Species Accounts

Buena Vista Lake shrew, Sorex ornatus relictus Paul W. Collins

Description: A small (98-105 mm TL), dull blackish to gray-brown shrew with a relatively short (35-39 mm), faintly bicolored tail, dark at terminus above and below; smoke gray ventrum; and relatively broad, flat skull (Grinnell 1932, Owen and Hoffmann 1983). Weight between 4.1 and 7.6 g (Williams et al. 1998). *S. o. relictus* has a darker dorsal pelage than the sympatric *S. o. ornatus*, which has a more grayish brown pelage and occurs in more upland habitats. Compared to *S. o. ornatus*, *S. o. relictus* is slightly larger, has a shorter tail, a shorter and heavier rostrum, and a higher brain-case (the latter two characters are discernable only in prepared skeletons) (Grinnell 1932).

Taxonomic Remarks: Grinnell (1932) described *S. o. relictus* based on specimens collected from the vicinity of Buena Vista Lake, Kern County; there are eight other subspecies of *Sorex ornatus* (Hall 1981, George 1988, Wilson and Reeder 1993). Grinnell (1932) suggested that intergradation between *S. o. relictus* and *S. o. ornatus* probably occurred along the lower courses of streams which entered the Kern-Tulare basin. A review of the systematics of *S. ornatus*, including *S. o. relictus*, based on biochemical and morphometric data, and an evaluation of the population genetics of fragmented, restricted populations such as are found in *S. o. relictus*, is underway (J. Maldonado 1992 pers. comm.).

Distribution: According to Grinnell (1933), the Buena Vista Lake shrew historically occupied marshlands throughout the southern end of the San Joaquin Valley from the Tulare Lake Basin in Kings County south to the vicinity of Bakersfield and Buena Vista Lake in Kern County. It probably occurred in the wetland habitats around the original historic Buena Vista, Tulare and Kern Lakes and along streams and sloughs throughout the lake basins (Grinnell 1932, 1933, Williams and Kilburn 1992). Grinnell (1933) listed its elevational range as below 300 ft (92 m).

When the Buena Vista Lake shrew was described by Grinnell (1933), its distribution had already been greatly reduced by the drainage of lakes and sloughs in the southern San Joaquin Valley. Since then, the loss of habitat has increased: Buena Vista Lake and the surrounding lakes and marshes have been drained and cultivated, and most watercourses have been channelized, with steep walls, and are maintained free of vegetation (Williams and Kilburn 1992). The species is now known to occur only at Kern Lake Preserve (Freas 1990, J. Maldonado pers. comm.) and at the Kern National Wildlife Refuge. Disjunct populations of this taxon may still occur in the vicinity of the Buena Vista Lake Aquatic Recreation Area, at the Kern National Wildlife Refuge, at the Tule Elk Reserve, and along sloughs and canals on the Valley floor leading into Goose Lake Slough (Williams 1986, Williams et al. 1998). Recent surveys have failed to confirm its presence at the following locations: The Nature Conservancy's Paine Wildflower Preserve, the Voice of America Transmitter site west of Delano (Clark et al. 1982), the Tule Elk Reserve (Maldonado 1992), and Goose Lake Slough (Germano and Tabor 1993).

Life History: The life history of the Buena Vista Lake shrew has not been studied, but is likely similar to other subspecies of *Sorex ornatus*. The information cited here is based on studies of other subspecies of *Sorex ornatus* (Owen and Hoffmann 1983, Zeiner et al. 1990). The short life span, limited reproductive potential, and narrow habitat requirements of ornate shrews may be considered limiting factors. Ornate shrews can be active during the day and night, but *S. o. sinuosus* is reportedly more active at night, especially during the breeding season (Rust 1978). During hot summer weather in dry habitats, ornate shrews may restrict their daytime activity to burrows of other

animals (Pearson 1959).

Ornate shrews possess high minimum (4.5 Kcal/day) and maximum (6.0 Kcal/day) metabolic rates (Newman and Rudd 1978a) which require an individual to consume a large volume of food daily to survive. Torpor has been observed in *Sorex ornatus* (Newman and Rudd 1978b) and may be an adaptation which ornate shrews use to reduce the amount of food needed daily in order to survive periods of adverse weather or food shortages. The metabolic rate and weight of *Sorex ornatus* increases during the spring and early summer breeding season and decreases slightly during the late summer and fall (Newman and Rudd 1978a).

Most *Sorex ornatus* breed from early spring through May with some limited late summer and early fall breeding generally by young born during the early part of the previous spring (Owen and Hoffmann 1983). The majority of females give birth in the spring to a single litter of four to six young following an estimated 21 day gestation period (Owen and Hoffmann 1983). The life expectancy of most ornate shrews is 12 to 16 months (Rudd 1955a), resulting in high annual turnover (Owen and Hoffmann 1983).

In favorable habitat, ornate shrews reach densities as high as 111/ha (Owen and Hoffmann 1983). Recent trapping results for *S. o. relictus* indicate they exist at much lower densities, probably no more than 10-15/ha (Williams et al. 1988). While ornate shrew populations are not limited by food availability (Newman 1970), they may affect the density and diversity of invertebrate prey (Owen and Hoffmann 1983). Ornate shrews forage throughout the day and night on insects and other invertebrates under logs, rocks and in leaf litter (Zeiner et al. 1990). As far as is known, they do not store or cache food.

Habitat: The Buena Vista Lake shrew probably shows the same habitat preferences as other subspecies of Sorex ornatus: dense vegetative cover; a mixture of logs, branches, and detritus/debris and leaf litter; a year-round supply of invertebrate prey; and close proximity to surface water (Collins and Martin 1985, Maldonado 1992). Buena Vista Lake shrews inhabited Valley freshwater marshes around the perimeter of Buena Vista Lake (Grinnell 1932), and probably occurred in similar marshlands throughout the Tulare Basin (Williams 1986). The Buena Vista shrew may be largely confined to areas of dense understory riparian and emergent marsh vegetation along streams and canals, and around the perimeter of remaining sloughs and lakes at the southern end of the San Joaquin Valley. Recent captures of shrews at the Kern Lake Preserve were made within a meter of the water line of Gator Pond in the shaded understory of cottonwood-willow riparian habitat, in dense stands of cattails (Typha spp.) and bulrushes (Scirpus spp.), or occasionally in dense patches of alkali heath (Frankenia grandifolia) (J. Maldonado pers. comm.). A partial list of plants found at many capture sites is: Fremont cottonwood (Populus fremontii), willow (Salix spp.), pickleweed (Salicornia sp), alkali heath (Frankenia grandifolia), wild-rye (Elymus sp.), and Baltic rush (Juncus *balticus*). Many capture sites contain a well-developed ground layer of dead branches, leaf litter, downed logs, exposed cottonwood and willow roots, and high soil moisture (J. Maldonado pers. comm.).

Status: Class I. This taxon may meet CESA criteria for listing as Endangered because of its extremely restricted distribution (only two known extant populations) and small population size, highly specific habitat preferences, and continued habitat loss from agricultural and urban development, and flood control activities. The conversion of lakes and sloughs in the southern San Joaquin Valley to agriculture, diversion of fresh water supplies, and channelization of streams and rivers have eliminated most of the wetland habitat that once supported this taxon (Williams 1986). The Buena Vista Lake bed is now cultivated, and Kern Lake has been reduced to 33 acres with a

small pond and artificially-maintained wetlands and a series of dry upland habitats (Williams et al. 1998). As Williams (1986) points out, this taxon may be extant at the Kern National Wildlife Refuge, in wetlands of the Kern River percolation area, and along sloughs and canals on the valley floor leading into Goose Lake. However, trapping efforts during the past decade at a number of wetland sites in the southern San Joaquin Valley have located only two small disjunct populations. Due to its small, restricted, populations, the Buena Vista Lake shrew is also threatened by environmental, demographic, and genetic stochasticity (Williams et al. 1998).

The decision whether to proceed with listing the Buena Vista Lake shrew will likely be bolstered by the outcomes of following two activities. First, U.S. Fish and Wildlife Service efforts to negotiate a Conservation Agreement with the Kern Lake Preserve, owned by the J.G. Boswell Company, have failed (Williams et al. 1998). Without a conservation agreement, the water may be diverted for agriculture, which may result in impacts to the Preserve's wetland habitats. Second, management of the Kern Fan Water Bank Project was recently abandoned by the Department of Water Resources and turned over to the Kern County Water Agency (Williams et al. 1998). This creates uncertainty over how the project will be designed and managed, and whether conservation of candidate and listed species will be a component of the project. These projects could potentially protect enough Buena Vista Lake shrew habitat to preclude the need for listing. The failure of both projects to effect habitat conservation for the Buena Vista Lake shrew would necessitate providing protection to the species under CESA. [Editor's note: The Buena Vista Lake shrew was Federally-listed as endangered on April 5, 2002.]

Management Recommendations: The highest priority is to protect the only known Buena Vista Lake shrew population and its habitat at the Kern Lake Preserve. Recovery of the species will require better protection and/or restoration of riparian woodland and freshwater marsh habitat along sloughs, channels, streams, rivers and historic lake basins in southwestern San Joaquin Valley. The recovery plan for upland species of the San Joaquin Valley (Williams et al. 1998) includes more detailed versions of the following recommendations: *i*) use greater efforts to locate other extant populations of Buena Vista Lake shrews within the southwestern Tulare Basin, *ii*) ensure that any flood control and water banking project on the Kern Fan includes creation and restoration of wetland habitat for the shrew, *iii*) reestablish shrews at the Tule Elk Reserve near Tupman if a permanent water supply can be secured, *iv*) resolve the taxonomic identity of ornate shrews on the Kern national Wildlife Refuge, *v*) survey other potential habitat areas including the Buena Vista Lake shrew within three years of recovery plan approval.

Additional surveys of remaining wetland habitats within the species' historic range should be surveyed, including, but not limited to Kern National Wildlife Refuge, Tule Elk Reserve, and Buena Vista, Jerry and Goose Lake Sloughs (Williams 1986, Williams et al. 1998). Additional information is also needed on the basic biology of the species, including population density, home range, movement, breeding biology, habitat associations, and extent of remaining suitable habitat. A better understanding is also needed of the species systematic status and whether the remaining populations are showing signs of population bottlenecking and inbreeding.

