Preble's Meadow Jumping Mouse

Zapus hudsonius preblei

REGULATORY STATUS

USFWS: Threatened
USFS R2: No special status
USFS R4: No special status
Wyoming BLM: Sensitive
State of Wyoming: Nongame Wildlife

CONSERVATION RANKS

USFWS: No special status
WGFD: NSS3 (Bb), Tier II
WYNDD: G5T2, S1
Wyoming Contribution: VERY HIGH
IUCN: Not evaluated

STATUS AND RANK COMMENTS

Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*; hereafter, Preble's) was first listed as Threatened under the Endangered Species Act (ESA) in 1998 [1]. In 2008, ESA protections were removed from populations in Wyoming, because it was determined that the subspecies was not Threatened with endangerment throughout all of its range, but Threatened status remained for populations in Colorado, which were recognized as a significant portion of the Preble's range [2]. Threatened status was reinstated for populations of Preble's in Wyoming in 2011 [3].

NATURAL HISTORY

Taxonomy:

Preble's is one of 12 subspecies of Meadow Jumping Mouse; Bear Lodge Meadow Jumping Mouse (*Z. h. campestris*) also occurs in Wyoming. There has been debate among researchers regarding the merit of historic and current subspecific designations within the species [4-6]. However, recent research supports current subspecific designations [7].

Description:

Preble's cannot be reliably distinguished from other subspecies of Meadow Jumping Mouse or from Western Jumping Mouse (*Z. princeps*) in the field. Consequently, genetic analyses are the only currently accepted method for identification [8]. In general, Meadow Jumping Mouse is a medium-sized rodent distinguished by a yellow dorsum with a thick dark stripe down the back, white venter, an exceptionally long tail, and large hind feet. Males and females are identical in appearance. Adults weigh 12–22 g, depending on season, and reach a total length of 180–220 mm. The tail comprises over half of the total length, ranging from 115–135 mm in length, and is round, sparsely haired, and bicolored. The ears are dark but edged in white. The hind feet are large (28–31 mm) and whitish-yellow. The sides have a yellow hue. Young are similar in appearance to adults but are lighter in color overall [9].

Distribution & Range:
Preble's is restricted to northeastern Colorado and southeastern Wyoming from the vicinity of the city of Colorado Springs on the east side of the Front Range of Colorado north along the Laramie Range to the vicinity of the North Platte River near Douglas, Wyoming. The subspecies is typically found at elevations between 1,420 and 2,300 m. In Wyoming, Preble's predicted range includes all or portions of 4 counties, although thus far the subspecies has only been found east of the crest of the Laramie Range [1, 8, 10]. Southeast Wyoming constitutes approximately the northern third of Preble's range.

Habitat:
Preble's is typically associated with prairie and foothill riparian habitats in areas with very dense vegetation. Specifically, shrub, grass, and woody debris cover are important microhabitat variables [11]. A dense woody overstory may also be required for high abundances of the subspecies. During the active season, Preble's are typically found near the stream bed (≤ 100 m), although they are known to range further. Upland areas adjacent to stream corridors and associated riparian vegetation are used to varying degrees based upon vegetation structure and other habitat characteristics [12, 13]. Preble's also occupies montane areas along riparian corridors in the Laramie Range [13].
Day nests are constructed of woven grass, forb, sedge, and rush, and are often associated with shrubs, trees, or decaying vegetation used to anchor the nest or provide cover [14, 15]. Typical hibernacula are underneath logs or in underground chambers in flood-safe areas of riparian zones, often at the base of woody vegetation [13]. Both subterranean maternity nests and hibernacula are typically lined with grass and leaf litter and require friable soils, as Preble's dig their own burrows [15].

Phenology:
Phenology of Preble's is assumed to be similar to that of Meadow Jumping Mouse elsewhere. In Colorado, females are typically pregnant by the third week of June and have two reproductive pulses per summer, one in July and one in August [16]. Gestation length is around 18 days [17]. Preble's are true hibernators and hibernate for approximately 210 days per year. Hibernation begins in September or October, and emergence occurs in late May or early June, with males emerging from hibernation before females [11-13, 16].

Diet:
Preble's is a dietary generalist that consumes a wide variety of invertebrates, primarily lepidopteron larvae and beetles, seeds, leaves, buds, fruits, and subterranean fungi, which may be a particularly important food item [13]. Overall, the importance of food items shifts throughout the active period and tracks vegetation green-up [18, 19].

CONSERVATION CONCERNS

Abundance:
Continental: LOCAL ENDEMIC
Wyoming: RARE
There are no estimates of abundance for Preble's range-wide or for Wyoming. The subspecies is thought to be rare in the state. In Colorado, population estimates range from 22.7 ± 7.9 to 85.6 ± 30.3 individuals per stream km. Overall capture success is 3.4 individuals per 100 trap nights [16]. In Wyoming, capture success is often lower (e.g., 0.3 to 0.9 individuals per 100 trap nights) [20], suggesting abundances may be lower as well. However, presence and abundance can vary

substantially among trapping sessions [16], and capture rates reported for Wyoming are thus far based on a single survey season.

Population Trends:
Historic: UNKNOWN
Recent: UNKNOWN
Historic and recent population trends are unknown. It is assumed that the subspecies has declined in abundance throughout its range [16], and current ESA protections are in part based on observations of local extirpations from sites where the subspecies was previously documented [1]. The only long-term trend evaluation of Preble's occurred in the southern part of the Preble's range in Colorado. Monument Creek has one of the largest documented populations of Preble's; however, populations at this site declined at a rate of 13% per year during the study, likely as a result of decreased recruitment and immigration [21].

Intrinsic Vulnerability:
HIGH VULNERABILITY
Multiple factors make Preble's highly vulnerable to extrinsic stressors. Foremost of these, Preble's is a habitat specialist, reliant upon well-developed riparian ecosystems within relatively low-elevation prairie and foothill areas [8]. The long duration of hibernation may also contribute to the subspecies' vulnerability by limiting reproductive potential [13]. Although survival tends to be high during the hibernation season, insufficient fat stores may lower overwinter survival; body mass when entering hibernation is the most useful predictor of overwinter survival [16, 22]. Finally, substantial natural variability in abundance and presence [16], limited dispersal distances, and the inherent instability of small population sizes in general might intensify the impact of these threats [10].

Extrinsic Stressors:
HIGHLY STRESSED
The primary conservation concern for Preble's is loss and degradation of riparian habitat. Urban, suburban, and agricultural development have led to a decline in the extent and quality of habitat, particularly along the Front Range in the vicinity of Denver and Colorado Springs [11]. However, this threat may be somewhat reduced in Wyoming, especially outside of Cheyenne because of a lower human population size and overall population density [10]. Because emigration and immigration events may be critical for maintaining local populations of Preble's, fragmentation of riparian habitats may reduce or eliminate the frequency of these events, making persistence of Preble's populations less likely [21]. Furthermore, because Preble's are largely confined to relatively narrow riparian habitats, populations are often described as being distributed in linear networks, which are easily fragmented by discrete disturbances. Additional habitat modifications, both natural and anthropogenic, may lead to habitat degradation and destruction in Wyoming. Overgrazing, drought, fires, and floods can destroy habitat, and the effects of these threats may be exacerbated by global warming [10]. Other potential threats may include increased rates of predation by human-associated predators such as Striped Skunk (*Mephitis mephitis*), Raccoon (*Procyon lotor*), and feral and Domestic Cat (*Felis silvestris*) [13] as well as competition with non-native House Mice (*Mus musculus*) and sympatric Deer Mice (*Peromyscus maniculatus*) that may lead to local extirpation or decreased survival [10, 21]. Finally, the impacts of exotic and noxious weeds and competition with the closely related Western Jumping Mouse are in need of further evaluation [10].

KEY ACTIVITIES IN WYOMING

Since ESA protections were first established, considerable research and monitoring efforts have been directed towards Preble's in Wyoming and Colorado. Surveys to determine presence of Preble's are required by the U.S. Fish and Wildlife Service (USFWS) for all projects where a federal nexus exists and there is a potential effect on Preble's or Preble's habitat [23]. Since initial listing, the Wyoming Natural Diversity Database (WYNDD) has conducted extensive research on the subspecies, and, in 2012, completed an assessment of *Zapus* in Wyoming that clarified the state of knowledge of Wyoming *Zapus*, including a detailed analysis of previous captures and museum specimens [8]. The Wyoming Game and Fish Department (WGFD) began funding annual surveys to determine presence and delineate range boundaries of the subspecies in 2009. Since that time, WGFD and WYNDD have continued to refine the known distribution of the subspecies, increase records of known occurrence, and evaluate site-specific threats to persistence [20, 24-26]. In 2013, the USFWS published a 12-month finding for Preble's that reiterated the need for Threatened classification due to the continued impact of extrinsic stressors on the subspecies. The draft recovery plan was published in 2016 [27], and the final recovery plan is expected in 2017.

ECOLOGICAL INFORMATION NEEDS

The current distribution of Preble's in Wyoming has been evaluated but is still incomplete and requires more discrete delineation of ecological and elevational boundaries. In particular, the northern and western range limits of Preble's in Wyoming remain poorly defined. Additionally, many unknowns exist regarding the impact of fire, drought, flood, and potential competition with the sympatric Western Jumping Mouse, including the potential for species-level hybridization in the northern limits of the subspecies range. Finally, basic demographic and life history information regarding survival, reproduction, dispersal, density, abundance, and population trends are lacking for the subspecies [28] and are central to more precise evaluations of the status of Preble's in Wyoming. Because population size and presence can vary drastically, long-term monitoring is likely needed to acquire robust population estimates.

MANAGEMENT IN WYOMING

This section authored solely by WGFD; Nichole L. Bjornlie. Most work to date on Preble's in Wyoming has focused on refining the distribution in order to prioritize areas in need of management and conservation effort. Moving forward, management priorities will focus on implementing the Recovery Plan, collaborating with landowners to conserve habitat, and monitoring populations to ensure recovery objectives are being met. Additional projects will continue to evaluate the impact of threats on population persistence and demographics.

CONTRIBUTORS

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REFERENCES

[1] United States Fish and Wildlife Service. (1998) Endangered and Threatened Wildlife and Plants; Final Rule to List the Preble's Meadow Jumping Mouse as a Threatened species, *Federal Register 63*, 26517-26530.

[2] United States Fish and Wildlife Service. (2008) Endangered and Threatened Wildlife and Plants; Final Rule to Amend the Listing for the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) to Specify Over What Portion of its Range the Subspecies is Threatened, *Federal Register 73*, 39790-39838.
[3] United States Fish and Wildlife Service. (2011) Endangered and Threatened Wildlife and Plants; Reinstatement of Listing Protections for the Preble's Meadow Jumping Mouse, *Federal Register 76*, 47490-47491.
[4] Ramey II, R. R., Liu, H.-P., Epps, C. W., Carpenter, L. M., and Wehausen, J. D. (2005) Genetic relatedness of the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) to nearby subspecies of *Z. hudsonius* as inferred from variation in cranial morphology, mitochondrial DNA and microsatellite DNA: implications for taxonomy and conservation, *Animal Conservation 8*.
[5] Vignieri, S. N., Hallerman, E. M., Bergstrom, B. J., Hafner, D. J., Martin, A. P., Devers, P., Grobler, P., and Hitt, N. (2006) Mistaken view of taxonomic validity undermines conservation of an evolutionarily distinct mouse: a response to Ramey et al. (2005), *Animal Conservation 9*, 237-243.
[6] Cronin, M. A. (2007) The Preble's meadow jumping mouse: subjective subspecies, advocacy and management, *Animal Conservation 10*, 159-161.
[7] King, T. L., Switzer, J. F., Morrison, C. L., Eackles, M. S., Young, C. C., Lubinski, B. A., and Cryan, P. (2006) Comprehensive genetic analyses reveal evolutionary distinction of a mouse (*Zapus hudsonius preblei*) proposed for delisting from the US Endangered Species Act, *Molecular Ecology 15*.
[8] Bowe, A., and Beauvais, G. P. (2012) An assessment of species and subspecies of *Zapus* in Wyoming. Report prepared for the USDI Fish and Wildlife Service - Wyoming Field Office by the Wyoming Natural Diversity Database., University of Wyoming, Laramie, WY.
[9] Clark, T. W., and Stromberg, M. R. (1987) *Mammals in Wyoming*, University of Kansas Press, Lawrence, Kansas.
[10] United States Fish and Wildlife Service. (2013) Endangered and Threatened Wildlife and Plants; 12-Month Finding on Two Petitions to Delist the Preble's Meadow Jumping Mouse, *Federal Register 78*, 31680-31712.
[11] Trainor, A. M., Shenk, T. M., and Wilson, K. R. (2007) Microhabitat characteristics of Preble's meadow jumping mouse high-use areas, *Journal of Wildlife Management 71*, 469-477.
[12] Trainor, A. M., Shenk, T. M., and Wilson, K. R. (2012) Spatial, temporal, and biological factors associated with Preble's meadow jumping mouse (Zapus hudsonius preblei) home range, *Journal of Mammalogy 93*, 429-438.
[13] Smith, H., Beauvais, G. P., and Keinath, D. A. (2004) Species assessment for Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) in Wyoming, p 55, Wyoming Natural Diversity Database and USDI Bureau of Land Management, University of Wyoming, Laramie, WY.
[14] Ryon, T. R. (2001) Summer nests of Preble's meadow jumping mouse, *Southwestern Naturalist 46*, 376-378.
[15] Bain, M. R., and Shenk, T. M. (2002) Nests of Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Douglas County, Colorado, *Southwestern Naturalist 47*, 630-633.
[16] Meaney, C. A., Ruggles, A. K., Lubow, B. C., and Clippinger, N. W. (2003) Abundance, survival, and hibernation of Preble's Meadow Jumping Mice (*Zapus hudsonius preblei*) in Boulder County, Colorado, *Southwestern Naturalist 48*, 610-623.
[17] Quimby, D. C. (1951) The life history and ecology of the jumping mouse, *Zapus hudsonius*, *Ecological Monographs 21*, 61-95.
[18] Shenk, T., and Sievert, M. M. (1999) Movement patterns of Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) as they vary across time and space. Report prepared for the Colorado Division of Wildlife, Ft. Collins, Colorado.
[19] Whitaker, J. O., Jr. (1972) *Zapus hudsonius*, *Mammalian Species 11*, 1-7.
[20] Thompson, J., Cudworth, N., and Grenier, M. (2012) Population Inventories of Jumping Mice (*Zapus* spp.) in Areas Previously Designated as Preble's Meadow Jumping Mice (*Z. hudsonius preblei*) Critical Habitat in Southeastern Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Grenier, M. B., Abel, B., and Cudworth, N., Eds.), pp 3-9, Wyoming Game and Fish Department.
[21] Schorr, R. A. (2012) Using a temporal symmetry model to assess population change and recruitment in the Preble's meadow jumping mouse (*Zapus hudsonius preblei*), *Journal of Mammalogy 93*, 1273-1282.
[22] Schorr, R. A., Lukacs, P. M., and Florant, G. L. (2009) Body mass and winter severity as predictors of overwinter survival in Preble's Meadow Jumping Mouse, *Journal of Mammalogy 90*, 17-24.

[23] United States Fish and Wildlife Service Mountain-Prairie Region. (2004) Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) survey guidelines, United States Fish and Wildlife Service, http://www.fws.gov/mountain-prairie/species/mammals/preble/CONSULTANTS/SCPindex.htm.

[24] Abernethy, I., and Beauvais, G. (2013) Distribution of Jumping Mice (*Zapus*) In Wyoming Progress Report 2012. Report prepared for the USDI Fish and Wildlife Service - Wyoming Ecological Services Field Office by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

[25] Abernethy, I., and Beauvais, G. (2014) Distribution of Jumping Mice (*Zapus*) In Wyoming Progress Report 2013. Report prepared for the USDI Fish and Wildlife Service - Wyoming Ecological Services Field Office by the Wyoming Natural Diversity Database, University of Wyoming, Laramie, Wyoming.

[26] Cudworth, N., and Grenier, M. (2012) Genetic Differentiation and Distribution of *Zapus* spp. Captured in Areas Previously Designated as Preble's Meadow Jumping Mice (*Z. hudsonius preblei*) Critical Habitat in Southeastern Wyoming, In *Threatened, Endangered, and Nongame Bird and Mammal Investigations: Annual Completion Report* (Grenier, M. B., Abel, B., and Cudworth, N., Eds.), pp 10-17, Wyoming Game and Fish Department.

[27] United States Fish and Wildlife Service. (2016) Endangered and Threatened Wildlife and Plants; Draft Recovery Plan for Preble's Meadow Jumping Mouse, *Federal Register 81*, 21374.

[28] Beauvais, G. P. (2003) Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) in Wyoming: Status report, July 2003, Wyoming Natural Diversity Database, University of Wyoming, Laramie, WY.

Figure 1: A live-captured jumping mouse (*Zapus* spp.). (Photo courtesy of WYNDD)

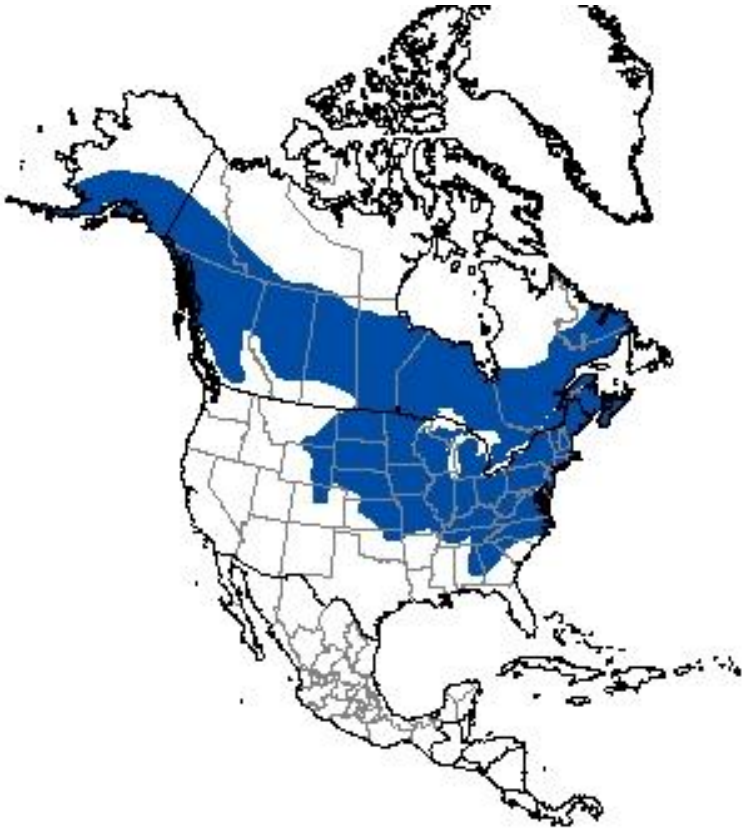

Figure 2: North American range of *Zapus hudsonius*. (Map from: Patterson, B. D., et al. (2007) Digital Distribution Maps of the Mammals of the Western Hemisphere, version 3.0, NatureServe, Arlington, Virginia.)

Figure 3: Heavily vegetated riparian corridor with woody overstory along Friend Creek, Albany County, Wyoming. (Photo courtesy of WGFD)

STATE MAP

Figure 4: Map not available.