

Meadow jumping mice usually have two litters per year, but there are records of three litters per year. An average of five young are born per litter, but the size of a litter can range from two to eight young (Quimby 1951, Whitaker 1963).

The Preble's is long-lived for a small mammal, in comparison with many species of mice and voles that seldom live a full year. Along South Boulder Creek, Boulder County, Colorado, seven individuals originally captured as adults were still alive 2 years later, having attained at least 3 years of age (Meaney *et al.*, in prep.). However, like many small mammals, the Preble's annual survival rate is low. Preble's survival rates appear to be lower over the summer than over the winter. Over-summer survival rates ranged from 22 to 78 percent and over-winter survival rates ranged from 56 to 97 percent (Shenk and Sivert 1999b; Ensight Technical Services 2000, 2001; Schorr 2001; Meaney *et al.*, in prep.).

The Preble's has a host of known predators including garter snakes (*Thamnophis* spp.), prairie rattlesnakes (*Crotalus viridis*), bullfrogs (*Rana catesbeiana*), foxes (*Vulpes vulpes* and *Urocyon cinereoargenteus*), house cats (*Felis catus*), long-tailed weasels (*Mustela frenata*), and red-tailed hawks (*Buteo jamaicensis*) (Shenk and Sivert 1999a, Schorr 2001). Other potential predators include coyotes (*Canis latrans*), barn owls (*Tyto alba*), great horned owls (*Bubo virginianus*), screech owls (*Otus* spp.), long-eared owls (*Asio otus*), northern harriers (*Circus cyaneus*), and large predatory fish.

Other mortality factors of the Preble's include drowning and vehicle collision (Schorr 2001, Shenk and Sivert 1999a). Mortality factors known for the meadow jumping mouse, such as starvation, exposure, disease, and insufficient fat stores for hibernation (Whitaker 1963) also are likely causes of death in the Preble's subspecies.

White and Shenk (2000) determined that riparian shrub cover, tree cover, and the amount of open water nearby are good predictors of Preble's densities, and summarized abundance estimates from nine sites in Colorado for field work conducted during 1998 and 1999. Estimates of abundance ranged from 4 to 67 mice per km (6 to 110 mice per mi) of stream and averaged 33 mice per km (53 mice per mi) of stream.

While fecal analyses have provided the best data on the Preble's diet to date, they overestimate the components of the diet that are less digestible. Based on fecal analyses the Preble's eats insects; fungus; moss; pollen; willow; *Chenopodium* sp. (lamb's quarters);

Salsola sp. (Russian thistle); *Helianthus* spp. (sunflowers); *Carex* spp. (sedge); *Verbascum* sp. (mullein); *Bromus*, *Festuca*, *Poa*, *Sporobolus* and *Agropyron* spp. (grasses); *Lesquerella* sp. (bladderpod); *Equisetum* spp. (horsetail); and assorted seeds (Shenk and Eussen 1998, Shenk and Sivert 1999a). The diet shifts seasonally; it consists primarily of insects and fungus after emerging from hibernation, shifts to fungus, moss, and pollen during mid-summer (July-August), with insects again added in September (Shenk and Sivert 1999a). The shift in diet along with shifts in mouse movements suggests that the Preble's may require specific seasonal diets, perhaps related to the physiological constraints imposed by hibernation (Shenk and Sivert 1999a).

The Preble's is a true hibernator, usually entering hibernation in September or October and emerging the following May, after a potential hibernation period of 7 or 8 months. Adults are the first age group to enter hibernation because they accumulate the necessary fat stores earlier than young of the year. Similar to other subspecies of meadow jumping mouse, the Preble's does not store food, but survive on fat stores accumulated prior to hibernation (Whitaker 1963). Apparent hibernacula of the Preble's have been located both within and outside of the 100-year floodplain of streams (Shenk and Sivert 1999a, Ryon 2001, Schorr 2001). Those hibernating outside of the 100-year floodplain would likely be less vulnerable to flood-related mortality.

Meadow jumping mice are docile to handle and not antagonistic toward one another (Whitaker 1972). Introduced species that occupy riparian habitats may displace or compete with the Preble's. House mice (*Mus musculus*) were common in and adjacent to historic capture sites where the Preble's was no longer found (Ryon 1996).

The Preble's is primarily nocturnal or crepuscular but also may be active during the day, when they have been seen moving around or sitting still under a shrub (Shenk 1998). Little is known about social interactions and their significance in the Preble's. Jones and Jones (1985) described lively social interactions in which several Preble's mice were observed jumping into the air and squeaking and suggested that they formed a gregarious unit. In a recent study, for the month their radio-collars were active, several Preble's mice came repeatedly from different day-nest locations to meet at one spot at night (Shenk, pers. comm., 2002).

Conservation Issues

The Preble's is closely associated with riparian ecosystems that are relatively narrow and represent a small percentage of the landscape. If habitat for the Preble's is destroyed or modified, populations in those areas will decline or be extirpated. The decline in the extent and quality of Preble's habitat is considered the main factor threatening the subspecies (Service 1998, Hafner *et al.* 1998, Shenk 1998). Habitat alteration, degradation, loss, and fragmentation resulting from urban development, flood control, water development, agriculture, and other human land uses have adversely impacted Preble's populations. Habitat destruction may impact individual Preble's mice directly or by destroying nest sites, food resources, and hibernation sites, by disrupting behavior, or by forming a barrier to movement.

Despite numerous surveys, the Preble's has not recently been found in the Denver and Colorado Springs metropolitan areas, and is believed to be extirpated from these areas as a result of extensive urban development. Given the overlap of the Preble's range with an area of extensive and rapid urban development along the Colorado Front Range, it is likely that significant losses of Preble's populations and habitats have occurred and may continue to occur.

Conversion of native riparian ecosystems to commercial croplands and grazed rangelands was identified as the major threat to Preble's persistence in Wyoming (Clark and Stromberg 1987, Compton and Hugie 1993). Intensive grazing and haying operations may negatively impact the Preble's by removing food and shelter. While some Preble's populations coexist with livestock operations, overgrazing can decimate riparian communities on which the Preble's depends. Similarly, haying operations that allow significant riparian vegetation to remain in place may be compatible with persistent Preble's populations.

Trail systems frequently parallel or intersect riparian communities and thus are common throughout Preble's range. Trail development can alter natural communities and may impact the Preble's by modifying nest sites, food resources, and hibernation sites, and by fragmenting its habitat. Humans and pets using these trails may alter behavior patterns of the Preble's and cause a decrease in survival and reproductive success.

Habitat fragmentation limits the extent and abundance of the Preble's. In