Midvalley Fairy Shrimp (*Branchinecta mesovallensis*)

Status

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

Federal: None; petitioned for endangered status (U.S. Fish and Wildlife Service 2003) but rejected for listing (U.S. Fish and Wildlife Service 2004)

Population Trend

Global: Declining due to habitat loss and fragmentation (Center for Biological Diversity 2001, Eriksen and Belk 1999, Belk & Fugate 2000)

State: As above

Within Inventory Area: Unknown

Data Characterization

The location database for the midvalley fairy shrimp (*Branchinecta mesovallensis)* within the study area includes a single data record from 1997 near the Byron Airport and can be accurately located within the inventory area. The single location is a shallow vernal pool within nonnative grassland. Additional natural and artificial habitats have a high probability of being occupied by the midvalley fairy shrimp throughout the grassland habitats within the inventory area.

Except for the original description (Belk and Fugate 2000), a scanning electron micrograph of the cyst (resting egg) (Hill and Shepard 1997), and over-generalized natural history data (Helm 1997), no peer-reviewed technical literature has been published concerning the midvalley fairy shrimp. However, a U.S. Fish and Wildlife Service study is currently in progress, and the data from that study is available. In addition, Eriksen and Belk (1999) have presented a brief discussion of the midvalley fairy shrimp and provided a distribution map.

Range

Midvalley fairy shrimp is endemic to California Central Valley grassland vernal pools (Belk and Fugate 2000). Known occurrences include scattered populations from the Mather Field area of Sacramento south through Galt from Sacramento County; the Jepson Prairie, Travis Air Force Base, and Vacaville areas in Solano County; from Lodi north to the county border in San Joaquin County; the Byron Airport in Contra Costa County; the Virginia Smith Trust (Haystack Mountain) and Arena Plains National Wildlife Reserve in Merced County; 1 location in central Madera County; and 1 in northern Fresno County (Erickson and Belk 1999, Belk and Fugate 2000, Rogers in prep.).

Occurrences within the ECCC HCP/NCCP Inventory Area

Midvalley fairy shrimp could be found throughout the inventory area in appropriate habitats. A single record for this species exists near the Byron Airport. The paucity of data points within open space areas is due to a lack of survey effort. Because this species has a brief life cycle and inhabits shallow temporary pools and artificial habitats that may only pond between 4 and 14 days, it is very likely that this species would be missed during typical U.S. Fish and Wildlife Service protocol-level surveys (U.S. Fish and Wildlife Service 1996).

Biology

Habitat

Typical habitat for special-status fairy shrimp in California includes vernal pools, seasonally ponded areas within vernal swales, rock outcrop ephemeral pools, playas, and alkali flats (Eng et al. 1990). Other kinds of depressions that hold water of a similar volume, depth, and area, and for a similar duration and seasonality to vernal pools and ponded areas within swales may also be potential habitat. These other depressions, however, are typically artificial habitats and are partially or completely unvegetated. Examples include railroad toe-drains, roadside ditches, abandoned agricultural drains, ruts left by heavy construction vehicles, and depressions in fire breaks (Eng et al. 1990).

Midvalley fairy shrimp require seasonally ephemeral aquatic habitats that pool in winter and spring. This species most commonly occurs in small to medium grassy or clay-bottomed vernal pools, roadside ditches, and railroad toe-drains (Rogers in prep.). The midvalley fairy shrimp is adapted to habitats that are inundated for short periods and can complete its life cycle (cyst to adult with fertilized eggs) in as little as 4 days, especially under extreme circumstances, such as years with below-average rainfall (Rogers in prep.). The ability to rapidly complete its life cycle allows the midvalley fairy shrimp to use habitats that are extremely hydrologically unstable (i.e., fill and dry quickly).

Little is known about midvalley fairy shrimp habitat requirements. Typically, the midvalley fairy shrimp is found in small, shallow, “flashy” vernal pools that only pond for 4 days, but it also can also be found in artificial habitats, such as railroad toe-drains, that may be up to 20 centimeters deep and pond for 3 months (Rogers in prep.). Further study may reveal that the species occurs in a wider range of conditions and pool types.

Feeding

Midvalley 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 the fairy shrimp are capable of filtering is currently unknown (Eriksen

and Belk 1999), but fairy shrimp will attempt to consume whatever material they can fit into their feeding groove and do not discriminate based on taste like other crustacean groups (Eriksen and Belk 1999). Midvalley fairy shrimp will also rasp periphyton from sticks, stems and slender leaves (Rogers in prep.).

Ecology

Midvalley 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 because 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 winter.

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 (Wissinger et. al. 1999). If conditions are suitable, these transported cysts may hatch at the new location and potentially establish a new population. Cysts are also be transported in mud carried on the feet of animals, including livestock, that may wade through the habitat (Rogers in prep.).

Other than 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 once water temperatures reach at least 20ºC (Eriksen and Belk 1999). However, midvalley fairy shrimp can hatch, mature, and produce viable cysts in 4 days under extreme circumstances (Rogers in prep.).

Midvalley fairy shrimp have been found co-occurring with the fairy shrimp Linderiella occidentalis in the Lodi and Galt areas (Rogers in prep.). This species has also been reported co-occurring with the vernal pool fairy shrimp (*Branchinecta lynchi*) on 3 occasions, where it was likely washed into the vernal pool fairy shrimp habitat by abnormally high rainfall (Eriksen and Belk 1999).

Threats

Midvalley 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). Although only recently described, midvalley fairy shrimp has probably declined over its range as a result of agricultural, suburban, and industrial conversion of its habitat (Eriksen and Belk 1999, Belk and Fugate 2000). Because of the limited and disjunct distribution of vernal pools, coupled with the even more limited distribution of the midvalley fairy shrimp, 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 extinctions. 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), although 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. In addition, introducing nonnative plants, destroying or degrading the surrounding upland habitat, introducing fish (e.g., *Gambusia* sp.) into special-status shrimp habitats, and activities that would discourage or prevent waterfowl and waders from feeding at occupied habitats (thereby restricting gene-flow between populations), would also significantly affect midvalley fairy shrimp populations.

Conservation and Management

Conservation of the midvalley fairy shrimp is directly tied to conservation of suitable vernal pool habitat. However, because comprehensive surveys for the midvalley fairy shrimp in the inventory area have not been conducted and because known occurrences throughout the species range are based mostly on incidental observations (e.g., the California Natural Diversity Database), the population size and locations of this species in the inventory area are not known. Also, suitable habitat for the midvalley fairy shrimp in the 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 study area meet the habitat requirements of midvalley fairy shrimp is unknown. Further, the importance of artificial habitats that may support midvalley fairy shrimp in the inventory area has not been evaluated. However, the primary data gap concerning suitable habitat for the midvalley fairy shrimp is the lack of understanding of what defines suitable habitat.

The rapid life cycle of this species (as little as 4 days) can also result in a lack of detections even while conducting protocol surveys. The U.S. Fish and Wildlife Service (1996) protocol special-status shrimp survey guidelines require that surveys are conducted in 2-week intervals, from initial inundation of the habitat in winter to its subsequent drying in spring. Therefore, standard special-status shrimp surveys according to the required protocols may not detect populations of the midvalley fairy shrimp during years with reduced rainfall.

Species Distribution Model

No species distribution model could be developed for the midvalley 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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