

Longhorn Fairy Shrimp
(Branchinecta longiantenna)

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



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

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5-YEAR REVIEW
Longhorn Fairy Shrimp (*Branchinecta longiantenna*)

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 occurrences 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 longiantenna*)

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 longhorn 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 recovery priority), reflecting a high 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), longhorn fairy shrimp 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. Longhorn fairy shrimp are easily distinguished from other fairy shrimp by the male's extremely long second antennae. Longhorn fairy shrimp are dependent on seasonally inundated wetlands, such as vernal pools, and are endemic to California vernal pool habitat. Longhorn fairy shrimp are restricted to the Central Valley.

Longhorn fairy shrimp are rare, and at the time of listing four widely separated populations of this species were known (59 FR 48136). Since the time of listing in 1994, extensive surveys for fairy shrimp species throughout the range of longhorn fairy shrimp have not located additional populations of this species, although longhorn fairy shrimp have been detected in additional localities within the four populations. Currently, the California Natural Diversity Database (CNDDDB) reports 11 occurrences of this species (CNDDDB 2007). The CNDDDB occurrences are positive-sighting reports submitted to the California Department of Fish and Game (CDFG) by the public. The information is not verified or updated unless a subsequent report for the identical location is submitted. One CNDDDB occurrence record may represent a single vernal pool, a single puddle, multiple pools within a vernal pool complex, a substantial portion of a vernal pool complex, or an entire complex.

This 5-year review discusses the longhorn fairy shrimp in terms of populations. For the purpose of this 5-year review, the Service has grouped together "clusters" of individual longhorn fairy

shrimp locality records that are in close proximity to each other (i.e., within a few miles), and defined these clusters as “populations.” Populations are defined by entire vernal pool complexes, rather than individual pools (Simovich *et al.* 1992). Longhorn fairy shrimp populations are comprised in most cases of multiple localities where the species has been detected. For example, the Carrizo Plain population, in San Luis Obispo County, consists of 20 known localities (A. Kuritsubo, Bureau of Land Management, *in litt.*, 2006), of which only six are reported as occurrences in the CNDDDB. As another example, the CNDDDB (2007) reports one occurrence of longhorn fairy shrimp at the Vasco Caves Preserve, in Contra Costa County. The number of actual longhorn fairy shrimp localities within the Vasco Caves Preserve has not been quantified. There are numerous rock outcrops within the preserve that support longhorn fairy shrimp (Steve Bobzien, East Bay Regional Park District, personal communication, 2007). 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 four populations known at the time of listing.

The four known populations of longhorn fairy shrimp include: (1) areas within and adjacent to the Carrizo Plain National Monument, San Luis Obispo County; (2) areas within the San Luis National Wildlife Refuge (NWR) Complex, Merced County; (3) areas within the Brushy Peak Preserve, Alameda County; and, (4) areas within the Vasco Caves Preserve, near the town of Byron in Contra Costa County (Service 2005). The Brushy Peak and Vasco Caves Preserves are within three miles of each other. This species was also detected in a roadside ditch two miles north of Los Banos, in Merced County. Only one individual was detected in the ditch and this occurrence is considered to be an anomaly and not a sustainable population (CNDDDB 2007). Three of the four confirmed populations are found entirely on public lands that are currently protected and managed for vernal pool species. A portion of the Carrizo Plain population is found on public lands, with the remaining portion occurring on private lands.

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 longhorn 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 longhorn 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) public 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 longhorn 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 regions 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. The Recovery Plan identifies specific percentages of suitable habitat to be protected in each of the four longhorn fairy shrimp core areas, which include: (1) North Carrizo Plain; (2) South Carrizo Plain; (3) Altamont Hills; and (4) the Grasslands Ecological Area. In the Recovery Plan, core areas are ranked as zone 1, 2, or 3 in order of their overall priority for recovery (zone 3 represents currently unoccupied, historical habitat, which has not been identified for this species). Core areas containing longhorn fairy shrimp are included as both zones 1 and 2 in the Recovery Plan, with no core areas ranked as zone 3. These core areas are multi-species habitats that may also contain other federally-listed vernal pool species, and are much larger than the areas that are actually occupied by longhorn fairy shrimp.

Table 1 provides a summary of the four core recovery areas, by vernal pool region, and the corresponding zone designation for each core area. The four core recovery areas are described in further detail below in section II.C.2.a.

Table 1: Longhorn fairy shrimp core recovery areas.

<p>Carrizo Vernal Pool Region Core areas: North Carrizo Plain (zone 2) South Carrizo Plain (zone 2)</p>
<p>Livermore Vernal Pool Region Core area: Altamont Hills (zone 1)</p>
<p>San Joaquin Vernal Pool Region Core area: Grasslands Ecological Area (zone 1)</p>

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.

Recovery goals include both population and habitat criteria. To downlist the longhorn fairy shrimp, the Recovery Plan recommends that 100 percent of known localities where the species has been detected (i.e., “occurrences”, not necessarily as defined by CNDDDB) be protected rangewide. In addition, the Recovery Plan specifies criteria for protection of suitable longhorn fairy shrimp habitat within the four core recovery areas; suitable habitat includes both occupied and unoccupied habitat. For longhorn fairy shrimp, the Recovery Plan recommends that 95 percent of the suitable habitat in each of the zone 1 and zone 2 core recovery areas be protected. To delist the longhorn fairy shrimp, the Recovery Plan recommends that 100 percent of any newly discovered and reintroduced populations be protected. At this time, new populations have not been discovered or reintroduced, although surveys for fairy shrimp species have not been conducted throughout the range of longhorn fairy shrimp. In addition, the Recovery Plan recommends that species be reintroduced to vernal pool regions and soil types from which status surveys indicate the species has been extirpated. The Service is not aware of any populations of longhorn fairy shrimp that have been extirpated; therefore, this criterion is not applicable.

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 longhorn 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 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.

Within the four known populations, species localities are distributed across the species’ geographic range and the genetic range is protected. Extreme edges of the longhorn fairy shrimp’s range are protected. Therefore, this criterion is close to fulfillment in the sense that the majority of localities are protected from land-use conversion, although other threats may be present (see section II.C.2.a. below). The northern-most population occurs within the Altamont Hills core area, where all known localities are protected within the Brushy Peak Preserve and the Vasco Caves Preserve. The Carrizo Plain National Monument partially protects the southern-most population of this species, where 12 of 20 known localities are protected. The San Luis NWR contains 18 known localities of longhorn fairy shrimp, and all localities within the San Luis NWR are protected for vernal pool species. Table 2 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 longhorn fairy shrimp 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 2: Known populations (from North to South) of longhorn fairy shrimp and protection status.

Population	Land owner(s)	Status of Protection of Population
Vasco Caves Preserve	East Bay Regional Park District	Protected – Public lands
Brushy Peak Preserve	Livermore Area Recreation and Park District	Protected – Public lands
San Luis NWR	Service	Protected – Public lands
Carrizo Plain	Bureau of Land Management and private	12 localities protected on the Carrizo Plain National Monument and 8 localities on private land are not protected.

1D. Additional occurrences (i.e., localities) are permanently protected, if determined essential to recovery goals.

At this time, the Service is aware of additional localities that have been discovered since the species was listed in 1994 (CNDDDB 2007). Most of the additional localities have been detected within protected areas (i.e., Vasco Caves Preserve, Brushy Peak Preserve, San Luis NWR, and Carrizo Plains National Monument). The only exceptions include the eight localities outside of the Carrizo Plain National Monument, San Luis Obispo County, and the single location locality two miles north of Los Banos, in Merced County. Only one individual was detected in the roadside ditch near Los Banos, and this occurrence is considered to be an anomaly and not a sustainable population (CNDDDB 2007). The Service has determined that this locality is not essential to the recovery of this species.

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 localities 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. The San Luis NWR Complex is comprised of the San Joaquin, San Luis, and Merced NWRs. All of these NWRs have vernal pools that contain longhorn fairy shrimp. Of these three NWRs, only the San Joaquin NWR has a Comprehensive Conservation Plan (CCP). This CCP discusses management of vernal pool species, including longhorn fairy shrimp. Refuge biologists are currently preparing CCPs for the other two refuges within the complex, which will also address vernal pool species management (K. Griggs, in literature, Service, 2007). The Bureau of Land Management (BLM) has a management plan for the Carrizo Plain National Monument that predates the listing of the longhorn fairy shrimp, and this document does not address this species. However, the BLM is currently working on a new management plan that addresses the longhorn fairy shrimp, which is anticipated to be finalized in 2008 (A. Kuritsubo, personal communication, 2006). The Brushy Peak and Vasco Caves Preserves do not currently have management plans (S. Bobzien, personal communication, EBRPD, 2007). As yet, no consistent monitoring program is in place for longhorn fairy shrimp in any of its four populations.

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

The San Luis NWR is managed by the Service, the Carrizo Plain National Monument is managed by the Bureau of Land Management, the Vasco Caves and Brushy Peak Preserves are managed by East Bay Regional Park District. Therefore, funding for management and protection of vernal pool species depends on funding to these agencies. This criterion has been partially met through budget practices of the involved agencies.

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 localities 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.

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 at any of the sites with known occurrences; therefore, the Service is unable to determine if this criterion has been met. 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. The Carrizo Plain population has been monitored for evidence of reproduction on a non-annual basis and females with brood pouches have been detected when the species is present (A. Kuritsubo, personal communication, 2006).

Vernal pool region working groups (see section 5A and 5B for a description of 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.

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.

Informal monitoring of known populations of longhorn fairy shrimp has occurred within the Carrizo Plain, the San Luis NWR, the Brushy Peak Preserve, and the Vasco Caves Preserve. For all known localities, biologists have noted observations of longhorn fairy shrimp when out in the field, but no standardized site assessments exist for any of the localities (A. Kuritsubo, personal communication, 2006; S. Bobzien, personal communication, 2007; D. Woolington, Service, personal communication, 2006). The primary threat to this species described in the 1994 final listing rule is habitat loss due to agriculture conversion and urbanization. While this continues to be a threat to vernal pool species in general, the majority of known populations of longhorn fairy shrimp are protected from land-use conversion on public lands. Therefore, this threat has been removed from protected populations. Other threats exist, such as the increased risk of local extirpations from stochastic events because of the small number of isolated populations for this species, and risks from environmental disturbances, including severe drought, degradation of habitat from invasive weedy plant species, inappropriate grazing regimes, and other unforeseen events. Information regarding current threats to the species are further described 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 has not processed any scientific/recovery permits in support of research on this species. The Service has contacted species experts and there is no ongoing or proposed research pertaining to longhorn 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 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 working groups. Service employees have met with various stakeholders to determine interest of stakeholders 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, 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:

Informal status surveys have occurred at four sites: the Carrizo Plain National Monument, the Kestersen Unit of the San Luis NWR, the Brushy Peak Preserve, and the Vasco Caves Preserve (A. Kuritsubo, personal communication, 2006; D. Woolington, personal communication, 2007; Steve Bobzien, personal communication, 2007). Monitoring has not been sufficient to quantify abundance and identify trends but rather just presence of the species.

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.):

Longhorn fairy shrimp are known from only four widely separated populations. Longhorn fairy shrimp are currently found in pools located within a matrix of alkali sink and alkali scrub plant communities north and northwest of Soda Lake and at the southern end of the Carrizo Plain National Monument in the Carrizo Vernal Pool Region, in a series of sandstone outcrop pools in the Livermore Vernal Pool Region, and from alkaline grassland vernal pools in the San Luis NWR (Service 2005). Since the time of listing in 1994, additional localities of longhorn fairy shrimp have been detected within all four previously known populations (CNDDDB 2007). Extensive surveys for other fairy shrimp species within the range of longhorn fairy shrimp have not detected additional populations since the time of listing. We believe the lack of surveys in areas between Carrizo Plain and the Livermore Vernal Pool Regions suggests there may be additional, undiscovered populations of this species (Service 2005). A summary of the latest information on the four known populations and the single Los Banos observation is provided in section II.C.1.c, below.

Most of what is known about the species is described in Eng *et al.* (1990), Eriksen and Belk (1999), and Helm (1998), and summarized in the Recovery Plan (Service 2005). The

distribution of the longhorn fairy shrimp may never have extended into the northern portion of the Central Valley or into southern California. Extensive surveying of vernal pool habitats in southern California has never revealed populations of longhorn fairy shrimp. There is some evidence that temperatures may not be warm enough for the species to mature in the northern portions of the Central Valley. However, it is likely the longhorn fairy shrimp was once more widespread in the regions where it is currently known to occur, and in adjacent areas such as the San Joaquin and Southern Sierra Foothill Vernal Pool Regions, where habitat loss has been extensive. Despite lack of knowledge on the tolerance of longhorn fairy shrimp to cooler temperatures, its presence in northern Central Valley vernal pool regions cannot be ruled out until further surveys have been conducted (Service 2005).

II.C.1.c. Known Occurrences

Longhorn fairy shrimp are known to occur in four widely separated populations. All four populations are comprised of multiple pools containing longhorn fairy shrimp, many of which are not reported in the CNDDDB. A discussion of the four known populations follows, as well as a discussion of the single longhorn fairy shrimp detected near Los Banos, Merced County:

Carrizo Plain, San Luis Obispo County

The BLM reports 12 vernal pools where this species has been detected within the Carrizo Plain National Monument. Six are within the southern portion of the monument and six are within the northern portion of the monument, near Soda Lake. These 12 vernal pools are currently protected. The BLM reports another eight vernal pools where this species has been detected outside of the monument that are not currently protected. These eight vernal pools occur on privately-owned parcels that are about 20 acres in size (A. Kuritsubo, personal communication, 2006).

San Luis National Wildlife Refuge, Merced County

Several vernal pools containing longhorn fairy shrimp have been reported within the Kesterson and Sno-bird Units of the San Luis NWR Complex, in Merced County (Kenneth Griggs, *in litt.*, 2007). The San Luis NWR Complex reports 18 vernal pools where longhorn fairy shrimp have been detected (Kenneth Griggs, *in litt.*, 2007). All of the known localities of this species within the NWR are currently protected and managed for vernal pool species.

Vasco Caves Preserve, Contra Costa County

There are several vernal pools with longhorn fairy shrimp within the 1,400-acre Vasco Caves Preserve, which is owned and managed by the East Bay Regional Park District (EBRPD) (Steve Bobzien, personal communication, 2007). The exact number of vernal pools within the preserve containing this species has not been quantified. The preserve contains rock outcrops with multiple indentations that seasonally pool water and support longhorn fairy shrimp. One of the largest rock outcrops contains 84 small pools, all of which have had longhorn fairy shrimp detected in them, although not during every year surveyed (Steve Bobzien, personal

communication, 2007). All of the known localities of this species in this population are within the preserve and are currently protected.

Brushy Peak Preserve, Alameda County

There are several vernal pools that have longhorn fairy shrimp within the 507-acre Brushy Peak Preserve, which is owned by the Livermore Area Recreation and Park District and managed by the EBRPD (Steve Bobzien, personal communication, 2007). The exact number of vernal pools within this preserve containing this species has not been quantified. Similar to the Vasco Caves Preserve, the Brushy Peak Preserve contains rock outcrops with multiple indentations that seasonally pool water and support longhorn fairy shrimp. The number of pools supporting longhorn fairy shrimp varies from year to year (Steve Bobzien, personal communication, 2007). All of the known localities of this species in this population are within the preserve and are currently protected.

Los Banos, Merced County

In 2003, the California Department of Transportation (Caltrans) reported a single specimen of longhorn fairy shrimp in a roadside ditch adjacent to Miller Road, approximately 2 miles north of Los Banos (CNDDDB 2007). The survey was conducted by Caltrans as part of the proposed State Route 152 Los Banos Bypass project. The Service is currently in consultation under ESA section 7 with Caltrans through the Federal Highway Administration for this transportation project. The seasonal wetland in which the longhorn fairy shrimp was detected is not within an area proposed for construction activities. This occurrence is not currently protected. We do not consider this observation an indication of a viable population, although we are not aware of follow-up surveys to determine if this wetland feature commonly supports this species.

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

The longhorn fairy shrimp is highly adapted to the unpredictable conditions of vernal pool ecosystems. Longhorn fairy shrimp require a minimum of 23 days, but averaged 43 days, to reach maturity in artificial pools (Helm 1998). Although the longhorn fairy shrimp is only known from a few localities, these sites contain very different types of vernal pool habitats. Longhorn fairy shrimp in the Livermore Vernal Pool Region in Contra Costa and Alameda Counties live in small, clear, sandstone outcrop vernal pools. These sandstone pools are sometimes no larger than 3.3 feet in diameter, have a pH near neutral, and very low alkalinity and conductivity. Water temperatures in these vernal pools have been measured between 50 and 64 degrees Fahrenheit (Helm 1988). In both the San Joaquin and Carrizo Vernal Pool Regions, the longhorn fairy shrimp is found in clear to turbid, grassland pools. These grassland pools may be as large as 203.4 feet in diameter. Water temperatures in the grassland vernal pools are also warmer, between 50 to 82 degrees Fahrenheit (Helm 1998, Eriksen and Belk 1999). The species was most recently observed in a disturbed roadside ditch near Los Banos. Longhorn fairy shrimp have been found at elevations ranging from 75.5 feet in the San Joaquin Vernal Pool Region to 2,887 feet in the Carrizo Vernal Pool Region (Service 2005, CNDDDB 2007).

Although adapted to variable vernal pool habitats, longhorn fairy shrimp presumably have evolved to persist under a range of variation in climatic conditions such as rainfall and drought. We do not know the extent of this historical range of variation or at what point the species will no longer be able to adapt to conditions outside of this range. For example, in a Mediterranean climate such as that of California, the annual season of precipitation (November to March) is relatively predictable, although amount of precipitation can vary substantially from year to year (Graham 2003). For population maintenance, vernal pools must last longer, on average, than the time needed for a species to reach maturity and produce viable eggs, and relatively small changes in the timing or amount of precipitation can affect population dynamics (Graham 2003). Based on existing data (Helm 1998, Eriksen 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 vernal pool fairy shrimp populations as cyst banks (dormant eggs in the soil from previous years) are depleted. Thus drought is likely to decrease or terminate reproductive output as pools fail to flood, or dry up before reproduction is complete, and prolonged droughts over several successive years could extirpate particular localities or entire populations of longhorn fairy shrimp.

The longhorn fairy shrimp has been found in the same general area (although at different localities) as the endangered Conservancy fairy shrimp (*Branchinecta conservatio*) and vernal pool fairy shrimp (*B. lynchi*), and the non-listed California fairy shrimp (*Linderiella occidentalis*), versatile fairy shrimp (*B. lindahli*), and spadefoot toad (*Spea hammondi*) tadpoles. Active adult longhorn fairy shrimp have been observed from the same vernal pool as versatile fairy shrimp and spadefoot toad tadpoles on the Carrizo Plain (Eng *et al.* 1990, Eriksen and Belk 1999).

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:

Urban development and conversion of native habitats to agriculture were major threats noted for the longhorn fairy shrimp when it was listed as endangered in 1994 (59 FR 48136). At the time of listing, the majority of known populations of this species were protected on public lands. Since the time of listing, additional localities have been detected, but they have all been detected within the same populations as those that were previously known, with the exception of the Los Banos detection in a roadside ditch, and this detection is not considered a viable population (CNDDDB 2007). Table 2, in section 1B, provides information on which populations of longhorn fairy shrimp are currently protected from the threat of habitat destruction and modification.

We have little information on the size and configuration of the longhorn fairy shrimp habitat that is protected within the four extant populations. Even habitat that has been protected is often subject to changed hydrological conditions, invasion by nonnative plants and other species, increased vegetation growth, and other conditions that serve to make habitat less suitable for longhorn fairy shrimp. Studies have not been conducted to determine the minimum area (upland and wetland) needed to sustain vernal pool species in the long term, nor have surveys identified

the amount of suitable habitat that is present at protected longhorn fairy shrimp localities. Furthermore, lack of monitoring information makes it difficult for land managers to note habitat threats as they appear and to respond with timely control measures.

Although much longhorn fairy shrimp habitat has been protected, some unprotected localities remain. At this time, there are eight non-protected localities of longhorn fairy shrimp within portions of the Carrizo Plain population. These localities occur on privately-owned parcels that are about 20 acres in size (A. Kuritsubo, in literature, 2006). The Service is not aware of any development plans for these parcels at this time. There is also potential for longhorn fairy shrimp to occur in unprotected areas that have not been surveyed for fairy shrimp species, particularly in areas south of the Brushy Peak and Vasco Caves Preserves and north of the Carrizo Plain, along the west side of the Central Valley.

Within the Livermore area in Alameda County, we believe that wind energy leases may potentially threaten longhorn fairy shrimp. Wind energy developers approach landowners to obtain use of the property for wind energy facilities. These leases are long-term, 20 to 30 years, and may be “floating.” Floating means that the locations of the wind power equipment can be moved around on a given percentage of a person’s property. Wind leases are fairly common in the grasslands of eastern Alameda County. At this time we do not have specific information about the existence of wind leases on the parcels that support longhorn fairy shrimp; however, if wind leases exist on these parcels and were to be developed, the longhorn fairy shrimp populations in those vernal pools could be subject to direct and indirect effects of site preparation and placement of wind generation equipment (e.g., altered hydrology, sedimentation, placement of fill), construction of access roads or fencing (altered hydrology, sedimentation, placement of fill), and vegetation management (chemical runoff or drift). In addition, access for monitoring and adaptive management could be limited.

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 longhorn 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 (ESA), is the primary Federal law that provides protection for longhorn 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) should be obtained. Section 9 and Federal

regulations pursuant to section 4(d) 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 longhorn 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 longhorn 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 suitable habitat for longhorn 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). Longhorn 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 longhorn 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 proposed 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, due to its rarity. Additional threats not discussed in the 1994 listing rule include climate change, nonnative invasive plant species, and inappropriate grazing regimes. The threats of climate change, invasive plant species, inappropriate grazing, and risk of stochastic extirpations remain for localities of longhorn fairy shrimp whether they are on protected lands or not. Threats to longhorn fairy shrimp are not likely being managed at all on private, unprotected lands. The majority of localities of this species do not have systematic monitoring programs to ensure that potential threats posed by invasive weedy species, inappropriate grazing regimes, and climate change 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 monitoring and funding are not, in themselves, threats to longhorn fairy shrimp; however, without these components, potential threats, as described above, likely will not be identified and eliminated. The ultimate status of the species depends heavily on full implementation of monitoring plans, experimental studies, and adaptive management to identify and address threats. We currently lack adequate information to determine the magnitude and imminence of these various threats at any longhorn fairy shrimp locality.

Small Numbers of Populations/Stochastic Extinction: The combination of highly specialized pool type and soil characteristics makes the longhorn fairy shrimp exceedingly rare. This species is only known to occur in four disjunct populations. 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). Localities or entire populations may be highly susceptible to extirpation due to stochastic (random or chance) events, such as a series of prolonged, catastrophic droughts, or additional environmental disturbances (Gilpin and Soule 1988; Goodman 1987), such as adverse effects from adjacent development or agriculture activities, altered hydrology due to climate change, invasive plant species, and inappropriate grazing regimes. If a catastrophic extirpation event occurs in any locality, the opportunities for recolonization from other source localities within that population may be reduced, with long-term impacts to the abundance and sustainability of longhorn fairy shrimp in that population. We consider the loss of long-term viability in any one of the four extant populations a serious threat the species' recovery.

The number of longhorn fairy shrimp in most localities is unknown, and we do not know whether any population can be characterized as "small" such that stochastic demographic or genetic factors would be important to its long-term viability. Some occurrence data (CNDDDB 2007) suggest that longhorn fairy shrimp numbers may be quite low in some sites, but we are not aware of any quantified, systematic assessment of abundance for this species. Population dynamics for longhorn fairy shrimp have not been investigated, and we do not know of any studies that have assessed the status of cyst banks within isolated or connected pools. Fairy

shrimp cysts of many species are commonly dispersed by waterfowl, other migratory aquatic birds, and vertebrate animals (Eriksen and Belk 1999). Cysts will hatch into active shrimp under appropriate conditions of water temperature and chemistry. As a result, fairy shrimp individuals may sometimes occur, at least temporarily, in sites that provide the needed hatching conditions, but may not provide the conditions necessary for the long-term persistence of the species in that site (Eriksen and Belk 1999). Therefore, we believe that isolated populations of longhorn fairy shrimp continue to be threatened by stochastic extirpation due to environmental disturbance, while any potential effects of demographic and genetic stochasticity remain unknown.

Nonnative Invasive Plant Species: Nonnative invasive plant species are known to adversely affect vernal pool habitat throughout California (see Service 2005 for a summary). Nonnative 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). Nonnative grasses maintain dominance at pool edges, sequestering light and soil moisture. In addition, Italian ryegrass (*Lolium multiflorum*) and waxy manna grass (*Glyceria declinata*) increase thatch buildup (Sacramento County 2006), which can lead to oxygen depletion in the pools (Dunne and Leopold 1978), and 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. This negatively affects vernal pool crustaceans through a decrease in available aquatic habitat both spatially and temporally.

Although localities where longhorn fairy shrimp occur have not been intensively surveyed, it is reasonable to expect invasive plants are present at some or many of them. However, surveys are needed to document the extent of nonnative plant cover at longhorn fairy shrimp localities and determine the level of management response required. We consider gathering this information a critical task for evaluating the species' status over the next 5 years.

Grazing: Appropriate grazing practices may be a necessary component to ensure proper function of hydrology in vernal pools (Marty 2005, Pyke and Marty 2005). In particular, grazing may be necessary to ensure that non-native weedy plants such as Italian ryegrass and waxy manna grass, which increase thatch buildup and decrease ponding durations, do not decrease the aquatic habitat available to longhorn 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. Grazing occurs at the NWR, EBRPD lands, and at Carrizo Plains (A. Kuritsubo, pers. comm., 2006; Steve Bobzien, pers. comm., 2007; D. Woolington, pers. comm., 2007). In addition, adaptive management through appropriate grazing is not utilized at any of the known populations for this species, which is essential to ensure the sustainability of longhorn fairy shrimp in localities that are grazed (Marty 2005). As is the case with nonnative plants, we also lack the information to determine the magnitude of grazing impacts at longhorn fairy shrimp localities, and consider this an important survey task for evaluating the species' status over the next 5 years.

Drought and Climate Change: Longhorn fairy shrimp are dependent on vernal pools that have sufficient water to remain wet throughout the annual reproductive phase of the species. Climate

change is expected to change hydrologic conditions in some parts of California (Lenihan *et al.* 2003; Pyke 2004). In addition, climate change is expected to influence the amount and timing of precipitation inputs to vernal pools and the rate of loss through evaporation and evapotranspiration, which may result in negative effects to vernal pool crustacean species through altered vernal pool hydrology (Pyke and Marty 2005, Pyke 2005). In addition, protected areas could become unusable to the longhorn fairy shrimp if climatic conditions do not allow the necessary hydrological conditions to persist (Pyke and Fisher 2005). Monitoring of vernal pool ecosystems to determine effects from drought and altered hydrology due to climate change is necessary to determine what adaptive land management practices would be the most appropriate to ensure the sustainability of vernal pool species, including longhorn fairy shrimp (Pyke and Marty 2005).

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field *et al.* 1999, Cayan *et al.* 2005, IPCC 2007, Pyke 2005). However, climatic conditions for smaller sub-regions such as California remain uncertain (Pyke 2005). It is unknown at this time if climate change in California will result in a localized, relatively small cooling and drying trend, or a warmer trend with higher precipitation events (Pyke 2005). 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.

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.

In contrast, warmer conditions could increase inundation periods. Although longer flooding could increase available habitat for longhorn fairy shrimp, we have no information whether larger pools are in fact occupied by this species, which is often found in small depressions. However, increased inundation periods associated with a warming trend could also negatively affect the species by facilitating the increased abundance of predator species that require more permanent water sources in vernal pools such as dragonflies, aquatic beetles, and amphibians (including the nonnative bullfrog, *Rana catesbiana*) (Erikson and Belk 1999, Balfour and Morey 1999, Pyke 2005a).

II.D. Synthesis

When the longhorn 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 the remaining populations, and loss of habitat due to urban development and conversion to agriculture. The Service has determined that this species is still in danger of extinction throughout its range. Longhorn fairy shrimp are extremely rare and are only known to occur in four disjunct populations. Although longhorn fairy shrimp have been detected in new localities within the populations known at the time of listing, the species' distribution remains essentially unchanged. We lack monitoring data to indicate numbers of longhorn fairy shrimp at any locality, or whether the species is present in only a small percentage of the pools at a site. In most cases, we have no information to indicate that observed localities represent demographically independent units that contribute to species viability, and the long-term viability of the species at most sites is unknown. This species is highly susceptible to extirpation at any locality due to chance events or additional environmental disturbance as described above. If a catastrophic extirpation event occurs in any locality, the opportunities for recolonization from other source localities within that population may be reduced, with long-term impacts to the abundance and sustainability of longhorn fairy shrimp in that population. We consider the loss of long-term viability in any one of the four extant populations a serious threat the species' recovery.

The majority of the four known populations of longhorn fairy shrimp are found on public lands, so many of the known localities are protected from land-use conversion; however the localities near Livermore, in Alameda County, are potentially threatened by wind leases. A small proportion of known localities remains unprotected on private lands in the Carrizo Plain population. Given the overall rarity of the longhorn fairy shrimp, we believe protection of all localities would best ensure the long-term viability of the Carrizo Plain population and its contribution to the overall survival and recovery of the species.

Beyond habitat preservation, other conservation measures, such as habitat and species monitoring, are necessary to ensure the long-term sustainability of this species. Potential threats such as habitat degradation due to inappropriate grazing regimes, altered hydrology due to drought and climate change, and nonnative invasive weedy species remain for longhorn fairy shrimp whether they are on protected lands or not. We have no information on the magnitude and imminence of these threats at any known locality of longhorn fairy shrimp. Habitat management and monitoring are essential so that potential threats to the species can be identified and eliminated. 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. Until we have better knowledge on the extent of threats to this species and its habitat, we recommend retaining the current ESA classification for the longhorn fairy shrimp. However, in section IV below we recommend actions that should be implemented over the next 5 years to obtain the information needed to assess the current status and threats to the species.

We conclude that the longhorn 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 reduce the long-term viability of localities or entire populations; (2) all localities of longhorn fairy shrimp are still threatened by additional environmental disturbances, including drought and climate change, degradation of habitat from invasive weedy plant species, inappropriate grazing regimes, and other unforeseen events; and (3) the lack of

monitoring data for 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 at particular localities 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.

IV. RECOMMENDATIONS FOR FUTURE

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 longhorn fairy shrimp experts. Implementation of these recommendations over the next 5 years, particularly items 1 and 2, is needed to provide information that would allow us to consider the potential downlisting of this species:

1. Protection of the known occurrences on private lands in the Carrizo Plain core areas should be a priority for this species.
2. Develop a standardized monitoring method to identify threats and management needs, and to monitor species status and population trends at the Carrizo Plain, San Luis NWR, Vasco Caves Preserve, and Brushy Peak Preserve populations.
3. Management and monitoring plans should be prepared for all four known populations of this species. Currently, only the San Joaquin River NWR (which is part of the San Luis NWR Complex) has a completed Comprehensive Conservation Plan. The Service is preparing a CCP for the San Luis NWR and Merced NWR (also part of the San Luis NWR Complex). The date of completion for these two CCPs is unknown at this time. BLM is preparing a management plan to address vernal pools species. Results from standardized monitoring discussed in item 2, above, should be included in the management plans for these four populations.

4. In addition, the following research should be prioritized over the next five years:
 - a. Conduct surveys on private lands with a high potential for supporting longhorn fairy shrimp, particularly in areas south of the Brushy Peak and Vasco Caves Preserves and north of the Carrizo Plain, along the west side of the Central Valley;
 - b. Conduct surveys, in the vicinity of Miller Road, north of Los Banos, Merced County, to determine whether or not the single longhorn fairy shrimp found in a road-side ditch represents a self-sustaining population, or represents an anomaly; and,
 - c. Conduct research on vernal pool habitat restoration and longhorn fairy shrimp reintroduction methods to determine the feasibility of introducing longhorn fairy shrimp to biologically appropriate vernal pool regions and soil types.
5. Regional vernal pool working groups should be created in regions where longhorn fairy shrimp are known to occur.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF LONGHORN FAIRY SHRIMP**

Current Classification: Endangered
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 Endangered

Review Conducted By Sacramento Fish and Wildlife Office Staff

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 4.16.07

The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.

REGIONAL OFFICE APPROVAL:

The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.

Lead Regional Director, Fish and Wildlife Service

Approve  Date 9/28/07

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other regions is required.