

Chamaesyce hooveri
(Hoover's Spurge)

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



© 2003 George W. Hartwell

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

January 2009

5-YEAR REVIEW
Hoover's Spurge (*Chamaesyce hooveri*)

I. GENERAL INFORMATION

I.A. 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 2005 *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Recovery Plan) (Service 2005), Environmental Impact Statements, documents generated as part of section 7 consultations, peer reviewed journal articles, species survey and monitoring reports, Federal Register Notices, the California Natural Diversity Database (CNDDDB 2007), which is maintained by the California Department of Fish and Game (CDFG), and personal communications with species experts.

I.B. Contacts

Lead Regional or Headquarters Office – Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist, Region 8, California and Nevada; (916) 414-6464

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

I.C. Background

I.C.1. FR Notice citation announcing initiation of this review: 72 FR 7064, February 14, 2007. We received no public comments in response to this notice.

I.C.2. Listing history

Original Listing

FR notice: 62 FR 14338

Date listed: March 26, 1997

Entity listed: Species (*Chamaesyce hooveri*)

Classification: Threatened

I.C.3. Associated rulemakings:

Critical habitat for this species was proposed on September 24, 2002 (67 FR 60033). The final rule to designate critical habitat for *Chamaesyce hooveri* 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 7117). Clarifications on

the economic and non-economic exclusions for the final designation of critical habitat were published on May 31, 2007 (72 FR 30279).

I.C.4. Review History

We have not conducted any previous 5-year reviews for this species. Updated information on its status and threats were included in the 2005 Recovery Plan.

I.C.5. Species' Recovery Priority Number at start of review:

The recovery priority is 8C, reflecting a moderate degree of threat, a high potential for recovery, and a taxonomic rank of full species. The "C" after the number indicates the conflict of the species with development projects or other ground-disturbing activity.

I.C.6. Recovery Plan or Outline

Name of plan: Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon
Date issued: December 15, 2005

II. REVIEW ANALYSIS

Species Overview

Chamaesyce hooveri is a summer annual member of the Euphorbiaceae (spurge family) that is a vernal pool endemic. *Chamaesyce hooveri* forms gray-green mats from a few inches to a few feet across. The flowering structure is a small, highly simplified cup-like "cyathium," as in all other spurges (*Chamaesyce* and *Euphorbia*). The flowering structure in *C. hooveri* has petal-like glands that are red to olive in color. Flowers bloom in July. This species is readily distinguished from other species of *Chamaesyce* by characteristics of growth habit, plant color and leaf shape. It is distinguished from plants in the genus *Euphorbia* on the basis of growth habit, vascular anatomy, and photosynthetic pathway. *Chamaesyce hooveri* generally grows in relatively large, deep vernal pools among the rolling hills, remnant alluvial fans and depositional stream terraces at the base of the Sierra Nevada foothills. It tends to occur where competition from other species has been reduced by prolonged seasonal inundation or other factors.

Chamaesyce hooveri has been reported in six counties: Tehama, Butte, Glenn, Stanislaus, Merced, and Tulare. Thirty occurrences have been reported to CNDDDB and we know of an additional site found on the Hamilton Ranch mitigation site in Tehama County (LSA 2003; C. Witham, biological consultant, per. comm. 2007). An occurrence as defined by the CNDDDB is a location separated from other locations of the species by at least one-fourth mile that may contain populations, individuals, or colonies. We have used site to refer to populations, individuals, or colonies that have not been reported to the CNDDDB. Of the 31 known occurrences and sites, 27 are presumed to be extant (LSA 2003; CNDDDB 2007). The majority of the presumed extant occurrences and sites are located in the Vina Plains area, in Tehama and Butte Counties, where 14 occurrences and one site are presumed extant (LSA 2003; CNDDDB 2007). The next largest concentration of occurrences is in Tulare County, where seven

occurrences are presumed extant. The CNDDDB indicates that of the 26 occurrences that are listed as “presumed extant,” 6 occurrences have not been surveyed in over 20 years and another 8 have not been surveyed since the late 1980s (CNDDDB 2007). Because surveys have not been performed at many of these occurrences in nearly twenty years, the actual status of these occurrences is not known at this time. The majority of occurrences of *C. hooveri* are not protected. The 12 occurrences of this species that are protected from the direct effects of development include: The Nature Conservancy’s Vina Plains Preserve in Butte and Tehama Counties; the Sacramento NWR in Glenn County, the California Department of Fish and Game’s Stone Corral Ecological Reserve in Tulare County, and the Bert Crane Ranch in Merced County.

II.A. Application of the 1996 Distinct Population Segment (DPS) policy

II.A.1. Is the species under review listed as a DPS?

Yes,
 No

The Endangered Species Act (ESA) 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 listing as distinct population segments (DPS) 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.

II.B. Recovery Criteria

II.B.1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes
 No

II.B.2. Adequacy of recovery criteria.

II.B.2.a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

Yes
 No

II.B.2.b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

Yes
 No,

II.B.3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

General recovery criteria for *Chamaesyce hooveri* and 19 other listed plants and animals are described in the Recovery Plan (Service 2005). This Recovery Plan uses an ecosystem-level approach because many of the listed species and species of concern addressed in the plan co-occur in the same natural ecosystem and share the same threats. The over-arching recovery strategy for *Chamaesyce hooveri* 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) participation and outreach. The Recovery Plan provides recovery criteria that implicitly address the four listing factors noted in the final rule to list the species: destruction, modification, or curtailment of habitat or range (Factor A), disease or predation (Factor C), 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, was included as a minor threat in the listing and is not addressed in the Recovery Plan.

Delisting criteria for *Chamaesyce hooveri* 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.

The Recovery Plan identifies specific percentages of suitable habitat to be protected in each of the eight core areas, which include: Oroville, Vina Plains, Grasslands Ecological Area, Sacramento NWR, Merced, Cottonwood Creek, Tulare, and Turlock. 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 represent viable populations (possibly even source populations of vernal pool species for larger metapopulations). Core areas are ranked as Zone 1, 2, or 3 in order of their overall priority for recovery. Core areas containing *Chamaesyce hooveri* are included as both Zones 1 and 2 in the Recovery Plan, with no core areas ranked as Zone 3. In order to delist the species, the Recovery Plan recommends

¹.A) Present or threatened destruction, modification or curtailment of its habitat or range;
B) Overutilization for commercial, recreational, scientific, or educational purposes;
C) Disease or predation;
D) Inadequacy of existing regulatory mechanisms;
E) Other natural or manmade factors affecting its continued existence.

that 95 percent of the suitable *C. hooveri* habitat in each of the Zone 1 core areas and 85 percent of the suitable *C. hooveri* habitat in each of the Zone 2 core recovery areas be protected. The Service does not yet have sufficient information to quantify either the acreage of suitable habitat within each core area. 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.

In the Recovery Plan, the core areas that pertain to *Chamaesyce hooveri* are distributed among four vernal pool regions: Northeastern Sacramento Valley, Solano-Colusa, San Joaquin Valley, and Southern Sierra Foothills. Known Occurrences, Section II.C.1.c below, includes a summary of information about all known occurrences. Descriptions of the protected habitat, by core recovery areas, within each of these four vernal pool regions are described in Section II.C.1.

1B. Species occurrences 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 not yet been met. Most occurrences of *Chamaesyce hooveri* are on private land that is not currently protected. It is presumed that there is genetic variation providing a range of adaptability between the occurrences found in different parts of the geographic range, such as between vernal pool regions. It is for this reason that the Recovery Plan recommends conservation of occurrences and suitable habitat in all core habitat areas where the species is found.

1C. Reintroductions must be carried out and meet success criteria established in the recovery plan.

The Recovery Plan recommends reintroduction to vernal pool regions and soil types from which the status surveys indicate the species has been extirpated. The Service has not yet determined if it is appropriate to reintroduce the species.

1D. Additional occurrences identified through future site assessments, GIS and other analyses, and status surveys that are determined essential to recovery are protected. Any newly found occurrences may count towards recovery goals if the occurrences are permanently protected as described in the recovery plan.

At this time, we are aware of an additional site found on Hamilton Ranch in Tehama County, but have not yet determined if it is essential to recovery. Future surveys may locate additional occurrences of this species, particularly on private lands that support suitable habitat and soil types. No GIS or other analyses to identify areas of potential occurrences have been conducted. This recovery criterion has not been met.

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.

To our knowledge, monitoring of hydrology has not occurred at any of the presumed extant occurrences; therefore, we have no data to evaluate ecosystem function of protected areas.

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.

The Nature Conservancy has developed habitat management and monitoring plans for the Vina Plains. The Vina Plains Preserve is managed under the 2006 *Vina Plains Preserve 2-year Resource Management Plan* (R. Reiner, The Nature Conservancy, pers. comm. 2007). The Sacramento NWR utilizes an Annual Habitat Management Plan that records occurrences of *Chamaesyce hooveri* in a database to help guide operations and management activities, but does not address monitoring and management of ecosystem function. A Draft Comprehensive Conservation Plan was published for the Sacramento NWR in July 2008, which discussed management issues for vernal pool species (Service 2008; J. Silveira pers. comm. 2009). An internal draft management plan has been drafted for the Stone Corral Ecological Reserve, but the date that it will be available for public review is not yet known.(E. Cypher, CDFG, pers. comm. 2008). Therefore, work to meet this criterion is proceeding, but it has not currently been met.

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

This criterion has not been met. Most of the occurrences are on private lands that have no known management in perpetuity or long-term monitoring. The Vina Plains Preserve, established by The Nature Conservancy in 1982, has a management and monitoring plan in place. An endowment fund was not established when the preserve was purchased, so funds for preserve operations are obtained each year through private fund-raising efforts. A small portion of the operating funds are received from a lease for on-site livestock grazing. To date fundraising success has been sufficient to fund operations. Formal monitoring of *Chamaesyce hooveri* occurs every five years (R. Reiner, TNC, pers. comm. 2007). The funding for management and protection of the three occurrences of this species on Service lands is allocated to the NWR annually. No monitoring is currently occurring on the Stone Corral Ecological Reserve (E. Cypher, Regional Botanist, Central Region, California Department of Fish and Game, pers. comm., 2007).

2C. Monitoring indicates that ecosystem function has been maintained in the 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.

The occurrences on the main tract of the Vina Plains Preserve and on the Sacramento NWR have

been monitored; however, continuous monitoring of ecosystem function has not occurred for a duration that meets the requirements specified in the 2005 Recovery Plan (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). This criterion has not been met.

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.

The Recovery Plan recommends collection of seeds from each core area. No seed has been collected and accessioned from any of the occurrences. This criterion has not been met.

3. Status Surveys:

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

3A. Status surveys, 5-year status 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.

This criterion has not been met. Although seven of the occurrences have periodically received some level of monitoring, the monitoring has not occurred over a duration that meets the requirements specified in the 2005 Recovery Plan (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 for all habitat protected in 1. A-E.). Regional vernal pool working groups will be important for tracking the progress of recovery efforts, including monitoring the status of populations of this species, particularly on private lands that are not currently monitored.

Multi-year monitoring has occurred on (1) The Nature Conservancy's Vina Plains Preserve in Tehama County (Nicoletti and Reiner 2003; R. Schlising, Chico State University, pers. comm. 2007), and (2) the Sacramento NWR (J. Silveira, *in litt.* 2009). At Vina Plains, Robert Schlising monitored 35 pools from 1995 to 1999, and 17 of those pools from 1999 to 2004. The results of these surveys are still being analyzed. Alexander and Schlising (1998) summarized the 1995 survey work. In the summer of 2004, *Chamaesyce hooveri* was found in four pools and a high presence of this and other rare vernal pool plant species was reported at the Vina Plains. Eleven pools have been and continue to be monitored since 1992 at the Sacramento NWR (J. Silveira, *in litt.* 2006). We are unaware of any other multi-year monitoring or surveying efforts for this species.

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.

We are unaware of status surveys, status reviews, and habitat monitoring that show that threats identified during and since listing of *Chamaesyce hooveri* have been ameliorated or eliminated. This criterion has not been met.

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. The majority of information needs discussed in the 2005 Recovery Plan are still outstanding. Currently, this criterion has not been met.

4B. Research on genetic structure has been completed (for species where necessary – for reintroduction and introduction, seed banking) and results incorporated into habitat protection plans 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.

No new genetic work has been completed for this species.

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

No research on this topic has been completed.

5. Participation and outreach:

Public participation and outreach implicitly address all five 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 goal of recovery of the 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. The Service is currently in the preliminary stages of organizing both a recovery implementation team and multiple Regional working groups. Service employees have met with various stakeholders to determine interest of stakeholders to be involved in working groups and/or the recovery implementation team. This criterion has not yet been 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.

This action has not been initiated.

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

This action has not been initiated.

II.C. Updated Information and Current Species Status

II. C.1. Biology and Habitat

II.C.1.a. Abundance and population trends:

The Sacramento National Wildlife Refuge populations have been monitored annually since 1992 (J. Silveira, U.S. Fish and Wildlife Service, *in litt.* 2006). *Chamaesyce hooveri* is known to have occurred in 11 pools on the Refuge between 1992 and 2006. It is not seen in all the pools every year. In 2006, it was observed in 4 pools totaling over 1,200 plants. Population numbers have ranged from less than 100 plants seen in 2001 to over 2,500 plants seen in 1993 (J. Silveira, *in litt.* 2009).

II.C.1. b. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historical range (e.g., corrections to the historical range, change in distribution of the species within its historical range, etc.):

Chamaesyce hooveri is known from a few widely separated populations. The main area of concentration for *C. hooveri* is within the Northeastern Sacramento Valley Vernal Pool Region. The Vina Plains of Tehama and Butte Counties contain 15 (56 percent) of the 27 presumed extant sites for *C. hooveri* (CNDDDB 2007) in an area of about 35 square miles (Stone *et al.* 1988). One other site in the same region is near Chico in Butte County. Seven of the extant

occurrences are in the Southern Sierra Foothills Vernal Pool Region, including five in the Visalia-Yettem area of Tulare County and two in the Hickman-La Grange area of Stanislaus County. Three other occurrences are on the Sacramento National Wildlife Refuge in Glenn County, which is in the Solano-Colusa Vernal Pool Region. The one other extant occurrence is on the Bert Crane Ranch in Merced County, which is within the San Joaquin Valley Vernal Pool Region (Keeler-Wolf *et al.* 1998; CNDDDB 2007).

This species is currently found in three types of vernal pools: Northern Basalt Flow, Northern Claypan, and Northern Hardpan on both low and high terraces (Stone, *et al.* 1988). Since the time of listing in 1997, one additional site of *Chamaesyce hooveri* was found in Tehama County.

II.C.1.c. Known Occurrences

The following is a table of presumed extant sites of *Chamaesyce hooveri* by county (from north to south) summarizing information on vernal pool region, core area, county, ownership and date that the occurrence was last confirmed to be extant.

Table 1. *Chamaesyce hooveri* locations and ownership

VP Region	Core Area	County	Ownership	Last seen
NE Sac	Vina Plains	Tehama	Private	2003
NE Sac	Vina Plains	Tehama	Private	1986
NE Sac	Vina Plains	Tehama	Private	1987
NE Sac	Vina Plains	Tehama	Private	1987
NE Sac	Vina Plains	Tehama	Private	1986
NE Sac	Vina Plains	Tehama	Private	1987
NE Sac	Vina Plains	Tehama	Private	1987
NE Sac	Vina Plains	Tehama	Private	1986
NE Sac	Vina Plains	Tehama	Private	1995
NE Sac	Vina Plains	Tehama	TNC	2004
NE Sac	Vina Plains	Tehama	TNC	2004
NE Sac	Vina Plains	Tehama	TNC	2004
NE Sac	Vina Plains	Tehama	TNC	2004
NE Sac	Vina Plains	Butte	Private	1986
NE Sac	Vina Plains	Butte	Private	1987
NE Sac	Oroville	Butte	Private	1986
Solano-Colusa	Sac NWR	Glenn	Service	2006
Solano-Colusa	Sac NWR	Glenn	Service	2006
Solano-Colusa	Sac NWR	Glenn	Service	2006
So. Sierra Foothills	Merced	Stanislaus	Private	1986
So. Sierra Foothills	Merced	Stanislaus	Private	1986
San Joaquin	Grasslands	Merced	Private	1987
So. Sierra Foothills	Cottonwood Creek	Tulare	Private	1992
So. Sierra Foothills	Cottonwood Creek	Tulare	CDFG	1995
So. Sierra Foothills	Cottonwood Creek	Tulare	CDFG, Private	1997

So. Sierra Foothills	Cottonwood Creek	Tulare	CDFG	1992
So. Sierra Foothills	Cottonwood Creek	Tulare	CDFG	1992

In the Recovery Plan, the core areas that pertain to *Chamaesyce hooveri* are distributed among four vernal pool regions: Northeastern Sacramento Valley, Solano-Colusa, San Joaquin Valley, and Southern Sierra Foothills. Descriptions of the protected habitat, by core recovery areas, within each of these four vernal pool regions are described below.

Table 2: *Chamaesyce hooveri* core recovery areas.

Northeastern Sacramento Valley Vernal Pool Region Core areas: Oroville (Zone 1) Vina Plains (Zone 1)
San Joaquin Valley Vernal Pool Region Core areas: Grasslands Ecological Area (Zone 1)
Solano-Colusa Vernal Pool Region Core areas: Sacramento NWR (Zone 1)
Southern Sierra Foothills Vernal Pool Region Core areas: Merced (Zone 1) Cottonwood Creek (Zone 2) Tulare (Zone 2) Turlock (Zone 2)

Northeast Sacramento Vernal Pool Region

Oroville, Butte County

The Oroville core area is in Zone 1 and contains a total of approximately 2,900 acres of land owned/managed by California Department of Fish and Game, U.S. Forest Service, and the Dove Creek Conservation Bank. One occurrence is reported by CNDDDB in this core area on private land. The Service is not aware that any occurrences within the Oroville core area are protected.

Vina Plains, Butte and Tehama Counties

The Vina Plains core area is in Zone 1 and includes the (1) Vina Plains Botanical Management Area, a Caltrans-managed demonstration area along State Highway 99 extending northward from the Butte/Tehama county border to 4.5 miles north of the border; and (2) The Nature Conservancy's Vina Plains Preserve, a 4,600-acre area established for the protection of vernal pools.

The Vina Plains Botanical Management Area does not have conservation easements or fee title for land in this area that contain *Chamaesyce hooveri* populations.

The TNC's Vina Plains Preserve provides habitat that is protected from the direct affects of development. The Vina Plains Preserve forms the western boundary of the TNC's Lassen

Foothills Project, which is envisioned to protect 900,000 acres stretching from Lassen Peak to the Sacramento River. As of the date of this review, 80,000 acres has been put under easement for protection in perpetuity. If acquired, some of this acreage will be in the Vina Plains core area, and will protect any *Chamaesyce hooveri* populations from being destroyed by development. The Nature Conservancy's Vina Plains Preserve contains 4 known occurrences of this species. The amount of suitable *C. hooveri* habitat that is protected within this entire core recovery area has not been quantified at this time. The Service is not aware of other properties within this core recovery area that are protected for the benefit of vernal pool species. The Hamilton Ranch site is within a 400-acre portion of the ranch that has been proposed to be protected as compensation for projects in the Chico area, but does not currently have a conservation easement.

San Joaquin Valley Vernal Pool Region

Grasslands Ecological Area, Merced County

The Grasslands Ecological core area is in Zone 1. The amount of suitable *Chamaesyce hooveri* habitat that is protected within this core recovery area has not been quantified at this time. The Grasslands Ecological core area has one occurrence located within an easement on the Bert Crane Ranch.

Solano-Colusa Vernal Pool Region

Sacramento NWR, Glenn and Colusa Counties

The Sacramento National NWR core area is in Zone 1. The Sacramento NWR core area has three occurrences all located on the Sacramento National Wildlife Refuge, however the amount of suitable *Chamaesyce hooveri* habitat that is protected within this core area has not been quantified at this time.

Southern Sierra Foothills Vernal Pool Region

Merced, Stanislaus County

The Merced core area is in Zone 1. The amount of suitable *Chamaesyce hooveri* habitat that is protected within this core area has not been quantified at this time. The Merced core area has two occurrences and both are located on private lands. The majority of lands within this core recovery zone are privately owned. The Service is not aware that any occurrences within the Merced core area are protected.

Cottonwood Creek, Tulare County

The Cottonwood Creek core area is in Zone 2. California Department of Fish and Game's 900-acre Stone Corral Ecological Reserve protects a number of high quality hardpan pools (Keeler-Wolf *et al.* 1998), and is a documented location of *Chamaesyce hooveri* (CNDDDB 2007). There are four occurrences on the Stone Corral Ecological Reserve, although only three are identified

in CNDDDB as occurring on California Department of Fish and Game's land (E. Cypher, pers. comm. 2008). The Service is not aware of other properties within this core area that are protected for the benefit of vernal pool species.

Tulare, Tulare County

The Tulare Core core area is in Zone 2.. The amount of suitable habitat that is protected within this core recovery area has not been quantified at this time. The majority of lands within this core area are privately owned and not protected or managed for the benefit of vernal pool species.

Turlock, Stanislaus County

The Turlock core area is in Zone 2. The amount of suitable habitat that is protected within this core recovery area has not been quantified at this time. The majority of lands within this core area are privately owned and not protected or managed for the benefit of vernal pool species.

II.C.1.d. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Vernal pools supporting *Chamaesyce hooveri* typically occur on alluvial fans or terraces of ancient rivers or streams, with a few on the rim of the Central Valley basin. In addition, *C. hooveri* has been reported from several pools that were formed artificially when small ponds were created in appropriate soil types (CNDDDB 2007). The pools supporting this species vary in size from 0.24 to 600 acres, with a median area of 1.43 acres (Stone *et al.* 1988, Barbour *et al.* 2007). This species may occur along the margins or in the deepest portions of the dried pool-bed (Stone *et al.* 1988, Alexander and Schlising 1997). Deeper pools apparently provide better habitat for this species because the duration of inundation is longer and the deeper portions are nearly devoid of other vegetation, thus limiting competition from other plants (Stone *et al.* 1988; J. Stebbins *in litt.* 2000).

Throughout its range, two of the most frequent associates of *Chamaesyce hooveri* are the rare vernal pool grasses *Tuctoria greenei* (Greene's tuctoria) and *Orcuttia pilosa* (hairy Orcutt grass), at 12 and 10 occurrences, respectively. In four of these cases, all three species grow in the same pool (Alexander and Schlising 1997, CNDDDB 2007). However, *C. hooveri* tends to grow in different portions of the pools than these federally-listed grasses (Stone *et al.* 1988, Alexander and Schlising 1997).

Barbour *et al.* (2007) completed a classification of vernal pool plant community types that occur naturally in California's Central Valley. As a part of their study, they described the floristics and physical environment of Central Valley vernal pool communities and described the geographic range, degree of commonness, and presence of state or federally listed plant taxa for each Central Valley community. They found *Chamaesyce hooveri* in smaller pools than it had previously been reported. Additionally, *Tuctoria greenei* and *C. hooveri* were exclusively found in a community Barbour *et al* named *Tuctoria greenei-Chamaesyce hooveri*. Species richness was

low (only 5 species) across all sites and there were a total of 13 plant species co-occurring with *C. hooveri*, three of which were non-native.

II.C.1.e. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

No new genetic information is available.

II.C.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

III.C.2.a. Present or threatened destruction, modification or curtailment of its habitat or range:

At the time of listing, the primary threats to *Chamaesyce hooveri* were loss of habitat by agricultural conversion, habitat degradation by numerous activities associated with agricultural development, and past extirpation and continued threat by urban development projects (62 FR 14338). Habitat loss occurs from direct destruction and modification of pools due to filling, grading, discing, leveling, paving, and other activities, as well as modification of surrounding uplands, which alters vernal pool watersheds and the supporting upland ecosystem. Fifty-five percent of presumed extant sites of *C. hooveri* are on private land and are not protected (CNDDDB 2007). We do not have current information on the status of 19 of the 27 sites of *C. hooveri*.

During the 30 years prior to listing, agricultural land conversion was known to have caused the extirpation of one population and threatened two more populations of *Chamaesyce hooveri* in Tulare County (Stone *et al.* 1988). In Stanislaus County, the area east of Waterford and Hickman was being converted into grainfields, almond orchards, and irrigated pasture. Thus agricultural land conversion in this area threatened 2 more existing populations of *C. hooveri* (Stone *et al.* 1988). It is likely that several occurrences were eliminated by habitat losses before they became known, mainly from conversion of vernal pool habitat to agricultural uses (Stone *et al.* 1988).

A comparison of 2005 NAIP (National Agriculture Imagery Program) imagery against DOQQs (Digital Ortho Quarter Quadrangles) ranging from 1992 to 1998 for the eight core areas (see Table 2) revealed habitat conversion from natural habitat to more intensive agricultural uses such as row crops in five of the eight recovery core areas. We estimated a total of nearly 5,600 acres had been converted, with the greatest acreage, approximately 5,000 acres, converted within the Merced core area. Additionally, one of the occurrences of *Chamaesyce hooveri* within the Vina Plains core area appears to have been converted to more intensive agriculture. We have no new information to suggest that these threats to the species have substantially changed since the time of listing in 1997.

Habitat fragmentation and conversion - Vernal pool habitats in the Central Valley now represent approximately 9 percent of their former area (State of California 2003), and remaining habitats are considerably more fragmented and isolated than historically and during the recent past. California's human population is expected to increase by 60 percent between 2000 and 2025 (California Department of Finance 2004) and almost double the 1990 State population, by

2040 (Field *et al.* 1999). Much of this population expansion will occur in the Central Valley, where 73 percent of the land is privately owned, and only 6 percent of the land is in public ownership (Keeler-Wolf *et al.* 1998). In areas where habitat remains, increased urban conversion of vernal pool habitat continues to threaten this species and habitat loss is expected to continue as urban boundaries expand further especially through high and low terrace formations on the eastern side of the valley. Even in areas where habitat is protected, the urbanization of lands surrounding conserved areas results in the fragmentation of protected habitats, preventing dispersal between occurrences, as well as increased edge effects to pool complexes. Studies have not been conducted to determine the minimum area (upland and wetland) needed to sustain vernal pool species in the long-term. Habitat conversion is expected to continue as the human population increases (Teitz *et al.* 2005). One of the driving factors for intensification of agricultural uses is the expansion of urban areas, displacing the more intensive agricultural uses into formerly less intensively used areas.

The planned construction and expansion of the new University of California at Merced County (University) near Yosemite Lake may threaten suitable habitat of *Chamaesyce hooveri*. Rapid urbanization is expected to take place around the new campus. Currently, there are two known occurrences approximately 14 miles north of the campus that are the nearest recorded populations of *C. hooveri*, in an area outside of the University planning area. However, the campus and the surrounding lands are within the apparent range of suitable habitat for this species as determined by GIS analysis of soil layers and altitude (Vollmar 2002). Additional surveys and analyses of urban expansion plans will be necessary to determine whether this proposed project will affect suitable habitat for this species.

A proposal to link several cities in California, including San Francisco, Merced, Fresno, Bakersfield, Los Angeles, and San Diego, by 700 miles of high-speed rail (California High-Speed Rail Authority 2007) has the potential to impact this species. This project has the potential to increase the growth of the cities in the San Joaquin Valley by enabling commuting from larger communities. The human population growth for the San Joaquin Valley was modeled using four scenarios, including: Accommodating Urban Development, Prime Farmland Conservation, High-Speed Rail, and the Automobile-Oriented Managed growth scenario (Teitz *et al.* 2005). The High-Speed Rail scenario looked at the proposal connecting the Bay Area and Sacramento to Los Angeles by high-speed rail. Under this scenario, the probability of urbanization increased within a 20-mile radius of the stations tentatively identified for Merced and Visalia. Occurrences of *Chamaesyce hooveri* are within the 20-mile radius from Merced and Visalia and could be threatened by urbanization. Threats to the occurrences of critical habitat from urbanization within a 20-mile radius would increase significantly over current levels.

Twelve occurrences of *Chamaesyce hooveri* are in preserves or on public land. The Vina Plains Preserve, managed by The Nature Conservancy, includes four of the extant occurrences and one presumed extirpated occurrence. The California Department of Fish and Game manages four of the extant Tulare County occurrences as part of the Stone Corral Ecological Reserve complex. Three of the extant occurrences are on the Sacramento National Wildlife Refuge (CNDDDB 2007). One additional occurrence of *C. hooveri* in Merced County is on private land (the Bert Crane Ranch) that is protected from development by a conservation easement (J.

Silveira, *in litt.* 2000). Currently, 12 of the 27 known sites of *C. hooveri* are protected from the direct affects of development.

II.C.2.b. Overutilization for commercial, recreational, scientific, or educational purposes:

Overutilization of this species for commercial or other purposes was not known to be a threat at the time of the 1997 final rule. The 1997 listing rule does state that uncontrolled visits by groups or individuals to vernal pool areas could result in possible trampling of vernal pool plants. Vandalism is also listed as a potential threat. However, this factor does not appear to be a substantial threat, and is not addressed in the 2005 Recovery Plan recovery criteria. We are not aware of any information that would suggest that either uncontrolled visits or vandalism have become a greater threats since listing.

II.C.2.c. Disease or predation:

We are not aware of any new information regarding disease or predation since the listing of *Chamaesyce hooveri* in 1997. The 1997 listing rule stated that disease was not a factor and that livestock grazing and associated trampling was not a factor when moderate grazing regimes on dry pasture are utilized. However, livestock grazing and trampling may or may not adversely affect vernal pool plants depending on, among other things, the kind of livestock, stocking level, season-of-use, and grazing duration. Livestock grazing may have additional indirect effects on vernal pool hydrology and competition from nonnative plants (see II.C.2.e.)The stems of *C. hooveri* exude a latex when broken that appears to repel herbivores and that may be poisonous. Appropriate grazing regimes are addressed in the 2005 Recovery Plan criteria.

II.C.2.d. Inadequacy of existing regulatory mechanisms:

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

Federal Laws

Endangered Species Act: The Endangered Species Act of 1973, as amended (Act), is the primary Federal law that provides protection for *Chamaesyce hooveri*. 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. The Act affords protection to federally-listed plants 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. 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. See discussion under California State Laws below.

Habitat Conservation Plans (HCP) that are developed as part of an application for incidental take coverage under section 10 of the ESA have the potential to provide some level of protection for listed plants. Currently, one HCP, the PG&E San Joaquin Valley Operations and Maintenance HCP (PG&E San Joaquin Valley HCP), has been permitted. The PG&E San Joaquin HCP covers operations, maintenance, and minor construction activities for PG&E facilities located in portions of nine San Joaquin Valley Counties: Kern, Kings, Tulare, Fresno, Madera, Merced, Mariposa, Stanislaus, and San Joaquin.

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, but NEPA does not require or guide mitigation for impacts.

Federal Clean Water Act: Section 404 of the Clean Water Act may afford some protection to *Chamaesyce hooveri*. The U.S. Army Corps of Engineers (Corps) issues permits for the discharge of dredged or fill material into navigable waters of the U.S. 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. The Act is the primary Federal law that provides protection for *Chamaesyce hooveri* since its Federal listing as a threatened species in 1997.

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 their regulatory authority over vernal pools, unmitigated destruction of potential habitat for *Chamaesyce hooveri* may increase over the range of the species.

California State Laws

Currently, *Chamaesyce hooveri* is not listed under the California Endangered Species Act (Chapter 1.5 sec. 2050 *et seq.* of the California Fish and Game Code and Title 14 California Code

of Regulations section 670.2). The Native Plant Protection Act (Division 2, Chapter 10, section 1900 *et seq.*) also does not provide any special protection to this species.

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 feasible. However, CEQA does not guarantee that such conservation measures will be implemented. Section 15065 of the CEQA Guidelines requires a finding of significance if a project has the potential to “reduce the number or restrict the range of an endangered, rare, or threatened species.” Under CEQA, species that are eligible for listing as rare, threatened or endangered, but are not so listed are given the same protection as those species that are federally or State listed. Once significant effects are identified, the lead agency has the option to require mitigation for effects through changes in the project or to decide that overriding considerations make mitigation infeasible. In the latter case, projects may be approved that cause significant environmental damage. Protection of species through CEQA is left to the discretion of the State agency involved. Moreover, CEQA does not regulate many activities on private land which might negatively affect the species such as ministerial projects or grazing. The CEQA guidelines section 15369, defines ministerial as describing “a governmental decision involving little or no personal judgment by the public official as to the wisdom or manner of carrying out the project A ministerial decision involves only the use of fixed standards or objective measures, and the official cannot use personal, subjective judgment in deciding whether of how the project should be carried out.” Some examples of projects that are generally ministerial include roof replacements, interior alterations to residences, and landscaping changes.

II.C.2.e. Other natural or manmade factors affecting its continued existence:

Other natural or manmade threats cited in the 1997 final listing rule include competition by one or more native or nonnative plant species, but did not provide any detail with regard to which nonnative plant species. Current threats include the threat of competition discussed in the 1997 final rule, and in addition, drought and climate change, and extirpation due to small population size.

Nonnative Plants -- Competition from invasive native or non-native plant species threatens nine of the extant occurrences, including eight in the Vina Plains and one on the Sacramento National Wildlife Refuge in Glenn County. Native competitors of *Chamaesyce hooveri* include *Eryngium* species (coyote-thistle), *Malvella leprosa* (alkali mallow), a noxious weed according to Hill (1993), *Phyla nodiflora* (lippia), *Scirpus acutus* var. *occidentalis* (hard-stemmed tule, alkali bulrush (*Scirpus maritimus*), and *Xanthium strumarium* (cocklebur). Non-native competitors include bindweed (a noxious weed according to Dempster 1993) and *Crypsis schoenoides* (swamp grass) (J. Silveira *in litt.* 2000; CNDDDB 2007). On the Vina Plains Preserve, the pools with *Chamaesyce hooveri* also had the highest frequency of bindweed, at least in 1995 (Alexander and Schlising 1997). Increasing dominance by these competitors may be associated with changes in hydrology and livestock grazing practices (Stone et al. 1988, Alexander and Schlising 1997; CNDDDB 2007). We do not have information regarding the other occurrences.

Due to late spring rains during the last few years, an invasive plant, *Crypsis vaginiflora* has become dominant in many Basin-Rim vernal pools within the Sacramento NWR Complex (Sacramento, Delevan and Colusa). *Crypsis* germinates earlier than *Chamaesyce hooveri* and can outcompete the listed species (J. Silveira, pers. comm. 2007). No information is available for rest of the populations.

Drought and Climate Change – *Chamaesyce hooveri* is an obligate wetland species found only in vernal pools, typically on alluvial fans or terraces of ancient rivers or streams, with a few on the rim of the Central Valley basin. Therefore, maintenance of the natural hydrology of the pools is necessary for the survival and recovery of this species. Drought or flood conditions will place additional strains on the vernal pool ecosystem supporting *C. hooveri* occurrences, some of which are already fragmented or reduced by agricultural conversion and development. Where occurrences persist on only marginal habitat, the addition of extreme drought conditions is likely to result in higher rates of mortality in the short term with the effects of low reproductive output and survivorship persisting after the drought has ceased. It is unknown how quickly *C. hooveri* occurrences may rebound after severe climatic conditions.

Climate is predicted to change in California during the 21st century (Cayan *et al.* 2005, Field *et al.* 1999). 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 (Cayan *et al.* 2005; Field *et al.* 1999). The predicted impacts on California's ecosystems projected with a high certainty include (1) higher sea level; (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 range migrations by species in response to changes in ecological conditions as a result of climate change may be difficult or impossible without human intervention (Field *et al.* 1999)]; and, (3) increased human use and competition among urban, agricultural, and natural ecosystem uses due to decreased precipitation and water availability (Field *et al.* 1999). Although the specific effects of climate change on *Chamaesyce hooveri* are unknown, the effects of increased winter flooding and drought conditions in the spring and summer have the potential to adversely affect this species. Due to this apparent long lasting change in rainfall period, the overall trend within the Basin-Rim vernal pools within the Sacramento NWR Complex is a decline in habitat quality and numbers of plants (J. Silveira, pers. comm. 2007). No specific information is available for the rest of the occurrences.

Risk of extirpation from stochastic events and small population size -- Small population size poses a serious threat for at least four of the known occurrences, which total fewer than 100 individuals even in favorable years (CNDDDB 2007). Populations of this species can vary greatly from year to year, with some extant occurrences not appearing during certain years. Two other occurrences with populations of only a few hundred individuals also may be similarly threatened. Such small populations are subject to extirpation from random events such as extended drought and genetic drift. The conservation biology literature commonly notes the vulnerability of taxa known from small populations (e.g., Shaffer 1981, 1987; Menges 1991; Primack 2006; Groom *et al.* 2006). Small population size makes it difficult for this species to persist while sustaining the impacts of habitat fragmentation. Such populations may be highly susceptible to extirpation due to chance events, inbreeding depression, or additional environmental disturbance (Gilpin and Soule 1988; Goodman 1987).

II.D. Synthesis

When the *Chamaesyce hooveri* was listed as threatened in 1997, the primary threats to its survival and recovery were loss of habitat by agricultural conversion, habitat degradation by numerous activities associated with agricultural development, past extirpation and continued threat by urban development projects, inadequate regulatory mechanisms, and competition with nonnative weeds. 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, climate change, and small population size, may also threaten this species. The majority of the localities of *C. hooveri* do not have management plans, monitoring programs, or adequate funding to ensure that these localities are sustainable in perpetuity. Lack of management especially for nonnative species and hydrology; monitoring; and funding are not, in themselves, threats to *C. hooveri*; however, without these components, the potential threats described above may not be identified and eliminated.

The four occurrences within the Nature Conservancy's Vina Plains Preserve, in Tehama and Butte Counties, three occurrences on the Sacramento NWR in Glenn County, four occurrences California Department of Fish and Game's Stone Corral Ecological Reserve in Tulare County, and one occurrence at the Bert Crane Ranch in Merced County are protected from the direct effects of development or agricultural conversion. Fifteen occurrences remain unprotected on private lands.

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 agriculture practices and urbanization, invasive weeds, we conclude that *Chamaesyce hooveri* still meets the ESA definition of threatened (likely to become endangered in the foreseeable future throughout a significant portion of its range). No status change is recommended at this time.

III. RESULTS

III.A. 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

The current status of *Chamaesyce hooveri* remains relatively unchanged since the time of listing in 1997.

III.B. New Recovery Priority Number:

We recommend the recovery priority number remain the same.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS -

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

1. Protect vernal pool habitat from being destroyed or modified by development, agriculture, or other activities. Acquiring conservation easements or fee title to habitat lands are some ways that conservators can help guarantee protection of the species in perpetuity.
2. Develop standardized population trend survey protocols and implement to complete updated status surveys, especially for populations on private lands where trends have not been recently updated.
3. Manage invasive plants on preserves. Management should include research to determine effective eradication methods of nonnative competitors, and pool conditions that favor one plant over another.
4. Create and convene regional vernal pool working groups in regions where *Chamaesyce hooveri* occurs. Regional vernal pool working groups will be important for the tracking the progress of recovery efforts, including the amount of suitable habitat protected for each of the species in the core areas.
5. Collect seeds from each core area following the Center for Plant Conservation Guidelines (1991). Seed collections should be stored in at least two sites, including the National Center for Genetic Resources in Fort Collins, Colorado, and a facility certified by the Center for Plant Conservation.

V. REFERENCES

References Cited

- Alexander, D.G., and R.A. Schlising. 1997. Vernal pool ecology and vernal pool landscape management as illustrated by rare macroinvertebrates and vascular plants at Vina Plains Preserve, Tehama County, California. Unpublished report to the California Department of Fish and Game, Redding, California. 139 pp.
- Alexander, D. G., and R. A. Schlising. 1998. Patterns in time and space for rare microinvertebrates and vascular plants in vernal pool ecosystems at the Vina Plains Preserve, and implications for pool landscape management. Pages 161-168 in: Witham, C.W., E.T. Bauder, D. Belk, W.R. Ferren Jr., and R. Ornduff (Editors). Ecology, Conservation, and Management of Vernal Pool Ecosystems – Proceedings from a 1996 Conference. California Native Plant Society, Sacramento, California.
- Barbour, M.G, A.I. Solomeshch, J.J. Buck, R.F. Holland, C.W. Witham, R.L. MacDonald, S.L. Starr and K.A. Lazar. 2007. Classification, ecological characterization, and presence of listed plant taxa of vernal pool associations in California. Report to U.S. Fish and Wildlife Service, May 15, 2007. 146 pp.
- California Natural Diversity Database. 2007. Natural Heritage Division. California Department of Fish and Game, State of California
- California High-Speed Rail Authority. 2007. California High-Speed Rail – Biological resources evaluation of the Sacramento to Lodi segment. Prepared by DMJM Harris and CH2M Hill Team, DMJM Harris/AECOM and CH2MHILL. 9 pp. + tables + appendices.
- Cayan, D., M. Dettinger, I. Stewart and N. Knowles. 2005. Recent changes toward earlier springs – Early signs of climate warming in western North America. Watershed Management Council Networker, 13, Spring. Pages 3-9. Available at <http://www.watershed.org>.
- Center for Plant Conservation. 1991. Appendix. Genetic sampling guidelines for conservation collections of endangered plants. Pages 225-238 in Genetics and conservation of rare plants. D.A. Falk and K.E. Holsinger, editors. Oxford University Press, New York.
- Field, C.B., G.C. Daily, F.W. Davis, S. Gaines, P.A. Matson, J. Melack, and N.L. Miller. 1999. Confronting Climate Change in California. Ecological Impacts on the Golden State. A Report of the Union of Concerned Scientists and the Ecological Society of America. 62 pp.
- Gilpin, M. E. and M. E. Soulé. 1988. “Minimum viable populations: processes of species extinction.” In M. E. Soulé, ed. Conservation Biology: The Science of Scarcity and Diversity. Sinauer Associates, Inc.; Sunderland, MA. Pages 18-34.

- Goodman, D. 1987. "The demography of chance extinction." *In* M. E. Soule, ed. Conservation Biology: The Science of Scarcity and Diversity. Sinauer Associates, Inc.; Sunderland, MA. pp. 11-19.
- Groom, M. J., G. K. Meffe, and C.R. Carroll. 2006. Principles of conservation biology, third edition. Sinauer Associates, Inc., Sunderland, Massachusetts.
- Griggs, F.T. 2000. Vina Plains Preserve: Eighteen Years of Adaptive Management. *Fremontia* 27 (4) and 28 (1). Published by the California Native Plant Society.
- Keeler-Wolf, T., D.R. Elam, K. Lewis, and S.A. Flint. 1998. California vernal pool assessment preliminary report. May. California Department of Fish and Game, Sacramento, California. 159 pp.
- LSA Associates, Inc. 2003. Biological inventory report Hamilton ranch mitigation site Tehama County, California. Rocklin, California 26pp. +appendices.
- Menges, E.S. 1991. The application of minimum viable population theory to plants. Pages 45-61 *in* D.A Falk and K.E. Holsinger (editors). Genetics and conservation of rare plants . Oxford University Press, New York, New York. 283 pp.
- Nicoletti, M. and Reiner, R. 2003. Vernal Pool Survey of Vina Plains Preserve Large Pool Rare Plants; Spring 2003. Report to the Nature Conservancy. Chico, California. 14 pp.
- Primack, R. B. 2006. Essentials of conservation biology, fourth edition. Sinauer Associates, Sunderland, Massachusetts.
- Shaffer, M. L. 1981. Minimum population sizes for species conservation. *Bioscience* 31:131-134.
- Shaffer, M. L. 1987. Minimum viable populations: coping with uncertainty. Pages 69-86 *in* M.E. Soulé (editor). Viable populations for conservation. Cambridge University Press, New York, New York.
- State of California, Office of Planning and Research. 2003. Governor's Environmental Goals and Policy Report. November. State of California Governor's Office of Planning and Research, Sacramento, California.
- Stone, R. D., W. B. Davilla, D. W. Taylor, G. L. Clifton, and J. C. Stebbins. 1988. Status survey of the grass tribe Orcuttieae and *Chamaesyce hooveri* (Euphorbiaceae) in the Central Valley of California. 2 volumes. U.S. Fish and Wildlife Service Technical Report, Sacramento, California. 124 pp.
- Teitz, M.B., Deitzel, C and W. Fullton. 2005. Urban development futures on the San Joaquin Valley. Publisher?, San Francisco, California, 115pp..

U.S. Fish and Wildlife Service (Service). 1997. Endangered and threatened wildlife and plants; determination of endangered status for three plants and threatened status for five plants from vernal pools in the Central Valley of California. Federal Register 62: 14338-14352.

U.S. Fish and Wildlife Service (Service). 2005. Recovery plan for vernal pools ecosystems of California and Southern Oregon. Portland, Oregon. xxvi + 606 pp.

U.S. Fish and Wildlife Service (Service). 2008. Sacramento, Delevan, Colusa, and Sutter National Wildlife Refuges. Draft Comprehensive Conservation Plan. Prepared by U.S. Fish and Wildlife Service Region 8 Refuge Planning Office and Sacramento National Wildlife Refuge Complex, Sacramento and Willows, California..

Vollmar, J.E. (editor). 2002. Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands. Merced, California: Merced County UC Development Office.

In Litteris

Schlising, R. 2007. California State University, Chico, Emeritus Professor. Electronic messages providing information on the occurrences at the Vina Plains preserve

Silveira, J. 2000. Letter to Ellen Cypher, Endangered Species Recovery Program, Bakersfield, California. 1 page + 35 pages attachments.

Silveira, J. 2006. Letter to Recovery Permit Coordinator, U.S. Fish and Wildlife Service, Sacramento FWO, California.

Silveira, J. 2009. Electronic mail correspondence from Joe Silveira, Sacramento NWR, to Kirsten Tarp, Sacramento FWO.

Stebbins, J. 2000. Letter to Ellen Cypher, California State University, Stanislaus, Endangered Species Recovery Program, Bakersfield, California. 1 p. + 17 pp attachment.

Personal Communications

Cypher, Ellen. 2007, 2008. Regional Botanist, Central Region, California Department of Fish and Game. California Department of Fish and Game, Fresno, California.

Reiner, Richard. 2007. Conversation between Richard Reiner, Preserve Manager, The Nature Conservancy, Red Bluff, California and Kirsten Tarp U.S. Fish and Wildlife Service, Sacramento FWO.

Silveira, J. 2007, 2009. Conversations between Joe Silveira, Sacramento NWR, and Kirsten Tarp, U.S. Fish and Wildlife Service, Sacramento SFWO.

Witham, Carol. 2007. Conversation between Carol Witham, biological consultant, and Kirsten Tarp, U.S. Fish and Wildlife Service, Sacramento FWO.

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

Current Classification: Threatened
Recommendation resulting from the 5-Year Review

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

Appropriate Listing/Reclassification Priority Number, if applicable N/A

Review Conducted By Sacramento Fish and Wildlife Office staff

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Susan C Moore Date 1/16/09

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, Fish and Wildlife Service

Approve M. J. F. [Signature] Date 2-4-09