

**Conservancy Fairy Shrimp
(*Branchinecta conservatio*)**

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



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

September 2007

5-YEAR REVIEW

Conservancy Fairy Shrimp (*Branchinecta conservatio*)

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) and survey information from experts who have been monitoring various localities of this species. We also considered information from a Service-contracted report. The Recovery Plan and personal communications with experts were our primary sources of information used to update the species status and threats sections of this review.

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, California/Nevada Operations Office, 916-414-6464

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I.C. Background

I.C.1. FR Notice citation announcing initiation of this review

71 FR 14538, March 22, 2006. We received no information from the public in response to this notice.

I.C.2. Listing history

Original Listing

FR notice: 59 FR 48136

Date listed: September 19, 1994

Entity listed: Species (*Branchinecta conservatio*)

Classification: Endangered

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 the Conservancy fairy shrimp 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 30269).

I.C.4. Review History:

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

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

The recovery priority is 8 (based on a 1-18 ranking system where 1 is the highest recovery priority and 18 is the lowest), reflecting a moderate degree of threat, a high potential for recovery, and a taxonomic rank of full species.

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

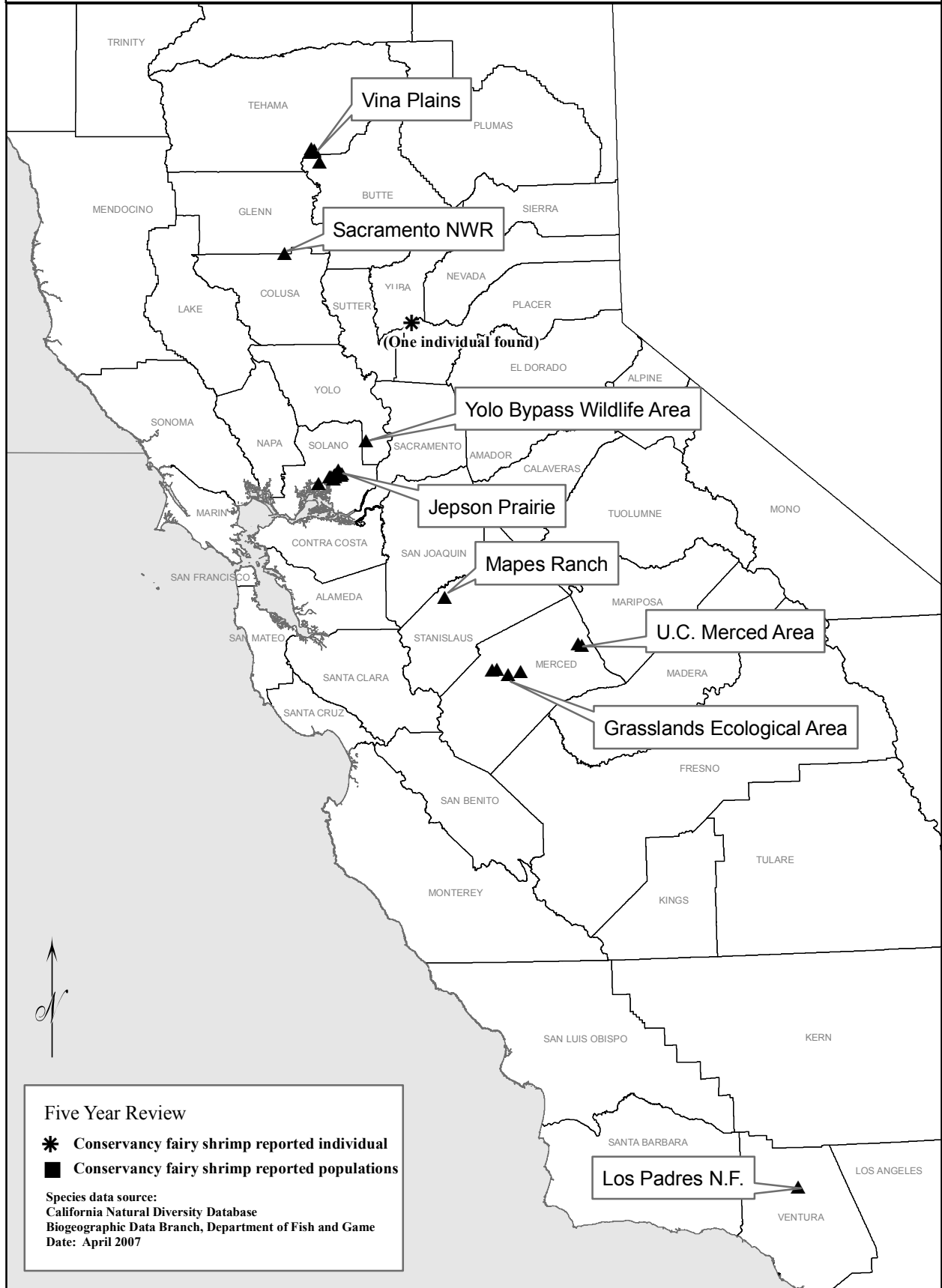
II. REVIEW ANALYSIS

Species Overview

As summarized in our Recovery Plan (Service 2005), Conservancy fairy shrimp (*Branchinecta conservatio*) are tiny freshwater crustaceans with delicate elongate bodies, large stalked compound eyes, and 11 pairs of phyllopods (swimming legs that also function as gills). Fairy shrimp do not have a hard shell, a characteristic of the order Anostraca to which they belong. This species differs from other branchinectids in the flattened portions of its antennae. Conservancy fairy shrimp are endemic to vernal pools in California and this species is restricted to the Central Valley except for one population in the Central Coast in Ventura County (Figure 1). The majority of sites inhabited by this animal are relatively large and turbid vernal pools called playa pools (Helm 1998, Eriksen and Belk 1999, Vollmar 2002). Playa pools typically remain inundated much longer than most vernal pools, often well into the summer, even though they often have maximum depths comparable to vernal pools. Playa pools are distinguished from vernal pools because they are larger in size and they are much rarer on the landscape than vernal pools (Vollmar 2002).

For the purpose of this 5-year review, the Service has grouped together “clusters” of individual Conservancy fairy shrimp locality records that are in close proximity to each other (i.e., within 5 miles or less of each other), and defined these clusters as “populations”. For example, in the Jepson Prairie area, the California Natural Diversity Database (CNDDB 2007) reports 13 locality records for this species. In addition, the Service is aware of one additional locality in the Jepson Prairie area that is not reported in the CNDDB, for a total of 14 known localities. Twelve of the 14 localities are within 1.25 miles of each other, with the remaining two localities within 3 miles of them. Because of the relatively close proximity of these 14 localities, the Service refers to this

Figure 1 **Reported Populations of Conservancy Fairy Shrimp**



0 25 50 100 Miles

0 40 80 160 Kilometers

cluster of localities as one population (the Jepson Prairie Population). However, other populations, such as the Yolo Bypass Wildlife Area, in Yolo County, are comprised of only a single vernal pool (i.e., locality). In general, our definition of “locality” does not necessarily coincide with a single vernal pool, nor do we think these groups necessarily represent biological populations. Rather, they are convenient for reference to various parts of the range. Thus, our grouping methodology is consistent with the identification of the six populations known at the time of listing.

Conservancy fairy shrimp are rare, and at the time of listing, six widely separated populations (i.e., clusters of localities) of this species were known (59 FR 48136). Extensive surveys for fairy shrimp species throughout the range of Conservancy fairy shrimp have located only two additional populations since the species was listed in 1994. Currently, the Service is aware of eight populations of Conservancy fairy shrimp, which include (from north to south): (1) Vina Plains, Butte and Tehama counties; (2) Sacramento National Wildlife Refuge (NWR), Glenn County; (3) Yolo Bypass Wildlife Area, Yolo County; (4) Jepson Prairie, Solano County; (5) Mapes Ranch, Stanislaus County; (6) University of California (U.C.) Merced area, Merced County; (7) Grasslands Ecological Area, Merced County; and, (8) Los Padres National Forest, Ventura County (Figure 1). Section II.C.1.c., Known Localities, provides more detail regarding the eight populations.

Conservancy fairy shrimp were reported at Beale Air Force Base (AFB) in 1991 (CNDDDB 2007). The Service has determined that the Beale AFB does not likely contain Conservancy fairy shrimp for the following reasons: (1) Conservancy fairy shrimp have not been detected at the AFB in subsequent surveys (Beale AFB 2005); and (2) the specimens at Beale AFB that were identified as Conservancy fairy shrimp were later correctly identified as vernal pool fairy shrimp (C. Rogers, EcoAnalysts, Inc., *in litt.*, 2007).

A single male Conservancy fairy shrimp was detected in Placer County in the spring of 2007 (B. Helm, Brent Helm Consulting, pers. comm., 2007). The Service does not have sufficient information to determine if this detection represents a population, or an anomaly. Further surveys are required to determine if the Placer County locality represents a sustainable population of this species.

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 listings as distinct population segments only to vertebrate species of fish and wildlife. Because the species under review is an invertebrate 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 Conservancy fairy shrimp 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 co-occur in the same natural ecosystem and share the same threats. The over-arching recovery strategy for Conservancy fairy shrimp 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 either directly or 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 not included as a threat in the listing rule and is not addressed in the Recovery Plan. Since the Recovery Plan has only recently begun to be implemented, species surveys and monitoring efforts that will provide data to evaluate progress towards recovery have yet to be implemented.

Downlisting /delisting criteria for Conservancy fairy shrimp 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.

Vernal pool regions used in the Recovery Plan are based largely on the presence of endemic species, with soils and geomorphology as secondary elements, and each region contains one or more of the vernal pool species covered in the plan. Core areas are distinct areas in each vernal pool region that support high concentrations of federally-listed vernal pool species, are representative of a given species’ range, and are generally where recovery actions are focused. Core areas represent viable populations (possibly even source populations of vernal pool species for larger metapopulations) that will contribute to the connectivity of habitat and thus increase dispersal opportunities between populations. More than one federally-listed vernal pool species may be found within a single core area, and the core areas encompass areas larger than just the known localities of Conservancy fairy shrimp. In the Recovery Plan, the eight core areas that pertain to the Conservancy fairy shrimp include: Vina Plains, Caswell, Grasslands Ecological Area, Ventura County, Jepson Prairie, Sacramento NWR, Collinsville, and Madera (Table 1).

Table 1: Conservancy fairy shrimp core recovery areas.

Northeastern Sacramento Valley Vernal Pool Region Core area: Vina Plains (zone 1)
San Joaquin Valley Vernal Pool Region Core areas: Caswell (zone 1) Grasslands Ecological Area (zone 1)
Solano-Colusa Vernal Pool Region Core areas: Sacramento NWR (zone 1) Jepson Prairie (zone 1) Collinsville (zone 1)
Southern Sierra Foothills Vernal Pool Region Core areas: Madera (zone 1)
Santa Barbara Vernal Pool Region Core area: Ventura County (zone 2)

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.

The Recovery Plan identifies specific percentages of suitable habitat to be protected in each of the eight core areas. Core areas are ranked as zone 1, 2, or 3 in order of their overall priority for recovery. Core areas containing Conservancy fairy shrimp are included as both zones 1 and 2 in the Recovery Plan, with no core areas ranked as zone 3 (zone 3 represents currently unoccupied, historical habitat, which has not been identified for this species). Table 2 provides a summary of the five vernal pool regions that pertain to Conservancy fairy shrimp, and the zone designations for each of the eight core areas.

To downlist the Conservancy fairy shrimp, the Recovery Plan recommends that 95 percent of the suitable species habitat in each of the zone 1 and zone 2 core areas (i.e., 95 percent of the suitable habitat in the Vina Plains core area, 95 percent of the suitable habitat in the Caswell area, etc.) be protected. This criterion has not been met. To delist the species, in addition to achieving the downlisting criteria, any newly discovered populations should be protected. This recovery criterion has been partially met, as the two populations discovered since listing have been protected.

The Service does not yet have sufficient information to quantify either the acreage of suitable habitat within each core area or the acreage of protected habitat that is suitable for Conservancy fairy shrimp. 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.

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

This criterion has been met. The majority of known Conservancy fairy shrimp populations (i.e., five of the eight populations) are protected by conservation easements or are protected on public lands. Unprotected localities include portions of the U.C. Merced population and the Vina Plains population, and the entire Mapes Ranch population. Two localities within the Jepson Prairie population are not protected under conservation easements, although they are currently managed for vernal pool species. Extreme edges of the Conservancy fairy shrimp's range are protected. The northern-most population occurs within Vina Plains, where 4 of 6 localities are protected. The Los Padres National Forest protects the southern-most population of this species. Table 1 provides information on the protection status of each population.

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

The Recovery Plan recommends introduction to vernal pool regions and soil types from which status surveys indicate the species has been extirpated. As of this review, the Service is not aware of any instances where the species has been extirpated. Therefore, this recovery criterion is not relevant to the species at this time.

Table 1: Known populations (from north to south) of Conservancy fairy shrimp and protection status.

Population	Land owner(s)	Status of Protection of Population
Vina Plains, Butte and Tehama County	The Nature Conservancy and private	4 of 6 localities are protected at the Nature Conservancy's Vina Plains Preserve under a conservation easement.
Sacramento NWR, Glenn County	Service	Protected – Federal lands.
Mariner Parcel, Placer County (not a confirmed population)	Private	Protected – conservation easement.
Yolo Bypass Wildlife Area, Yolo County	California Department of Fish and Game	Protected – State lands.
Jepson Prairie, Solano County	The Nature Conservancy and private	11 localities are protected under conservation easements; 3 localities are in restored wetland areas that are not under easements, but managed for vernal pool species.
Mapes Ranch, Stanislaus County	Private	Not protected.
U.C. Merced Area, Merced County	Private	One of four localities is protected at the Virginia Smith Trust parcel under a conservation easement. Three localities are not protected.
Grasslands Ecological Area, Merced County	Service, California Department of Parks and Recreation, and private	Protected – Federal (San Luis and Merced NWRs) and State lands, and conservation easement on private land.
Los Padres National Forest, Ventura County	U.S. Forest Service	Protected – Federal lands.

1D. Additional localities are permanently protected, if determined essential to recovery goals.

At the time of listing in 1994, there were six known populations of Conservancy fairy shrimp. Since that time, two additional populations have been detected. These two additional populations are the Grasslands Ecological Area, in Merced County, and the Yolo Bypass Wildlife Area, in Yolo County. A third population potentially occurs in Placer County, where a single male Conservancy fairy shrimp was detected within the Mariner Vernal Pool Conservation Bank in 2007 (B. Helm, pers. comm., 2007), although this detection may represent an anomaly. This is the only additional detection that has occurred since the Recovery Plan was finalized in 2005. Due to the rarity of Conservancy fairy shrimp, it is essential to protect all new detected localities to recover this species, and they are protected. Protection of both the Grasslands

Ecological Area and the Yolo Bypass Wildlife Area populations is essential to recovery goals because these populations occur in areas where the species was not previously known to occur. Similarly, if it is determined that the Placer County detection represents a viable population, protection of this population would also be essential to recovery goals.

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.

Monitoring of hydrology has not occurred at any of the known extant populations; therefore the Service is unable to determine whether the hydrology at extant locations has supported viable populations through a variety of hydrologic conditions. It is probable that many of the protected sites have functional hydrology that would meet the requirements specified in this recovery criterion. However, the Service has not identified the parameters that need to be monitored to determine if this criterion has been met.

2. Adaptive Habitat Management and Monitoring:

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

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

This criterion has been partially met. Within the Jepson Prairie population, the Jepson Prairie Preserve, Wilcox Ranch, and the Elsie Gridley Conservation Bank are managed under management plans. The Jepson Prairie Preserve and Wilcox Ranch are managed under the December 29, 2006, *Greater Jepson Prairie Ecosystem Regional Management Plan* (B. Wallace, Solano Land Trust, pers. comm., 2006). Vernal pool habitat at the Elsie Gridley Conservation Bank is managed under the September 20, 2005, *Elsie Gridley Conservation Bank Resource Management Plan* (Wetland Resources 2005). The Mariner Vernal Pool Conservation Bank, in Placer County, is managed under the September 6, 2006, *Mariner Vernal Pool Conservation Bank Management and Operations Plan* (Westervelt Ecological Services 2007). The Vina Plains Preserve, in Tehama County, is managed under the 2006 *Vina Plains Preserve 2-year Resource Management Plan* (R. Reiner, The Nature Conservancy, pers. comm., 2007).

Two sites with known localities of this species that will likely have management plans implemented in the future include the Yolo Bypass Wildlife Area and the Sacramento NWR. The Tule Ranch Unit of the Yolo Bypass Wildlife Area is grazed by cattle, but the unit is not currently managed specifically for vernal pool species. The *Yolo Bypass Wildlife Area Land Management Plan* is currently in draft form and was released for public review in the spring of 2007 (D. Feliz, CDFG, pers. comm., 2007). The Sacramento NWR utilizes an Annual Habitat Management Plan that records localities of federally-listed and sensitive species, including Conservancy fairy shrimp, in a database to help guide operations and management issues. A

Comprehensive Conservation Plan is expected to be finalized for the Sacramento NWR in August 2008, which will address management issues for vernal pool species (J. Silveira, Service, *in litt.*, 2007).

The vernal pool habitat within the Great Valley Grasslands State Park is not grazed, and current management practices are designed to protect vernal pool habitat (J. Karlton, California Department of Parks and Recreation, pers. comm., 2007).

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 been met for the majority of known populations of Conservancy fairy shrimp through budget practices of the involved agencies. The San Luis, Merced, and Sacramento NWRs are managed by the Service. The Los Padres National Forest is managed by the U.S. Forest Service. The Yolo Bypass Wildlife Area is managed by California Department of Fish and Game (CDFG) and the Great Valley Grasslands State Park is managed by the California Department of Parks and Recreation. Funding for these sites depends on allocations of funding to these Federal and State agencies. Funding in perpetuity exists for the Jepson Prairie Preserve through an endowment; however, the funding obligated is not large for a preserve of this size, and Solano Land Trust is currently attempting to increase the endowment amount (B. Wallace, pers. comm., 2006). The Elsie Gridley Vernal Pool Conservation Bank has an endowment fund to ensure management and long-term monitoring in perpetuity (Wetland Resources 2005). The Montezuma Wetlands Preserve has a trust account held by Solano County to ensure that monitoring of the site occurs, but funding in perpetuity is not guaranteed (D. Lipton, Lipton Environmental Group, *in litt.*, 2007). The Mariner Vernal Pool Conservation Bank in Placer County has an endowment fund to ensure that management and monitoring activities occur in perpetuity (Westervelt Ecological Services 2007). The Vina Plains Preserve lacks an endowment and is managed through normal operating budgets and fundraising by the organization (R. Reiner, TNC, pers. comm. 2006). As far as we know, portions of the Vina Plains population, U.C. Merced population, and the entire Mapes Ranch population do not have funding mechanisms to provide for management and long-term monitoring in perpetuity.

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.

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

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.

Monitoring has not occurred during a time period that meets the requirements specified in the Recovery Plan; therefore, this criterion has not been met at this time. The Recovery Plan states that standardized status surveys should establish parameters that evaluate population sizes to determine overall trends in species status rangewide (e.g., evidence of reproduction and recruitment). Specific monitoring parameters have not yet been identified for this species.

Vernal pool region 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.

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.

Formal status surveys and habitat monitoring have not occurred at any sites with known Conservancy fairy shrimp on an annual basis. The primary threat to this species described in the 1994 final listing rule is habitat loss due to urbanization and conversion to agriculture. This continues to be a threat to vernal pool species in general; however, the majority of known populations of Conservancy fairy shrimp are protected from land-use conversion on Federal, State, or private lands. Therefore, this threat has been removed from protected populations. Other threats, such as potential for stochastic extinction resulting from isolated and small numbers of populations, and habitat degradation from improper grazing practices and invasive weedy plants, remain the same. Due to the lack of habitat monitoring at the majority of known localities of this species, the Service is not aware if site-specific threats (i.e., inappropriate grazing practices, invasive weedy plant species, or other unforeseen threats) have increased or decreased since the time of listing. Information regarding threats to the species is provided in section II.C.2. below.

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. 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 (Service 2005). The majority of information needs discussed in the Recovery Plan are still outstanding. The Service is not aware of any ongoing or proposed research pertaining specifically to Conservancy fairy shrimp; therefore, 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.

See 4A, above.

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

See 4A, above.

5. Participation and outreach:

Public participation and outreach implicitly addresses 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 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 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, 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:

Annual surveys have not occurred at any sites with known Conservancy fairy shrimp populations except for the Montezuma Wetland Preserve, where annual surveys have occurred since 1996, but not in all vernal pools (J. Vollmar, Vollmar Consulting, pers. comm., 2007). Periodic surveys have been conducted at Jepson Prairie Preserve, Vina Plains Preserve, Wilcox Ranch, and the Sacramento, Merced, and San Luis NWRs, but these surveys were not conducted in a manner to determine the population trends of this species, but rather just presence of the species (D. Woolington, Service, pers. comm., 2007, J. Silveira, *in litt.*, 2007; B. Wallace, pers. comm., 2006; J. Vollmar, pers. comm., 2007, L. Serpa, The Nature Conservancy, pers. comm., 2007).

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.):

The historical range of Conservancy fairy shrimp is not known (Service 2005). The species' range has not increased since the species was listed in 1994. Two populations of Conservancy fairy shrimp were detected on State lands since the time of listing, and include the Great Valley Grasslands State Park and the Yolo Bypass Wildlife Area; however, these detections did not increase the known range of this species.

II.C.1.c. Known Localities

Following is a discussion of known localities of Conservancy fairy shrimp by vernal pool regions. Areas that are within a core recovery area are also discussed.

Northeast Sacramento Vernal Pool Region

Vina Plains, Butte and Tehama Counties

The Vina Plains population is comprised of five localities within a 1-mile area, and a sixth locality within five miles of the other localities. There are four known localities within the Nature Conservancy's Vina Plains Preserve (CNDDDB 2007). Localities outside of the Vina Plains Preserve include the Laniger Lakes locality, Tehama County (LSA Associates, 2003), and a locality detected by California Department of Transportation (Caltrans) biologists along State Route 99 in Butte County, just south of the Tehama County line, in 1995 (CNDDDB 2007).

All of these localities are within the Vina Plains Core Recovery area, which is a zone 1 core recovery area (i.e., the highest priority of habitat protection needed for recovery of this species). Protected localities within this core recovery area include those found within the Vina Plains Preserve. The Laniger Lakes locality has been proposed for protection as a preserve to offset losses to vernal pool habitat resulting from development projects in Chico, California. The Service is currently reviewing this proposal. The locality along State Route 99 is on private land and not protected. The Caltrans Neary parcel is within this core recovery area. Caltrans has proposed to preserve this site as compensation to offset losses to vernal pool habitat resulting from road construction projects in Butte County. The Neary parcel is adjacent to the Vina Plains Preserve and similar vernal pool habitat is present in both properties; however, surveys for fairy shrimp conducted at the Neary parcel did not detect Conservancy fairy shrimp (C. Warren, Caltrans, pers. comm., 2007). The Service is not aware of other properties within this core recovery area that are protected for the benefit of vernal pool species.

Solano-Colusa Vernal Pool Region

Jepson Prairie, Solano County

The Jepson Prairie population contains 14 localities, which represent 42 percent of the known localities of this species. These 14 localities are within 3 miles of each other, with 12 of the localities located within a 1.25-mile area. This species has been detected within the Jepson Prairie Preserve, Wilcox Ranch, Elsie Gridley Vernal Pool Conservation Bank, the proposed Burke Ranch Vernal Pool Conservation Bank (currently under review by the Service), the Potrero Hills Landfill, and the Montezuma Wetlands Preserve.

Five of these localities are within the Jepson Prairie Core Recovery Area, which is a zone 1 core area (with the exception of the Montezuma Wetlands Preserve, which is within the Collinsville core area discussed in the next paragraph). Of the five sites within the Jepson Prairie core area, all but the Burke Ranch property and the Potrero Hills Landfill site are protected under conservation easements. There are a number of other preserved properties within this core area, including: Muzzy Ranch, Campbell Ranch Conservation Bank, North Suisan Conservation Bank, and the CDFG's Barker Slough Ecological Reserve and the Calhoun Cut Ecological Reserve. These preserved areas are protected for the benefit of native species, including vernal pool species. The Service is not aware of other sites containing suitable habitat within this core area that are protected for the benefit of vernal pool species.

The Montezuma Wetlands project is within the Collinsville Core Recovery Area, which is a zone 1 area. The Montezuma Wetlands project site is managed for vernal pool species, but is not protected under a conservation easement (D. Lipton, *in litt.*, 2007). The Service is not aware of

other sites containing suitable habitat within this core area that are protected for the benefit of vernal pool species.

Yolo Bypass Wildlife Area, Yolo County

Conservancy fairy shrimp were detected in a single vernal pool in 2003 within the Yolo Bypass Wildlife Area, which is owned and managed by CDFG (CNDDDB 2007, C. Witham, California Native Plant Society, *in litt.*, 2007). Subsequent surveys of this vernal pool have not been conducted (D. Feliz, pers. comm., 2007). This locality is not within a core recovery area.

Sacramento National Wildlife Refuge, Glenn County

Only one locality of Conservancy fairy shrimp is known within the Sacramento NWR. This locality was detected in 1994 in a single vernal pool. Surveys throughout the NWR have not detected additional localities of this species, although not all vernal pools have been sampled to date (J. Silveira, *in litt.*, 2007).

This locality is within the Sacramento NWR Core Recovery Area, which is a zone 1 core area. The Sacramento NWR manages the complex for the benefit of vernal pool species, including Conservancy fairy shrimp. The Service is not aware of other sites containing suitable habitat within this core area that are protected for the benefit of vernal pool species.

San Joaquin Valley Vernal Pool Region

Mapes Ranch, Stanislaus County

This locality of Conservancy fairy shrimp is ten miles west of Modesto, on Mapes Ranch, and contains two vernal pools where the species has been reported. This detection was made in two separate vernal pools in 1991 (CNDDDB 2007). The Service is not aware of subsequent surveys of the vernal pools and the current status of Conservancy fairy shrimp at this site is not known.

Mapes Ranch is within the Caswell Core Recovery Area, which is a zone 1 area. The two vernal pools within Mapes Ranch are on private land and not protected. The San Joaquin NWR is within this core area, but Conservancy fairy shrimp have not been detected in vernal pools within the NWR (D. Woolington, pers. comm., 2007).

Grasslands Ecological Area, Merced County

The Grasslands Ecological Area is comprised of five known localities within a 1-mile area. Conservancy fairy shrimp are known to occur within the San Luis NWR, Merced NWR, the California Department of Parks and Recreation's Great Valley Grasslands State Park, and the Vieira-Sandy Mush Road Vernal Pool Conservation Bank.

All of these localities are within the Grasslands Ecological Core Recovery Area, which is a zone 1 core recovery area. All of the known localities within this core area are protected. The Service

is not aware of other sites containing suitable habitat within this core area that are protected for the benefit of vernal pool species.

Southern Sierra Foothills Vernal Pool Region

U.C. Merced Area, Merced County

The U.C. Merced Area population is comprised of four localities within a 1-mile area. Two localities of Conservancy fairy shrimp are known to occur within the Flying M Ranch (CNDDDB 2007). The Ichord Ranch and the Virginia Smith Trust property have one locality each (J. Vollmar, pers. comm., 2007).

These localities are within the Madera Core Recovery Area, which is a zone 1 core area. The Virginia Smith Trust property is protected under a conservation easement. The Flying M Ranch and the Ichord Ranch properties are not protected under conservation easements at this time (J. Vollmar, pers. comm., 2007). There are a number of sites within this core area that are protected with conservation easements that may have suitable habitat for Conservancy fairy shrimp, although suitable habitat within these sites has not been quantified and species surveys have not been performed. These sites include Flynn Ranch, Knapp Ranch, Nelson Ranch, Cunningham Ranch, Furey Ranch, and the Drayer Ranch Conservation Bank (J. Vollmar, pers. comm., 2007). The Service is not aware of other sites containing suitable habitat within this core area that are protected for the benefit of vernal pool species.

Santa Barbara Vernal Pool Region

Los Padres National Forest, Ventura County

Conservancy fairy shrimp are reported within the Los Padres National Forest, along Lockwood Valley Road, which is managed by the U.S. Forest Service. The vernal pools with Conservancy fairy shrimp are fenced off to prevent cattle from grazing and to prevent human intrusion (USFS 2005).

This locality is within the Ventura County Core Recovery Area, which is a zone 2 core recovery area. The Service is not aware of other sites containing suitable habitat within this core area that are protected for the benefit of vernal pool species.

Southeastern Sacramento Valley Vernal Pool Region

Mariner Property, Placer County

A single male Conservancy fairy shrimp was detected at the Mariner Vernal Pool Conservation Bank in 2007 (B. Helm, pers. comm., 2007). It is unknown at this time if this individual represents a sustainable population or an anomaly. Future surveys will determine the status of the species within the bank.

This locality is located within the western Placer County Core Recovery Area. Conservancy fairy shrimp were detected at this site after the 2005 Recovery Plan was finalized. The Recovery Plan did not address this core area in relation to Conservancy fairy shrimp. There are multiple sites within this core area that are protected for the benefit of vernal pool species, including the Orchard Creek Vernal Pool Conservation Bank, Twelve Bridges Preserve, Sheridan Conservation Bank, and Yankee Slough Conservation Bank. Conservancy fairy shrimp have not been detected during fairy shrimp surveys at any of these sites.

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

The Conservancy fairy shrimp occurs in vernal pools found on several different landforms, geologic formations and soil types. For example, at the Vina Plains in Tehama County, the species occurs in pools formed on Peters Clay soil on the volcanic Tuscan Formation. At Jepson Prairie, the Conservancy fairy shrimp is found in large playa-like depressions on deep alluvial soils of Pescadero Clay Loam on Basin Rim landforms. Vernal pools that contain Conservancy fairy shrimp in the Los Padres National Forest tend to occupy atypical habitat settings that are located under a pine forest canopy instead of annual grassland (Service 2005).

Conservancy fairy shrimp are typically associated with large, clay-bottomed vernal pool playas with turbid water (Vollmar 2002). However, three pools inhabited by this species in Butte County and two pools in Solano County at the Montezuma wetlands are atypical, because they are relatively small in area and have very low turbidity (Vollmar 2002). In addition, this species was detected in 2007 in Placer County in a small vernal pool that was also not especially turbid (B. Helm, pers. comm., 2007). While these localities appear to be unusual exceptions, they clearly point out that the habitat requirements of this species are not completely understood, and also support the possibility that Conservancy fairy shrimp might be present in smaller pools in other parts of the species' range (Vollmar 2002).

The Conservancy fairy shrimp co-occurs at some localities with other vernal pool crustacean species, including vernal pool fairy shrimp (*Branchinecta lynchi*), the California fairy shrimp (*Lindieriella occidentalis*), and the vernal pool tadpole shrimp (*Lepidurus packardii*). Conservancy fairy shrimp also co-occurs at some localities with federally-listed plant species including slender Orcutt grass (*Orcuttia tenuis*) and Colusa grass (*Neostapfia colusana*).

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

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

The majority of known populations of this species are protected from the direct effects of development on Federal, State, and private lands. At the time of listing in 1994, Conservancy fairy shrimp localities were protected in the Jepson Prairie Preserve, the Vina Plains Preserve, the Sacramento NWR, the Merced NWR, the San Luis NWR, and Los Padres National Forest (59 FR 48136). Since the species was listed in 1994, Conservancy fairy shrimp localities have been protected under conservation easements at the Wilcox Ranch and the Elsie Gridley

Conservation Bank, both in Solano County, and the Virginia Smith Trust parcel and the Vieira-Sandy Mush Road Vernal Pool Conservation Bank, both in Merced County. The Mariner Vernal Pool Conservation Bank, in Placer County, had a single Conservancy fairy shrimp detected in 2007, and this bank is protected under a conservation easement. Two populations of Conservancy fairy shrimp were detected on State lands since the time of listing, and include the Great Valley Grasslands State Park and the Yolo Bypass Wildlife Area. Protected areas are described in section II.C.1.c. above.

Although substantial progress with regard to protecting Conservancy fairy shrimp habitat has been made, many unprotected localities remain. Three of four localities of the U.C. Merced population are not protected from habitat loss or modification. These three localities are located on the Ichord Ranch and Flying M Ranch. Two of six localities of the Vina Plains population are on private land and not protected from habitat loss or modification. No localities within the Mapes Ranch population are protected. Some localities within the Jepson Prairie population are located in restored wetland areas that are not protected by conservation easements, but currently managed for vernal pool species. The Service is not aware of any projects that are proposed within the vicinity of the unprotected Conservancy fairy shrimp localities in the Vina Plains, Jepson Prairie, or Mapes Ranch populations.

The U.C. Merced population is threatened by habitat fragmentation and degradation from increased development pressures in the region. There is also a threat of direct habitat loss; however, this appears less severe than the threats of fragmentation and degradation. Currently, the known localities within the U.C. Merced population are zoned by the City of Merced as exclusive agriculture, and are not managed for vernal pool species (Jones and Stokes 2007). The Conservancy fairy shrimp localities occur in close proximity to the U.C. Merced campus on the Flying M Ranch, the Ichord Ranch, and the Virginia Smith Trust property. The Virginia Smith Trust property is protected under a conservation easement but the Ichord Ranch and the Flying M Ranch are not protected (J. Vollmar, Vollmar Consulting, pers. comm., 2007).

Approximately 107 acres of occupied habitat for Conservancy fairy shrimp occurs within the U.C. Merced project area (Jones and Stokes 2007). Approximately 10,000 acres, including the 2,000-acre U.C. Merced Campus, have been designated under a University Community Specific Urban Development Plan (SUDP) (City of Merced 1997). This area is zoned as agriculture until designated for future urban use (City of Merced 1997). The University Community SUDP includes all of the known localities of Conservancy fairy shrimp within this population (i.e., the Virginia Smith Trust parcel, Ichord Ranch, and Flying M Ranch). Current land-use plans for U.C. Merced have designated the Virginia Smith Trust parcel as conservation land, but the remaining localities (Ichord Ranch and Flying M Ranch) are not designated as conservation lands (Jones and Stokes 2007). Although the Service is not aware of specific projects that would result in the destruction of these two localities, they are threatened because of the uncertainty of where future development will occur in the area.

Although build-out of the U.C. Merced campus does not currently involve specific plans to destroy vernal pool habitat with known Conservancy fairy shrimp, it is unknown at this time if future proposed development of the campus would indirectly affect the proximal Conservancy fairy shrimp habitat. For example, the Virginia Smith Trust parcel locality is within

approximately 500 feet of an area designated as “Campus Land Reserve”, which is an area that has no proposed development at this time but may be developed at a later point in time depending on future decisions of U.C. Merced (Jones and Stokes 2007). There is potential that this occurrence will be indirectly affected by activities associated with the campus from increases in deleterious substances (such as fertilizers, herbicides, oil from streets and parking lots, etc.), human intrusion, habitat fragmentation, and modification of hydrology.

In addition, the U.C. Merced campus has contributed to an increase in development of commercial and residential subdivisions in the area. The City of Merced predicts that population growth will expand to 239,210 individuals by 2035 within the City, an increase from 60,900 individuals in 1990 (City of Merced 1997). Even if development does not result in the destruction of known localities of this species, this development will occur in areas adjacent to known occurrences of Conservancy fairy shrimp. There is potential for development projects within close proximity to occupied Conservancy fairy shrimp habitat to cause indirect effects resulting from increases in deleterious substances, human intrusion, habitat fragmentation, and modification of hydrology, even if the actual vernal pools are not filled.

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

Overutilization for commercial purposes was not known to be a factor in the 1994 final rule (59 FR 48136). Overutilization for any purpose does not appear to be a threat at this time.

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

The 1994 final rule does not state whether disease is a factor for Conservancy fairy shrimp (59 FR 48136). The Service is not aware of any new information regarding disease or predation as threats to this species.

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

The Federal Endangered Species Act: The Endangered Species Act of 1973, as amended (Act), is the primary Federal law that provides protection for Conservancy fairy shrimp. 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. If a Federal agency is not involved in a proposed project, and federally-listed species may be taken as part of the project, then an incidental take permit pursuant to section 10(a)(1)(B) of the Act should be obtained. Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the “take” of federally endangered wildlife. The protection of Section 9 afforded to endangered species is extended to threatened wildlife and plants by regulation.

Federal Clean Water Act: The Section 404 of the Clean Water Act may afford some protection to Conservancy fairy shrimp. 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 ESA to consult with the Service. If ESA protections were removed, Section 404 of the Clean Water Act would not contribute to the conservation of Conservancy fairy shrimp on its own.

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 discontinues regulation of vernal pools, unmitigated destruction of potential habitat for Conservancy fairy shrimp may increase over the range of the species. However, the State of California's Regional Water Quality Control Board has the option to regulate projects that result in the dredge and fill of wetland habitat if a Federal 404 permit is not required (see California State Laws, below).

California State Laws: The State's authority to conserve wildlife is comprised of the California Endangered Species Act (CESA) and the California Environmental Quality Act (CEQA). Conservancy fairy shrimp are not listed under CESA. 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. If a project may impact known populations of Conservancy fairy shrimp, these impacts would be disclosed to the Service and allow the Service an opportunity to comment on the proposed project's effects to this species. Typically, project proponents propose conservation measures to offset or minimize adverse effects to listed species. However, CEQA does not guarantee that such conservation measures will be implemented.

The Clean Water Act Section 401 Water Quality Certification and/or Waste Discharge Requirements are regulated by the State of California's Regional Water Quality Control Board. Anyone proposing to conduct a project that requires a Federal permit or involves dredge or fill activities that may result in a discharge to U.S. surface waters and/or "Waters of the State" are required to obtain a Clean Water Act Section 401 Water Quality Certification and/or Waste Discharge Requirements permit. However, if a proposed project does not require a Federal permit, but does involve dredge or fill activities that may result in a discharge to "Waters of the State", the Regional Water Quality Control Board has the option to regulate the project under its state authority (Porter-Cologne) in the form of Waste Discharge Requirements or Waiver of Waste Discharge Requirements.

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

Other natural or manmade threats cited in the 1994 final rule include stochastic extinction due to the high degree of isolation and small numbers of populations of this species (59 FR 48136). Stochastic extinction as a result of random or unpredictable disturbances is a continued threat to the species. Additional threats not discussed in the 1994 listing rule include climate change, invasive plant species, inappropriate grazing regimes, and contaminants (e.g., pesticide use).

The threats of climate change, invasive plant species, inappropriate grazing, contaminants, and risk of localized stochastic extirpations remain for all localities of Conservancy fairy shrimp whether they are on protected lands or not. Threats to Conservancy fairy shrimp are not likely being managed at all on private, unprotected lands. The majority of localities of this species do not have management plans or monitoring programs to ensure that potential threats posed by invasive weedy species, inappropriate grazing regimes, or pesticide use are managed and controlled in perpetuity. In addition, funding is not sufficient at any of the protected localities for systematic surveys to be conducted to determine if potential threats are present. The lack of management, monitoring, and funding are not, in themselves, threats to Conservancy fairy shrimp; however, without these components, potential threats may not be identified and eliminated.

Drought and Climate Change: Climate change is expected to have an effect on vernal pool hydrology through changes in the amount and timing of precipitation inputs to vernal pools and the rate of loss through evaporation and evapotranspiration (Pyke 2004, Pyke and Marty 2005). These changes in hydrology will likely affect fairy shrimp species because they are obligate aquatic organisms with life histories dependent on certain hydrologic conditions (Pyke 2005a). The suitability of vernal pools for fairy shrimp depends in large part on the timing and duration of wetland inundation, as these species are dependent on vernal pools that have sufficient water to remain wet throughout the annual reproductive phase of the species.

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, IPCC 2007, Pyke 2005a). However, climatic conditions for smaller sub-regions such as California remain uncertain (Pyke 2005a). 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 2005a). However, it is possible that either scenario would result in negative effects to vernal pool invertebrate species (Pyke 2004, Pyke and Marty 2005). Cooling and drying trends could adversely affect Conservancy fairy shrimp through decreased inundation periods that do not allow the species sufficient time to complete its life cycle. In contrast, warmer conditions could increase inundation periods, which would not necessarily be a negative effect because increased inundation periods would increase available habitat for Conservancy fairy shrimp. However, increased inundation periods associated with a warming trend could also negatively affect the species by not providing cool enough temperatures for Conservancy fairy shrimp to hatch or reproduce. In addition, increased inundation periods could increase the abundance of predator species that require more permanent water sources in vernal pools such as dragonflies, aquatic beetles, and amphibians (Erikson and Belk 1999, Pyke 2005a).

Based on existing data (Helm 1998, Erikson and Belk 1999), weather conditions in which vernal pool flooding promotes hatching, but in which pools dry (or become too warm) before embryos are fully developed, are expected to have the greatest negative effect on the resistance and resilience of Conservancy fairy shrimp populations as depletion of previous years' cysts (accumulation of dormant eggs in vernal pool soils) occurs. Vernal pool crustaceans have developed life-history strategies to survive drought periods. They are, however, adapted to

complete their life cycles within limited temperature ranges and require a minimum length of inundation to reach maturity and reproduce. Climate change is expected to lead to increased variability in precipitation and to increased loss of soil moisture due to evaporation and transpiration of water from plants (Field *et al.* 1999), which may exacerbate effects due to drought. Drought-mediated decreases in water depth and inundation period could increase the frequency at which pools dry before shrimp have completed their life cycle, or cause pool temperatures to more often exceed temperatures suitable for hatching and persistence of the species.

Pyke (2004, 2005b) postulated that climate change in the future may result in changes in hydrology that would adversely affect Conservancy fairy shrimp at sites that are currently preserved for this species. In addition, the current configuration of vernal pool habitats within preserves are not likely to sustain Conservancy fairy shrimp in the event of a prolonged drought, as this species requires longer inundation periods to complete its life cycle. Habitat that is not currently suitable, but may be suitable in the future, may not be available for preservation in the future (Pyke 2005a, 2005b). 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, Pyke and Fisher 2005), including the Conservancy fairy shrimp.

Small Numbers of Populations/Local Stochastic Extirpations: The combination of highly specialized pool type and soil characteristics makes the Conservancy fairy shrimp exceedingly rare (Vollmar 2002). This species is only known to occur in eight disjunct populations, with some populations being comprised of a single vernal pool. The conservation biology literature commonly notes the vulnerability of taxa known from one or very few locations (e.g., Shaffer 1981, 1987; Primack 1998; Groom *et al.* 2006). Such populations may be highly susceptible to extirpation due to chance events or additional environmental disturbance (Gilpin and Soule 1988; Goodman 1987), such as adverse effects from changes in hydrology or temperatures due to climate change, invasive plant species, and inappropriate grazing regimes. If an extirpation event occurs in an isolated population, the opportunities for recolonization will be greatly reduced due to physical isolation from other source populations.

Non-native Plants: Non-native herbaceous species occur commonly in vernal pool complexes and have become a threat to native vernal pool species through their capacity to change pool hydrology (Marty 2005). It is likely that the lack of fires, coupled with the lack of adequate grazing, has increased the densities of non-native herbaceous vegetation surrounding vernal pools, degrading the habitat (Wells *et al.* 1997). Non-native grasses maintain dominance at pool edges, sequestering light and soil moisture, and Italian ryegrass (*Lolium multiflorum*) and waxy mangrass (*Glyceria declinata*) increase thatch buildup (dead, dried plant material) (Sacramento County 2006), which can lead to oxygen depletion in the pools (Dunne and Leopold 1978). These non-native plants thus can contribute to the shortening of inundation periods through increased evapo-transpiration in the vernal pools (Marty 2005) and the reduction of the amount of water entering the system through surface and subsurface flows. Invasive weedy plants are a threat at many of the localities for this species, including Vina Plains (R. Schlising, C.S.U. Chico, *in litt.*, 2007), Jepson Prairie (B. Wallace, pers. comm., 2006), and the Sacramento NWR (although they are not yet a problem at the single Conservancy fairy shrimp locality;

J. Silveira, pers. comm., 2007). The Service does not have information on this threat at other localities due to a lack of monitoring at these sites, although it is reasonable to expect non-native plants are present at some of them.

Grazing: Inappropriate grazing practices include complete elimination of grazing in areas where non-native grasses dominate the uplands surrounding vernal pools, and inappropriate timing or intensity of grazing. Appropriate grazing practices utilize a grazing regime to ensure proper function of hydrology in vernal pools (Marty 2005). In particular, an appropriate grazing regime ensures that non-native weedy plants such as Italian ryegrass and waxy manna grass, which increase thatch buildup and decrease ponding durations and decrease the aquatic habitat available to Conservancy fairy shrimp. The majority of localities for this species are grazed by cattle, although not all are grazed for the benefit of vernal pool species. Management and monitoring plans that do not include an adaptive management approach and do not facilitate natural processes and functions may not result in conservation of Conservancy fairy shrimp. Similarly, lack of funding to implement grazing management and monitoring activities may contribute to a decline of habitat conditions and species baseline (Service 2005).

Contaminants/Pesticides: Pesticides, herbicides, and other chemicals can be conveyed into the vernal pool habitats by overland run-off during rain events, or they may enter vernal pools by drift or direct over-spray (Johnson 2005). In addition, pesticides applied to agricultural fields and orchards in the Central Valley can volatilize to the atmosphere. Once in the atmosphere the pesticides can be transported by bulk air movement and directly enter the vernal pool system from rainfall (Johnson 2005). Pesticides are commonly accumulated in the soil, and long-term accumulation of certain compounds may also result (Johnson 2005). Little is known about the relative sensitivity of vernal pool invertebrates to commonly used agricultural pesticides and chemical concentrations. However, research has shown that many commonly used pesticides may result in adverse effects to aquatic invertebrate species (Weston *et al.* 2005). Johnson (2005) found that 11 of 18 vernal pools sampled within the Sacramento NWR contained pesticides, although this study did not include the single vernal pool with a known occurrence of Conservancy fairy shrimp. However, pesticides are known to be used within close proximity of known Conservancy fairy shrimp localities. Marovich and Kishaba (1997) overlaid CNDDDB occurrences with pesticide-use areas detailed in the California Department of Pesticide Regulation's annual Pesticide Use Reports, and determined that a variety of common pesticides were applied within the vicinity of known occurrences of Conservancy fairy shrimp. The actual distances of pesticide applications from Conservancy fairy shrimp localities were not reported in this study, but distances ranged from 0 to 3 miles (Marovich and Kishaba 1997).

Because pesticides can be transported through the variety of methods discussed at the beginning of this discussion, and the high prevalence of pesticide use throughout the Central Valley, we believe it is likely that vernal pools containing Conservancy fairy shrimp have been exposed to harmful pesticides to some degree. The current effects of contaminants on this species are not known at this time. Further research and monitoring are necessary to determine the degree that the Conservancy fairy shrimp is threatened by contaminants such as pesticides.

II.D. Synthesis

When the Conservancy fairy shrimp was listed as endangered in 1994, the primary threats to its survival and recovery were stochastic (random) extinction by virtue of the small isolated nature of many of the populations, and loss of habitat due to urban development and conversion to agriculture (59 FR 48136). The Service has determined that this species is still in danger of extinction throughout its range. Conservancy fairy shrimp are extremely rare and are only known to occur in eight disjunct populations, with some populations being comprised of single vernal pools. This species is highly susceptible to extirpation due to chance events or additional environmental disturbance as described above. If an isolated population is extirpated, the opportunities for recolonization will be greatly reduced due to physical isolation from other source populations.

The majority of the eight known populations are protected from direct habitat loss by conservation easements or are found on public lands, so substantial progress with regard to protecting Conservancy fairy shrimp habitat has been made. However, several known localities remain unprotected. Unprotected localities include the majority of the U.C. Merced population, portions of the Vina Plains population, and the entire Mapes Ranch population. The U.C. Merced population is of particular concern because of its close proximity to the U.C. Merced campus and the expected increase in commercial and residential development in the area. In addition, many of the Conservancy fairy shrimp localities within this population are zoned as exclusive agriculture and are not managed for the benefit of vernal pool species (Jones and Stokes 2007).

Although preserves and public lands have set been set aside for the protection of vernal pool habitats, the long-term sustainability and viability of Conservancy fairy shrimp within these preserves is not yet known. Studies have demonstrated that the current configuration of vernal pool habitats within preserves is not likely to sustain Conservancy fairy shrimp in the event of a prolonged drought, as this species requires longer inundation periods to complete its life cycle (Pyke 2004, Pyke 2005b). Therefore, despite protection of vernal pool habitat in conservation areas, available information suggests the distribution of these areas is not yet sufficient to provide for the species' recovery.

Beyond habitat preservation, other conservation measures, such as habitat management and monitoring, are necessary to ensure the long-term sustainability of this species. Potential threats such as habitat degradation due to inappropriate grazing regimes, pesticide use, invasive weedy species, or other unforeseen circumstances remain for the majority of the localities of Conservancy fairy shrimp whether they are on lands protected from habitat modification or not. Although the habitat might be secure from conversion, it is not secure from ecological factors that can modify habitat and affect population status and viability. Site-specific habitat management and monitoring are essential so that potential threats to the species can be identified and eliminated. The majority of the known Conservancy fairy shrimp localities are not currently managed under management plans. None of the known localities have sufficient funding for systematic monitoring to determine habitat quality or species status trends. In most cases, threats to this species, such as those described above, will not be detected and managed for.

We conclude that the Conservancy fairy shrimp still meets the ESA definition of endangered for the following reasons: (1) the rare nature of this species increases the risk of local extirpations from stochastic events that could preclude recolonization by disjunct populations; (2) all localities of Conservancy fairy shrimp are still threatened by additional environmental disturbances, including possible changes in hydrology resulting from drought and climate change, degradation of habitat from invasive weedy plant species, inappropriate grazing regimes, and other unforeseen events; and (3) the lack of management and monitoring activities at the majority of known localities of this species makes it difficult to characterize the size and connectivity of occupied habitats, identify the magnitude and imminence of remaining threats, and ensure that threats will be identified and ameliorated. Therefore, we recommend no status change 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**

III.B. New Recovery Priority Number: N/A

We recommend that the recovery priority number remain 8, reflecting a moderate degree of threat and high recovery potential.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

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

1. Preservation of Zone 1 and 2 core areas should be pursued to preserve known localities that are currently not protected. Core areas that are within Zone 1 include Vina Plains, Caswell, Grasslands, Jepson Prairie, Sacramento NWR, Collinsville, and Madera. The Ventura core area is the only Zone 2 area for this species. Protection of localities under conservation easements in the Madera Core Area should be prioritized because of the high degree of threat from development in the area.
2. Develop standardized monitoring for species status at areas with known localities throughout the range of this species. Conduct additional research at these sites to

incorporate research recommendations outlined in the Recovery Plan. Results from monitoring and research should be included in the management plans for these areas.

3. Conduct surveys on private lands with a high potential for supporting Conservancy fairy shrimp to detect new localities of this species. Landowner permission is necessary prior to conducting surveys for this species.
4. Conduct surveys at the Mariner Conservation Bank in Placer County to determine if the single Conservancy fairy shrimp found in a single vernal pool wetland represents a self-sustaining population, or represents an anomaly.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF THE CONSERVANCY FAIRY SHRIMP

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

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

Review Conducted By Sacramento Fish and Wildlife Office Staff

FIELD OFFICE APPROVAL:

ACTING

Lead Field Supervisor, Fish and Wildlife Service

Approve [Signature] Date 9-6-07

REGIONAL OFFICE APPROVAL:

Acting

Lead Regional Director, Fish and Wildlife Service

Approve [Signature] Date 9/24/07