (both public and private) land use interests, and (3) to support issuance of an authorization for incidental take of California tiger salamanders that may occur in the course of carrying out a broad range of activities on the Santa Rosa Plain. The Conservation Strategy will not preserve the covered species unless implemented by the appropriate agencies.

The Conservation Strategy provides the biological basis for a permitting process for projects that are in the potential range of listed species on the Santa Rosa Plain. This is intended to provide consistency, timeliness, and certainty for permitted activities. The Conservation Strategy study area is comprised of the potential California tiger salamander range and the listed plant range within the Santa Rosa Plain. The Conservation Strategy establishes interim and long-term mitigation requirements and designates conservation areas where mitigation will occur. It describes how preserves will be established and managed. It also includes guidelines for translocation, management plans, adaptive management, and funding. Finally, the document describes the implementation planning process. The Service and California Department of Fish and Game are implementing interim mitigation guidelines (Service and CDFG, *in litt.* 2006) for Federal and non-Federal actions. The Cities of Santa Rosa, Cotati, and Rohnert Park identified the areas expected to be proposed for development by the year 2015, which greatly assisted the ability of the Conservation Strategy Team to develop a conservation strategy that contributes to the recovery of these species and allowing a variety of land uses to occur.

The County of Sonoma, the Cities of Santa Rosa, Cotati, Rohnert Park, the Town of Windsor, Service, and California Department of Fish and Game have commenced a process to develop a plan for implementing the Conservation Strategy. An implementation committee has been formed that is comprised of elected and staff representatives of the local jurisdictions and representatives of the agricultural, development, and environmental communities. Staff representatives from the Service and California Department of Fish and Game provide technical assistance to the implementation committee. The implementation plan is expected to provide a mechanism for applying the Conservation Strategy to cover public and private projects, agricultural activities, and residential and commercial development.

5. The 2007 Programmatic

On November 9, 2007, we consulted with the U.S. Army Corps of Engineers with a formal programmatic biological opinion for permits, enforcement actions, and mitigation banks that are under their jurisdiction and that may adversely affect *Blennosperma bakeri*, *Lasthenia burkei*, *Limnanthes vinculans*, and the California tiger salamander. (This document does not cover *Navarretia leucocephala ssp. plieantha* because of its limited distribution.) Also, projects that may impact sites supporting *B. bakeri* or *L. burkei*, where surveys have documented 2,000 plants or more in any year in the past 10 years, may not be appended, but will be evaluated on a case by case basis. The 2005 Santa Rosa Plain Conservation Strategy was the biological framework upon which this 2007 Programmatic was based and replaced the 1998 Programmatic. This document provides the framework for mitigation, conservation, translocation, and minimization measures. The Service and the U.S. Army Corps of Engineers collaborated in partnership during the preparation of 2007 Programmatic.

6. Endangered Plant Monitoring Program

Currently, there is not a standardized comprehensive monitoring program for extant populations of the three endangered plants covered in this 5-year review (C. Sloop, Laguna de Santa Rosa Foundation, pers. comm., 2007); however, recently established Preserves and mitigation and conservation banks include adaptive management and monitoring plans which have supporting endowments. The Santa Rosa Plain Conservation Strategy (Conservation Strategy Team 2005) identifies the establishment of an effective adaptive management process involving long-term population assessment surveys as an important goal and objective for species recovery and persistence. Additionally, the Laguna de Santa Rosa Foundation, a local conservation group, is leading an effort to establish a volunteer-based monitoring research program to conduct yearly population assessment surveys using Laguna de Santa Rosa foundation science staff and expert California Native Plant Society volunteers to complete baseline surveys of these three listed plants. The surveys are proposed to be conducted within the framework of hypothesis testing to assess the success of various management regimes over the long-term (C. Sloop, Laguna de Santa Rosa Foundation, pers. comm., 2007).

7. Preserves

The threats identified in the 1991 listing rule continue to threaten these species (Service files 2008). There have been a number of mitigation banks, conservation banks, and mitigation sites (Preserves) that are preserved in perpetuity to offset some of the impacts imposed by various projects and changes of land use. Table 2 summarizes a subset of these Preserves that support or will support these three species. For example, the Alton North Conservation Bank is creating and enhancing vernal pools and will be inoculated with soil containing seed of *Blennosperma bakeri* and *Lasthenia burkei*. The California Department of Fish and Game is currently developing a database to comprehensively track existing and future Preserves.

Summary of Factor A

The largest continuing threat to these species is urban development, land conversion to viticulture or other intense agriculture activities, and alteration of hydrology through various human activities. Wastewater irrigation and off-highway vehicles are also relatively new and increasing levels of threat. There have been several conservation efforts since the time of listing with various levels of success. The Santa Rosa Plain Conservation Strategy and the 2007 Programmatic have a high level of potential for success in assisting in the recovery of these species.

Table 2. Preserves: The following Preserves support or will support one or more of the three species covered in this 5-year review. All or the majority were protected for mitigation of project impacts (Service files 2008).

Preserve	<i>Blennosperma bakeri</i>	<i>Lasthenia burkei</i>	<i>Limnanthes vinculans</i>
Alton Lane Mitigation Site	X	X	X
Alton North Conservation Bank	X	X	
Christina Preserve			X
Davis Preserve			X
Desmond Mitigation Bank			X
FEMA Mitigation Site			X
Gobi II Mitigation Site			X
Hale Mitigation Bank	X		X
Margaret Preserve			X
Slippery Rock Mitigation Bank	X	X	X
Southwest Santa Rosa Vernal Pool Preservation Bank	X		X
Swift-Turner Conservation Bank	X	X	X
Wright Preservation Bank			X
Yuba Mitigation Site			X

2.3.2.2 Factor B, Overutilization for commercial, recreational, scientific, or educational purposes:

The 1991 final rule stated that the three species may be vulnerable to overutilization for scientific or horticultural purposes or excessive visits by individuals interested in seeing rare plants following increased publicity following Federal listing (56 FR 61173). Additionally, the final rule noted that *Limnanthes* species have the potential to be of high agronomic value and collection for this purpose may become more of a threat following Federal listing. We are not aware of any information that would suggest that these activities have become a greater threat since the time of listing.

The collection of seed/inoculum from extant locations for the purpose establishing additional populations of *Blennosperma bakeri* and *Lasthenia burkei* in Preserves is becoming more important in recovering these species because of the very low number of remaining viable populations. There may be some amount of risk of collecting seeds from extant populations, but it is anticipated that the level of risk is likely much less than the benefits from establishing new populations at sites being restored. For example, there was great success at establishing *B. bakeri* at the proposed Carinalli-Todd Mitigation Bank. To reduce the potential for unacceptable risk to these extant populations, the California Department of Fish

and Game is requiring baseline surveys prior to the collection of seeds and follow-up monitoring surveys to gauge any potential adverse effects (S. Wilson pers. comm. 2007).

2.3.2.3 Factor C, Disease or predation:

The 1991 final rule to list the three plants did not include any information on disease. We are not aware of any disease factors that threaten occurrences of these species to date. The 1991 final rule does state that some populations have been extirpated or greatly reduced by foraging livestock, according to CNDDDB (1989) (56 FR 61173). However, it also recognizes that there is disagreement among local biologists as to the extent of the threat of grazing on the three species, especially since there have been no carefully designed experiments and the potential for this threat is based on casual observations. Finally, the final rule concluded that although the effect of moderate livestock grazing remains open to question, overgrazing probably has adversely affected and may continue to threaten the three listed plants in some places.

Since the time of listing, grazing has been removed at many locations and has resulted in thatch build-up, and there is anecdotal evidence that thatch build-up of non-native vegetation has caused a reduction in the size of extant populations (see section 2.3.2.1). The California Department of Fish and Game is re-establishing grazing practices on some California Department of Fish and Game owned lands to reduce thatch build-up and non-native competitors to the three listed plants (e.g., Todd Road Unit Ecological Preserve). The Grazing Management Plan for the Todd Road Unit of the Santa Rosa Plain Ecological Reserve (Sotoyome Natural Resource Conservation District, 2006) is anticipated to serve as a “template” for other California Department of Fish and Game owned and/or managed sites where appropriate. The “template” grazing plan will be modified to fit each site-specific Preserve. Newly created Preserves in the Santa Rosa Plains include grazing in the adaptive management plan as a management tool. The management plans recognize that light to moderate grazing can enhance habitat for the three listed plants by reducing non-native plant competitors. The management plans also prescribe monitoring to guide future management decisions.

2.3.2.4 Factor D, Inadequacy of existing regulatory mechanisms:

In the final rule (56 FR 61173), the Service found that many existing regulatory mechanisms were not sufficient to protect plants, including section 404 of the Clean Water Act, the protections of the California Endangered Species Act, and the California Environmental Quality Act. The 1991 final rule also found that listing the plants under the Federal Endangered Species Act would provide better protection by requiring the Army Corps of Engineers (and other Federal agencies) to consult with the Service prior to final determinations on a proposed activity.

The Federal Endangered Species Act: The Endangered Species Act of 1973, as amended (Act), is the primary Federal law that provides protection for the three listed plants since their Federal listing as endangered species in 1991. 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 and threatened wildlife; however, the take prohibition does not apply to plants. Instead, plants are protected 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. Section 9 also makes illegal the international and interstate transport, import export and sale or offer for sale of endangered plants and animals. The Act may provide incidental protection to federally listed plants that co-occur with federally listed wildlife species.

In 2003, the Sonoma County Distinct Population Segment of California Tiger Salamander was listed as endangered. The historical and current range of this population of California tiger salamander overlaps the most of the ranges of the three listed within the Santa Rosa Plain. If a Federal agency is not involved in a proposed project, and federally listed animals may be taken as part of the project, then the project proponent should obtain an incidental take permit pursuant to section 10(a)(1)(B) of the Act. The Service may issue such a permit upon completion of a satisfactory habitat conservation plan (HCP) for the listed species that would be taken by the project. The three listed plants have probably been afforded some amount of additional protection as a result of the California tiger salamander listing as endangered. Currently there are no completed regional or county-wide HCPs or NCCPs (see California State Laws below) in any of the counties where the three listed plants occur.

Federal Clean Water Act: The Section 404 of the Clean Water Act has afforded some protection to the three listed plants. 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 to a project applicant that may affect federally listed species, the Corps is required under section 7 of the Endangered Species Act to consult with the Service. 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. If the Corps loses regulatory authority over vernal pools, unmitigated destruction of suitable habitat for the three listed plants

may increase over the range of the species. In addition, the Corps may be less likely to investigate potential unauthorized fill of vernal pools in the Santa Rosa Plain due to recent court case judgments. There are very few if any occurrences of the three listed plants located on Federal property, therefore the majority of protections afforded to these species is where there is a permit required from the Corps or if take may occur to the California tiger salamander.

California State Laws: The State's authority to conserve plants is comprised of four pieces of legislation: The California Endangered Species Act (CESA), the Native Plant Protection Act (NPPA), the California Environmental Quality Act (CEQA), and the Natural Community Conservation Planning Act (NCCPA).

Lasthenia burkei and *Limnanthes vinculans* became State-listed as endangered in 1979 and *Blennosperma bakeri* in 1992. CESA (California Fish and Game Code, section 2080 *et seq.*) and NPPA (Division 2, Chapter 10, section 1908) prohibit the unauthorized take of State-listed threatened or endangered plant species. Unlike the take prohibition in the Act, the State prohibition includes plants; however, landowners are exempt from this prohibition for plants taken via 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 (NPPA Division 2, Chapter 10, section 1913); however, it is unlikely the three listed plants would survive such transplanting.

The California Environmental Quality Act (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.

2.3.2.5 Factor E, Other natural or manmade factors affecting its continued existence:

Other manmade threats stated in the 1991 final rule include competition from non-native grasses and forbs, trampling associated with grazing, and the maintenance of roadway shoulders through grading and application of herbicides (56 FR 61173). Other natural factors stated in the final rule include natural fluctuations in rainfall patterns resulting in localized extinctions or population declines (Patterson 1990). The potential for stochastic (random or unpredictable) extirpations of occurrences increases due to their isolation and small size (Patterson *et al.* 1994; CNDDDB 2008). Current threats include the threats

discussed in the 1991 final rule, and in addition new threats of thatch build-up and potential disruption of normal gene flow.

Accumulation of Thatch: In areas near the urban boundary, cattle grazing is often discontinued in anticipation of land use changes (C. Martz, California Department of Fish and Game, pers. comm., 2006). Cessation of cattle grazing has been found to exacerbate the negative effects of invasive non-native plants on vernal pool inundation period. The change in vernal pool inundation due to loss of grazing is an emerging threat for these species. Vernal pool inundation was reduced by 50 to 80 percent in the Southeastern Sacramento Valley when grazing was discontinued (Marty 2005). Habitat protection in the absence of management has been detrimental to vernal pool and swale species on the Santa Rosa Plain. For example, populations of *Lasthenia burkei* and *Limnanthes vinculans* have apparently declined by several orders of magnitude at the Todd Road Unit of the Laguna de Santa Rosa Ecological Reserve (Pavlik *et al.* 1998, 2000) after removal of livestock and no active vegetation management. This often is the cause for uncontrolled thatch build-up of non-native vegetation and continues to be a threat in the Santa Rosa Plain.

Pavlik and Leger (2004) conducted experimental management treatments on three separate properties within the Santa Rosa Vernal Reserve System (Sonoma County) to test whether they could use mowing and vegetation removal as a technique to shift the cover of dominant plant species from non-native to native, and to shift the abundance of rare species of conservation interest from sparse to abundant. At vernal pool sites where a seed bank of native plants is present, repeated mowing and vegetation removal appears to improve habitat quality for native plants, and continued mowing treatments may further improve habitat quality at these sites (Pavlik and Leger 2004).

Gene Flow: A new potential threat to these three plants may include the disruption of normal gene flow due to population restoration efforts that may mix populations, which may cause unanticipated adverse effects such as disruption of locally adapted gene complexes and outbreeding depression (when offspring from individuals from different populations have lower health/fitness than progeny from individuals from the same population). Several sites are proposed as Preserves in the Santa Rosa Plain and include proposals to seed/inoculate created or restored vernal pools. The threat level of this activity is unknown; however, the 2007 Programmatic includes measures to reduce this potential threat as well as the requirement to obtain a collection permit from California Department of Fish and Game.

Climate Change: 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, Pyke 2005). However, climatic conditions for smaller sub-regions such as California remain uncertain (Pyke 2005).

Climate is predicted to change in California during the 21st century (Field *et al.* 1999; Cayan *et al.* 2005). Even modest changes in warming could result in a reduction of the spring snowpack, earlier snowmelt, and more runoff in winter with less runoff in spring and summer, more winter flooding, and drier summer soils (Field *et al.* 1999; Cayan *et al.* 2005). The predicted impacts on California's ecosystems projected with a high certainty include (1) higher sea level; and (2) decreased suitable habitat for many terrestrial species as climate change intensifies human impacts [for example isolated patches of vernal pools can be so poorly connected with other patches that migrations required by climate change may be difficult or impossible without human intervention (Field *et al.* 1999)].

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). However, it is possible that either scenario could result in negative effects to vernal pool species (Pyke 2004; Pyke and Marty 2005). Cooling and drying trends could adversely affect *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* through decreased inundation periods that do not allow the species sufficient time to complete its life cycle. In contrast, warmer conditions with higher precipitation could increase the area of vernal pools, which would not necessarily be a negative effect because increased vernal pool area could increase available habitat for *B. bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans*. There could also be increased competition from nonnative plants. Monitoring of vernal pool ecosystems to determine effects from climate change is necessary to determine what adaptive land management practices would be the most appropriate to ensure the sustainability of vernal pool species (Pyke and Marty 2005), including *B. bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans*.

2.3.2.6 Summary of Current Threats

Table 3. Comparison of threats, pre-listing versus post listing to *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans*. Pre-listing information was derived from the final listing rule (56 FR 61173).

Listing Factor*	Threat	Species Thought To Be Affected By Threat Before Listing	Species Currently Affected By Threat
A	Conversion to agriculture	all three	all three
A	Urban development (residential and commercial)	all three	all three
A	Alteration of hydrologic regime	all three	all three

Listing Factor*	Threat	Species Thought To Be Affected By Threat Before Listing	Species Currently Affected By Threat
A	Erosion	<i>L. burkei</i> (Manning Flat occurrence)	<i>L. burkei</i> (Manning Flat occurrence)
A	Off-highway vehicle use in vernal wetlands	all three	all three
B	Overutilization for commercial purposes <ul style="list-style-type: none"> • Collection for <i>Limnanthes</i> lubricating qualities • Collection of seed/inoculum 	<i>Limnanthes vinculans</i>	all three
B	Excessive visitation by rare plant enthusiasts	all three	none (there has been no evidence of significant damage due to excessive visitation)
C	High-intensity livestock grazing	all three	all three
D	Inadequacy of existing regulations	all three	all three
E	Competition from non-native plants	all three	all three
E	Trampling associated with grazing	all three	all three
E	Roadside maintenance	all three	all three
E	Stochastic extirpation of occurrences due to their isolation and small size	all three	all three
E	Disruption of normal gene flow due to population restoration efforts that mix populations	Not recognized as a threat at the time of listing	all three
E	Accumulation of thatch	Not recognized as a threat at the time of listing	all three
E	Herbicide or pesticide application	all three	all three

Listing Factor*: The listing factors are presented in full below.

Factor A: The present or threatened destruction, modification, or curtailment of their habitat or range

Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

Factor C: Disease or Predation

Factor D: The inadequacy of existing regulatory mechanisms

Factor E: Other natural or manmade factors affecting their continued existence

2.4 Synthesis

The threats to *Blennosperma burkei*, *Lasthenia bakeri*, and *Limnanthes vinculans* that led to the listing of these species as endangered in 1991 are summarized in section 2.3.2.6. We have no information indicating that threats to these species have substantially changed since the time of listing in 1991. The primary threats to these species continue to be the modification and destruction of suitable habitat, and the resulting fragmentation, associated with urbanization, agricultural conversion, alteration of hydrologic regime, off-highway vehicle use, grazing, and competition with non-native plants. Since 1991, threats such as habitat loss, habitat degradation, and fragmentation have continued to such an extent that populations of *Lasthenia burkei* appears to have been lost to a significant degree especially in the northwestern part of the Santa Rosa Plain, around the Town of Windsor, and north of Santa Rosa Creek. There have been increased efforts in the past 3 years in the establishment of Preserves, perhaps as a result of the completion of the Santa Rosa Plain Conservation Strategy. Some of these Preserves protect in perpetuity some occurrences of these species and may contribute to their recovery, but it is too soon to determine the viability of these protected occurrences at this time. Recent efforts to develop comprehensive monitoring of extant or presumed extant occurrences may prove valuable to determine the extent conservation efforts and ongoing threats since the time of listing. For example, competition with non-native plant species is a continuing threat for these species in the Santa Rosa Plain populations, especially where grazing has been removed entirely and in remnant vernal pool habitats in fragmented landscapes.

Therefore, based on the continuing threats to *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* summarized in Table 3, including threats related to habitat loss, habitat degradation and fragmentation, and competition by non-native plants, we conclude that *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* still meet the Act's definition of endangered, and are in danger of extinction throughout their range.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist (Indicate reasons for delisting per 50 CFR 424.11):
 - Extinction
 - Recovery
 - Original data for classification in error
- No change is needed

3.2. New Recovery Priority Number:

Blennosperma bakeri: 5C (no change)

Lasthenia burkei: 2C (no change)

Limnanthes vinculans: 2C (no change)

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

1. Protect extant occurrences and establish new occurrences that will contribute to the recovery of *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans*. Establishment of new occurrences should be done with great care and oversight to prevent adversely affecting extant occurrences.
2. Manage non-native competitors on Preserves and other sites. Management should include research to determine effective eradication methods while avoiding adverse effects to *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans* and the California tiger salamander where their ranges overlap.
3. Develop and implement standardized population trend survey protocols to update status surveys, especially for populations on private lands where trends have not been determined or recently updated.
4. Conduct research:
 - a. to assess specific hydrological and physical requirements for these species in order to address relationships between landform, soil chemistry, geographic location, and precipitation regimes; and the presence of these species occurrences.
 - b. on reproductive ecology, gene flow patterns, and seed bank dynamics, including a comparison of established restoration sites and remaining natural sites to gauge the long-term effectiveness of restoration sites.
5. Prepare a Recovery Plan including downlisting and delisting criteria.

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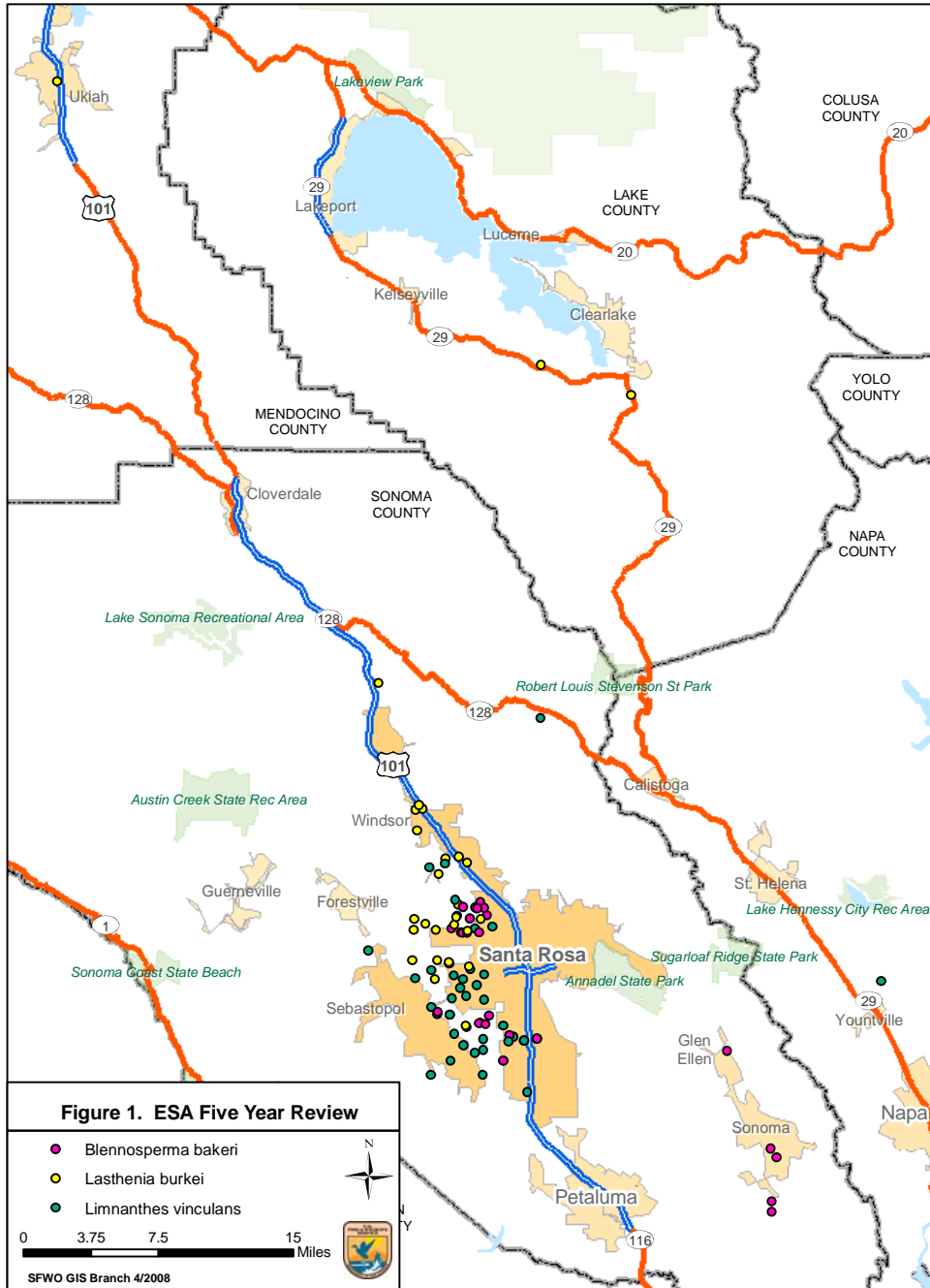


Figure 1. Current distribution of occurrences for *Blennosperma bakeri*, *Lasthenia burkei*, and *Limnanthes vinculans*.

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

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Sacramento Fish and Wildlife Office staff

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Cay C. Mowbray Date 9/24/08

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve M. J. P. [Signature] Date 9/30/08

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

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Sacramento Fish and Wildlife Office staff

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

for Approve Cary Monda Date 4/28/08

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve Will Fin Date 7/30/08

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

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Sacramento Fish and Wildlife Office staff

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 4/28/08

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve  Date 9/30/08