

species is known from the Flying M Ranch, on University of California lands, and on the Ichord Ranch where it is currently threatened by indirect and cumulative effects associated with the development of the University of California, Merced campus.

#### **e. Conservation Efforts**

On September 19, 1994, the final rule to list the Conservancy fairy shrimp as endangered was published in the *Federal Register* (U.S. Fish and Wildlife Service 1994a). In 2005, critical habitat was designated for the Conservancy fairy shrimp and several other vernal pool species in *Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Evaluation of Economic Exclusions From August 2003 Final Designation; Final Rule* (U.S. Fish and Wildlife Service 2005).

Within the Northeastern Sacramento Vernal Pool Region, the Conservancy fairy shrimp is protected at the Vina Plains preserve owned by the Nature Conservancy. In the Solano-Colusa Vernal Pool Region the Conservancy fairy shrimp is protected on lands within the Jepson Prairie Ecosystem, including the Burke Ranch and the Jepson Prairie Preserve owned by the Solano County Open Space and Farmland Conservancy and jointly managed by the University of California Reserve System at the Sacramento National Wildlife Refuge in Glenn County and in the Tule Ranch unit of the California Department of Fish and Game Yolo Basin Wildlife Area, in Yolo County. In the San Joaquin Vernal Pool Region, Conservancy fairy shrimp populations are protected at Grasslands Ecological Area on State and federally owned lands, and on the Arena Plains National Wildlife Refuge and the San Luis National Wildlife Refuge in Merced County (California Natural Diversity Database 2005). Although Conservancy fairy shrimp populations are protected from development on these locations, specific management and monitoring for the species may not be currently conducted at these sites.

### **3. LONGHORN FAIRY SHRIMP (*BRANCHINECTA LONGIANTENNA*)**

#### **a. Description and Taxonomy**

**Taxonomy.**—The longhorn fairy shrimp (*Branchinecta longiantenna*) was first collected in 1937, but was not formally described until 1990 (Eng *et al.* 1990). The longhorn fairy shrimp is named for its relatively long antennae. The type specimen was collected from a sandstone outcrop pool on the Souza Ranch in Contra Costa County, California.

**Description and Identification.**—Although longhorn fairy shrimp generally look similar to other fairy shrimp species (see **Box 1-** Appearance and Identification of Vernal Pool Crustaceans), this species is easily identified by the male's very long second antennae, which is about twice as long, relative to its body, as the second antennae of other species of *Branchinecta*. Longhorn fairy shrimp antennae range from 6.7 to 10.4 millimeters (0.3 to 0.4 inch) in length (Eriksen and Belk 1999). Females can be recognized by their cylindrical brood pouch, which extends to below abdominal segments six or seven. Mature males have been measured between 12 and 21 millimeters (0.5 to 0.8 inch) in length, and females range from 13.3 to 19.8 millimeters (0.5 to 0.8 inch) in length (Eng *et al.* 1990).

Longhorn fairy shrimp are easily distinguished from other fairy shrimp by the male's extremely long second antennae (Eng *et al.* 1990). Female longhorn fairy shrimp may be confused with alkali fairy shrimp (*Branchinecta mackini*), but there are no dorsal outgrowths on the thoracic segments of longhorn fairy shrimp females, while these structures are present in alkali fairy shrimp females (Eng *et al.* 1990).

#### **b. Historical and Current Distribution**

**Historical Distribution.**—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.

**Current Distribution.**—Longhorn fairy shrimp are extremely rare. The longhorn fairy shrimp is known from only a small number of widely separated populations (**Figure II-36**). Sugnet (1993) found only 3 occurrences of the longhorn fairy shrimp out of 3,092 locations surveyed, and Helm (1998) found longhorn fairy shrimp in only 9 of 4,008 wetlands sampled. 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 at the Kesterson National Wildlife Refuge and a roadside ditch located two miles north of Los Banos in the

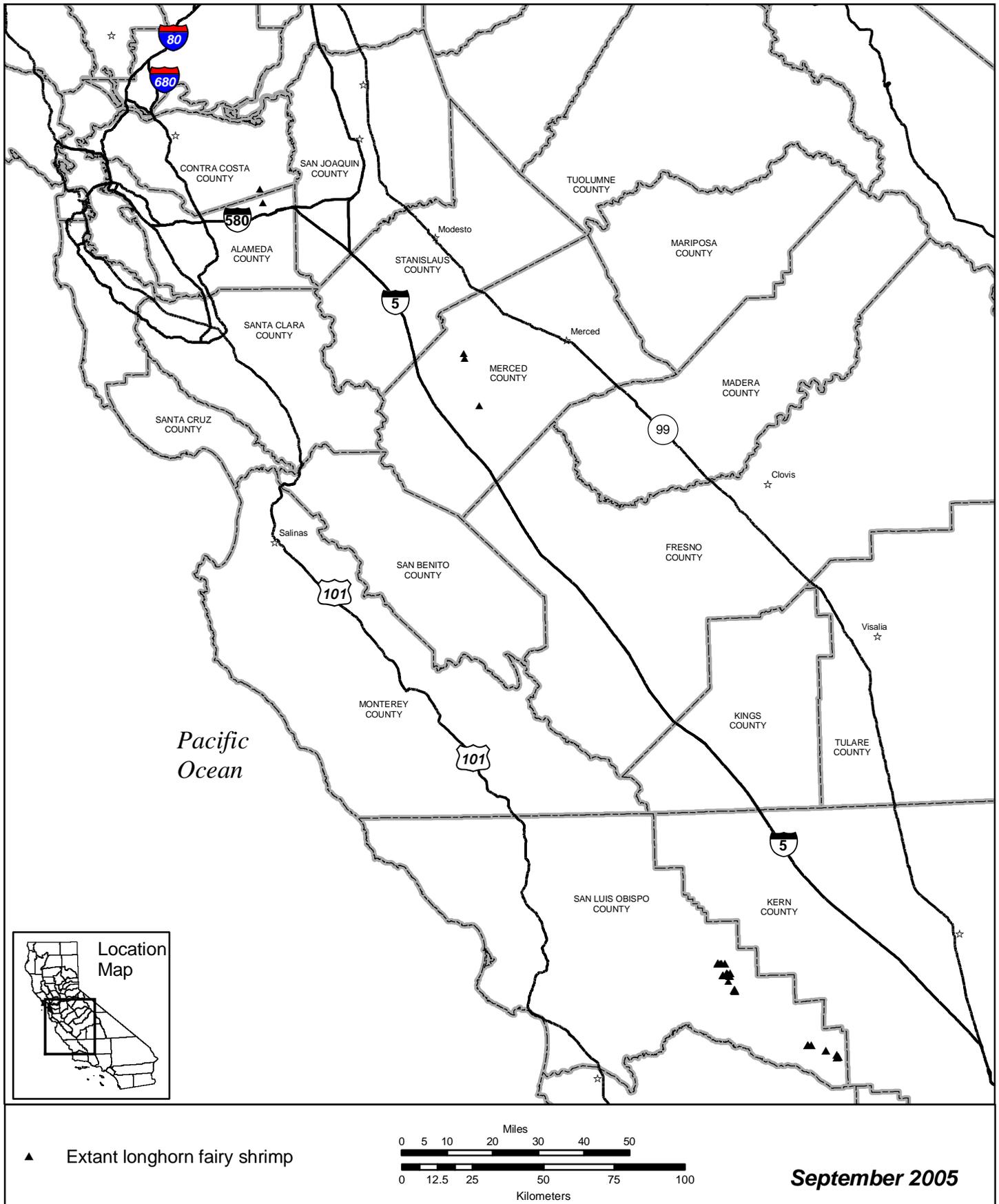


Figure II-36. Distribution of longhorn fairy shrimp (*Branchinecta longiantenna*).

San Joaquin Vernal Pool Region. Lack of surveys throughout much of the San Joaquin valley and in areas between the Carrizo and the Livermore Vernal Pool Regions suggests there may be additional, undiscovered populations of this species. Until research addressing the tolerance of longhorn fairy shrimp to cooler temperatures has been conducted, its presence in northern Central Valley vernal pool regions cannot be ruled out.

### c. Life History and Habitat

**Life History.**—The longhorn fairy shrimp is highly adapted to the unpredictable conditions of vernal pool ecosystems. Longhorn fairy shrimp required a minimum of 23 days, but averaged 43 days, to reach maturity in artificial pools described by Helm (1998). However, Helm (1998) found no significant differences between the life span or reproductive rate of the longhorn fairy shrimp and other species of fairy shrimp he studied.

**Habitat.**—Although the longhorn fairy shrimp is only known from a few locations, 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 1 meter (3.3 feet) in diameter (Eng *et al.* 1990), have a pH near neutral, and very low alkalinity and conductivity (Eriksen and Belk 1999). Water temperatures in these vernal pools have been measured between 10 and 18 degrees Celsius (50 and 64 degrees Fahrenheit). In both the San Joaquin and Carrizo Vernal Pool Regions, the longhorn fairy shrimp is found in clear to turbid, grassland pools (Helm 1998, Eriksen and Belk 1999). These grassland pools may be as large as 62 meters (203.4 feet) in diameter (Eng *et al.* 1990). Water temperatures in the grassland vernal pools are also warmer, between 10 and 28 degrees Celsius (50 to 82 degrees Fahrenheit). The species was most recently observed in a disturbed roadside ditch 2 miles north of Los Banos (California Natural Diversity Data Base 2003). Longhorn fairy shrimp have been found at elevations ranging from 23 meters (75.5 feet) in the San Joaquin Vernal Pool Region to 880 meters (2,887 feet) in the Carrizo Vernal Pool Region.

**Community Associations.**—The longhorn fairy shrimp has been found in the same general area as the Conservancy fairy shrimp, vernal pool fairy shrimp, California fairy shrimp, versatile fairy shrimp (*Branchinecta lindahli*) and spadefoot toad (*Spea hammondi*) tadpoles at different locations (Eng *et al.* 1990, Eriksen and Belk 1999, J. Darren *in litt.* 2005). 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.

#### **d. Reasons for Decline and Threats to Survival**

Most species addressed in this recovery plan are threatened by similar factors because they occupy the same vernal pool ecosystems. These general threats, faced by all the covered species, are discussed in greater detail in the Introduction section of this recovery plan. Additional, specific threats to longhorn fairy shrimp are described below.

In the Carrizo Vernal Pool Region, longhorn fairy shrimp habitat near Soda Lake is threatened by activities associated with the occasional placement of a trailer on a parcel and the construction of the associated dirt access road (J. Darren BLM, *in litt.*, 2005). In the Livermore Vernal Pool Region, longhorn fairy shrimp occurrences in the Altamont Pass area in Contra Costa and Alameda Counties may be threatened by ongoing and future wind energy developments (Eng *et al.* 1990). The Souza Ranch area in Contra Costa County is also threatened by wind energy and water storage projects (Eng *et al.* 1990). In the San Joaquin Vernal Pool Region, the longhorn fairy shrimp is protected from development on the Kesterson Unit of San Luis National Wildlife Refuge; however, there are no management guidelines explicitly addressing management of longhorn fairy shrimp at the refuge.

#### **e. Conservation Efforts**

On September 19, 1994, the final rule to list the longhorn fairy shrimp as endangered was published in the *Federal Register* (U.S. Fish and Wildlife Service 1994a). In 2005, critical habitat was designated for the longhorn fairy shrimp and several other vernal pool species in *Final Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants in California and Southern Oregon; Evaluation of Economic Exclusions From August 2003 Final Designation; Final Rule* (U.S. Fish and Wildlife Service 2005).

Although there has been a significant amount of research addressing vernal pool habitats, few studies have addressed longhorn fairy shrimp specifically. The longhorn fairy shrimp is difficult to study because of its rarity. Most of what is known about the species is described in Helm (1998), Eriksen and Belk (1999), and Eng *et al.* (1990). Factors that limit the distribution of this species have been suggested in the literature, but have yet to be tested.

In the Carrizo Vernal Pool Region, vernal pool habitat supporting the longhorn fairy shrimp has been protected on the Carrizo National Monument. Longhorn

fairy shrimp populations are regularly monitored by Bureau of Land Management staff. In the San Joaquin Vernal Pool Region, vernal pool habitats occupied by the longhorn fairy shrimp are protected at the Kesterson National Wildlife Refuge.

#### **4. VERNAL POOL FAIRY SHRIMP (*BRANCHINECTA LYNCHI*)**

##### **a. Description and Taxonomy**

**Taxonomy.**—The vernal pool fairy shrimp (*Branchinecta lynchi*) was first described by Eng, Belk and Eriksen (Eng *et al.* 1990). The species was named in honor of James B. Lynch, a systematist of North American fairy shrimp. The type specimen was collected in 1982 at Souza Ranch, Contra Costa County, California. Although not yet described, the vernal pool fairy shrimp had been collected as early as 1941, when it was identified as the Colorado fairy shrimp by Linder (1941).

**Description and Identification.**—Although most species of fairy shrimp look generally similar (see **Box 1- Appearance and Identification of Vernal Pool Crustaceans**), vernal pool fairy shrimp are characterized by the presence and size of several mounds (see identification section below) on the male's second antennae, and by the female's short, pyriform brood pouch. Vernal pool fairy shrimp vary in size, ranging from 11 to 25 millimeters (0.4 to 1.0 inch) in length (Eng *et al.* 1990). Vernal pool fairy shrimp closely resemble Colorado fairy shrimp (*Branchinecta coloradensis*) (Eng *et al.* 1990). However, there are differences in the shape of a small mound-like feature located at the base of the male's antennae, called the pulvillus. The Colorado fairy shrimp has a round pulvillus, while the vernal pool fairy shrimp's pulvillus is elongate. The vernal pool fairy shrimp can also be identified by the shape of a bulge on the distal, or more distant end, of the antennae. This bulge is smaller and less spiny on the vernal pool fairy shrimp. The female Colorado fairy shrimp's brood pouch is longer and more cylindrical than the vernal pool fairy shrimp's. Female vernal pool fairy shrimp also closely resemble female midvalley fairy shrimp. These two species can be distinguished by the number and placement of lobes on their backs, called dorsolateral thoracic protuberances. Vernal pool fairy shrimp have paired dorsolateral thoracic protuberances on the third thoracic segment that are lacking in the midvalley fairy shrimp (Belk and Fugate 2000).

##### **b. Historical and Current Distribution**

**Historical Distribution.**—The vernal pool fairy shrimp was identified relatively recently, in 1990, and there is little information on the historical range of the species. However, the vernal pool fairy shrimp is currently known to occur