Vernal Pool Fairy Shrimp (*Brachinecta lynchi*)

Status

State: Meets the requirements as a "rare, threatened, or endangered species" under CEQA

Federal: Threatened

Critical Habitat: Designated 2006 (USFWS 2006)

Population Trend

Global: Declining due to habitat loss and fragmentation (Eriksen and Belk 1999)

State: As above

Within Inventory Area: Unknown

Data Characterization

The location database for the vernal pool fairy shrimp (*Brachinecta lynchi)* within the inventory area includes 6 records from 1993, 1997, and 1999. The majority of locations are vernal pools within non-native grassland. Other natural and artificial habitats have a high probability of being occupied by additional populations of the vernal pool fairy shrimp throughout the grassland habitats within the ECCC HCP/NCCP inventory area.

Beyond the original description (Eng et al. 1990), a scanning electron micrograph of the cyst (resting egg) (Hill and Shepard 1997), and some generalized natural history data (Helm 1997), no peer-reviewed technical literature has been published concerning the vernal pool fairy shrimp. Eriksen and Belk (1999) presented a brief discussion of the vernal pool fairy shrimp and provided a distribution map.

Range

The vernal pool fairy shrimp is found from Jackson County near Medford, Oregon, throughout the Central Valley, and west to the central Coast Ranges. Isolated southern populations occur on the Santa Rosa Plateau and near Rancho California in Riverside County (Eng et al.1990, Eriksen and Belk 1999, Jones & Stokes file information). In 1996, the U.S. Fish and Wildlife Service reported that there were 32 known populations of the vernal pool fairy shrimp, ranging from the Stillwater Plain in Shasta County through most of the length of the Central Valley to Paisley in Tulare County, and along the central Coast Range from northern Solano County to Pinnacles National Monument in San Benito

County. Disjunct populations were also reported to occur in San Luis Obispo County, Santa Barbara County, and Riverside County.

Vernal pool fairy shrimp have been observed in the western portions (Central Valley region) of Tehama, Butte, Yuba, Placer, Stanislaus, Madera, Fresno, and Tulare Counties (Eriksen and Belk 1999). This species has also been observed in the eastern portions of Alameda, Yolo, and Glenn Counties (Eriksen and Belk 1999). It has been observed in Sacramento, Colusa, and Merced Counties as well.

Occurrences within the ECCC HCP/NCCP Inventory Area

Six records for this species exist in the ECCC HCP/NCCP inventory area. Vernal pool fairy shrimp may also be found elsewhere throughout the inventory area in appropriate habitats. The paucity of data points within the open-space areas is probably due to a lack of survey effort.

Existing vernal pool fairy shrimp records include numerous occupied pools on the Cowell Ranch on the northeast side of Mount Diablo, artificial pools in a railroad access road near Pittsburgh, and pools in the Byron Hot Springs area (e.g., Stromberg and Ford 2003). Critical habitat for the species includes the Altamont Hills Unit 19, which is the only known location that supports vernal pool fairy shrimp in sandstone outcrop pools . This unit lies north of Corral Hollow Road, west of Clifton Court Forebay, east of Danville, southeast of Concord, and south of Antioch (U.S. Fish and Wildlife Service 2003).)

Biology

Habitat

Vernal pool fairy shrimp are distributed from southern Oregon to southern California in a wide variety of habitat types (Eriksen and Belk 1999). Soil types associated with vernal pool fairy shrimp vary greatly with geography and influence the ecology of the species. This species is usually associated with vernal pools (79%) but can also be found in association with other ephemeral habitats including alkali pools, seasonal drainages, stock ponds, vernal swales and rock outcrops (Vollmar 2002). Critical habitat within the inventory area contain the only known location of vernal pool fairy shrimp in sandstone outcrop pools (USFWS 2003). Examples of artificially created ephemeral habitats include railroad toe-drains, roadside ditches, abandoned agricultural drains, ruts left by heavy construction vehicles, and depressions in firebreaks (Eng et al. 1990).

Vernal pools are subject to seasonal variations, and vernal pool fairy shrimp are dependent on the ecological characteristics of such variations. These characteristics include duration of inundation and presence or absence of water at specific times of the year (U.S. Fish and Wildlife Service 1994). The vernal pool fairy shrimp is capable of living in Central Valley vernal pools of relatively short duration (pond 6 to 7 weeks in winter and 3 weeks in spring) (Eriksen and Belk

1999). Other factors contributing to the suitability of pools for vernal pool fairy shrimp include alkalinity, total dissolved solids (TDS), and pH (U.S. Fish and Wildlife Service 1994; Eriksen and Belk 1999). This fairy shrimp occurs in pools with alkalinity ranging from 22 to 274 ppm (parts per million), 48 to 481 ppm TDS, and a pH range from 6.3 to 8.5 (Eriksen and Belk 1999). U.S. Fish and Wildlife Service (1994) described the water in pools occupied by vernal pool fairy shrimp as having low conductivity and chloride, though specific numbers were not given. Vernal pool fairy shrimp have been found in pools ranging from 0.1 acre to 0.05 acre (Eriksen and Belk 1999). However, Platenkamp (1998) found that at Beale Air Force Base in Yuba County vernal pool fairy shrimp occurred more frequently in small, deep pools. Specific descriptions of the size and depth of occupied vernal pools were not reported in this paper

Feeding

Vernal pool fairy shrimp are omnivorous filter-feeders. Fairy shrimp indiscriminately filter particles from the surrounding water, including bacteria, unicellular algae, and micrometazoa (Eriksen and Belk 1999). The precise size of items these fairy shrimp are capable of filtering is currently unknown. However, fairy shrimp will attempt to consume whatever material they can fit into their feeding groove and do not discriminate based upon taste, as do some other crustacean groups (Eriksen and Belk 1999). Vernal pool fairy shrimp will also rasp periphyton from sticks, stems, and slender leaves (Rogers in prep.).

Ecology

Vernal pool fairy shrimp are a component of the planktonic crustacea within seasonal temporary pools and can occur in densities as high as 200 per liter of water. Planktonic crustacea are important in the food web, as they represent a high-fat, high-protein resource for migratory waterfowl. Mallard, Green-winged Teal, Bufflehead, Greater Yellowlegs, and Killdeer all forage actively in Central Valley vernal pools on the invertebrate and amphibian fauna during the winter months.

Predator consumption of fairy shrimp cysts (resting eggs) aids in distributing populations of fairy shrimp. Predators expel viable cysts in their excrement, often at locations other than where they were consumed (e.g. Wissinger et al. 1999). If conditions are suitable, these transported cysts may hatch at the new location and potentially establish a new population. Cysts can also be transported in mud carried on the feet of animals, including livestock, that may wade through the habitat (Rogers in prep.).

Beyond inundation of the habitat, the specific cues for hatching are unknown (Eriksen and Belk 1999), although temperature is believed to play a large role. Typically, midvalley fairy shrimp mature in about 16 days when water temperatures reach at least 20 degrees Celsius (Eriksen and Belk 1999).

Vernal pool fairy shrimp commonly co-occur with the California linderiella *(Linderiella occidentalis*) (Eriksen and Belk 1999). This species has also been reported co-occurring with the midvalley pool fairy shrimp (*Branchinecta mesovallensis*) on 3 occasions, in which the midvalley fairy shrimp was probably washed into the vernal pool fairy shrimp habitat by abnormally high rainfall (Eriksen and Belk 1999). In most cases, however, the vernal poor fairy shrimp does not co-occur with other fairy shrimp species and when it is does it is not the numerically dominant one (Eng et al. 1990).

Threats

Vernal pool fairy shrimp are threatened by the same activities as other vernal pool invertebrates. These threats include the conversion of vernal pool habitat to agricultural lands and urban development, and stochastic extinction because of the small and isolated nature of remaining populations (U.S. Fish and Wildlife Service 1994). The limited and disjunct distribution of vernal pools, coupled with the even more limited distribution of the vernal pool fairy shrimp, means that any reduction in vernal pool habitat quantity could adversely affect this species.

Habitat fragmentation can isolate and reduce population size, resulting in a process of progressive population extinction. Small or isolated populations are more susceptible to extinction from random environmental disturbance. Recolonization opportunities are also diminished when physical barriers, such as development or lack of vernal pool habitat, isolate populations from one another or inhibit transport of cysts. Isolated populations are potentially more susceptible to inbreeding depression, which can result in local extinction or reduced fitness (Gilpin and Soule 1986, Goodman 1987a, 1987b). However, this has never been demonstrated for branchiopod crustaceans.

Activities that alter the suitability of habitat may impact the special-status crustaceans dependent on these habitats. These activities include damaging the impermeable clay and /or hardpan layers of the habitat bottom, filling in the habitat, and altering (e.g. through contaminants) or destroying the watershed that conveys overland flow into the habitat. Additionally, introduction of non-native plants, destruction or degradation of the surrounding upland habitat, introduction of fish (such as *Gambusia* spp.) into special-status shrimp habitats, and activities that would discourage or prevent waterfowl and waders from feeding at occupied habitats and thereby restrict gene flow between populations would also significantly affect midvalley fairy shrimp populations.

Conservation and Management

The conservation of vernal pool fairy shrimp is directly tied to the conservation of suitable vernal pool habitat. However, because comprehensive surveys for the vernal pool fairy shrimp in the ECCC HCP/NCCP inventory area have not been conducted and because known occurrences throughout the species range are based mostly on incidental observations (e.g., CNDDB), the population size and

locations of this species in the ECCC HCP/NCCP inventory area are not known. Also, suitable habitat for the vernal pool fairy shrimp in the ECCC HCP/NCCP inventory area was identified based on a general classification of land cover types. Field evaluation of the habitat classification has not been conducted, and the extent to which vernal pools in the inventory area meet the habitat requirements of vernal pool fairy shrimp is unknown. Also, the importance of artificial habitats that may support vernal pool fairy shrimp in the ECCC HCP/NCCP inventory area has not been evaluated.

Species Distribution Model

No species distribution model could be developed for the vernal pool fairy shrimp because vernal pools and other suitable microhabitats occur at too small a scale to be mapped in the inventory area (e.g., vernal pools are subsumed within "seasonal wetlands").

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