

County, and north-central El Paso County.

The Preble's is likely an Ice Age relic (Hafner *et al.* 1981, Fitzgerald *et al.* 1994). Once the glaciers receded from the Front Range of Colorado and the climate became drier, the Preble's was confined to the riparian (river) systems where moisture was more plentiful. The semi-arid climate in southeastern Wyoming and eastern Colorado limits the extent of riparian corridors and restricts the range of the Preble's in this region. The Preble's has not been found east of Cheyenne in Wyoming or on the extreme eastern plains in Colorado. The eastern boundary for the subspecies is likely defined by the dry shortgrass prairie, which may present a barrier to eastward expansion (Beauvais 2001).

The western boundary of Preble's range in both States appears related to elevation along the Laramie Range and Front Range. The Service has used 2,300 meters (m) (7,600 feet (ft)) in elevation as the general upward limit of Preble's habitat in Colorado (Service 1998). Recent morphological examination of specimens has confirmed the Preble's to an elevation of approximately 2,300 m (7,600 ft) in Colorado (Meaney *et al.* 2001) and to 2,360 m (7,750 ft) in southeastern Wyoming (Cheri Jones, Denver Museum of Natural Science, *in litt.*, 2001). In a modeling study of habitat associations in Wyoming, Keinath (2001) found suitable habitat predicted in the Laramie Basin and Snowy Range Mountains (west of known Preble's occurrence) but very little suitable habitat predicted on the plains of Goshen, Niobrara, and eastern Laramie Counties (east of known Preble's occurrence).

Although there is little information on past distribution or abundance of the Preble's, surveys have identified various locations where the subspecies was historically present but is now absent (Ryon 1996). Since at least 1991, the Preble's has not been found in Denver, Adams, or Arapahoe Counties in Colorado. Its absence in these counties is likely due to urban development, which has altered, reduced, or eliminated riparian habitat (Compton and Hugie 1993, Ryon 1996).

Ecology and Life History

Typical habitat for the Preble's comprises well-developed plains riparian vegetation with adjacent, undisturbed grassland communities and a nearby water source. Well-developed plains riparian vegetation typically includes a dense combination of grasses, forbs, and shrubs; a taller shrub and tree canopy may be present (Bakeman 1997). When present, the shrub canopy is often

Salix spp. (willow), although shrub species including *Symphoricarpos* spp. (snowberry), *Prunus virginiana* (chokecherry), *Crataegus* spp. (hawthorn), *Quercus gambelli* (Gambel's oak), *Alnus incana* (alder), *Betula fontinalis* (river birch), *Rhus trilobata* (skunkbrush), *Prunus americana* (wild plum), *Amorpha fruticosa* (lead plant), *Cornus sericea* (dogwood), and others also may occur (Bakeman 1997, Shenk and Eussen 1998).

The Preble's have rarely been trapped in uplands adjacent to riparian areas (Dharman 2001). However, in detailed studies of the Preble's movement patterns using radio telemetry, the Preble's has been found feeding and resting in adjacent uplands (Shenk and Sivert 1999b, Ryon 1999, Schorr 2001). These studies suggest that the Preble's uses uplands at least as far out as 100 m (330 ft) beyond the 100-year floodplain (Ryon 1999; Tanya Shenk, Colorado Division of Wildlife, *in litt.*, 2002). The Preble's also can move considerable distances along streams, as far as 1.6 km (1.0 mi) in one evening (Ryon 1999, Shenk and Sivert 1999a).

In a rangewide comparison of existing habitat data from Colorado, Clippenger (2002) found that subshrub cover and plant species richness are higher at most sites where meadow jumping mice are present as compared to sites where they are absent, particularly at distances 15 to 25 m (49 to 82 ft) from streams. In a study comparing habitats at Preble's capture locations on the Department of Energy's Rocky Flats Environmental Technology Site (Rocky Flats), Jefferson County, Colorado, and the U.S. Air Force Academy (Academy), El Paso County, Colorado, the Academy sites had lower plant species richness at capture locations but considerably greater numbers of the Preble's (Schorr 2001). However, the Academy sites had higher densities of both grasses and shrubs. It is likely that Preble's abundance is not driven by the diversity of plant species alone, but by the density and abundance of riparian vegetation (Schorr 2001).

The tolerance of the Preble's for invasive exotic plant species is not well understood. Whether or not exotic plant species reduce Preble's persistence at a site may be due in large part to whether plants create a monoculture and replace native species. There is particular concern about nonnative species such as *Euphorbia esula* (leafy spurge) that may form a monoculture, displacing native vegetation and thus reducing available habitat.

Fifteen apparent Preble's hibernacula (hibernation nests) have been located through radio telemetry, all within 78 m

(260 ft) of a perennial stream bed or intermittent tributary (Bakeman and Deans 1997, Shenk and Sivert 1999a, Schorr 2001). Of these, one was confirmed through excavation (Bakeman and Deans 1997); others were left intact to prevent harm to the mice. Apparent hibernacula have been located under willow, chokecherry, snowberry, skunkbrush, *Rhus* spp. (sumac), *Clematis* spp. (clematis), *Populus* spp. (cottonwoods), Gambel's oak, *Cirsium* spp. (thistle), and *Alyssum* spp. (alyssum) (Shenk and Sivert 1999a). At the Academy, four of six apparent hibernacula found by radio-telemetry were located in close proximity to *Salix exigua* (coyote willow) (Schorr 2001). The one excavated hibernaculum, at Rocky Flats, was found 9 m (30 ft) above the stream bed, in a dense patch of chokecherry and snowberry (Bakeman and Deans 1997). The nest was constructed of leaf litter 30 centimeters (cm) (12 in) below the surface in coarse textured soil.

The Preble's constructs day nests composed of grasses, forbs, sedges, rushes, and other available plant material. They may be globular in shape or simply raised mats of litter, and are most commonly above ground but also can be below ground. They are typically found under debris at the base of shrubs and trees, or in open grasslands (Ryon 2001). An individual mouse can have multiple day nests in both riparian and grassland communities (Shenk and Sivert 1999a), and may abandon a nest after approximately a week of use (Ryon 2001).

Hydrologic regimes that support Preble's habitat range from large perennial rivers such as the South Platte River to small drainages only 1 to 3 m (3 to 10 ft) in width, as at Rocky Flats and in montane habitats. Flooding is a common and natural event in the riparian systems in southeastern Wyoming and along the Front Range of Colorado. This periodic flooding helps create a dense vegetative community by stimulating resprouting from willow shrubs, and allows herbs and grasses to take advantage of newly-deposited soil.

Fire is also a natural component of the Wyoming foothills and Colorado Front Range, and Preble's habitat naturally waxes and wanes with fire events. Within shrubland and forest, intensive fire may result in adverse impacts to Preble's populations. However, in a review of the effects of grassland fires on small mammals, Kaufman *et al.* (1990) found a positive effect of fire on the meadow jumping mouse in one study and no effect of fire on the species in another study.