PETITION TO LIST THE NEW MEXICO MEADOW JUMPING MOUSE *(Zapus hudsonius luteus)* UNDER THE U.S. ENDANGERED SPECIES ACT

New Mexico meadow jumping mouse (Photo credit: J. Frey)

In the Office of Endangered Species
U.S. Fish and Wildlife Service
United States Department of Interior

Petitioner:

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WILDEARTH GUARDIANS
A FORCE FOR NATURE

EXECUTIVE SUMMARY

WildEarth Guardians hereby requests listing of the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) as an Endangered or Threatened species under the federal Endangered Species Act (ESA). Petitioners demonstrate that this subspecies biologically warrants Endangered status, and we further request emergency listing. We also request the designation of critical habitat for this subspecies.

The New Mexico meadow jumping mouse is in dire straits and requires prompt federal protection. The primary threat to the persistence of this jumping mouse is cattle grazing. Additionally, the loss of habitat in the Sacramento Mountains due to decreases in perennial water compounds the threat of livestock grazing. A lack of perennial water in mouse habitat is generally due to water use by human populations in urban areas. In non-urban areas the lack of water is generally due to agricultural use and irrigation. Global climate change impacts exacerbate the lack of water as changes in rainfall have resulted and will likely continue to result in longer-term droughts within the geographic distribution of the mouse. The New Mexico meadow jumping mouse has been extirpated from 74% of historical locations surveyed where it once occurred. From 2000-2006 only 11 locations have been confirmed as containing mice: 2 in Arizona and 9 in New Mexico. A population in southeastern Colorado is an extension of an extant population in northeastern New Mexico.

The petitioned jumping mouse was first scientifically described in 1911 based on specimens discovered in 1858 and 1904 in the Sangre de Cristo Mountains and northern Rio Grande valley in New Mexico. In New Mexico, additional observations of the jumping mouse through the 1960s indicated that it had a historical widespread distribution along the Rio Grande valley. The mouse was first discovered in the Sacramento Mountains in 1902, in the San Juan Mountains in 1928, and in the Jemez Mountains in 1969. Subsequent records through the 1970s were sparse in these mountain ranges. In Arizona, the mouse was first recorded in 1914 in the White Mountains, where it is likely restricted because it has not been observed outside of this mountain range. In Colorado, the first confirmed observations of the mouse were in 1996, along the eastern foothills of the Sangre de Cristo Mountains near the New Mexico border.

The State of New Mexico listed the species as threatened in 1983. The state listing prompted various studies and intensive surveys from the mid to late 1980s. While these studies found new localities of the species, they also observed that the distribution of the species was becoming reduced and restricted due to cattle grazing, diversion of water, and ultimate drying up of riparian areas. During the 1980s, surveys by Joan Morrison documented the presence of the mouse along the riparian zone of ditches and canals in the Rio Grande Valley. These data, and increased documentation of mice locations, served to alleviate concerns that the species was at risk of becoming endangered. While the U.S. Fish and Wildlife Service (FWS) previously considered the mouse as a candidate for ESA listing, the agency dropped it as a candidate in 1996 without an adequate scientific basis.

Surveys conducted in 2005 and 2006 in New Mexico by Dr. Jennifer Frey demonstrate that populations of the jumping mouse have greatly declined. Only 9 extant populations are currently identified in New Mexico. Of 31 localities surveyed in 2005 and 2006 where the mouse formerly occurred, it is now known to persist at only 5 locations, which is an 84% decline (Frey 2006i). Current populations contain few individuals in small, extremely fragmented areas of suitable habitat.

Density of montane populations was estimated to be 6.6 mice/acre. In the Jemez Mountains, the New Mexico meadow jumping mouse now occurs at 3 of 13 historical localities, although 2 new locations have been documented. The 5 total current localities where the species occurs in the Jemez Mountains are along 7.5 miles of one stream with fragmented habitat and in a small, remnant patch of habitat on another stream. In the Sacramento Mountains, mice formerly occurred at 18 localities, but are now known to persist at only 2 isolated locations, each consisting of only 1.1 miles of remnant riparian habitat. Of 4 likely historical locations in the Sangre de Cristo Mountains, mice have been extirpated from 2 locations. In the San Juan Mountains, the mouse no longer occurs at 1 verified historical location. Once identification of other historical specimens from the San Juan and Sangre de Cristo mountains has been verified, additional extirpations may be documented.

The mouse was formerly widespread along the Rio Grande in New Mexico. Although no recent surveys have been conducted, the mouse is considered extirpated from at least 2 of 7 historical locations based on studies conducted prior to 2000. In the upper Rio Grande valley, mice were last observed in 1988 on San Juan Pueblo, but at the same time were found to be extirpated at Espanola where they formerly occurred. Surveys at Albuquerque also failed to find the mouse. In the middle Rio Grande valley, the most recent study was at Bosque del Apache National Wildlife Refuge (BANWR) during 1991 and 1992. Density of mice in suitable habitat was 16-20 mice/acre, although the extent of suitable habitat was not reported. It is unknown if habitat for the jumping mouse has been conserved at BANWR, because the Refuge is managed for migratory waterfowl (USFWS 2007).

The population status of the New Mexico meadow jumping mouse in Arizona is extremely perilous. Data from 1991 indicate that jumping mouse populations were only present in 21% of historical localities surveyed. Surveys conducted in 1995 and 1996 found mice in four locations. In 2006 mice were found in a single location, with an additional location documented in 2007. Not all historical locations were surveyed in the studies conducted between 1991 and 2006. Yet, from 1913–1991, 16 localities for the mouse were known, and currently only two of these locations are verified to contain mice.

The decline in the distribution and populations of the jumping mouse is primarily caused by loss and degradation of habitat. Cattle grazing is the largest threat facing this mouse. Many historical localities are currently unsuitable due to dry or intermittent streams and/or degraded riparian vegetation. Cattle congregate in riparian areas, which causes soil compaction and increased erosion, destroying both the vegetative and structural habitat of riparian areas and associated streams. Grazing reduces the height, diversity,

and cover of riparian vegetation necessary for the survival of the jumping mouse. During surveys for the mouse in 2005 and 2006, all but one population was found in livestock exclosures, which serve as refugia for the mouse. The single exception where mice occurred in an area with cattle grazing was in an extensive wetland created by beaver dams that cattle were reluctant to enter (Frey 2007a). Environmental engineering by beaver serve to alleviate some of the destructive consequences of livestock grazing in riparian areas.

Water diversion for agricultural and urban use further degrades the conditions of already deteriorated riparian habitat. Rivers and streams are diverted for irrigation, and springs are capped for both agricultural and municipal uses. Ongoing drought conditions exacerbate the lack of water in the Rio Grande valley and in the montane habitats of the jumping mouse. In addition, climate change predictions spell increased imperilment for the mouse due to projected decreases in water availability and altered hydrology.

Other factors that reduce or degrade the mouse's habitat include camping and off-road vehicle recreation, forest fire with subsequent erosion flooding, and loss of beaver. Beaver activity creates complex wetland riparian habitat required by the jumping mouse and has been shown to provide some buffer to the negative impacts of cattle grazing in riparian habitat (Frey 2007a). Wildlife managers have long considered the beaver as a nuisance animal, and thus beavers have been actively removed from streams and ditches. The removal of beaver has decreased available habitat for the jumping mouse.

Based on surveys conducted in 2005 and 2006, the New Mexico meadow jumping mouse was uplisted from a threatened to an endangered species by the State of New Mexico. The New Mexico Natural Heritage Program also uplisted the subspecies from imperiled to critically imperiled in 2005. Arizona State lists the species as a Wildlife Species of Special Concern. The Arizona Natural Heritage Program lists the subspecies as imperiled. Colorado has listed the New Mexico meadow jumping mouse as critically imperiled since the presence of the subspecies in the state was first brought to the attention of the state government by a 1999 survey. Federal agencies list the jumping mouse as an ESA Candidate or Sensitive species. These federal and state designations fail to provide protections for jumping mouse habitat, and habitat loss and degradation is the leading threat to this subspecies. Under the current administrative and legal status of the jumping mouse, populations of this subspecies have continued to decline. In the Sacramento Mountains the mouse is in immediate danger of extirpation.

Given the threat from habitat destruction, caused primarily by livestock grazing, critical habitat should be designated concurrent with listing. In addition, given the rapid rate of decline, Petitioners request emergency listing to provide interim protection while the standard listing process is completed.

INTRODUCTION

The New Mexico meadow jumping mouse ("jumping mouse," "meadow jumping mouse," or "mouse") is endemic to New Mexico, southeastern Arizona, and limited portions of southern Colorado. The subspecies presently occurs in the southwestern United States in five areas, including four isolated mountain ranges in Colorado, New Mexico, and Arizona, and along the upper and middle Rio Grande valley in New Mexico. The mouse may also exist in a sixth area in the San Juan Mountains. There has been no recent evidence that the mouse persists in the San Juan Mountain but museum specimens indicate that the historic range of this mouse extended from the San Juan Mountains in southwestern Colorado and into the Chama valley, which junctions with the upper Rio Grande. Surveys are required to determine the current status of the jumping mouse in the San Juan part of its historic range.

Climatic evidence indicates that cool, moist grasslands occurred over central and southern New Mexico during periods of extended glaciers, allowing the jumping mouse to expand its range into the southwestern United States from its more northern distribution. During the subsequent warmer, drier climates of the interglacial period, the expanded range of the mouse was reduced and separated by environmental conditions. This geographic isolation led to the development of unique characteristics and habitats of this mouse. Jumping mice became restricted to two types of mesic habitats, montane riparian habitats and Rio Grande valley riparian habitats, where it now resides within its current range.

The petitioned jumping mouse is naturally rare, and population centers are isolated and fragmented due to its specialized habitat requirements. In these restricted areas, the jumping mouse is only found in riparian areas that have a tall, dense and diverse riparian habitat. This habitat is a result of perennial water. The jumping mouse has one of the longest hibernation periods of any other subspecies of meadow jumping mouse or other mammal. The mouse's extensive hibernation period makes pre-hibernation food requirements considerable and crucial. During pre-hibernation, dense, diverse riparian vegetation provides the necessary forage needed to accumulate fat reserves utilized during hibernation. A well-developed vegetated habitat also provides protection from predators, allows the mouse to avoid aggression from other small mammal species, and regulates habitat variables such as temperature and moisture. Thus, the jumping mouse is an obligate of well-developed riparian habitats, and its presence or absence is an indicator of habitat health.

The jumping mouse is considered to be a k-selected species because it is long-lived for a rodent species, and few offspring are produced. Annual reproduction consists of one litter of three to four young in montane areas and possibly two litters in the middle Rio Grande valley. Although this strategy is successful in environments that are stable and predictable, k-selected species are at a higher risk of extinction because they recover more slowly from reductions in population size and are subject to genetic and demographic stochasticity.

ENDANGERED SPECIES ACT IMPLEMENTING REGULATIONS

Section 424 of the regulations implementing the Endangered Species Act (50 C.F.R. § 424) is applicable to this petition. Subsections that concern the formal listing of the New Mexico meadow jumping mouse as an Endangered or Threatened species are:

> 424.02 (d) "Critical habitat" means "(1) the specific areas within the geographical area currently occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection..."
>
> 424.02 (e) "Endangered species" means a species that is in danger of extinction throughout all or a significant portion of its range."
>
> "Threatened species" means a species that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (16 U.S.C § 1532(20)).
>
> 424.11(c) "A species shall be listed…because of any one or a combination of the following factors:
>
> 1. The present or threatened destruction, modification, or curtailment of habitat or range;
> 2. Overutilization for commercial, recreational, scientific, or educational purposes;
> 3. Disease or predation;
> 4. The inadequacy of existing regulatory mechanisms; and
> 5. Other natural or manmade factors affecting its continued existence."

At least three of the factors enumerated under 50 C.F.R. § 424.11(c) and ESA Section 4 (16 U.S.C. § 1533(a)(1)) are imperiling the New Mexico meadow jumping mouse. The first and fourth factors – habitat loss and degradation and inadequate regulatory mechanisms – present the primary threats to the New Mexico meadow jumping mouse and are causing the species to face endangerment and extinction. In addition, other natural or manmade factors, including climate change, drought, and natural rarity, also threaten the petitioned subspecies.

THE SPIRIT OF THE ENDANGERED SPECIES ACT

The purposes of the ESA are two-fold, to conserve threatened and endangered species and the ecosystems on which they depend. The Act's Section 2 reads:

> The purposes of this chapter are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species…

See 16 U.S.C.A. § 1531(b). This is set forth as the very purpose of the ESA.

The New Mexico meadow jumping mouse is an obligate of intact, well-developed riparian habitat in restricted areas of the Southwest. Riparian areas comprise less than 1% of the land mass in the Southwest and have been identified by the US Geological Survey as one of the most limited and vulnerable plant communities in the Southwest (USGS 2007). In this region, riparian habitat supports diverse and abundant populations of wildlife (Thomas et al. 1979; Lee et al. 1989). These wildlife species use riparian areas for food, water and cover, resources that are in high demand in the arid Southwest (Ohmart 1996). The riparian zone is a complex habitat composed of a mosaic of ecotones, which serve as a corridor for species between moist streamside and arid upland. This mosaic of ecotones allows wildlife species to use a variety of habitats depending on their life stage and subsequent changes in habitat requirements (Thomas et al. 1979; Lee et al. 1989). Riparian areas occupied by beaver support an even greater amount of wildlife species, as beavers are environmental engineers that create concentrated areas of water through the construction of dams (Rosell et al. 2005). These areas become habitat for a variety of amphibian species as well as small mammals (Frey 2006b; Stevensa et al. 2007). Studies have estimated that 75 – 80 % of western wildlife depends on riparian areas (Chaney et al. 1990). Overall, the riparian ecosystem with its associated wildlife species is an important aspect of biodiversity in the desert Southwest and requires immediate protection and conservation.

Given the importance of riparian ecosystems to southwestern wildlife, and given that the New Mexico meadow jumping mouse's precipitous decline is signaling the endangerment of this crucial habitat, protection for this subspecies could safeguard the broader habitat that is a lifeline for so many other species. Protection of the jumping mouse implements the ecosystem protection purpose of the ESA. Our petition therefore goes to the very heart of this visionary law.

CLASSIFICATION AND NOMENCLATURE

Common Name

The common name for *Zapus hudsonius luteus* is the New Mexico meadow jumping mouse. Throughout this Petition, it will be called "New Mexico meadow jumping mouse," "jumping mouse," or "mouse" unless otherwise clarified.

Taxonomy

The New Mexico meadow jumping mouse was originally described in 1911 as a distinct species, *Zapus luteus* (Miller 1911). The type locality for this species is Espanola, Rio Arriba Co., NM (USNM No. 133,601). The species description is based on seven specimens collected in New Mexico from the Sangre de Cristo Mountains, Sacramento Mountains, and the upper Rio Grande near the town of Espanola (Miller 1911). In 1954, *Z. luteus* was synonymized with the western jumping mouse on the basis of skull and pelage characteristics and thus named *Z. princeps luteus* (Krutzsch 1954). This finding was supported by a similar study by Jones (1981). In 1981, genetic analysis of southwestern *Zapus* and other representatives of the genus was conducted (Hafner et al. 1981). This study concluded that *Z. p. luteus* was a peripheral, isolated relict and conspecific of the meadow jumping mouse, *Z. hudsonius,* and the mouse was therefore reclassified as *Z. h. luteus* (Hafner et al. 1981). Bailey (1913) described *Z. luteus australis* from Socorro, New Mexico. This subspecies was later identified as *Z. h. luteus* (Hafner et al. 1981). Therefore, references to *Z. p. luteus* and *Z. l. australis* are synonymous with the New Mexico meadow jumping mouse (*Z. h. luteus*).

The reclassification of *luteus* from a subspecies of the western jumping mouse to a subspecies of the meadow jumping mouse was important because the western jumping mouse is common in the southwestern United States and considered secure in New Mexico and Colorado, although it is not found in Arizona (NatureServe 2007). The reclassification indicates that the New Mexico meadow jumping mouse is thus a rare, peripheral and isolated subspecies of the meadow jumping mouse (*Z. hudsonius*). As such, the New Mexico meadow jumping mouse is now known as a geographically isolated and uncommon subspecies of the widely distributed meadow jumping mouse (Hafner et al. 1981). Recent investigations of the controversial subspecies status of the federally threatened Preble's meadow jumping mouse (*Z. hudsonius preblei*) conclusively demonstrated that the New Mexico meadow jumping mouse is a distinct geographic and genetic subspecies (Ramey et al. 2005; King et al. 2006; Vignieri et al. 2006).

The meadow jumping mouse (*Z. hudsonius*) belongs to the Order Rodentia, in the family Dipodidae, subfamily Zapodinae (Hafner et al. 1998). There are three species of *Zapus* in North America. These are *Z. princeps* (western jumping mouse), *Z. trinotatus* (Pacific jumping mouse) and *Z. hudsonius* (meadow jumping mouse) (USNM 2007).

There are three jumping mouse subspecies and all are imperiled. *Id*.

Zapus hudsonius luteus – New Mexico meadow jumping mouse
NatureServe rank: G5T2 - imperiled
States found: CO, AZ, NM

Zapus hudsonius campestris – Bear lodge or Black Hill meadow jumping mouse
NatureServe rank: G5T3 - vulnerable
States found: SD, WY

Zapus hudsonius preblei – Preble's meadow jumping mouse

NatureServe rank: G5T2 – imperiled, federally listed as threatened
States found: WY, CO

Petitioners request the designation of the New Mexico meadow jumping mouse as Endangered or Threatened under the ESA.

DESCRIPTION

Figure 1: New Mexico meadow jumping mouse (Photo credit: J. Frey).

Comparison with other rodents

Traits distinguishing jumping mice in the genus *Zapus* from other rodents include: presence of 4 upper cheekteeth (rather than 3 upper cheekteeth); long hind legs and feet; and extremely long tail that lacks a distinctive white tip (Hall 1981; Frey 2007g). The elongated hind legs and feet are well developed for jumping and swimming. The meadow jumping mouse differs from other species of jumping mice in having a baculum (penis bone) that lacks a flared tip and is less than 5.1 mm (0.2 inches) in length (Hall 1981). The New Mexico meadow jumping mouse differs from other subspecies of meadow jumping mice in genetic and morphometric characteristics (Hafner et al. 1981; Ramey et al. 2005; King et al. 2006; Vignieri et al. 2006). Further, the habitat requirements of the New Mexico meadow jumping mouse differ from other subspecies of meadow jumping mice. It is an obligate of intact, well-developed riparian habitat on moist soil, whereas other subspecies of meadow jumping mice are associated with a broader array of riparian, grassland, and other habitats (Pers. Comm. Dr. J. Frey 2007).

Pelage coloring

The upperparts of the New Mexico meadow jumping mouse are orangish, being slightly darker on the head and back than on the sides; the underparts are whitish (Figure 1) (Miller 1911; Krutzsch 1954). In comparison, the western meadow jumping mouse has yellowish sides with a distinct dark band on its back (Krutzsch 1954). In addition, the New Mexico meadow jumping mouse lacks a white ear fringe that is present in the western meadow jumping mouse (Krutzsch 1954).

Morphometrics

The New Mexico meadow jumping mouse is most similar to the western meadow jumping mouse (Hoffmeister 1986; Frey 2007g). In comparing these two species, the New Mexico meadow jumping mouse is smaller in body size, has a smaller skull that is proportionately narrower, and has a distinct groove on its first lower molar (Frey 2007). Body measurements for the New Mexico meadow jumping mouse average 8.4 inches (214 mm) for total length, 5.0 inches (128 mm) for tail length, 1.2 inches (30 mm) for hindfoot length, 0.5 inches (13 mm) for ear length, and 21 g for mass (Frey 2007g). Skull measurements average 0.8 inches (20 mm) in length and 0.4 inches (11 mm) in width (Frey 2007g). The sexes are similar in morphology (Krutzsch 1954; USNM 2007).

Distinctive traits

The New Mexico meadow jumping mouse has large, five-toed hind feet, smaller front feet with four toes, a long tail, and the ability to make long leaps. The tail of the mouse is longer than its body (Miller 1911). Adult mice are known to make jumps of up to three feet, but when they require speed they reduce their jumps to approximately one foot (Hoffmeister 1986). The New Mexico meadow jumping mouse is semi-aquatic, and its large feet may assist it with swimming (Pers. Comm. Dr. J. Frey 2007).

Range distinctions

Overall, the New Mexico meadow jumping mouse is morphologically and genetically distinctive in comparison with other subspecies of meadow jumping mice. The distribution of the New Mexico meadow jumping mouse is confined to 5 isolated mountain ranges and the Rio Grande valley. Because of the long period of geographic isolation of these 6 populations, it is possible that each population possesses unique characteristics (Pers. Comm. Dr. J. Frey 2008). Preliminary analyses of an ongoing study on variation in morphology indicate that some populations are unique in some features. However, the extent of this variation currently is unknown (Pers. Comm. Dr. J. Frey 2008).

GEOGRAPHIC DISTRIBUTION: HISTORIC AND CURRENT

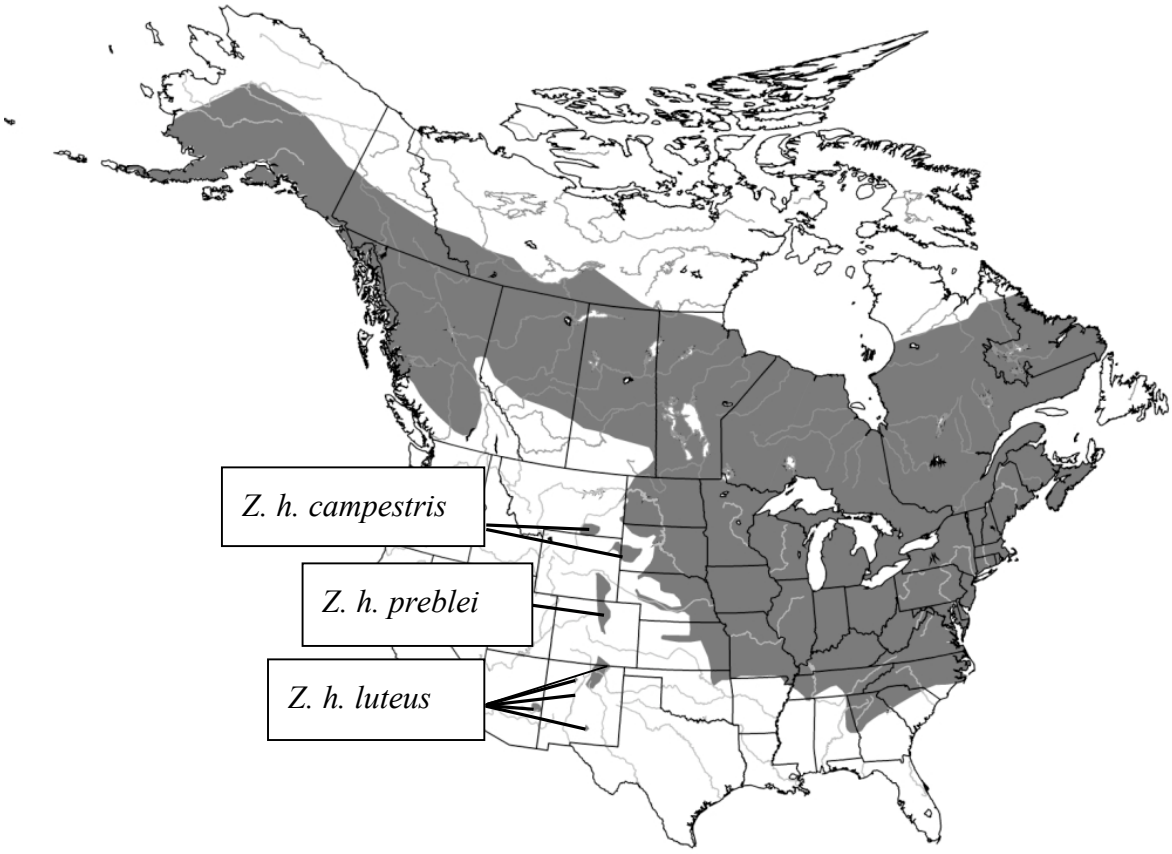

Figure 2: Distribution of the meadow jumping mouse and three subspecies, including the New Mexico meadow jumping mouse, are highlighted. (Excerpted from Frey et al. 2007d).

Overview

The genus *Zapus* is Nearctic in distribution, with the meadow jumping mouse reaching from central North America to Alaska (Figure 2) (Whitaker 1972; AGFD 2005). The New Mexico meadow jumping mouse is considered a peripheral isolated subspecies of meadow jumping mice (Hafner et al. 1981). Evidence indicates that cool, moist grassland habitat types predominated over central and southern New Mexico during periods of glacial extensions (Harris and Findley 1964; Harris 1970; Harris et al. 1973). Subsequent warming and drying of the climate resulted in fragmentation of the range of the meadow jumping mouse as it became restricted to areas of mesic habitat, including riparian areas, in major mountain ranges and along the Rio Grande (Hafner et al. 1981).

The New Mexico meadow jumping mouse is confined to 5 mountain ranges within New Mexico, Colorado, and Arizona, and the Rio Grande valley in New Mexico (Figure 3) (Frey 2006d; Frey 2007c). The mountain ranges it occupies are: San Juan Mountains (La Plata and Archuleta Co., CO, and Rio Arriba Co., NM), Sangre de Cristo Mountains (Colfax and Mora Co., NM and Las Animas Co., CO), Jemez Mountains (Sandoval Co.,

NM), the Sacramento Mountains (Otero Co., NM), and White Mountains (Apache Co. and Greenlee Co., AZ). The White Mountains population also may have historically occurred in Catron Co., NM (Pers. Comm. Dr. J. Frey 2008). The Las Animas Co., CO population is a continuation of the population found in Sugarite Canyon, Sangre de Cristo Mountains, in New Mexico. The Rio Grande range extends from the upper Rio Grande valley and mouth of the Chama River in Rio Arriba Co. southward through the middle Rio Grande in Socorro Co. The Rio Grande population may extend northward into Taos Co., NM, and possibly into adjacent areas of southern Colorado (Pers. Comm. Dr. J. Frey 2008).

In the following discussion "historical" is defined as all records, captures and surveys before 2000. "Current" or "recent" is defined as all records, captures and surveys from 2000 to present. These definitions are suggested by Dr. J. Frey (Pers. Comm. 2007). Table 1 summarizes the current status of the six populations of the New Mexico meadow jumping mouse across its range. It is known to persist at 11 locations. However, suitable habitat for some of these populations measures only a few acres in size. Across all populations, the mouse no longer occurs at 74% of the historical locations surveyed that it once occupied.

Table 1: Summary of historical and current localities for the New Mexico meadow jumping mouse across its range. Percent decline is based on the historical localities surveyed since 2000 where either the species or suitable habitat was not found. Data are summarized based on documents by Frey detailed in the following sections.

	Historical localities					
Population	**Total**	**Recently surveyed**	**Currently Present**	**Currently Absent**	**Percent decline**	**New localities**
San Juan, CO, NM[1]	3	1	0	1	100%	0
Sangre de Cristo, CO, NM[1]	4	3	1	2	67%	1
Jemez, NM	13	11	3	8	73%	2
Sacramento, NM	18	16	1	15	94%	1
White, AZ[2]	16	8	2	6	75%	0
Rio Grande, NM[3]	7	0	unknown	2	29%	0
Total[4]	61	39	7	34	74%	4

[1]Verification of identification has not been competed for all putative historical specimens. Reported data includes only those historical localities where the specimen identification is likely.

[2]Survey effort was not large enough to verify that the mouse was absent.

[3]Based on surveys in the 1980s and 1990s, the mouse is considered absent from at least 2 or 3 (29-42%) of the 7 historical locations.

[4]Percent decline calculated as currently absent/recently surveyed; assuming 2 of 7 Rio Grande localities are absent

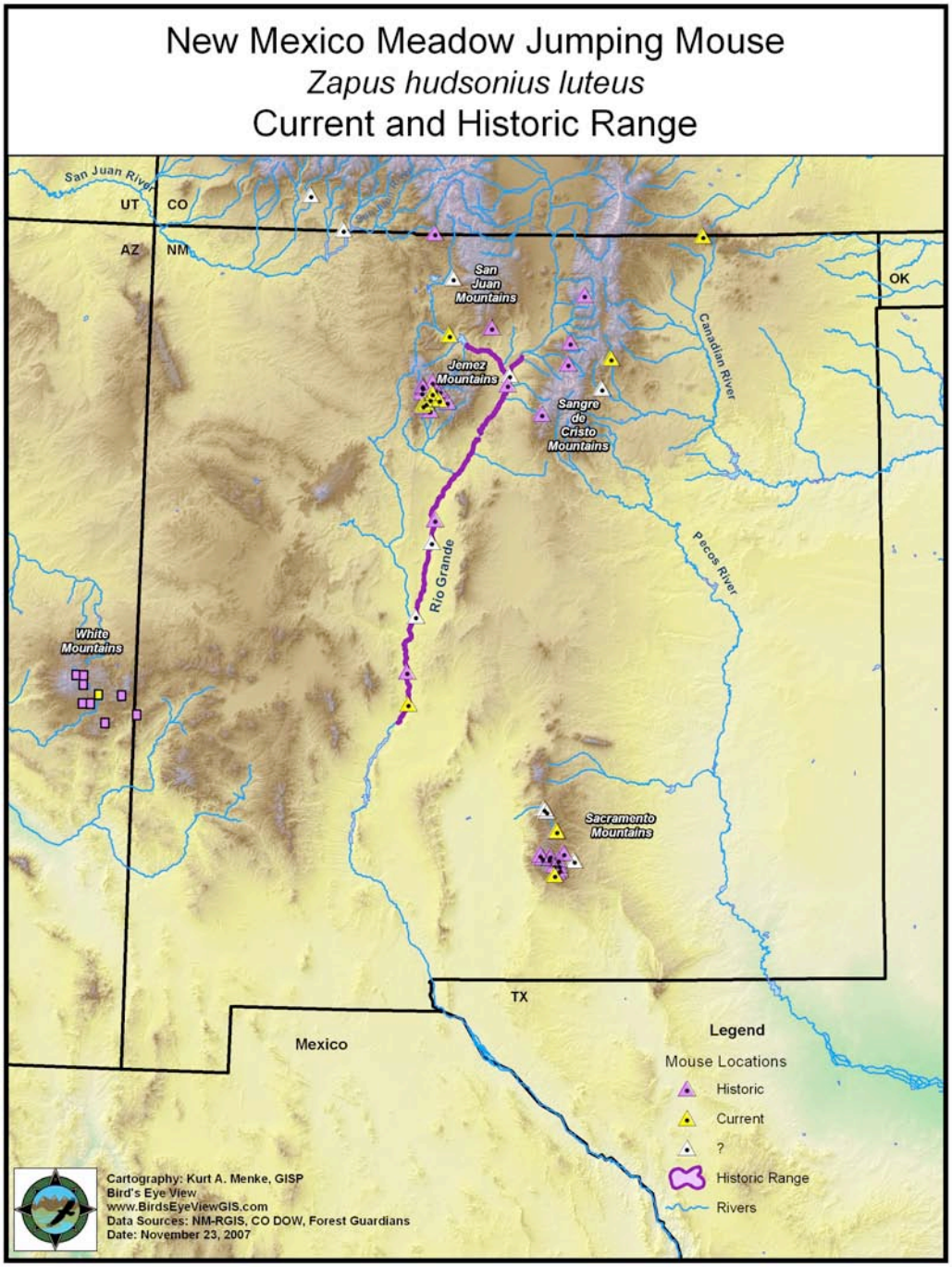

Figure 3: Current and historical locations of the New Mexico meadow jumping mouse within Colorado, New Mexico, and Arizona.

San Juan Mountains (Colorado and New Mexico)

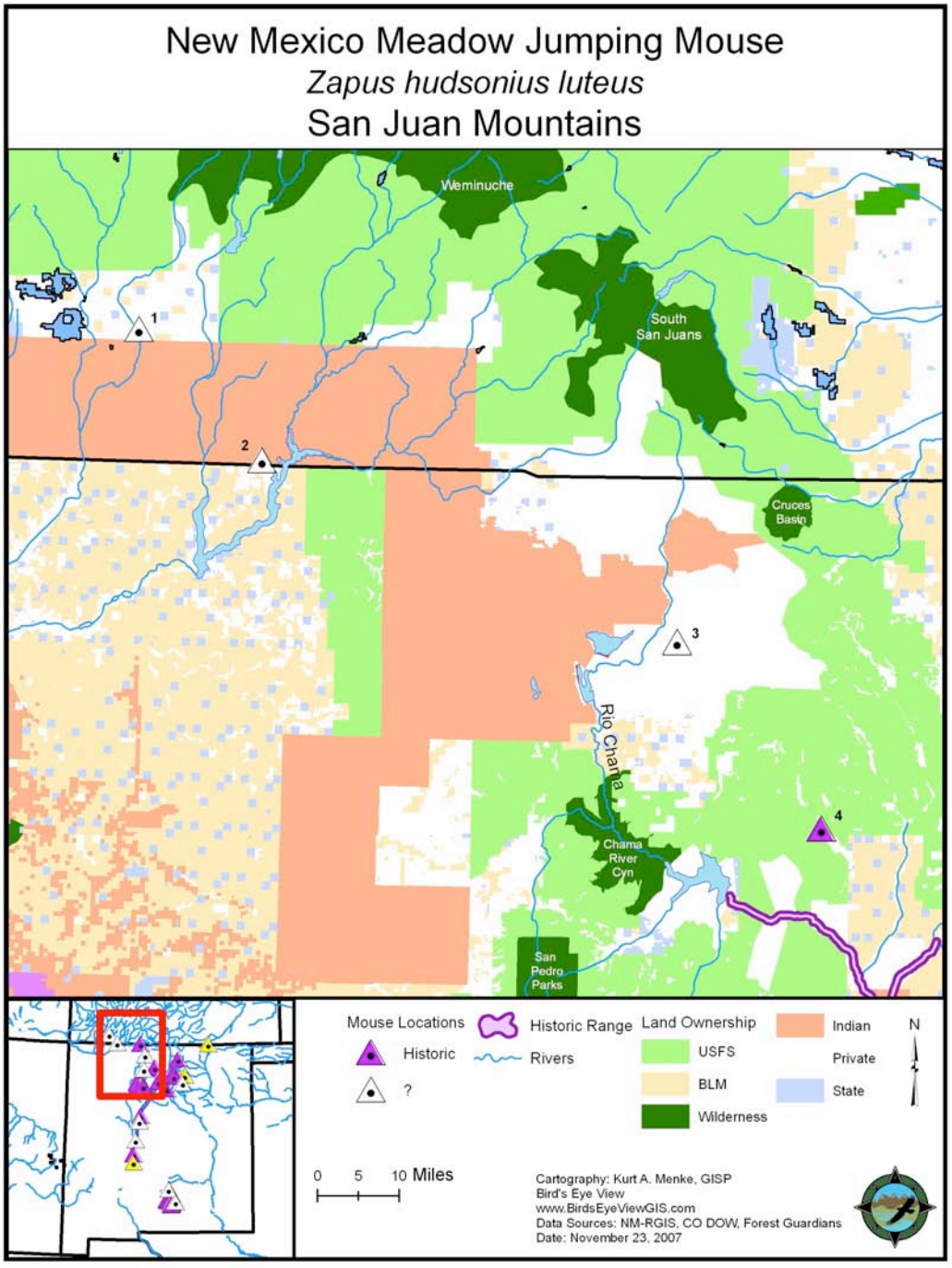

Figure 4: Historical and current locations of the San Juan population of the New Mexico meadow jumping mouse. Numbers refer to locations listed in Table 2. Locations and population status from Frey (Frey 2006a; Frey 2007c).

Table 2: Records of the New Mexico meadow jumping mouse in the San Juan Mountains and adjacent rivers. Excerpted from Frey (Frey 2006a; Frey 2006k; Frey 2006l; Frey 2007c).

Map Number	County	Locality	Date	Status	Notes
1	La Plata, CO	Florida	1945	No recent survey	Frey pers. comm.
2	Archuleta, CO	Near Arboles (T32N, R6W, S23)	1960	No recent survey	Frey pers. comm.
3	Rio Arriba, NM	Tierra Amarilla	1904	No recent survey	Identification not confirmed
4	Rio Arriba, NM	El Rito	1928	2005 no suitable habitat	May be more closely allied with Rio Grande population

Historical

Recent review of specimens indicate that the historical distribution of the New Mexico meadow jumping mouse extended into the southern portion of the San Juan Mountains, including adjacent river drainages (Frey 2007c). Records include at least 2 areas in southeastern Colorado within the San Juan River drainage, and 2 areas in northwestern New Mexico in the Chama River drainage (Figure 4, Table 2). These records indicate that the species may have historically occurred in suitable habitat throughout both river drainages along the flank of the San Juan Mountains (Frey 2006c; Frey 2007c).

Current

The current status of the New Mexico meadow jumping mouse in the San Juan Mountains area is unknown. Intensive surveys for this mouse have not been conducted. In 2005, suitable habitat for the mouse was not found at or near El Rito (Frey 2005a). The riparian areas consisted of large trees, and there was an absence of emergent wetland vegetation (Frey 2005a). Habitat degradation was indicated as caused by cattle grazing, flooding, and heavy human use (Frey 2005a). Verification of the identification of the specimen from Tierra Amarilla is still required (Frey 2007c).

Sangre de Cristo Mountains (Colorado and New Mexico)

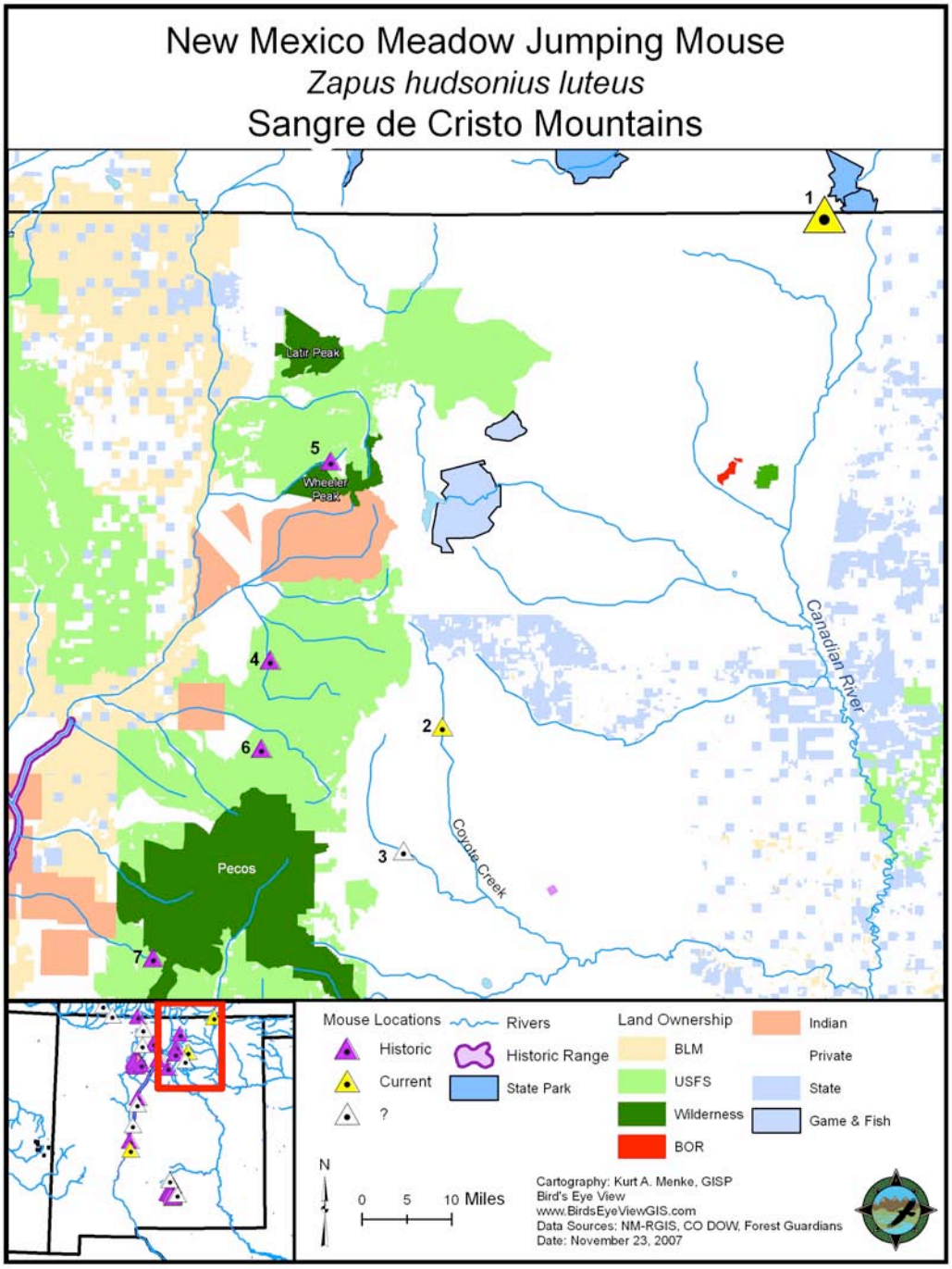

Figure 5: Historical and current locations of the Sangre de Cristo Mountains population of the New Mexico meadow jumping mouse. Numbers refer to locations listed in Table 3. Locations and population status from Frey (2006c, 2006g, 2006k, 2006l).

Table 3: Records of the New Mexico meadow jumping mouse in the Sangre de Cristo Mountains excerpted from Frey (2006a; Frey 2006k; Frey 2006l; Frey 2007c).

Map Number	County	Locality	Date	Status	Notes
1	Las Animas, CO; Colfax, NM	Sugarite Canyon	1999, 2006	2006 present	Jones (1999) Frey (2006)
2	Mora, NM	Coyote Creek	2006	2006 present	Frey (2006)
3	Mora, NM	Mora	1990	No recent survey	Morrison (1990)
4	Taos, NM	Hondo Canyon	1904	2006 not present	Cataloged as *Z. h. luteus*; collected as *Z. princeps* requires verification
5	Taos, NM	Taos Ski Valley, North of Williams Lake	1966	2006 not present	Collected as *Z. princeps* identification as *Z. h. luteus* fairly certain
6	Taos, NM	Fort Burgwin	1911	2006 not present	Miller (1911)
7	Taos, NM	Duran Canyon	1958	2006 not present	Collected as *Z. princeps;* tentatively referred to as *Z. h. luteus* but requires verification with larger sample

Historical

Recent review of specimens indicates that the historical distribution of the New Mexico meadow jumping mouse included the northern portion of the Sangre de Cristo Mountains (Frey 2006c, Frey 2006g). Specimens with confirmed identification are known from Las Animas Co., CO, and Colfax, Mora, and Taos counties, NM, which indicates a broad historical distribution throughout much of this mountain range (Figure 5, Table 3). It also is possible that the mouse's distribution reaches south into Santa Fe County along the Sangre de Cristo Mountains because historical records exists in Santa Fe County, but require verification (Frey 2006a). At one time, the Taos Ski Valley specimen was thought to be the only record from this area, and it was considered a peripheral population associated with the northern Rio Grande valley (Hafner et al. 1981; Hafner and Yensen 1998). However, that perspective was altered when the mouse was discovered in 1999 at Lake Dorothey State Wildlife Area in Las Animas County, Colorado, which was the first record of the subspecies in Colorado (Jones 1999). Since then additional records based on historical specimens and recent surveys indicate a

population centered in the Sangre de Cristo Mountains, rather than being an extension of the Rio Grande valley population.

Current

Recent surveys in the Sangre de Cristo Mountains indicate the mouse has persisted at one historical location, but has been extirpated from at least two historical locations (Frey 2006c; Frey 2006k; Frey 2006l). In 2006, surveys conducted in the Sangre de Cristo Mountains revealed that there has likely been a significant reduction in the distribution of the New Mexico meadow jumping mouse and its habitat in the Sangre de Cristo Mountains (Frey 2006c). During these intensive surveys, the New Mexico meadow jumping mouse only was found at one historical and one new location (Table 3, locations 1 and 2) in the Sangre de Cristo Mountains (Frey 2006c). The historical location was in Sugarite Canyon, where it was captured at five sites in Sugarite Canyon State Park (Frey 2006l). The historical records of the Sugarite Canyon population were in Colorado, which bisects the canyon (Pers. Comm Frey 2007). No recent surveys have been conducted in Colorado to determine the current population status of the meadow jumping mouse (Pers. Comm Colorado Division of Wildlife, 2007). However, habitat in the New Mexico portion of the Sugarite Canyon drainage appears to be healthy, and the mouse likely persists in this area within Colorado as well (Pers. Comm. Dr. J. Frey 2007). This canyon is part of the Canadian River drainage, which extends into Colorado. The recently discovered population of the New Mexico meadow jumping mouse in the Sangre de Cristo Mountains was at Coyote Creek State Park in Mora County (Frey 2006k; Frey 2006l) (Figure 5). This park is about 17 miles north of an historical record of the mouse located near the town of Mora and hence confirms the persistence of the species in Mora Co. Verification of the persistence of the mouse at Mora is not known. The New Mexico meadow jumping mouse was not found during recent surveys at Fort Burgwin, which was the first historical location where the species was discovered. Additional information regarding the historical location at Fort Burgwin indicates that trapping efforts conducted by a local mammalogist within the last ten years also had not resulted in any captures of this species (Frey 2006b).

Jemez Mountains (New Mexico)

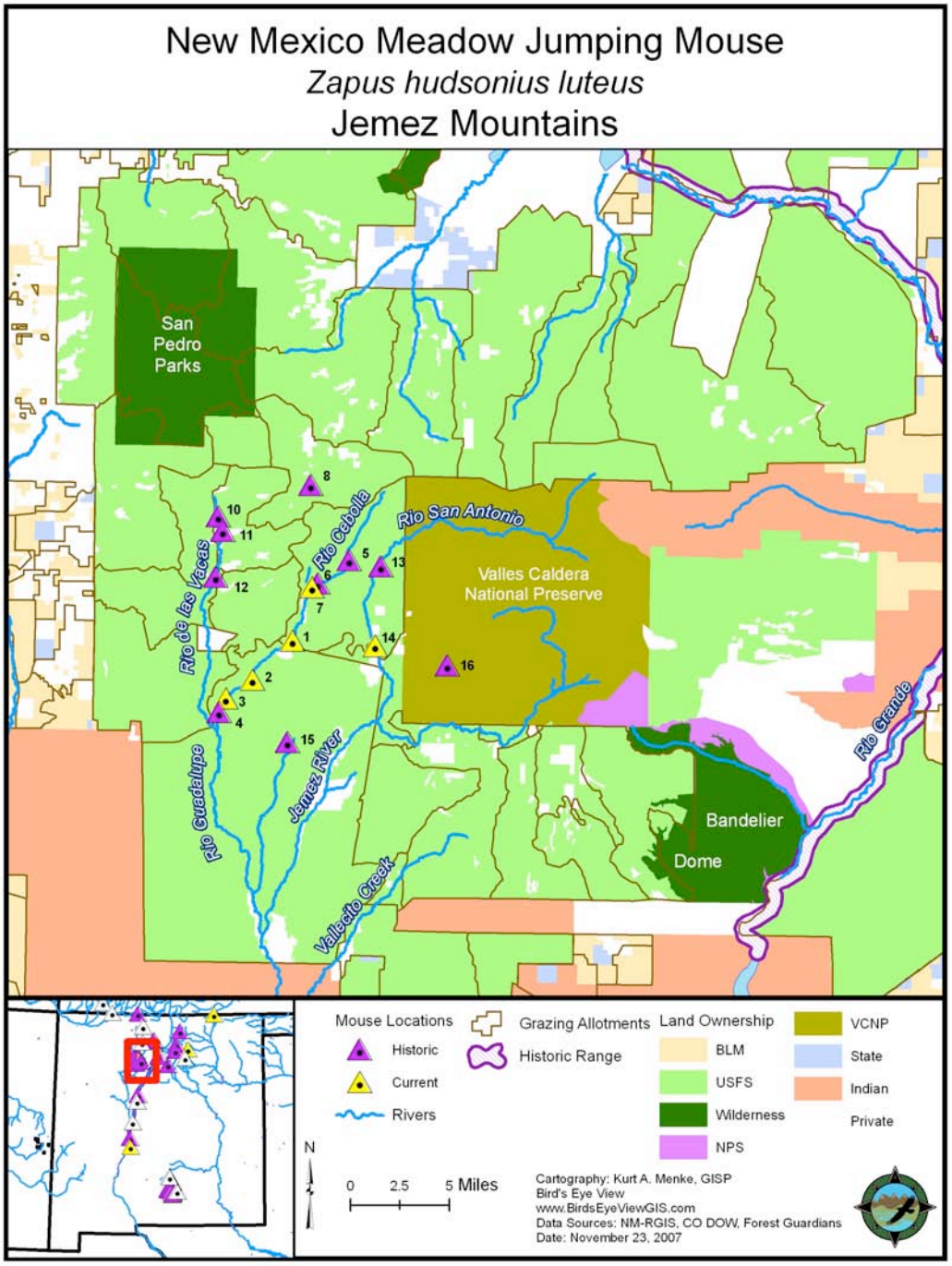

Figure 6: Historical and current locations of the New Mexico meadow jumping mouse in the Jemez Mountains. Numbers refer to locations listed in Table 4. Locations and population status from Frey (2005a).

Table 4: Records of the New Mexico meadow jumping mouse in the Jemez Mountains excerpted from Frey (Frey 2005a; 2007a).

Map Number	County	Locality	Date	Status	Notes
1-7	Sandoval	Rio Cebolla	1969, 1979, 1985, 1989, 2005	2005 present in 4 sites	Findley (1969) Morrison (1985; 1992), Frey (2005)
8-12	Sandoval	Rio de las Vacas (Rito Penas Negras)	1985, 1989	2005 not present	Morrison (1985; 1992)
13-14	Sandoval	San Antonio Creek	1985, 2005	2005 present in 1 of 2 sites	Morrison (1985) Frey (2005)
15	Sandoval	Virgin Canyon	1989	2005 not present	Morrison (1992)
16	Sandoval	Valles Caldera National Preserve	mid-1970s	No recent survey	(Pers. Comm. Dr. J. Frey)

Historical

The New Mexico meadow jumping mouse was first documented in the Jemez Mountains in the late 1960s and 1970s along the upper Rio Cebolla near Seven Springs and Fenton Lake, and on the Valles Caldera National Preserve, which was then known as the Baca Location (Figure 6, Table 4, Location 6) (Frey 2005a; Frey 2007a). In the mid to late 1980s, Morrison conducted a distribution and habitat survey in the area (Morrison 1985; 1987a; 1992). Morrison documented the mouse in three additional areas, including various locations within Rio de las Vacas drainage including the Rito Penas Negras, San Antonio Creek, and Virgin Canyon (Figure 6, Table 4). All known locations are within the Jemez River watershed.

Current

Surveys conducted in 2005 and 2006 provide evidence that in the 15 years since Morrison's (1986, 1989) studies, the New Mexico meadow jumping mouse has disappeared from 73% of historical localities surveyed in the Jemez Mountains (Table 1, Figure 6) (Frey 2005a; Frey 2007a; Frey et al. 2007d). It was found to persist at five locations in restricted areas along the Rio Cebolla and San Antonio Creek (Frey et al. 2007d). On the Rio Cebolla it was found at 3 historical and 1 new location, but was not found at 2 additional historical locations. On San Antonio Creek it was not found at the only historical locality, but was found at a new locality.

In the Jemez Mountains, the mouse is still found along a 12-mile stretch of the Rio Cebolla, although suitable habitat within this stretch is fragmented by areas of development and livestock grazing (Frey 2005a). However, the distribution of suitable

habitat and occurrence of mouse populations appears to have been reduced along this river. Along San Antonio Creek, the only suitable habitat found was within a fenced area. The upper portion of the stream where the mouse formerly occurred no longer had suitable habitat due to cattle grazing. The Rio de las Vacas drainage previously consisted of one third of historical localities in the Jemez Mountains. However, the mouse was not captured at any historical or new localities surveyed, and there was little potentially suitable habitat. Results were similar for surveys conducted along Virgin Canyon, which had a single historical record. *Id.* Cattle grazing was indicated as the main cause of habitat degradation for the mouse in the Jemez Mountains. The mouse was only located in habitat that received protection from grazing, either because the habitat was fenced to exclude cattle, or, in one instance where beaver had created a wetland that cattle did not enter (Frey 2005a; Frey 2007a).

Sacramento Mountains (New Mexico)

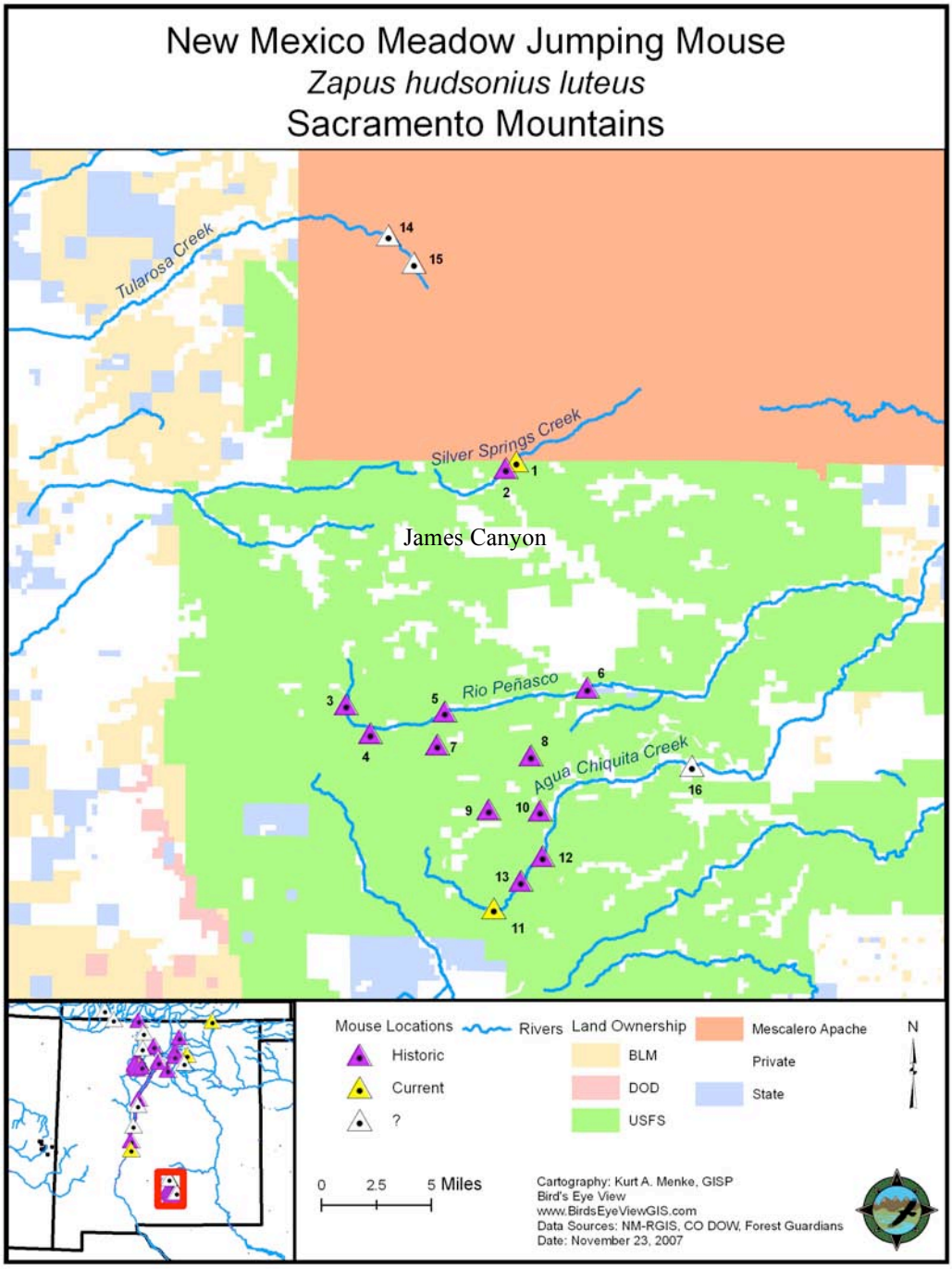

Figure 7: Historical and current locations of the New Mexico meadow jumping mouse in the Sacramento Mountains. Numbers refer to locations listed in Table 5. Locations and population status from Frey (2005a; 2006m; 2007f). James Canyon identified as a general location.

Table 5: Records of the New Mexico meadow jumping mouse in the Sacramento Mountains, excerpted from Frey (2005a).

Map Number	County	Locality	Date	Status	Notes
1-2	Otero	Silver Springs	1902, 1977 1988 2005	2005 present in 1 site	Bailey (1913), Morrison (1988a; 1989), Frey (2005; pers. comm.)
	Otero	James Canyon	1902 1978, 1979, 1988,	2005 not present	Bailey (1913), Morrison (1988a; 1989), Frey (pers. comm.)
3-7	Otero	Rio Penasco (includes Dark, Water and Wills Canyons)	1988, 1989 1992-1994	2005 not present	Morrison (1988a; 1989), Ward (1992-1994)
8-13,16	Otero	Agua Chiquita (includes Hay, Springs and Potato Canyons)	1931 1988 2005	2005 present in 1 site	Morrison (1988a; 1989), (Frey 2005, pers. comm.)
14-15	Otero	Tularosa Creek	1932	No recent surveys	Frey pers. comm.

Historical

The mouse was first discovered in the Sacramento Mountains in 1902 (Bailey 1913). Bailey's specimens were described as collected from the Rio Peñasco. However, a recent review of these records found that they were from James Canyon and Silver Springs Creek (Frey 2007e, in publication). During the early 1930s the subspecies was also captured from the lower Agua Chiquita Creek at the town of Weed and at two locations along Tularosa Creek near Mescalero (Frey 2006m; Frey 2007f) (Figure 7, locations 14, 15, and 16). These records were recently discovered and suggest that the mouse had a greater north to south distribution in the Sacramento Mountains than previously believed (Frey 2006m; Frey 2007f). It wasn't until the late 1970s and then late 1980s that the subspecies was again documented in the Sacramento Mountains (Figure 7, Table 5). Morrison's distribution and habitat surveys in the late 1980s identified the mouse as persisting at 12 sites along the drainages of Silver Springs Creek, James Canyon, the Rio Peñasco, and Agua Chiquita Creek (Morrison 1989). Morrison (1989) also surveyed for the jumping mouse in other areas of the Sacramento and Capitan Mountains but found no mice in these areas.

Current

Surveys conducted in 2005 determined that the New Mexico meadow jumping mouse had disappeared from 94% of historical localities surveyed (Table 1) (Frey 2005a). It was found to persist at only two small, isolated locations in the Sacramento Mountains (Frey 2005a) (Figure 7). One capture was at a historical locality along Silver Springs Creek, while the other was at a new locality along Agua Chiquita Creek (Frey 2005a). The estimated population size for the mouse was 20 acres of suitable riparian habitat with an estimated 132 mice at Silver Springs Creek, and 12 acres of suitable riparian habitat with an estimated 79 mice at Agua Chiquita (Frey 2005a). Both locations where the mouse was found were protected from grazing. Habitat at most historical localities surveyed were considered unsuitable due to lack of perennially running water or absence of riparian habitat due to livestock grazing and other causes (Frey 2005a).

White Mountains (Arizona)

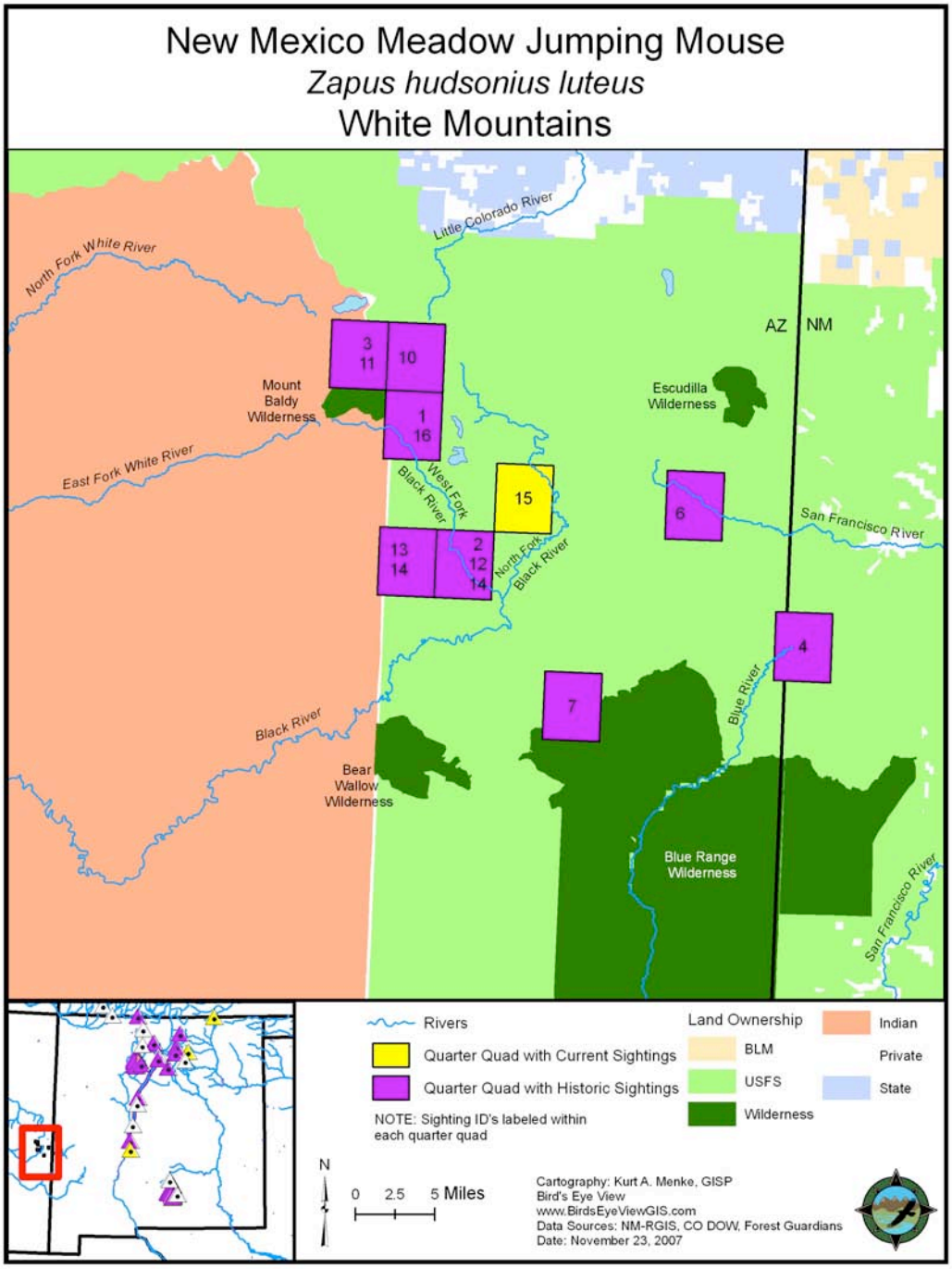

Figure 8: Historical and current locations of the New Mexico meadow jumping mouse in the White Mountains of Arizona. Numbers refer to locations listed in Table 6. Data from Arizona Natural Heritage Database (Pers. Comm. Swartz AZHD 2007). Exact locations unavailable and therefore mapped using USGS quarter quad data.

Table 6: Records of the New Mexico meadow jumping mouse in the White Mountains, Arizona. Data from Arizona Natural Heritage Database (2007).

Map Number	County	Locality	Initial Capture
1	Apache	Southwest Of Greer: Phelps Botanical Area.	1966
2	Apache	West Fork Black River: West Fork Forest Campground	1933
3	Apache	Sheep Crossing.	1964
4	Greenlee	Red Hills: Campbell Blue River: Box Canyon.	Prior 1986
6	Greenlee	San Francisco River: 1 Mi Below Alpine.	1914
7	Apache	Hannagan Creek: North Of Big Lake.	1933
10	Apache	West Fork Little Colorado River	1977
11	Apache	Southwest Of Greer: W Of Lee Valley Reservoir.	1981
12	Apache	West Fork Black River: P-S Ranch.	1986
13	Apache	Boggy Creek: Intersection With Fsr 25:	1991
14	Apache	Centerfire Creek: Upstream From Fsr 25.	1991
15	Apache	Three Forks Area: N Fsr 249.	1991
16	Apache	Thompson Creek: Burro Creek Confluence.	1991

*Map numbers 5, 8, 9 not available from Arizona Natural Heritage Database because they are on tribal property (Pers. Comm. Swartz AZHD 2007). Additional locations are present in the White Mountains but not provided by Ingradli and Kolozar (1997).
**Surveys during 2006 at map numbers 1, 3, 12, 13, 14, 16 did not find mice, although trapping effort may not have been intensive enough to establish absence.

Historical

Records of the mouse in Arizona have been reviewed by Frey (Pers. Comm. J. Frey 2007) and the Arizona Natural Heritage Database. All verified records of the mouse in Arizona are from the White Mountains of Apache and Greenlee Counties (Figure 8, Table 6) (Hoffmeister 1986). Through the 1990s approximately 16 locations occupied by the New Mexico meadow jumping mice had been documented (Figure 8, Table 6). Hall and Davis (1934) were the first to report the mouse in Arizona, although unreported specimens existed as far back as 1913. Frey states that from the 1930s to the 1980s, 9 additional locations were reported, including 5 new drainages (citing Krutzsch (1954), Cockrum (1960), Hafner et al. (1981), and Hoffmeister (1986)). The Arizona Game and Fish Department (AGFD) conducted surveys in two locations in 1987 and found mice in both locations (Dodd 1987). One of these locations was a new record for the New Mexico meadow jumping mouse (Dodd 1987, Pers. Comm. J. Frey 2007). In 1991 an intensive survey for the mouse was conducted (Morrison 1991). A total of 24 sites were surveyed, 4 of which were historical locations (Pers. Comm. J. Frey 2007). The mouse was only recorded in 5 of the 24 (21%) locations (Morrison 1991). One of the five locations was an historical locality (Morrison 1991, Pers. Comm. Dr. J. Frey 2007). In 1995 and 1996, AGDF personnel returned to 3 of the 5 locations where the New Mexico meadow jumping mouse had been trapped in 1991 and an additional 9 locations were also surveyed (Kolozar and Ingraldi 1997). Jumping mice were trapped at 2 of the 3 locations

found in 1991 and at 2 of the additional 9 locations (Kolozar and Ingraldi 1997). Therefore, in 1996 mice were known to persist at 4 locations (Pers. Comm. J. Frey 2007).

Current

In 2006, the Arizona Department of Game and Fish returned to all 5 locations where jumping mice were trapped in 1991 and 1 of the 2 additional sites where jumping mice were trapped in 1995-1996 (Pers. Comm. J. Underwood AGDF 2007). Two additional historic locations where the New Mexico meadow jumping mouse had been trapped in the 1980s were also surveyed, totaling 8 locations. Only one mouse was trapped at a single location (location 15, Figure 8). However, effort at each location varied between 40-120 trap-nights, which is not considered long enough to establish the absence of the mouse at those sites (Pers. Comm. Dr. J. Frey 2007). The single capture was at Three Forks where previous capture efforts had resulted in the greatest amount of meadow jumping mice (Pers. Comm. AZGFG Underwood 2007). Limited survey work was conducted in 2007 by AGDF, and the persistence of the mouse was documented at a second historical location (Pers. Comm. Dr. J. Frey 2007). Thus, currently the mouse is known to persist at 2 locations in Arizona.

Rio Grande Valley (New Mexico)

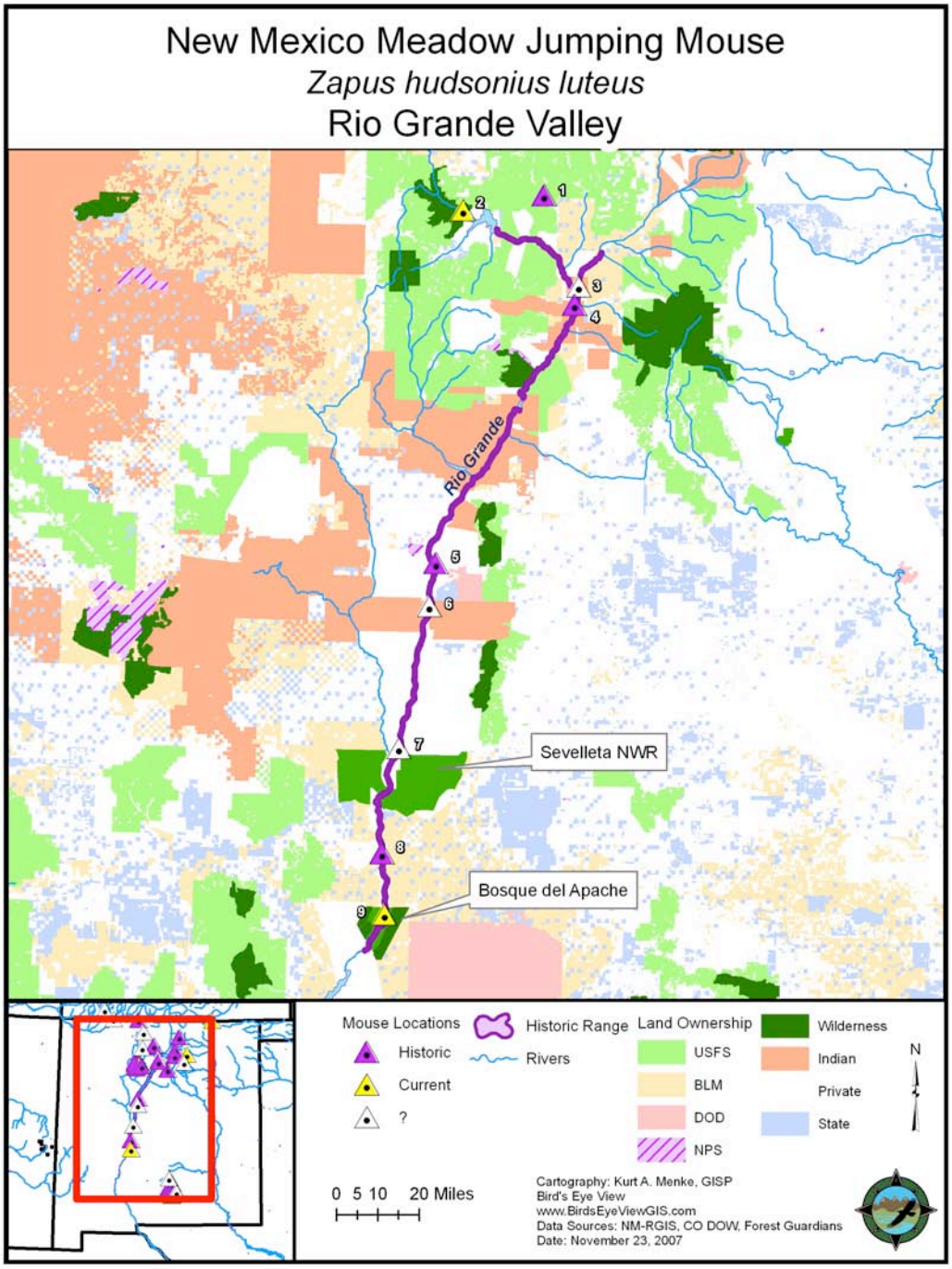

Figure 9: Historical and current locations of the New Mexico meadow jumping mouse in the Rio Grande and Chama River valleys. Numbers refer to locations listed in Table 7. Locations and population status from Frey (2006d).

Table 7: Records of the New Mexico meadow jumping mouse from the Rio Grande and Chama River valleys, excerpted from Frey (Frey 2006d).

Map Number	County	Locality	Date	Status	Notes
1	Rio Arriba	El Rito	1928	2005 not present	White (1928) possibly more related to San Juan Mt. populations
2	Rio Arriba	Rio Chama valley	1987	No recent surveys	Morrison (1988)
3	Rio Arriba	San Juan Pueblo	1987	No recent survey	Morrison (1988)
4	Rio Arriba	Espanola	1904	1985, 1987 not present	Miller (1911)
5	Bernalillo	Albuquerque	1917	Recent surveys not present	Frey (Pers. com.)
6	Bernalillo	Isleta Pueblo	1981, 1982, 1987	No recent surveys	Hink and Ohmart (1984), Morrison (1987)
7	Valencia	Belen; Casa Colorado Wildlife Area	1987	No recent surveys	Morrison (1988)
8	Socorro	Socorro	1909	No recent surveys, habitat conditions poor	Bailey (1913)
9	Socorro	BANWR	1976, 1977, 1978, 1979, 1991, 1992	Present in 1992, no recent surveys	Hafner et al. (1981), Najera (1994)

Historical

The New Mexico meadow jumping mouse likely had a broad pre-1930s historical distribution associated with well-developed riparian areas in the Rio Grande valley (Frey 2006d). It is believed this habitat was widespread in the middle Rio Grande valley (Scurlock 1998). Frey (2006d) reviewed available records and biogeographic features and determined that the historical distribution along the Rio Grande extended from Rio Grande Canyon (approximately 13 miles above the junction of the Rio Grande and Rio Chama) in the north and south to at least Bosque del Apache National Wildlife Refuge (BANWR) (Figure 9, Table 7). Based on records in the Rio Grande watershed in the Sangre de Cristo Mountains (e.g. Miller 1911, Hafner et al 1981, Frey 2006c) it is possible that the species' distribution also included the Rio Grande above the Rio Grande Canyon (Frey 2006d). Historical distribution along the Rio Chama likely extended from

its confluence with the Rio Grande upstream into the San Juan Mountains and its drainages (Figure 9, Table 7) (Frey 2006d).

The New Mexico meadow jumping mouse was first discovered in the Rio Grande Valley in 1904 at Espanola by Miller (1911) (Figure 9, Table 7). Specimens were next collected in Socorro (1909), Albuquerque (1917), and BANWR (mid 1930s) (Frey 2006d) (Figure 9, Table 7). No other specimens were collected along the Rio Grande over the next 40 years until 1976 when a specimen was collected at BANWR (Frey 2006d). This capture prompted the genetic and morphometric study conducted by Hafner et al. (1981) which involved collection of 32 additional specimens from BANWR during 1977-1979 (Frey 2006d). During an intensive study of intensive biological survey of riparian habitats and associated vertebrate animals in the middle Rio Grande from 1981-1983, the mouse was discovered near Isleta in 1984 (Hink and Ohmart 1984).

During 1985 and 1987 Morrison conducted surveys for the mouse along the Rio Grande at 46 survey sites, which included 2 of 5 then known historical locations (Morrison 1985, 1988b). In 1987 Morrison captured the mouse at two historical localities (Isleta, BANWR), and at 2 new locations at San Juan Pueblo and Casa Colorado Wildlife Area. The mouse was not captured at the historical locality in Espanola or at 9 locations between Bernardo and La Joya (between points 6 and 7 of Figure 9 Table 7). Consequently, as of 1987 there were 7 known locations for the mouse, of which it persisted at 4 (Morrison 1989). During 1991 and 1992, the mouse was captured at BANWR (Najera 1994, Zwank 1997).

Current

There have been no recent surveys for the New Mexico meadow jumping mouse in the Rio Grande valley. However, based on observations of habitat, the mouse's current distribution is disjunct, and it may not be present in many historic locations due to extreme habitat fragmentation characterized by large areas of apparently unsuitable habitat (Frey 2006d). In the vicinity of Espanola, suitable habitat is rare and largely disjunct, and surveys for the mouse during the 1980s failed to document its persistence (Morrison 1988b; Frey 2006d) (Figure 9). In the vicinity of Albuquerque, which is a historical locality, various small mammal studies, including targeted surveys for the mouse, have failed to capture the species (Pers. Comm. S. Carey 2007; Frey 2006d). Frey (2006d) thought that it was unlikely the mouse would have persisted at Socorro given current habitat conditions. The current status of the subspecies and its habitat at Isleta and CCWA is unknown (Frey 2006d). Suitable habitat is likely intact at BANWR, and it seems likely the species persists there (Frey 2006d). Thus, the subspecies has likely disappeared from at least two or three (22-33%) of its known historical locations along the Rio Grande (Figure 9) (Frey 2006d). Frey (2006d: Page 2) states "the likelihood of discovering new populations, especially in the middle Rio Grande valley, seems remote due to a failure to document the species during previous extensive survey work and paucity of suitable habitat."

LIFE HISTORY

Habitat requirements

The New Mexico meadow jumping mouse is restricted to riparian zones, both in high elevation mountains and along the Rio Grande (Findley et al. 1975; Morrison 1987a; Morrison 1990; Zwank et al. 1997; Frey 2005a; Frey 2006c; Frey 2007a). In the Rio Grande valley, the mouse has also been captured along ditches and irrigation canals that have suitable habitat (Morrison 1992).

In montane riparian areas mouse capture sites were in persistent emergent wetlands (e.g., dominated by plants such as sedge or reed canary grass) or scrub/shrub riparian habitats (e.g., dominated by shrubs such as alder and willow) (Frey 2006c) (Figure 10). Although the major vegetative characteristics vary, the microhabitat at mouse capture sites invariably consists of very tall, dense herbaceous plants on moist soil (Frey 2006c). The herbaceous plant species are usually sedges, but may also include grasses and forbs. This vegetative composition is highly indicative of suitable New Mexico meadow mouse habitat (Frey 2007b). Suitable mouse habitat can be statistically predicted based on the height of plant cover (Frey 2008).

The New Mexico meadow jumping mouse requires high plant abundance and diversity (Frey 2005a; Frey 2006c; Frey 2007a) (Figure 10 and Table 8). Table 8 indicates vegetative characteristics associated with capture sites of the New Mexico meadow jumping mouse in the Jemez, Sacramento, and Sangre de Cristo mountains (Frey 2006c).

Other factors indicative of suitable jumping mouse montane habitat are elevation, distance to perennial water, soil moisture, and ground cover. In montane habitats mice have been captured at elevations ranging from approximately 2,000 m – 2,350 m (6,516 ft – 7709 ft) (Morrison 1990; Frey 2006c; Frey 2007c). The average distance to running water at capture sites was 1.8 m (Frey 2005a). Soil moisture is very high: the average soil moisture was 9.3 on a scale of 1-10 at capture locations in the Jemez, Sacramento, and Sangre de Cristo Mountains (Frey 2006c).

It is possible that New Mexico meadow jumping mice nest and hibernate in drier areas adjacent to riparian habitats (Morrison 1988a).

Table 8: Vegetative characteristics measured at New Mexico meadow jumping mouse capture sites in the Jemez, Sacramento and Sangre de Cristo Mountains during 2005 and 2006. Data from Frey (2006c).

Vegetative Variable	**Average**
Canopy Cover	20%
Vertical Cover	38 inches
Vertical Stubble Height	33 inches
Laid-over Stubble Height	25 inches
Vegetative Litter Depth	1.7 inches
Tree numbers	0
Shrub numbers	15
Ground Cover (Class 1-6)*	
Sedge	2.6
Forb (broad leaved herbs)	2.6
Equisetum (horsetails)	1.0
Grass	1.4
Alder/willow	1.1

*Class 1 = 0-5%, Class 2 = 5-25%, Class 3 = 25-50%, Class 4 = 50-75%, Class 5 = 75-95% and Class 6 = 95-100%.

Figure 10: Photos of New Mexico meadow jumping mouse capture locations. Locations with suitable habitat where the species was captured in 2005 and 2006: A) Jemez Mountains, San Antonio Creek, B) Sacramento Mountains, Silver Springs Creek, C) Sugarite Canyon State Park, upper end of Lake Alice, D) Location on the Rio Peñasco, Sacramento Mountains, where the mouse was captured in 1988, but that had unsuitable habitat in 2005. All photographs from Frey (Pers. Comm. 2007).

A comprehensive habitat analysis of jumping mouse capture sites along the length of the Rio Grande has not been conducted. Studies of the mouse at BANWR, which is its southernmost location, have described vegetative associations (Morrison 1987; Zwank et al. 1997). At BANWR Morrison (1987c) found New Mexico meadow jumping mice in willow/grass/forb habitats along permanent ditches. No jumping mice were trapped in dry grassland/woodland, edges of cattail marshes or in cattail/rush/willow/salt cedar along permanent ponds, in or around impoundments, in wet sedge meadows, or along ditches that had been recently burned and revegetated (Morrison 1987c). Zwank et al. (1997) captured New Mexico meadow jumping mice in all habitats were trapping occurred, including wetland impoundments, agricultural cropland and riparian woodlands. All capture sites had dense understory and midstory vegetation, were frequently inundated with water, and had a diverse vegetative community of grasses, forbs and sedges (Najera 1994). More mice were captured in areas with understory and midstory vegetation, while fewer mice were captured in areas with overstory vegetation (Zwank et al. 1997).

Between the 1980s and early 1990s, Morrison's work dominated the literature surrounding the New Mexico meadow jumping mouse. She located new populations of the mouse and measured various habitat variables at capture locations. This provided a basis for investigations by Dr. J. Frey, the current leading expert on this species, to conduct surveys and other studies on the mouse. Morrison's descriptions of habitat were based on data collected in both the riparian and upland zone throughout an entire survey location (Frey 2007b). In contrast, Frey's investigations measured the habitat at the exact location a mouse was captured (Frey 2007b). Consequently, descriptions of habitat by Morrison and Frey sometimes differ. Morrison described the New Mexico meadow jumping mouse's habitat as riparian zones dominated by grass and forbs (Morrison 1992). This describes the general features of typical mouse habitat. In contrast, Frey describes the mouse's habitat as being dominated by tall, dense sedges. This describes the specific habitat used by the mouse (Frey 2007b). Therefore, Morrison's habitat descriptions of Rio Grande populations (included in the above habitat description) likely portray the wider habitat. Recent surveys in the White Mountains of Arizona only provided general habitat descriptions (Kolozar and Ingraldi 1997). No quantitative study on habitat in the White Mountains has been completed. Habitat of the New Mexico meadow jumping mouse found in southeastern Colorado is likely the same as that measured by Frey in New Mexico (Frey 2006b) as the Colorado population is an extension of the New Mexico population (Pers. Comm. Dr. J. Frey 2007). There has been no study of the habitat at historical capture sites in the San Juan Mountains.

The New Mexico meadow jumping mouse is an obligate of well-developed riparian habitat and lives only within this zone and immediately adjacent areas. These riparian habitats are generally found in broad valleys, adjacent to meadows and grasslands (Frey 2007b). Because emergent herbaceous wetland habitat is often embedded within a broader meadow or grassland valley, habitat descriptions sometimes describe the mouse's habitat as meadow or grassland (Frey 2007b). However, the mouse does not occur in meadows or grasslands that lack suitable riparian habitat. This is an important distinction because other subspecies of meadow jumping mice are often associated with grasslands (Frey 2007b).

Behavior

The New Mexico meadow jumping mouse is typically nocturnal and is evidently solitary in its nocturnal foraging activities (Morrison 1987a). Although there have been observations of mice during the day, in only one study was a New Mexico meadow jumping mouse captured during the day (Morrison 1985, 1987b).

The New Mexico meadow jumping mouse appears to be more difficult to trap than other small mammals (Morrison 1988b; Najera 1994; Frey 2007a). These mice appear to be inherently trap-shy and may not be as attracted to baited traps as are other small mammals (Morrison 1988b). Males are trapped more often than females but this may be due to the greater movements of males associated with establishment of territories, dispersal, and efforts to locate mates (Morrison 1987a).

Movement and habitat utilization

Movements of the mouse are related to the size and shape of the suitable habitat area (Morrison 1988b). Movements are different throughout the active season and are likely influenced by cover, food availability, breeding behavior, and other factors. New Mexico meadow jumping mouse individuals can be mobile. With successive captures, adult mice have been shown to travel distances greater than 100 feet (Morrison 1987a). The greatest distance traveled by an adult male between two successive nights was between 500-800 feet with an average 173 feet (Morrison 1987a; Morrison 1987c). The greatest distance traveled for a female was 225 feet, with an average 95 feet. Very rarely have New Mexico meadow jumping mice been trapped in the same trap on two successive nights (Morrison 1987a; Morrison 1988b; Morrison 1989). Movement of juveniles just after they emerge from nests appears to be somewhat less in distance (Morrison 1987a).

Home ranges of New Mexico meadow jumping mice are linear and parallel watercourses. Data from populations at BANWR and in the Jemez Mountains suggest that home ranges of New Mexico meadow jumping mice are long and narrow, corresponding to the amount of suitable habitat (Morrison 1987a; Morrison 1988b). These observations are consistent with research showing other species of jumping mice (*Z. princeps)* that inhabit narrow strips of streamside riparian vegetation had long and narrow home ranges (Brown 1967; Cranford 1983). The home range of the New Mexico meadow jumping mouse differs between males and females, 0.63 acres and 0.45 acres respectively. Range length might be a better estimation of home range for the New Mexico meadow jumping mouse because they have elongated home ranges along stream (Morrison 1987a). For male mice the average range length is 308 feet and for females the average is 245 feet.

Food habits

The diet is varied for this subspecies and consists of both vegetal (seeds and fruits) and animal (insects, snails, slugs and millipedes) material (Hubbard 1984; Hoffmeister 1986). Jumping mice feed primarily on seeds of grasses and forbs, but seeds of sedges, bulrush and cattail are infrequently eaten (references cited in Morrison 1990). During May in New York, 50% of the food of meadow jumping mice was insect and 20% was seeds

(Whitaker 1963). As more seeds became available during the growing season, they were more frequently consumed. Moist habitats support the growth of tall, dense plants that provide a wide variety of food, as well as cover (Cranford 1983).

New Mexico meadow jumping mice have a short active season of between 4-5 months (Morrison 1985, 1987a, 1988b, 1989). Upon emerging from hibernation, jumping mice must breed, rear their young, then accumulate fat sufficient to sustain them through hibernation, all within a relatively short time. Similarity in timing of the jumping mouse's active season and peak growth of vegetation may be due to the necessity of obtaining suitable food during the short active season (Myers 1969; Cranford 1983). Morrison (1990) thought that the quality and type of vegetation in New Mexico meadow jumping mouse habitat might be related to food requirements. Specifically, Morrison (1990) thought that habitats dominated by grasses and forbs provided suitable food, but that those dominated by sedges and rushes did not.

Population size and density

Territories for jumping mice (*Zapus*) are generally thought to be two acres or less in size (Hubbard 1984). As discussed previously, home range for the New Mexico meadow jumping mouse is 0.63 acres and 0.45 acres for males and female respectively. Range length was measured at 308 feet and 245 feel for males and females respectively. In the Jemez Mountains, there appears to be a great deal of overlap in home ranges of both male and female mice, particularly near streams (Morrison 1987a). Overlap in home range has been noted by other researchers of meadow jumping mice, where populations were concentrated along the edge of water (Blair 1940). However, it is possible that only males have inclusive home ranges, and females are more territorial (Stinson 1977).

Numerous studies (Krebs 1966, Nichols and Conley 1982) have shown that populations of small rodents often violate the assumptions underlying mark/recapture models for estimating population size. Direct enumeration and the Modified Lincoln Index were used to estimate population size of the mouse during 1987 in an emergent wetland along the Rio Cebolla above Fenton Lake in the Jemez Mountains (Morrison 1987a). Mark/recapture study models used to estimate small rodent populations can dramatically over-estimate species that are trap-shy and therefore direct enumeration is a better determination of population size. Direct enumeration determined the population to consist of 50 subadults and adult New Mexico meadow jumping mice (34 males and 16 females), and 79 mice comprised the population entering hibernation (Morrison 1987a). Based on Morrison's data, the estimated density of mice at Fenton Lake was 6.6 mice/acre (Frey 2005a). At BANWR, studies in 1988 estimated densities of 16-20 mice/acre in suitable habitat (Morrison 1988b). These densities are greater than for other *Zapus* species. In general, *Zapus* species densities have been measured at 2-3 mice/acre with the greatest measured at 10 mice/acre (Smith 1999). In Colorado, population densities of the federally threatened Preble's meadow jumping mouse ranged from 0.45–1.62 mice/acre (Meaney et al. 2003).

Because of the New Mexico meadow jumping mouse's specialized habitat requirements and the limited size of suitable habitats, it is likely that populations of the mouse are

extremely localized and small (Morrison 1987b). Rather than large populations at a single site, it is more likely that pairs are distributed along the strips of suitable habitat (Morrison 1988b). In the Jemez and Sacramento Mountains, mouse abundance differed depending on the size of available habitats (Frey and Malaney 2008). The lowest relative abundances were found at three small, isolated localities, including Silver Springs Creek (0.13 mice per 100 trap nights) and Agua Chiquita Creek (0.28 mice per 100 trap nights) in the Sacramento Mountains, and San Antonio Creek (0.48 mice per 100 trap nights) in the Jemez Mountains. In contrast, abundance at four localities from relatively extensive areas of suitable habitat on the Rio Cebolla in the Jemez Mountains were > 1.00 mice per 100 trap nights.

Capture studies have to be assessed carefully when considering the presence/absence of the mouse and the size of a population, because these mice are trap-shy and differentially trapped by various trap types (Morrison 1987a). Incidental captures do not necessarily indicate the presence of a large population and intensive trapping must be conducted to conclude the presence/absence of the species. During surveys in the Jemez and Sacramento Mountains, it required an average of 121 trap nights to capture the New Mexico meadow jumping mouse at sites in which it was found, although at one site it required 400 trap nights to capture one mouse (Frey 2005a).

Demography and reproduction

Most female meadow jumping mice (*Zapus hudsonius)* breed soon after emerging from hibernation and produce a litter of young after a gestation period of about 18 days (Quimby 1951). The breeding season for the New Mexico meadow jumping mouse is from July to August in mountain populations, and May to early September in the southern Rio Grande (Morrison 1987a, 1988b). The mouse only breeds once per year in the northern part of the New Mexico and may produce two litters in the central Rio Grande Valley (Morrison 1988b). Litters average three to four young (NMDGF 1993). It appears that the birth of young coincides with the onset of peak seed production (Morrison 1987a).

Newborn meadow jumping mice are hairless and their eyes and ears are unopened (Hoffmeister 1986). Their ears open at one week, while it takes three weeks for their eyes to open. The young are completely furred at three weeks. *Id*.

Studies have shown a normal demographic structure for the New Mexico meadow jumping mouse in its montane habitat and along the Rio Grande Valley, with a sex ratio close to 0.50 (Morrison 1987a; Morrison 1988b; Morrison 1989).

Meadow jumping mice nests are made of grass and are generally placed in or under tall vegetation, which provides a protective structure (Smith 1999). Nests have also been found underground (Whitaker 1972).

Hibernation and active cycle

Meadow jumping mice usually hibernate under objects or in underground nests built of leaves and grass (Cranford 1978). Individuals put on excess fat before hibernating (Smith 1999). By spring nearly all excess fat has been used, with the animal losing about six grams of fat during hibernation, which can be anywhere from 20-50% of its body mass (Whitaker 1963). One factor that may cause jumping mice to come out of hibernation is the warming of the soil to approximately 8.5°C to 9°C (Brown 1967).

Unlike most mice, meadow jumping mice (*Zapus hudsonius*) spend a large amount of the year in hibernation. In the Jemez Mountains, adults hibernate from early September to early June, while juveniles enter hibernation about one month later (Morrison 1987a). Populations in the middle Rio Grande valley appear to have a longer active cycle than montane populations (Morrison 1988b). Data on the active cycle from populations in the middle Rio Grande valley (Isleta and Bosque del Apache National Wildlife Refuge) show that the mice are most active from May-October (Morrison 1988b; Najera 1994).

Males appear to emerge from and enter hibernation earlier than females (Morrison 1987a). Juveniles may be active longer than adults to build up fat reserves for hibernation. *Id.*

Mortality

The average life-span of an adult *Zapus* averages 1-2 years and the longest known life-span is three years (Hubbard 1984; Smith 1999). Most mice in the wild die in their first year; only about 9% of those that live past their first year make it to their third year (Smith 1999). Estimated over-winter survival rate for the Preble's meadow jumping mouse, measured in Colorado, is 54.1 ± 18.8%, summer survival rate is 16.2 ± 9.6%, with a combined annual survival rate of 8.8 ± 6.0% (Meaney et al. 2003). The period following emergence from hibernation is energetically stressful and survival probabilities may be low during this time. Survival rates following emergence, over-winter, and summer have not been measured for the New Mexico meadow jumping mouse (Morrison 1987a), but may be comparable to the Preble's meadow jumping mouse.

Because summer survival is low, high-quality hibernation habitat that results in high winter survival might be key to the persistence of populations (Meaney et al. 2003). High winter survival is likely related to quality of both pre-hibernation and hibernation habitat. Pre-hibernation fattening occurs 3 to 4 weeks prior to hibernation and insufficient fat deposition might be linked to high over-winter mortalities (Whitaker 1963). Adequate pre-hibernation fattening is likely a result of adequate high quality food sources, such as seeds (Cranford 1978). Little is known about hibernation habitat for the New Mexico meadow jumping mouse, but good cover with appropriate soil moisture (not saturated) is an important component for the Preble's, and likely the New Mexico jumping mouse as well (Meaney et al. 2003).

Habitat degradation and loss

The direct loss of habitat due to diversion of water for agriculture and other uses is a threat to the persistence of the New Mexico meadow jumping mouse, as it relies on specific habitat requirements, including perennial running water. Cattle grazing has the highest potential for impact on streamside riparian and wet meadow habitats (Morrison 1990), and remaining New Mexico meadow jumping mice are often found only in areas protected from grazing (Frey and Malaney 2008). Impacts caused by grazing include loss of cover, alteration of vegetative communities through selective removal of plant species, soil compaction, and general destruction from trampling (Allen 1989, Frey 2005a). Habitat degradation also occurs through recreational activities, forest fire and flooding, stream improvements projects, loss of beaver, and ditch cleaning/burning/mowing, all of which are concentrated in riparian habitats (Morrison 1990; Najera 1994). Drought and climate change impacts occurring in the Southwest has exacerbated the effects of these habitat-altering activities and present significant threats to this subspecies. These issues are further elaborated upon in the section entitled "Identified Threats to the Petitioned Species: Criteria for Listing."

Predation

Meadow jumping mice are likely preyed upon by representatives of all major vertebrate groups (Quimby 1951). These natural predators may include great horned owls, screech owls, red-tailed hawks, weasels, and foxes (Smith 1999).

Disease

There are no diseases currently known to be significantly affecting populations of the New Mexico meadow jumping mouse in New Mexico, Arizona, or Colorado. Meadow jumping mice may carry such parasites as fleas, larvae of ticks and possibly bot-flies (Quimby 1951).

HISTORIC AND CURRENT POPULATION STATUS & TRENDS

Extensive surveys of historical locations in New Mexico and Arizona for the New Mexico meadow jumping mouse have been conducted in recent years but the lack of historic population data and differences in study methods do not allow a comparison of the size of historic and current populations. Therefore population trends are not easily detected. From the section on historic and current geographic distribution above, the Petitioner has shown that a large decrease in the presence of meadow jumping mice in historic locations has occurred. Of 39 historical locations that have been recently surveyed, only 7 are known to still support mice – an overall reduction of 74% (see Table 1). This is a conservative measure because some historical localities not surveyed are believed to currently lack suitable habitat.

Only one historical survey determined a direct enumeration of a New Mexico meadow jumping mouse population. This was done at Fenton Lake within the Jemez Mountains. It was estimated that 79 individuals entered the hibernating population in 1986 (Morrison 1987a). Using Morrison's 1987 data, Frey (2005) determined that the post-hibernation population at Fenton Lake in 2005 consisted of 4.5 males/acres and 2.1 females/acre. Using these densities, Frey (2005) estimated the two known current populations in the Sacramento Mountains to consist of 90 males and 42 females (Silver Springs Creek = ~ 20 acres of riparian habitat) and 54 males and 25 females (Agua Chiquita Creek = ~ 12 acres of riparian habitat).

While capture rates may be low for the New Mexico meadow jumping mouse, the measurement can provide comparison of population status between sites and between years. It is important to note here that various researchers use different survey techniques, including different types of traps. These can skew capture rate results (Pers. comm. J. Frey 2007). For example, Morrison used snap traps during most of her surveys, which might have higher capture rates than live traps, which were used in more recent studies. Therefore, while comparisons of capture rates may be useful to determine population trends, it is also necessary to be cautious in their interpretation.

During 2005 and 2006 capture rates at localities where the mouse occurred averaged 0.84 captures/100 trap-nights and ranged from 0.13 – 1.45 captures/100 trap-nights (Frey and Malaney 2008). The lowest capture rates were found at three small, isolated localities, including Silver Springs Creek (0.13/100 trap-nights) and Agua Chiquita Creek (0.28/100 trap-nights) in the Sacramento Mountains, and San Antonio Creek (0.48/100 trap-nights) in the Jemez Mountains (Frey and Malaney 2008). In contrast, those from four localities on the Rio Cebolla in the Jemez Mountains were > 1.00/100 trap-nights. In the Sangre de Cristo Mountains capture rates were 1.7–7.6 captures/100 trap nights (Frey 2006c). One survey conducted at BANWR in 1997 determined the population density of the New Mexico meadow jumping mouse to be between 16–20 mice/acre but capture rates or captures per trap nights were not reported (Zwank et al. 1997). No studies have been recently conducted at BANWR to determine whether the presence and density of mice has changed.

Frey (2007a) determined that in locations where the New Mexico meadow jumping mouse was found in the Jemez Mountains, the abundance of the mouse relative to all other species captured averaged 1.12%. Morrison's 1985 data showed that the relative abundance in Virgin Canyon of the Guadalupe River, a specific site in the Jemez Mountains, averaged 0.91%, meaning that less than 1% of the small mammal species captured were New Mexico meadow jumping mice (Frey 2007a). In 2005, no mice were captured in this area, and habitat appeared unsuitable (Frey 2005a).

In Arizona capture rates were between 0.4 and 3.6 mice/100 trap-nights with an average of 1.98/100 trap-nights in 1991 surveys (Morrison 1991). Dodd (1987) had similar levels of trap success with 1.2-3.5 mice/100 trap nights. In the 1995 and 1996 capture studies, capture rates were lower with a range of 0.33-2.34 mice captured per 100 trap nights, averaging 0.98/100 trap nights (Kolozar and Ingraldi 1997).

LAND OWNERSHIP

Landownership for populations of the New Mexico meadow jumping mouse varies from U.S. Forest Service, U.S. Fish and Wildlife, State of New Mexico, State of Colorado, tribal, and private lands (Figure 11; Table 9). Known New Mexico populations all reside on U.S. Forest Service land (Santa Fe National Forest in the Jemez Mountains and Lincoln National Forest in the Sacramento Mountains), with the exception of Sugarite Canyon and Coyote Creek populations, which are located on New Mexico State land. In Arizona, historical mouse populations are found in a mixture of state, private, federal, and tribal lands. The Las Animas Co., Colorado population of New Mexico meadow jumping mice is located on state land. *Id.*

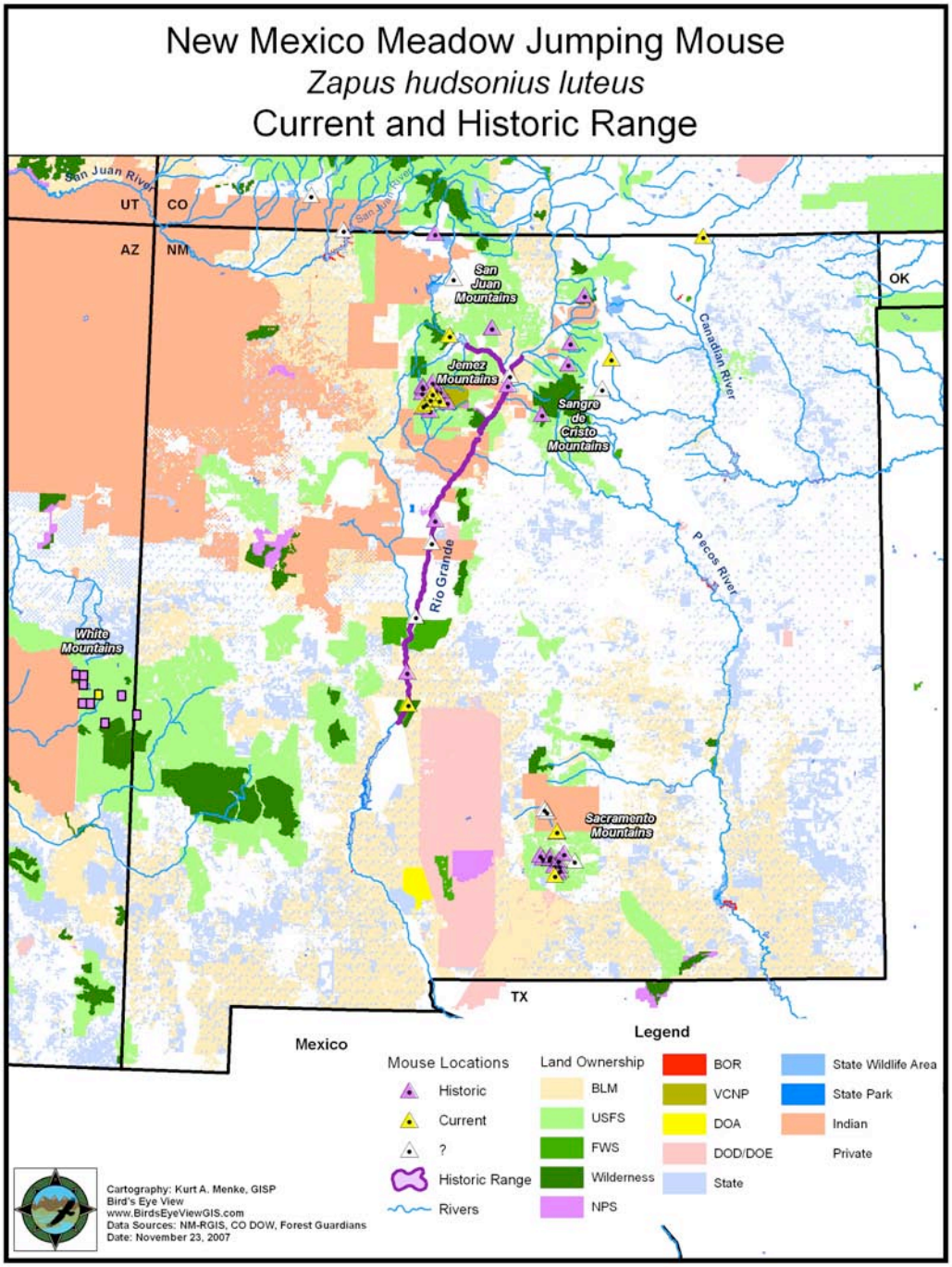

Figure 11: Land ownership of historic and known current capture locations for the New Mexico meadow jumping mouse (Frey 2005a, 2006a, 2006b, 2007c).

Table 9: Land ownership of historic and known current (indicated with asterisk) capture locations for the New Mexico meadow jumping mouse (Frey 2005a, 2006a, 2006b, 2007c).

Location	Landowner
Rio Grande Valley	
Espanola, Rio Arriba Co., NM	Ownership not known
San Juan Pueblo, Rio Arriba Co., NM	Tribal, San Juan Pueblo
Albuquerque	Exact collection location unknown
Isleta Pueblo, Bernalillo Co., NM	Tribal, Isleta Pueblo
Casa Colorado Wildlife Area, Valencia Co., NM	State of New Mexico
Socorro, Socorro Co., NM	Exact collection location unknown
*BANWR, Socorro Co., NM	U.S. Fish and Wildlife
San Juan Mts and Rio Chama Valley	
La Plata Co., CO	Exact collection location unknown
Archuleta Co., Co	Tribal, Southern Ute
Tierra Amarilla, Rio Arriba Co., NM	Specimen requires verification, Exact collection location unknown
El Rito, Rio Arriba Co., NM	USFS, Carson National Forest
Rio Chama Valley, Rio Arriba Co., NM	Private
Sangre de Cristo Mountains	
*Lake Dorothey State Wildlife Area, Las Animas Co., CO	State of Colorado
*Sugarite Canyon State Park, Colfax Co., NM	State of New Mexico
*Coyote Creek State Park, Mora Co., NM	State of New Mexico
Taos Ski Valley, Taos Co., NM	Private and USFS, Carson National Forest, specimen requires verification
Fort Burgwin, Taos Co., NM	Southern Methodist University, surrounded by USFS, Carson National Forest, Identification fairly certain
Duran Canyon, Taos Co., NM	USFS, Carson National Forest, specimen requires verification
Jemez Mts, New Mexico	
*Rio Cebolla, Sandoval Co., NM	USFS, Santa Fe National Forest and NMDGF, and private
*San Antonio Creek, Sandoval Co., NM	USFS, Santa Fe National Forest and Valles Caldera National Preserve (National Park Service)
Virgin Canyon (Guadalupe Creek), Sandoval Co., NM	USFS, Santa Fe National Forest
Rio de las Vacas, Sandoval Co., NM	USFS, Santa Fe National Forest
Sacramento Mts, New Mexico	
*Silver Springs Creek	USFS, Lincoln National Forest, Private and Tribal, Mescalero

Location	Landowner
James Canyon	Private, and possibly city of Cloudcroft
Rio Penasco	USFS, Lincoln National Forest
*Agua Chiquita Creek	USFS, Lincoln National Forest
***White Mts, Arizona**	Apache-Sitgreaves National Forest, Private, Tribal, and State of Arizona

IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING

The New Mexico meadow jumping mouse meets at least three criteria for listing under the ESA (criteria met are bolded):

1. **Present and threatened destruction, modification, and curtailment of habitat and range;**
2. Overutilization for commercial and recreational purposes;
3. Disease;
4. **The inadequacy of existing regulatory mechanisms; and**
5. **Other natural or manmade factors affecting its continued existence.**

The first and fourth factors – habitat loss and degradation and inadequate regulatory mechanisms – present the primary threats to the New Mexico meadow jumping mouse and are causing the species to face endangerment and extinction. The largest and most continual threats to this subspecies are habitat loss and degradation due to cattle grazing and diversion of water. Recent surveys have documented the profound decline in the distribution of the subspecies at historical localities. No regulatory mechanisms currently protect the New Mexico meadow jumping mouse's habitat, and no survey programs have been established to continue to monitor the population status of the species. In addition, other natural or manmade factors, including climate change, drought, and natural rarity, also threaten the petitioned subspecies.

I. Present and Threatened Destruction, Modification, or Curtailment of Habitat or Range

Habitat loss and fragmentation

Habitat loss is a significant cause of imperilment for 85% of the species listed under the ESA and is the single greatest threat to biodiversity in the United States (Wilcove et al. 1988). Likewise, habitat loss, degradation, and fragmentation of suitable habitat are the primary threats to the New Mexico meadow jumping mouse. The main factor in habitat loss for the New Mexico meadow jumping mouse is cattle grazing (Table 10). Depletion of riparian microhabitats due to diversion of water for agriculture and development has also caused the loss of suitable habitat. *Id*. Drought conditions in the southwest have exacerbated the dry conditions of already compromised New Mexico meadow jumping

mouse riparian habitat. Other activities, such as road and bridge construction, beaver removal, and recreation are additionally destructive to the New Mexico meadow jumping mouse's habitat and cumulatively lead to a need to list this species under the ESA. Fragmented habitat has been observed in the Jemez, Sacramento and Sangre de Cristo mountains and along the Rio Grande (Frey 2005a, 2005b, 2006b, 2006d).

Fragmentation of habitat increases the threat to populations of New Mexico meadow jumping mice. While the New Mexico meadow jumping mouse's riparian habitat is rare and naturally fragmented, recent surveys found current suitable habitat to be even more discontinuous than previous. *Id*. In many of the montane sites where the mouse was found, the species persists in very small areas of only a few acres and are widely separated from other occupied sites (Figures 2, 4, 5, 6, 7, 11, 12, 13). In the Sacramento Mountains the Silver Springs population of New Mexico meadow jumping mice inhabits 12 acres of suitable habitat, while the Agua Chiquita population inhabits 20 acres of suitable habitat (Frey 2005b). Habitat is fragmented due to cattle grazing and drying up of streambeds. The New Mexico meadow jumping mouse is known to travel distances averaging just over 100 feet and may only extend as far as 800 feet. This distance is not large enough for mice to move from degraded habitat to establish populations in distant suitable habitat. As the 2006 Biennial Review of Threatened and Endangered Species of New Mexico stated (NMDGF 2006: 120),

> The highly fragmented nature of the meadow jumping mouse's distribution in the state of New Mexico is a major contributor to the vulnerability of the species and increases the likelihood of very small isolated populations being extirpated. Even if suitable habitat exists (or is restored) in some locations, the likelihood of recolonization from other populations is extremely limited.

Table 10: Surveys for the New Mexico meadow mouse in the Jemez and Sacramento mountains, and threats to habitat health (Frey 2005a).

Location	Historical	Trapping occurred	Mice Captured	Habitat	Threats to habitat
Jemez Mts					
San Antonio Hot Springs	Yes	No	No	Unsuitable	Heavy human use; abundant signs of cattle; no riparian zone developed
San Antonio Campground	No	Yes	Yes	Suitable	
Virgin Canyon	Yes	Yes	No	Unsuitable	No riparian zone developed; area relatively dry; cattle signs observed
Cebollita Spring	No	Yes	No	Suitable	Exclosure small and considered too small to support an isolated population; cattle numerous outside of exclosure; no riparian vegetation or cover outside of exclosure
Upper Rio Cebolla	No	No	No	Unsuitable	No riparian developed; cattle present in valley
Upper Rio Cebolla	Yes	No	No	Unsuitable	No riparian developed; cattle present
Seven Springs	Yes	Yes	Yes	Suitable	
Fenton Lake	Yes	Yes	Yes	Suitable	
Lower Rio Cebolla exclosures	No	Yes	Yes	Suitable	
Lower Rio Cebolla	Yes	Yes	No	Unsuitable	Signs of cattle grazing; heavy human impacts which included large bare, compacted areas from camping, streamside trails, trash and human excrement
Rio de las	Yes (2	No	No	Unsuitable	River broad and shallow with little to no riparian zone; evidence of

Location	Historical	Trapping occurred	Mice Captured	Habitat	Threats to habitat
Vacas	sites)				previous livestock exclosure present, but fences down and abundant evidence of cattle grazing
Trail Creek	No	No	No	Unsuitable	Area grazed by cattle
Upper Rito Penas Negras	Yes (2 sites)	Yes	No	Unsuitable	Stream confined to a channel; soil not moist; riparian habitat not developed; area small, isolated and lack of vertical cover; sign of cattle grazing
Lower Rito Penas Negras	Yes	No	No	Unsuitable	Cattle ubiquitous; water present but no riparian vegetation present Stream was channelized and uplands suffered from erosion
Sacramento Mts					
Upper Silver Springs Creek	Yes	No	No	Unsuitable	No evidence of a flowing spring, but pond dug at location of spring; no riparian vegetation associated with pond; valley used for livestock grazing; no water present or riparian vegetation
Silver Springs exclosures	Yes	Yes	Yes	Suitable	
Lower Silver Springs Creek	Yes	No	No	Unsuitable	Livestock grazing; erosion; no water or riparian vegetation present most of reach
James Canyon Drainage	Yes	No	No	Unsuitable	Upper canyon occupied by a wastewater treatment facility; only water in canyon was in wastewater ponds; no wet soil or riparian vegetation in canyon; all springs had been developed and/or capped; no flowing ground water; large erosional gully
Upper Rio Penasco	No	Yes	No	Suitable	
Rio Penasco	No	Yes	No	Unsuitable	Upper area was a “walk-through” cattle pasture; cattle grazing present; no water or riparian vegetation along most reaches
Dark Canyon	Yes	No	No	Unsuitable	Springs at mouth of canyon had been developed; no wet soil or suitable herbaceous vegetation
Water Canyon	Yes	No	No	Unsuitable	No water or riparian vegetation

Location	Historical	Trapping occurred	Mice Captured	Habitat	Threats to habitat
Wills Canyon	Yes	No	No	Unsuitable	Intermittent flowing water; copious signs of cattle grazing; stream channel eroded; herbaceous riparian vegetation poorly developed or nonexistent
Agua Chiquita Creek upper exclosures	No	Yes	Yes	Suitable	
Agua Chiquita Creek	Yes	Yes	No	Unsuitable	Livestock grazing ubiquitous; most areas with no flowing water and no riparian vegetation
Hay Canyon	Yes	Yes	No	Unsuitable	Grazing ubiquitous; little to no riparian development;
Spring Canyon	Yes	Yes	No	Unsuitable	Dry eroded streambed; Abundant signs of cattle grazing; No development of riparian habitat; Further down canyon, stream present but cattle caused a degree of tramping of riparian vegetation
Potato Canyon	Yes	No	No	Unsuitable	Streambed was a dry erosion gully; no riparian vegetation present

Cattle grazing

Data from extensive historical and recent surveys indicate that cattle grazing causes habitat destruction and the resulting extirpation of isolated populations of New Mexico meadow jumping mice. Extant montane populations of the mouse in the Sangre de Cristo, Jemez, and Sacramento mountains are almost exclusively limited to areas that receive protection from livestock grazing (Frey 2006c). The only instance where the mouse was found in an area that was grazed was on the Lower Rio Cebolla in the Jemez Mountains (Frey 2007a). At this location, mice were captured in an extensive wetland created through beaver activity, which excluded cattle grazing due to the reluctance of cattle to enter mud. Beaver buffer the negative effects of grazing in riparian areas and can provide suitable habitat for the New Mexico meadow jumping mouse in areas where grazing is not intense. *Id*.

In 1987, Morrison cited cattle grazing as one of the greatest threats to persistence of the New Mexico meadow jumping mouse (Morrison 1987a). Morrison reiterated this point stating, "[g]razing probably has the highest potential for impact on streamside riparian and wet meadow habitats" and "grazing is the single activity that has the greatest potential for impacting the [New Mexico meadow jumping mouse]" (Morrison 1990: page 142; Morrison 1989a: page 27). In 2005, Frey concluded that the primary reason for the decline in distribution and abundance of the New Mexico meadow jumping mouse was loss of tall, dense herbaceous riparian vegetation and that absence of livestock grazing was the best predictor of the species presence (Frey 2005a). Figures 13 and 14 show that all known populations of New Mexico meadow jumping mice in the Jemez and Sacramento mountains reside in grazing allotments. Grazing pressure on sites in the White Mountains and Rio Grande is currently unknown.

A study in the changes of the Jemez Mountains landscape indicated that impacts caused by grazing included loss of vegetative cover, alteration of vegetative communities through selective removal of plant species, soil compaction, and general destruction from trampling (Allen 1989). In areas subject to heavy grazing these effects essentially destroy jumping mouse habitat (Morrison 1990). Most observations show that vegetation in New Mexico meadow jumping mouse habitat is extremely sensitive to cattle activity (Morrison 1987a; Frey 2005a). The impacts occur even with low numbers of cows. For example, at Fenton Lake in the Jemez Mountains, a few trespassing cows trampled the marsh area and severely trampled vegetation, damaging one of the few known areas inhabited by the New Mexico meadow jumping mouse (Morrison 1987a). Morrison (1987: page 40) concluded that, "even moderate grazing in a marshy area such as Fenton Lake could seriously affect populations of jumping mice."

The damage caused by cattle may also be swift. In an area where both cattle and mice were found, Morrison (1989: page 20) observed that the cattle had not been in the Sacramentos' Spring Canyon long, because "vegetation had not been excessively grazed nor was the soil too heavily trampled." However, Morrison (1989) observed that within 7 days of cattle grazing, the habitat at Spring Canyon had changed dramatically and was no longer was suitable for the New Mexico meadow jumping mouse. Seven days after her

first observations, the vegetative cover was considered to be only poor to fair and the soil was heavily trampled and compacted (Morrison 1989). In 1991, Morrison concluded that the White Mountains populations of the mouse may be declining as a result of riparian habitat degradation due to livestock grazing (as well as recreation) (Morrison 1991).

In 2005, Frey demonstrated the same relationship between the presence of New Mexico meadow jumping mice and exclusion of cattle (Frey 2005a). She showed that jumping mice prefer habitat unaltered by grazing activity, as they were significantly more likely to occur in a livestock exclosure rather than in habitat grazed by cattle (Frey and Malaney 2008). Frey determined that the presence of a functioning livestock exclosure was the best predictor of the presence of the New Mexico meadow jumping mouse. *Id.*

Presence of a livestock exclosure has numerous effects on riparian habitat and the small mammal community (Frey 2006b). Statistical analysis has shown that habitat within livestock exclosures had significantly higher soil moisture, vertical cover, stubble height, sedge/rush ground cover, litter ground cover and litter depth, but significantly less gravel ground cover and bare ground. In addition, while the capture rate of the New Mexico meadow jumping mouse was significantly higher within livestock exclosures, the capture rate of deer mice (*Peromyscus maniculatus*) and all murid rodents combined was significantly higher outside of the livestock exclosures. In the Sacramento Mountains, statistical analysis also showed that historic locations which no longer contained New Mexico meadow jumping mice had significantly less soil moisture, shorter vegetation height measurements, shorter stubble height, and less sedges/rush coverage. These locations also had significantly more bare ground and evidence of cattle grazing (Frey 2005b) (Figure 12).

Figure 12: Sacramento Mountains, Agua Chiquita. Picture shows well-developed riparian habitat in which the New Mexico meadow mouse was captured and on the other side of the fence unsuitable habitat, with cows present and an absence of riparian vegetation (Photo: Pers. Comm. Frey 2007).

In surveys conducted by Morrison in the Sacramento Mountains in the 1980s, only 1 of 12 sites where New Mexico meadow jumping mice were captured had signs of cattle grazing, and 42% of the sites where mice were captured were within fenced-off wildlife enclosures (Morrison 1989). In 2005, the two extant populations in the Sacramento Mountains were both found within livestock exclosure areas (Frey 2005a). All captures within the Jemez Mountains in 2005 were also in areas that received protection from grazing. *Id*. Data from the Sangre de Cristo Mountain range also indicate that the presence of cattle influenced and/or caused the extirpation of the New Mexico meadow jumping mouse in one of the two confirmed historical locations (Fort Burgwin/Tierra Azul wetland) (Frey 2006a). Before the Tierra Azul wetland came under U.S. Forest Service management it was heavily grazed. *Id*. The only two locations where the mouse was found in the Sangre de Cristo Mountains were in state parks, which do not allow livestock grazing.

At a historical location in the San Juan Mountains near the town of El Rito, surveys conducted in 2005 determined that the area did not contain suitable New Mexico meadow jumping mouse habitat (Frey 2005a). There were abundant signs of cattle grazing at this site and the riparian zone consisted of large trees, but there was little to no herbaceous ground cover. *Id*.

In Morrison's 1991 surveys for New Mexico meadow jumping mice on the Apache-Sitgreaves National Forest, Arizona, livestock were permitted in 17 of the 24 study sites, with no information available in another 6 sites, leaving only 1 known site without grazing. In 3 of the 17 grazed sites, grazing was heavy and cover was either fair to poor. In the 13 sites where grazing was moderate, cover was very good in only 3 areas, with cover considered good to fair in the other 10 sites. The New Mexico meadow jumping mouse was found at the single area that was not grazed, where the cover was considered very good (Morrison 1991). Three other sites where the mouse was found had moderate grazing but good to very good cover. Finally, the mouse was also found in one heavily grazed area that had fair cover. However, this site (Three Forks) was adjacent to a moderately grazed area with good cover that is known to have high densities of New Mexico meadow jumping mice (Pers. Comm. Underwood AZGFD 2007). Other surveys described habitat cover in simple terms and did not differentiate between grazed and ungrazed areas or compare cover (Kolozar and Ingraldi 1997). Grazing continues to be permitted on the Apache-Sitgreaves National Forest in areas considered to have suitable New Mexico meadow jumping mice habitat (USFS 2004a; USFS 2006). This is also true for the Santa Fe National Forest, Lincoln National Forest, and Carson National Forest in the Jemez, Sacramento, and Sangre de Cristo Mountains in New Mexico (Figures 13 and 14).

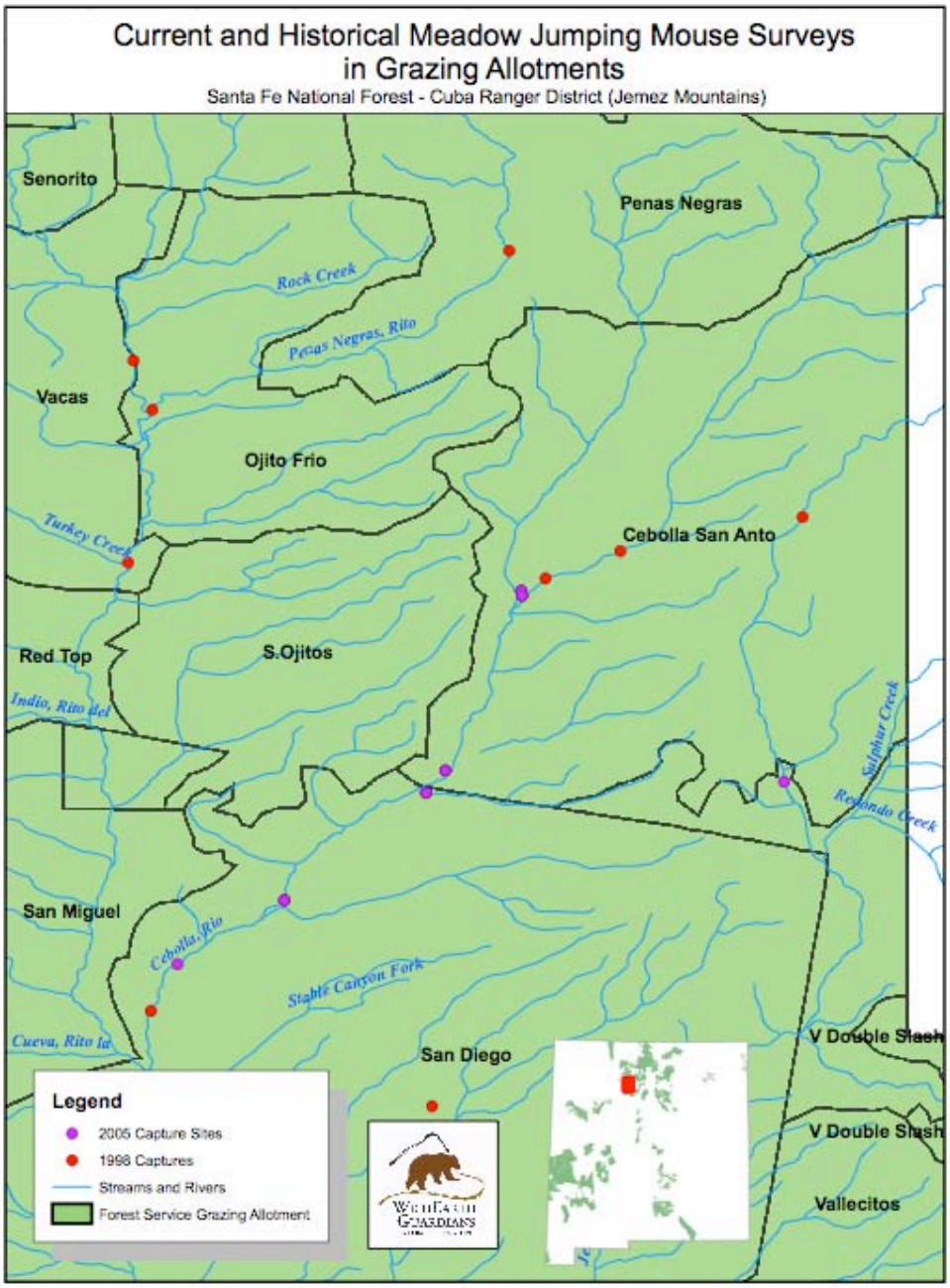

Figure 13: Current and historical distribution of the New Mexico meadow jumping mouse in the Jemez Mountains. Livestock allotments outlined in grey, allotment names in bold formatting. Data and population status from Frey (2005a, 2007). Allotment boundary data from U.S. Forest Service.

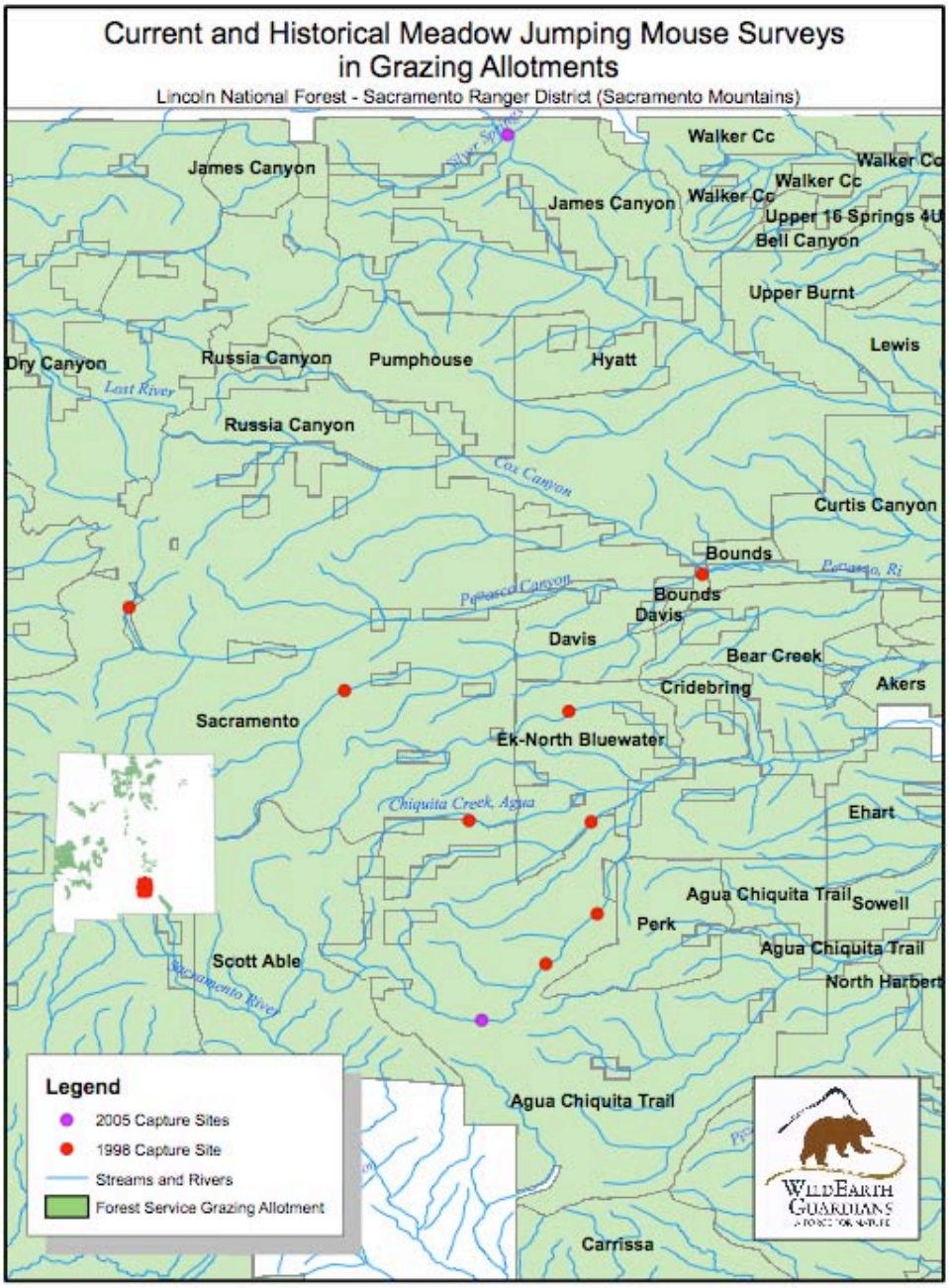

Figure 14: Current and historical distribution of the New Mexico meadow jumping mouse in the Sacramento Mountains (Frey 2005a) and livestock allotments. Livestock allotments are outlined in grey and indicated in bold formatting. Allotment boundary data from U.S. Forest Service.

Flooding and Fire

Flash floods in the southwest are a common event and can cause severe erosion along streams, rivers and arroyos. Flooding events in montane areas are exacerbated by the loss of vegetation due to forest fires (Martin 2000) and other factors such as logging and livestock grazing in riparian areas. High-level flooding events can erode drainages, cut existing alluvial fans, and widen main channels. Sedimentation accretion also occurs in these events and has produced deposits as thick as 3 m. *Id*.

In areas where the New Mexico meadow jumping mouse has been located, flooding has negatively impacted current and potential riparian habitat (Frey 2005a, 2006c, 2006h, 2006o, 2007e) (Figure 15). In three specific areas where mice were located, flooding and erosion has been exacerbated by previous forest fires and destroyed suitable habitat. Surveys at Fenton Lake, in the Jemez Mountains, by Morrison (1987) and Frey (2005), had relatively high capture success and the riparian habitat was well-developed (Morrison 1987a; Frey 2005a). In 2007, Frey observed that flooding had dramatically changed the riparian habitat at Fenton Lake and that the intensity of the flooding was greater due to a previous forest fire (Frey 2006h). The riparian sedge habitat, required by the New Mexico meadow jumping mouse, had been entirely destroyed and runoff had greatly increased soil accretion in areas of the valley bottom. *Id*. In the Sacramento Mountains, erosion due to flooding and fire events was observed in Potato Canyon and James Canyon, both of which contained extirpated mice populations (Frey 2005a; Frey 2006o; Frey 2007e). Potato Canyon was described as "a dry erosion gully" with no riparian vegetation (Frey 2005a) (Figure 15). In the Sangre de Cristo Mountains erosion and flooding was identified as having occurred in many potential New Mexico meadow jumping mouse locations (Frey 2006c).

Figure 15: Conditions in 2005 at a historical location at Potato Canyon, Sacramento Mountains; riparian habitat had been eliminated due to forest fire and erosion (Photo: Pers. Comm Frey 2007).

Ditch management

While the New Mexico meadow jumping mouse has been found to inhabit man-made habitats such as ditches, irrigation drains and canals, there are threats to the persistence of populations in these locations. In 1988, Morrison stated that ditch maintenance activities at BANWR were in direct conflict with the continued existence of populations of the jumping mouse on the Refuge (Morrison 1988b). Morrison discussed ditch maintenance practices and their effect on New Mexico meadow jumping mice:

> Dredging of ditches and clearing and burning of willow/grass/forb riparian vegetation alters habitat, as well as probably destroys nests. Such radical changes to habitat may seriously impact populations of a species with such specific habitat requirements as the New Mexico meadow jumping mouse. Indeed, jumping mice were found at BANWR along ditches where it appeared that no maintenance had been performed for a long time, while they were not found along other ditches which had recently been cleaned. Vegetation species that were growing along the edges of these cleaned ditches were different from those species found along ditches where the New Mexico meadow jumping mouse was present. It may take a long time for the combination of vegetative species and cover preferred by jumping mice to recur in these disturbed areas.
>
> It is also possible that these disturbed areas may be rapidly recolonized by more adaptable, aggressive small mammals, such as *Peromyscus* spp., *Mus musculus,* and *Sigmodon hispidus*, which may out compete *Z. h. luteus* for reentry into these areas. If habitat conditions suitable for meadow jumping mice are never reestablished, the species may never be able to recolonize these disturbed areas. Also, since jumping mice are not ubiquitous, as are other small mammals which have less habitat specificity, they may not be able to relocate to other sites, if preferred willow/grass/forb riparian habitat along ditches is lost. *Id*. at page 44.

Najera (1994) also showed that intensive mowing along canals, ditches and wetland impoundments caused a dramatic decrease in all species of mice captured. In two study areas no New Mexico meadow jumping mice were captured once mowing had occurred, while another study area had a single capture approximately two weeks after mowing had occurred. Other researchers have also demonstrated that mowing greatly reduced the use of an area by *Microtus* spp. and increased the density of *Peromyscus maniculatus* in tall grass prairie habitat (Lemen and Clausen 1984; Brennan 1985).

In 1987, Morrison noted that aggressive ditch management (earth movement, burning, mowing and cleaning of ditches) was occurring at BANWR and impacting jumping mice populations (Morrison 1987d). Despite having been informed of the harm that aggressive ditch management would cause the mouse and its habitat, BANWR continued its aggressive ditch management practices (Morrison 1988c). Leaving one side of a ditch or canal undisturbed may provide a refuge for the mouse. Maintenance of these structures should be conducted with forethought for the mouse and its habitat (Morrison 1990; Najera 1994).

Water diversion

Severe destruction of meadow jumping mouse habitat has occurred in the Rio Grande valley due to conversion of riparian habitat to agricultural fields (Hafner et al. 1981). Consequently, in 1983 the taxon was listed as threatened in New Mexico based on the probable decline in numbers and range as a result of negative human impacts on its habitat (NMDGF 1988).

Hink and Ohmart (1984) noted that meadow jumping mouse habitat was once widespread in the middle Rio Grande valley prior to the 1930s. They observed that the construction of irrigation drains had reduced and restricted the distribution of New Mexico meadow jumping mice habitat. Their primary study area was near Isleta Pueblo, and they concluded that the jumping mouse population associated with the Isleta marsh was a remnant population and that the species may not occur elsewhere in the area due to habitat degraded by water diversion (Hink and Ohmart 1984). Figure 16 and Table 11 demonstrate the downward trend in water discharge in the Rio Grande at Albuquerque, which was a historical meadow jumping mouse location and is located north of Isleta.

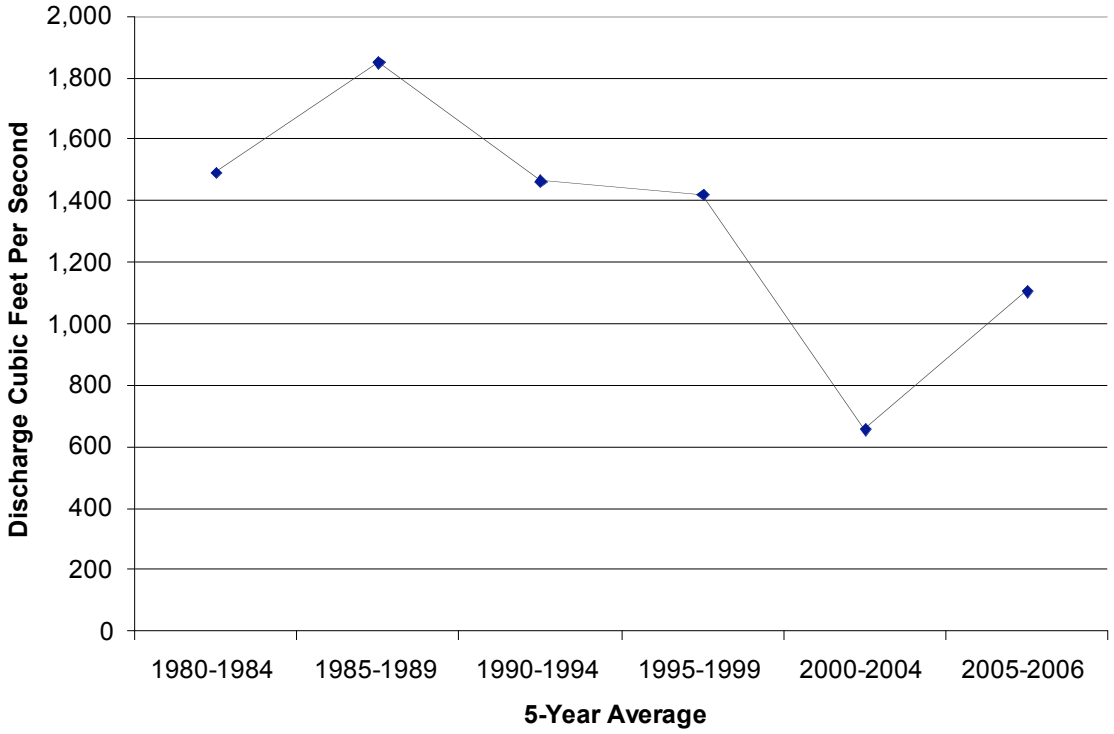

Figure 16: Discharge of Rio Grande in Albuquerque, Bernalillo County. Five year averages shown with exception of 2005-2006. Source: USGS Water Data.

In 1988, Morrison observed that riparian areas were dry in Espanola along the upper Rio Grande valley (Morrison 1988b). She concluded that wetlands had likely been drained due to ditch construction and agricultural cultivation. Morrison determined that these

areas were no longer suitable for meadow jumping mice because conditions of periodic flooding that result in the moist soils and diverse vegetation preferred by the species no longer existed. She also observed that in other developed areas around Espanola, the remaining riparian habitat was quite small, having been reduced in size by water diversion disturbance activities. *Id*. Figure 17 and Table 11 show the change in water flow from the 1980s-2006 along the Rio Grande near Espanola.

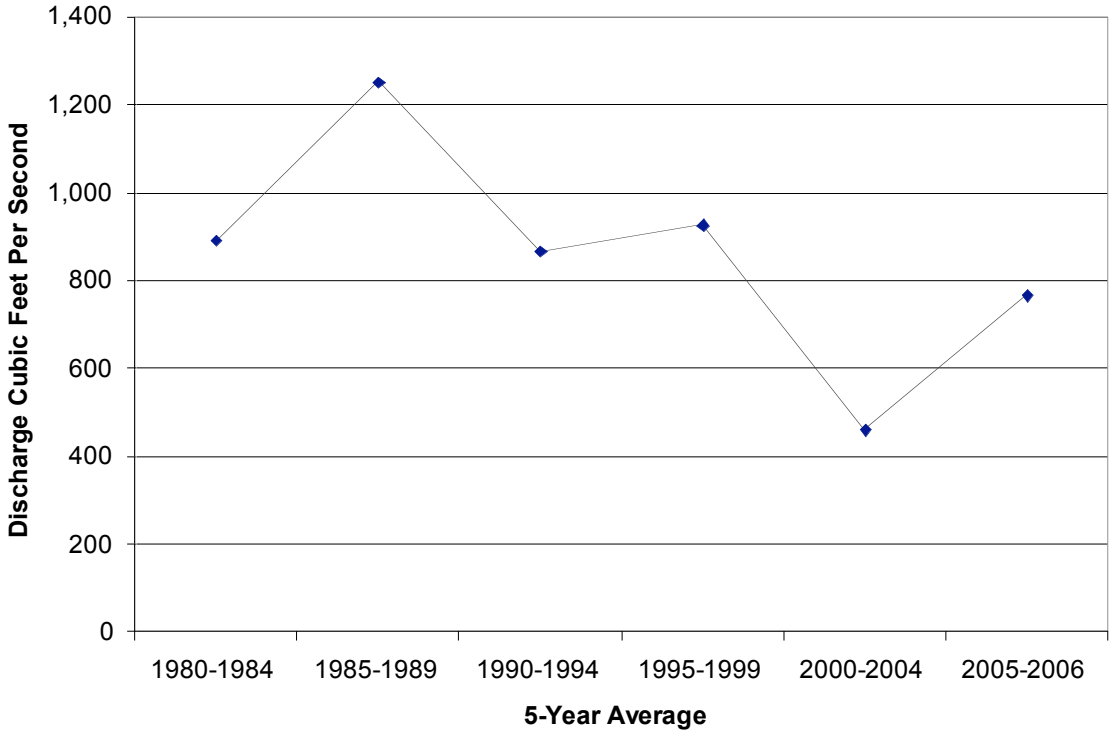

Figure 17: Discharge of Rio Grande 20 miles north of Espanola, Rio Arriba County. Five year averages shown with exception of 2005-2006. Source: USGS Water Data.

In 2005, Frey documented the elimination of one historic meadow jumping mouse population as a result of city infrastructure development southeast of Cloudcroft, New Mexico in the Sacramento Mountains (Frey 2005a). During her surveys, she noted that many springs had been capped, diverted, or otherwise developed, which reduced or eliminated stream flows. In some areas, such as along the lower Rio Peñasco, Frey observed that virtually all water was diverted for irrigation and had effectively eliminated natural riparian habitats.

In 2006, Frey reported that virtually all broad valleys in the Sangre de Cristo Mountains were under private ownership and were irrigated through complex systems of stream diversions, delivery channels, and return drains (Frey 2006b). Such changes in hydrology degrade or eliminate riparian habitat. Frey noted that so much water was diverted from the Rio Santa Barbara that the water was confined to the middle of the

rocky stream channel and did not reach the banks to create an herbaceous habitat zone. *Id*.

Average discharge between decades has continued to decrease along the Jemez River, which includes the watershed from which all historical and current locations of the mouse in the Jemez Mountains occur (Figure 18 and Table 11). In three areas where New Mexico meadow jumping mice are found the annual discharge of major rivers has decreased from the 1980s to 2006 (Figures 16-18). While data is not available for each drainage or stream along which the meadow jumping mouse is found, these data indicate that water and hence riparian habitat have decreased since the 1980s.

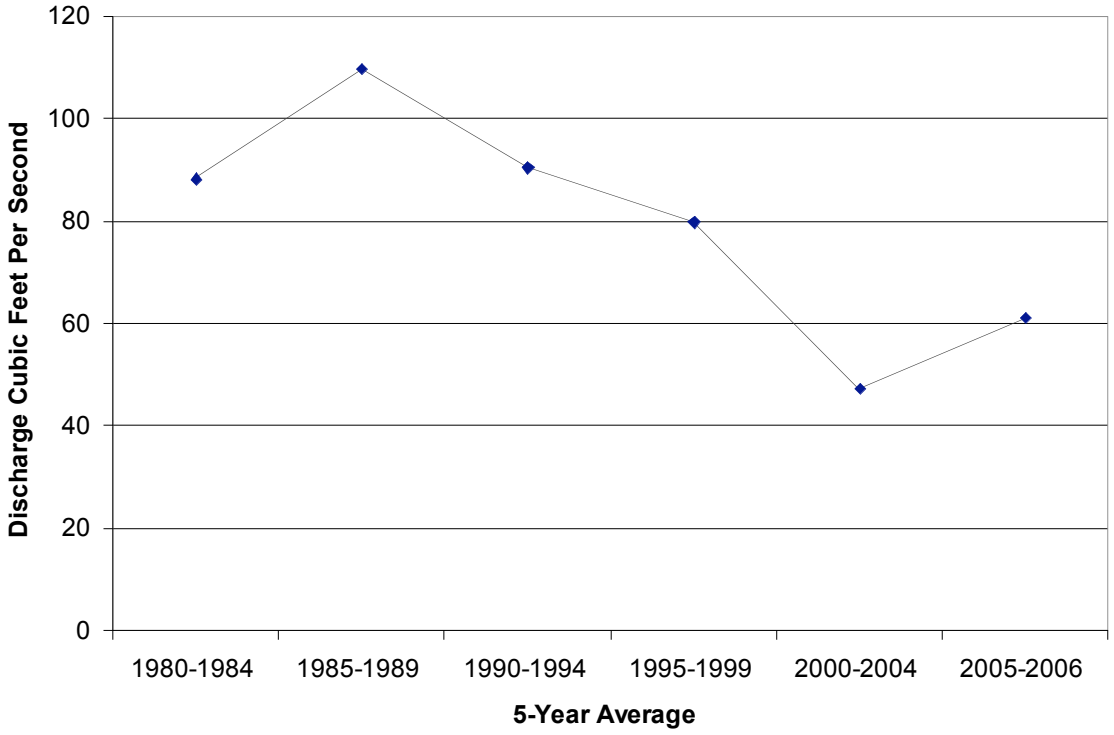

Figure 18: Discharge of Jemez River, Sandoval County. Five year averages shown with exception of 2005-2006. Source: USGS Water Data.

Table 11: Average discharge of major rivers within meadow jumping mouse habitat in New Mexico. Source: USGS at http://waterdata.usgs.gov/nwis/rt.

River	1980-1989 (ft^3/second)	1990-1999 (ft^3/second)	2000-2006 (ft^3/second)
Jemez River	99	85	51
Upper Rio Grande near Espanola	1,072	897	548
Middle Rio Grande in Albuquerque	1,673	1,444	786

Oil and gas drilling

Along Sugarite Canyon plans were recently proposed by TDC Engineering to drill five exploratory wells for coal-bed methane gas exploration (Moffatt 2007). This project posed several threats to the New Mexico meadow jumping mouse. Coal-bed methane gas extraction requires pumping large amounts of groundwater to the surface to release the natural gas held in the coal. This water is then either held in pits, re-injected into the ground or put in creeks (Keith et al. 2003). This process depletes the underground aquifer on which small streams rely as well as their associated riparian habitat. The pumped water also requires disposal. In certain instances the water is pumped into creeks/streams which poses a risk to the health and condition of riparian and wetland areas, because the water expelled from the gas extraction has high salinity and sodium levels. *Id*. These minerals decrease the health of natural riparian vegetation and increase the suitability for noxious species such as salt cedar, Russian olive and other halophilic plants, which tend to require great amounts of fresh water to survive, therefore decreasing surface water in riparian areas. *Id*. TDC Engineering also requested permission to create 4.5 miles of roads through Sugarite Canyon in New Mexico. Road-building in riparian habitat increases erosion, resulting in a decrease of water quality in the area and ultimately affecting the riparian zone on which the meadow jumping mouse is dependent. Due to a lawsuit brought by the city of Raton to protect their water supply and public outcry, the drilling proposal was withdrawn. However, the area may continue to be threatened by fossil fuel development because the Raton basin, of which Sugarite Canyon is a part, is considered a significant source for coal-bed methane extraction (Hoffman and Brister 2003).

Commercial and residential development

In Taos Ski Valley, where an historic jumping mouse location exists, recent surveys indicate that all areas that had potential for well developed riparian habitat were heavily developed with buildings or pavement (Frey 2006c).

As early as 1988, Morrison expressed concern for the continued existence of meadow jumping mice populations in the Espanola area, along the upper Rio Grande, particularly on private land (Morrison 1988b). Morrison remarked that it was

> …apparent that habitat suitable for meadow jumping mice may have once been present all along the Rio Grande valley, and in some areas along the Rio Chama valley; however, in developed areas, it often appeared that land disturbance had occurred right up to the edge of the cattail zone, resulting in the destruction of the intermediate zone of willows, grasses, and forbs which meadow jumping mice seem to prefer. *Id*. at page 46.

She also observed that the construction of levees and roads in conjunction with development of a shopping center had resulted in the filling in of marshes adjacent to the river, which left a vegetation zone comprised of bulrushes, sedges, cattails and stagnant water, not suitable for meadow jumping mice. *Id*. The city of Espanola straddles the Rio

Grande. Current census data indicates that the city of Espanola has approximately 10,000 people within 8.38 square miles with an approximate density of 1,155 people per square mile (U.S. Census Bureau 2000). This high population density within such a small area means that there is a great requirement for water, and the most accessible source is the Rio Grande, essentially decreasing water available for mouse habitat. Albuquerque is also a city which borders the Rio Grande and where historical populations of the meadow jumping mouse have likely been extirpated. Population density is even greater in Albuquerque, at 2,482 people per square mile. *Id.*

At one site in Espanola, Morrison (1988b) found a meadow that at one time had likely been larger but had been mowed, presumably for hay. Such activities undoubtedly have reduced the abundance of grasses and forbs preferred by the meadow jumping mouse. Morrison also questioned whether the remaining meadow areas were large enough to support populations of mice. *Id.*

Roads and bridge associated with increased recreation

A threat to the jumping mouse in the Jemez Mountains is the paving and rerouting of New Mexico Highway 126. This highway parallels the riparian zone through the core area of currently occupied jumping mouse habitat along the middle Rio Cebolla (including Fenton Lake) and along the upper Rio de las Vacas and its Clear Creek tributary. Frey (2005b) observed that based on the location of survey flags, a proposed bridge will cross the marsh in the area where the mouse is most common.

Elsewhere, the paved highway may cause increased runoff, increased recreation, and create additional effects detrimental to the jumping mouse. *Id*. Frey reported that flooding at Fenton Lake, which had destroyed riparian vegetation, had likely been exacerbated by runoff from Hwy 126. She expressed concerns that paving this road would contribute to future flooding at the park and other areas (Frey 2006h).

While the New Mexico Department of Game and Fish has worked at mitigating potential negative impacts of the bridge on the jumping mouse, potential effects of the bridge to the riparian habitat at Fenton Lake are unknown (Frey 2005b). Researchers have found that,

> Road construction [through wetlands] may result in significant loss of biodiversity at both local and regional scales due to restricted movement between populations, increased mortality, habitat fragmentation and edge effects, invasion by exotic species, or increased human access to wildlife habitats, all of which are expected to increase local extinction rates or decrease local recolonization rates. (Findlay and Bourdages 2000: page 86).

This bridge is part of an associated widening and paving project of New Mexico Highway 126. The project is being conducted by the Federal Highway Administration. The main rationales given for improving and realigning Hwy 126 are for recreational

purposes due to a perceived need to increase vehicle capacity because the U.S. Forest Service is constructing new camping and recreational facilities. Subsequent rationales include the need for safe travel with increased use and to increase the driving pleasure of the prospective recreationalists (FHWA 2001).

Recreational activities such as camping and fishing can negatively impact jumping mouse habitat (Morrison 1987a; Frey 2005b). In 2005, this occurred in the Jemez Mountains along the lower Rio Cebolla (Frey 2005a). Negative impacts to habitat primarily were the result of vehicles (including all-terrain vehicles and motorcycles) and camping. Off-road vehicles cause compaction, erosion, and destruction of vegetation. Popular camping areas were often located adjacent to streams, had heavily compacted soils, and were virtually barren of vegetation. *Id*. Along the lower Rio Cebolla much of the riparian habitat destruction appeared to be associated with trails created by people finding places to eliminate human excrement. These conditions were noted by Frey in areas where meadow jumping mice had been historically present. *Id*. In 2005 it was determined that suitable habitat was not present in this area to support meadow jumping mice due to human-caused degradation (Frey 2005b).

Likewise, in the White Mountains of Arizona, Morrison concluded that the New Mexico meadow jumping mouse may be declining not only as a result of riparian habitat degradation due to livestock grazing but also from recreation (Morrison 1991). Neither the New Mexico State Parks nor the U.S. Forest Service collect land use data in areas inhabited by the New Mexico meadow jumping mouse that are used for recreation (Pers. Comm. USFS, J. Wargo 2007, Pers. Comm. NMSP, S. Carey 2007). Therefore it is difficult to determine the amount of disturbance to jumping mouse habitat in these areas.

Interspecific competition

The New Mexico meadow jumping mouse may be naturally rare, in part due to competition with relatively aggressive and abundant voles, which directly compete for space (Boonstra and Hoyle 1986). Voles have been found in the same habitat as the meadow jumping mouse and in certain instances were twice as abundant as the meadow jumping mouse (Morrison 1988b). Other small mammal species caught during New Mexico meadow jumping mouse surveys include: *Sorex monticolus, Sorex neomexicanus, Sorex palustris, Spermophilus lateralis, Tamias spp., Perognathus flavescens*, *Neotoma cinerea, Neotoma mexicana, Peromyscus boylii, Peromyscus maniculatus, Peromyscus nasutus, Peromyscus truei, Reithrodontomys megalotis*, *Sigmodon hispidus*, *Sigmodon fulviventer*, *Neotoma albigula*, *Microtus longicaudus, Microtus mogollonensis*, *Microtus montanus, Microtus ochrogaster, Microtus pennsylvanicus, Zapus princeps, Mus musculus*, *Rattus* spp., and *Mustela erminea* (Morrison 1987a, 1989, 1991; Frey 2005a, 2006c). In a discussion about ditch maintenance and the removal of New Mexico meadow jumping mouse habitat, Morrison stated that,

> …it is also possible that these disturbed areas may be rapidly recolonized by more adaptable, aggressive small mammals such as *Peromyscus* spp.,

Mus musculus and *Sigmodon hispidus*, which may out compete the New Mexico meadow jumping mouse for reentry into these areas (Morrison 1988b: page 44).

II. Overutilization for commercial, recreational, scientific, or educational purposes

Specimens continue to be collected during inventory surveys. Frey (2005a) stated that collection of specimens and accession into public museums is a critical aspect of inventory work, although she recommended that no specimens be collected from the two remaining populations of the Sacramento Mountains until the populations have recovered.

III. Disease

No diseases are known to affect this species, although there has been documentation of parasitism by grey flesh flies in the related and geographically close Preble's meadow jumping mouse. In 1998, a Preble's meadow jumping mouse was found to be parasitized by five grey flesh flies (*Wohlfahrtia vigil*) (Schorr and Davies 2002). The mouse was discovered at the United States Air Force Academy in Colorado Springs, Colorado, which is approximately 130 miles from the closest documented location of *Z. h. luteus*. This is the first documented case of grey flesh fly parasitism of jumping mice (Family Dipodidae). While it is unknown whether the Colorado Springs population of Preble's jumping mouse has been affected or if it is present in the closely located meadow jumping mouse populations, grey flesh fly myiasis can be fatal.

IV. Inadequacy of Existing Regulatory Mechanisms

Nature Serve Rankings

NatureServe presents information that has been developed by biologists in state and provincial natural heritage programs and conservation data centers and by staff of The Nature Conservancy and NatureServe. These programs have relied on collaboration with and contributions of data from scientists at universities, conservation organizations, natural history museums, botanical gardens, and state and federal agencies (NatureServe 2007). FWS regards NatureServe as an authoritative source for conservation ranks for species in the U.S. See discussion in Rosmarino and Tutchton (2007).

The conservation status of a species or community is designated by a number from 1 (Critically imperiled) to 5 (Demonstrably widespread, abundant, and secure), preceded by a letter reflecting the appropriate geographic scale of the assessment (G = Global, N = National, and S = Subnational).

We hereby incorporate all analysis, references, and documentation provided by NatureServe in its on-line database at: http://www.natureserve.org/explorer into this

Petition by reference, including all data and analysis underlying its conservation status classification scheme.

Global Status: G5T2 – (last reviewed in 1998 and changed from T3 to T2)
G5 Secure, **Widespread and Abundant**
T2 Imperiled – Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
Infraspecific Taxon (trinomial)—The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined for global conservation status ranks. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1.

While the G5 rank demonstrates that the species *Zapus hudsonius* is secure, the New Mexico meadow jumping mouse subspecies is considered imperiled, at risk of endangerment. As discussed in Forest Guardian's petition to list G1 species under the ESA, category 1 is analogous to the ESA's definition of "endangered" or at a minimum "threatened" species, and the factors considered by NatureServe overlap with the ESA's factors required for listing (Rosmarino and Tutchton 2007). It is likely that any further loss of jumping mouse populations will cause the mouse to enter Category T1 as defined by NatureServe.

National Status: N2- (last date reviewed unknown)
Imperiled—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

New Mexico Heritage Program: S1 – (last reviewed 2005 and uplisted from S2)
Critically Imperiled - in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

Colorado State/Heritage Program listed: S1 – (Listed as an S1 since 1999)
Critically Imperiled - in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

Arizona Heritage Program: S2 – (last reviewed 2006, status unchanged). The meadow jumping mouse was placed on the state's list for heritage grants for the year 2007/2008 grant cycle (Pers. comm. AZDGF).

Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.

The global, national and subnational statuses assigned by NatureServe do not provide any regulatory or policy mechanisms to protect the New Mexico meadow jumping mouse.

International Union for the Conservation of Nature and Natural Resources (IUCN)

IUCN Red List Category: NT – (last reviewed in 2000)
Near Threatened - A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

This status does not provide any regulatory or policy mechanisms to protect the New Mexico meadow jumping mouse subspecies.

Federal Agency Rankings

USFWS: ESA Candidate Species[1]
Taxa that warrant listing under the ESA.
FWS classified it as Listing Priority Number 3, which is the highest possible priority for a subspecies.

This status requires that the species be considered in biological and environmental evaluations but does not require any protection or mitigation for populations or habitat.

USFS/BLM: Sensitive – (last date reviewed unknown)
Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by:
a. Significant current or predicted downward trends in population numbers or density.
b. Significant current or predicted downward trends in habitat capability that would reduce a species existing distribution.

The Forest Plan for the Santa Fe National Forest does not provide protections for the historical, current and potential locations for the mouse which occur in this forest (USFS

[1]The New Mexico meadow jumping mouse was a Category 2 candidate species in 1985 (50 FR 37967); a Category 1 candidate species with a declining trend as of 1991 (56 FR 58810); a Category 2 candidate species with a stable trend as of 1994 (59 FR 58989) but was removed from candidacy when the FWS removed all Category 2 species from the candidate list (61 FR 7596-7613). In December 2007, FWS again designated this subspecies as a candidate, warranting listing under the ESA (72 FR 69034, 69036).

1987). The Carson National Forest Plan does not mention the New Mexico meadow jumping mouse despite historical and potential locations for the mouse occuring in this forest (USFS 1986). The Lincoln and Apache-Sitgreaves National Forests are currently reviewing their plans which include the Sacramento Mountains (NM) and White Mountains (AZ), respectively. In Environmental Assessments for grazing allotment permit renewals the New Mexico meadow jumping mouse was considered. Notwithstanding its Federal designation as Sensitive and known harms from livestock grazing, the assessments concluded that the New Mexico meadow jumping mouse would not be harmed by continued grazing in historical and current suitable habitat (USFS 2003; USFS 2004b; USFS 2004c; USFS 2007).

State Rankings

> **New Mexico State:** Endangered – (last reviewed in 2006 and reclassified from threatened)
> Any species of fish or wildlife whose prospects of survival or recruitment within the state are in jeopardy due to any of the following factors: 1) the present or threatened destruction, modification or curtailment of its habitat; 2) overutilizaiton for scientific, commercial or sporting purposes; 3) the effect of disease or predation; 4) other natural or man-made factors affecting its prospects of survival or recruitment within the state; or 5) any combination of the foregoing factors.

This status does not provide any regulatory or policy mechanisms to protect the New Mexico meadow jumping mouse except for direct take and the requirement that permits be acquired for collection. State status as endangered also allows for a recovery plan. The state released a draft recovery plan in March 2008, and issued a revised draft recovery plan in April 2008 (NMDGF 2008). The recovery plan has not been finalized due to the intense pressure the state is receiving from economic interests not to protect the meadow jumping mouse. As a sign of the uphill battle this mouse faces from these interests, the Middle Rio Grande Conservancy District promptly sued the state in May 2008 over the draft mouse recovery plan, predicting a "devastating impact" on agriculture from mouse protection.[2] Listing at the state level does not provide regulatory protections for habitat, and therefore will not prevent the New Mexico meadow jumping mouse from becoming extinct due to the loss of habitat (its primary threat). While recognizing some important measures needed for mouse recovery, including beaver restoration and protection from livestock grazing, the draft state recovery plan relies on voluntary participation and is unenforceable (NMDGF 2008, WildEarth Guardians 2008).

In 2005 states submitted comprehensive wildlife conservation strategies to the FWS to maintain eligibility for State Wildlife Grants. New Mexico identified that key habitat conservation for its Species of Greatest Concern was an overriding conservation desire (NMDGF 2005). New Mexico has 452 Species of Greatest Concern and within past years has been granted approximately $1 million/year in national appropriations for

[2]Associated Press. 2008. Conservancy District Sues NM Game and Fish Over Rodents. Albuquerque Journal, May 21, 2008.

conservation. *Id*. This averages out to $2,242 per species per year, an amount too minimal to overcome the New Mexico meadow jumping mouse's dire condition. It also prescribes only cooperative efforts to conserve species. *Id*. The mouse clearly requires enforceable regulatory protections for its habitat.

> **Arizona State: Wildlife Species of Special Concern** (last reviewed in 2006, status unchanged). The meadow jumping mouse is identified as a high priority species by the Arizona State Comprehensive Wildlife Conservation Strategy (AGFD 2006).
> Species whose occurrence in Arizona is or may be in jeopardy, or with known or perceived threats or population declines, as described by the Arizona Game and Fish Department's listing of Wildlife of Special Concern in Arizona.

This status does not provide any regulatory or policy mechanisms to protect the New Mexico meadow jumping mouse.

Lack of management plans or regulations

Regulations, or the lack thereof, create unmitigated impacts to the New Mexico meadow jumping mouse and its habitat. These impacts include, but are not limited to, cattle grazing, ditch management, recreation, and road improvement projects. Some of these issues have been previously discussed in this Petition and are highlighted here in further detail in regards to regulation and management.

Since the 1980s and into 2007 researchers outlined what was required to manage and conserve the New Mexico meadow jumping mouse and its habitat (Morrison 1988c, 1990, 1991, 1992; Frey 2005a, 2006c, 2006k, 2006l; Frey et al. 2007d). These recommendations have not been implemented by the Federal government. The states in which the mouse is found do not have the authority to enforce key recommendations regarding habitat protection.

The status of the meadow jumping mouse in the Sacramento Mountains is the most dire. In Morrison's 1989 report on the meadow jumping mouse in the Sacramento Mountains she recommended complete fencing of sections of streams to protect mouse habitat while allowing cattle access to water (Morrison 1989). Two of the locations on Agua Chiquita Creek where Morrison captured the mouse in 1989 were in a fenced area that excluded cattle. In Frey's 2005 surveys she found that this fenced area was currently managed as a "riparian pasture" (Frey 2005a). Riparian pastures are "small pastures set aside to be managed to achieve a specific vegetative response" with the intended purpose to provide closer management and control of use of the pasture for cattle grazing (Baker et al. 2001). In 2005 there was essentially no riparian habitat in this pasture where Morrison had previously captured meadow jumping mice, and it was extirpated from both localities (Figure 19) (Frey 2005a). Frey was informed by a US Forest Service employee that a local rancher was illegally cutting fencing to allow his cattle access to forage (Frey 2005b). In 2007 Frey found that a section of fencing had been dismantled at one of the

remaining livestock exclosures on Agua Chiquita Creek where the species was known to persist as of 2005. This is particularly alarming because Morrison (1989) documented that even a short period of cattle grazing can drastically degrade mouse habitat.

Figure 19: Sacramento Mountains, Agua Chiquita. This is the uppermost location within a "riparian pasture" where Morrison captured meadow jumping mice in 1988. Photo is of conditions in 2005. Note presence of water but lack of riparian habitat due to cattle grazing (Photo: Dr. J. Frey 2007).

The lack of adequate and prompt efforts to recover or protect this subspecies contributes to the need to list this mouse. After completion of surveys in the Sacramento Mountains Frey (2005a: page 64) stated that **"***Z. h. luteus* [New Mexico meadow jumping mouse] in the Sacramento Mountains is nearing extinction and immediate action is needed to recover these populations." Dr. Frey listed four actions of priority that were required to recover this species in the Sacramento Mountains:

1) maintain existing livestock exclosures and prevent habitat disturbance
2) expand the size of each population as rapidly as possible by establishing additional livestock exclosures within each drainage
3) create additional refugial habitat areas
4) restore riparian habitat throughout the Rio Penasco watershed *Id*.

Frey (2005a) specifically addressed grazing and made recommendations to alleviate grazing impacts on the New Mexico meadow jumping mouse. These recommendations included:

1) development of alternate water sources (other than riparian zones)

2) creation of stable access to water to concentrate the impact of livestock in small areas of impact
3) improve upland forage with mineral and salt supplements
4) install drift fences to deflect livestock from riparian areas
5) use riparian pasture for small time periods
6) avoid grazing in mouse habitat from early June to mid October

Frey (2005a) specifically mentions that along the Agua Chiquita additional livestock exclosures should be established above and below existing exclosures to allow riparian vegetation to reestablish. The 2004 environmental assessment (EA) for the Agua Chiquita grazing allotment has not been revised in regards to Frey's recommendations nor as a result of the data provided by Frey which shows that the Agua Chiquita contains one of only two known populations of New Mexico meadow jumping mouse in the Sacramento Mountains (Frey 2005a) (USFS 2004b). Frey (2005a) reports that the New Mexico Department of Game and Fish recommended in 2005 that grazing should be discontinued in riparian areas that are used for nesting or foraging by threatened and endangered species. Frey therefore maintained that livestock grazing at any of the sites where the New Mexico meadow jumping mouse was found (Agua Chiquita and Silver Springs) should be terminated, and these areas should be maintained as refugia. Not only have federal agencies not followed recommendations from the foremost expert on this taxon, they have also ignored recommendations by the State of New Mexico.

In addition, the 2004 EA for Agua Chiquita stated that 40% grazing pressure in riparian areas would not affect mouse habitat. This statement is contrary to evidence provided by Morrison (1989) which demonstrated that even slight amounts of grazing drastically impacts mouse habitat. Frey (2006c) demonstrated that the New Mexico meadow jumping mouse is found in habitat in which stubble height averages 33 inches (Table 8). In contrast, grazing pressure of 40% leaves a stubble height of only 3-5 inches as measured at the ended of the grazing season (USFS 1998).

There are no studies that demonstrate what levels of grazing pressure the New Mexico meadow jumping mouse can withstand. Therefore the statement that "suitable jumping mouse habitat, where present in the allotment, would be maintained" is unfounded (USFS 2004b). The EA for this grazing allotment also indicates that rather than establishing new riparian exclosures, exclosures would be removed. *Id*. Grazing was scheduled to occur in the allotment from May – October, during the entire active season of the New Mexico meadow jumping mouse. Specifically along Agua Chiquita creek, grazing is allowed during the end of the grazing season, a time when the mouse most relies on well developed riparian habitat for food as required for its long hibernation period.

The 2004 EA for the Dry Canyon and Davis grazing allotments was written when mice were still believed to be present in these areas, although current surveys have been unable to locate mice on these allotments. Suitable habitat was not afforded protections in these grazing plans nor were efforts made to create additional suitable habitat. The permit renewal maintained grazing pressures at 40% in riparian areas (USFS 2004c), which will result in vegetation heights far too deficient to sustain the jumping mouse. Current

monitoring data in these allotments shows that of the little data collected by the USFS, utilization thresholds have been exceeded on many occasions.

The EK/North Bluewater and Bounds allotments permit renewal scoping notices were issued on 8/2/07 and 4/24/07, respectively. Both of these allotments previously had mice, but populations are likely extirpated. The proposed action for the EK/North Bluewater allotment was to combine it with Dog Canyon and issue a term grazing permit for 3300 AUMs. Grazing is scheduled to be year-round in these allotments. The scoping notice for the Bounds allotment states that the 5 acres of riparian habitat (at an historical location for the New Mexico meadow jumping mouse) has been maintained under the current management and the "intensity of impacts of livestock grazing on this area is minimal" (USFS 2007). In 2005, Frey (2005a) described this same area (the Rio Peñasco at Cox Canyon) as having no living riparian vegetation and reported evidence of ubiquitous cattle grazing. The scoping notice for the Bounds allotment states that under the 2005 Consolidated Appropriations Act an environmental analysis will not be conducted as there are no "extraordinary circumstances regarding federally listed plant or animal species." *Id*. This statement is indicative of the immediate need to list the New Mexico meadow jumping mouse under the ESA, because the USFS does not regard the mouse's Federal status as Sensitive or its State status as endangered, to require additional protective measures. It is also clear that the USFS does not recognize the necessity of well-developed riparian habitat in order to preserve the New Mexico meadow jumping mouse. In addition, the mouse has since been designated a candidate for ESA listing. 72 Fed. Reg. 69034, 69036.

In the Santa Fe National Forest, which includes the Jemez Mountains, the Forest Plan describes Management Area C as areas that contain most of the Forest's large rivers and associated riparian ecosystems (USFS 1987). The management emphasis in this area is the "enhancement of visual quality and developed recreation opportunities while protecting essential wildlife habitat and riparian zones." *Id* at page 106. The Plan continues to state that, "grazing and timber activities occur where consistent with the primary emphasis of this area." *Id* at page 106.

In the Cebolla and San Antonio grazing allotments within the Jemez Mountains, an EA has not been completed since 1998. In the previous EA for these allotments, the New Mexico meadow jumping mouse is listed as a Sensitive Species, but the EA does not include a discussion about the impacts of grazing on this subspecies (USFS 1998). A total of 347 cattle are grazed in these allotments from June to September, the entire active season of the mouse. The EA calls for monitoring in key areas to ensure light grazing intensity, resulting in a mere 1-4 inch stubble height remaining after grazing on Kentucky bluegrass and mountain muhly and 5-7 stubble height on Arizona fescue and timber oatgrass. If this "light" grazing intensity is the same in riparian areas, the New Mexico meadow jumping mouse will not remain, as mice are found in riparian habitat averaging 33 inches stubble height (Frey 2006c).

The EA for these allotments also states that within the allotments' riparian areas, some livestock grazing occurs during unscheduled use periods, which may reduce the rate of

riparian vegetation recovery. Under the proposed action (approved in 1998) riparian areas will be grazed with "emphasis on strict control of the timing, duration and intensity of grazing within the Cebolla and San Antonio riparian pastures" (USFS 1998). While the statements of this EA appears to protect New Mexico meadow jumping mouse habitat, recent surveys have shown that the only mice present in these allotments are within livestock exclosures or where beaver wetlands are present (Frey 2005a, 2007a).

The EA for the Ojito Frio, Vacas and Penas Negras grazing allotments in the Jemez Mountains was completed in 2003 (USFS 2003). One-third of historical localities of the New Mexico meadow jumping mouse in the Jemez Mountains occurred in the Rio de Las Vacas drainage, which is contained in these allotments. The Environmental Assessment stated that current surveys had not been completed for the mouse, but that it likely occurred in the area. *Id*. A total of 303 cattle were authorized for Penas Negras, 181 for Ojito Frio, and 216 for Vacas. The utilization threshold was 31- 40%, resulting in 4-5 inch stubble heights at the end of the season. *Id*. The EA stated that, "combined with the exclusion of cattle from 48% of stream zone and limited access to 10-45 days in remaining stream zones would provide adequate forage and cover for this species [New Mexico meadow jumping mouse]" (USFS 2003: page 29). However, evidence indicates that this amount and extent of cattle grazing reduces mice habitat. In 2005, surveys of the Rio de las Vacas drainage indicated that riparian habitat was mediocre to poor throughout the drainage and no suitable habitat for the mouse was present (Frey 2005a). In the lower portion of the Rito Penas Negras cattle were found to be ubiquitous and riparian vegetation was absent. *Id.*

In the Sangre de Cristo Mountains, Frey (2006c) recommends that additional livestock exclosures be established on lands managed by the Carson and Santa Fe National Forests. She states that cattle should be permanently eliminated from the Tierra Azul, which is a portion of the Rio Pueblo de Taos that currently has a well-developed wetland. *Id.* She also recommended that land management should focus on increasing the distribution and quality of emergent wetlands. *Id.* It appears that neither recommendation has been implemented.

Development and city infrastructure (municipal water use and agriculture), road and bridge construction, diversion of springs and surface water, and recreation through off-road vehicle use and camping are additional threats to the persistence of the New Mexico meadow jumping mouse. Neither New Mexico State Parks nor the Santa Fe National Forest maintain data on recreation use in areas in which the New Mexico meadow jumping mouse has been located (Pers. Comm. J. Wargo, USFS 2007, Pers. Comm. S. Cary, NM State Parks, 2007). Maintenance activities such as ditch cleaning and mowing can destroy New Mexico meadow jumping mouse habitat ((Morrison 1988b; Frey 2006k). In addition, beaver removal has negatively impacted the New Mexico meadow jumping mouse, and Frey (2006k) recommends increases beaver presence in potential mouse habitat.

Presently no management plans have been finalized nor have consistent population and habitat monitoring programs been initiated for the mouse in New Mexico, Arizona or

Colorado. This is despite the repeated recommendations by Frey that such monitoring should occur (Frey 2005a, 2006c, 2006k, 2006l, 2007a; Frey et al. 2007d). As we have demonstrated, due to the lack of policies and regulations, no protection exists for individual populations of New Mexico meadow jumping mice or its habitat. While the State of New Mexico has uplisted the species to endangered and the New Mexico Wildlife Conservation Act of 1974 declares that native wildlife found to be threatened or endangered should be managed to maintain and, to the extent possible, enhance their numbers, no such action has taken place, and there are no enforceable prohibitions against habitat degradation when it affects a State endangered species.

In 1992, Morrison concluded that the New Mexico meadow jumping mouse inhabited man-made habitats such as irrigation drains and canals. With this evidence it was determined that the species was not as sensitive to disturbed habitats as originally believed (Morrison 1992). This opinion was used as reasoning by the FWS to reclassify the mouse from its ESA candidate list from a Category 1 species to a Category 2 species in 1995 (Sayers 1995). The taxon was then removed from the candidate list altogether when the Category 2 list was dropped, although data at that time did not show that known populations were unthreatened. The population status of the New Mexico meadow jumping mouse was not assessed for another ten years when Frey resurveyed populations in the Jemez, Sacramento, and Sangre de Cristo Mountains and assessed areas along the Rio Grande Valley. These surveys show that the mouse has not persisted in its natural habitat, and no new populations were found in disturbed habitats.

Historically, Morrison made management recommendations that would protect and conserve the New Mexico meadow jumping mouse. Those recommendations were not followed. Subsequently, Frey made very strong and concrete recommendations on management activities that would prevent the New Mexico meadow jumping mouse from becoming endangered. Yet, no action has been taken to initiate these steps such as the creation of refugia by exclusion of livestock, restoration of extirpated populations, or commencing long-term monitoring plans (Frey 2007d). Clearly, inadequacy of regulatory mechanisms is threatening the mouse.

V. Other Natural or Man-made Factors Affecting the Meadow Jumping Mouse's Continued Existence

Life history

The meadow jumping mouse is naturally rare. Organisms such as the New Mexico meadow jumping mouse that have low intrinsic rates of population growth due to low reproduction and long generation times (for a rodent species), are at higher risk of extinction because they recover more slowly from reductions in population size (Beissinger 2000; Frey 2006c). They also remain threatened longer due to demographic and genetic stochasticity. *Id.* Most k-selected species such as the meadow jumping mouse have populations that live near the carrying capacity of their environment. As such, unless suitable habitat is increased, meadow jumping mice populations will not increase (Frey 2006c).

Factors that reduce availability of seeds may have a negative effect on the species. Meadow jumping mice hibernate for about nine months each year, one of the longest and most profound hibernations in any animal. They must obtain sufficient nutrition during the growing season in order to accumulate fat reserves required to survive the long period of hibernation. Individuals that enter hibernation with a low body mass do not survive. As many as 67% of individuals in a population may die over winter (Whitaker 1972). Thus, habitat quality is important for population persistence. Although *Z. hudsonius* has been reported to eat many kinds of fungi, plants and invertebrates, its basic food is grass seeds (Whitaker 1972). As a consequence of its short activity period, the New Mexico meadow jumping mouse is only able to produce a single litter each year in its montane habitat, although it may produce two litters in the middle Rio Grande portion of its range (Morrison 1987a; Morrison 1988b). In effect the meadow jumping mouse has a k-selected life history which puts the species at a relatively greater risk for extinction when its habitat is degraded or lost (Kirkland and Kirkland 1979; Frey 2006c).

Drought and Climate Change

During the past 45 years the Southwest has been drier and had more droughts than any other region in the United States (NSC 2000). The Environmental Protection Agency estimates average temperature in New Mexico could rise about 4 degrees Fahrenheit by 2100 (EPA 1998). Overwhelming pressures for water resources are already causing the destruction of narrow riparian areas along the streams and rivers of New Mexico. However, the Intergovernmental Panel on Climate Change determined that changes in climate and land use will place additional pressures on already-stressed riparian ecosystems (Fischlin et al. 2007). Researchers state, "[c]limate change will constrain North America's over-allocated water resources, increasing competition among agricultural, municipal, industrial and ecological uses" (Field et al. 2007: page 619). There has been wide confirmation of synergistic impacts from land-uses and climate changes on endemic species (Fischlin et al. 2007). See also IPCC 2008.

In wetlands in arid regions such as the Southwest, changes in precipitation regimes may cause biodiversity loss. In western mountains, warming is expected to result in reduced snowpack and earlier melting of snowpack by the middle of the 21st century. As a consequence, spring and winter flooding will increase, while summer flows will decrease substantially (Field et al. 2007). Winter and spring flooding could kill hibernating New Mexico meadow jumping mice and destroy habitat needed by mice when they emerge from hibernation. Decreased summer stream flows will reduce distribution and quality of riparian habitats used during their brief, but critical activity season.

Many species respond to warming by shifting their ranges to the north or to higher elevations (Field et al. 2007). However, this adaptation is not possible for all species. For some species, human development and other habitat changes have cut off natural migration routes, while others will become extinct if they cannot move to suitable habitat (NSC 2000). This would likely be the case for the New Mexico meadow jumping mouse, which now exists in habitat that has been increasingly fragmented due to habitat

degradation. Because the mouse is a habitat specialist relying on linear riparian corridors restricted to a narrow range, it will be challenging for the species to adapt to climate change. The New Mexico meadow jumping mouse is an Ice Age relict that is only found in cool, moist riparian corridors. Global warming can only make the mouse's current range more unsuitable as temperatures increase and conditions shift further away from those of the region's Ice Age past.

In the mid-to-late 1980s New Mexico was in a period of high moisture (Figure 20) (Frey 2005a). This was the time when Morrison was conducting her studies in the Rio Grande Valley, Jemez Mountains, and Sacramento Mountains (Morrison 1985, 1988b, 1989). In contrast, later studies conducted by Frey were at a time when the southwest had been experiencing moderate to extreme drought conditions for at least five years (Figure 20) (Frey 2005a). Frey reports on the influence of drought on the jumping mouse,

> In riparian associated jumping mice, patterns of dispersal and gene flow are largely determined by habitat connectivity with most movements via riparian corridors (Vignieri 2005). Thus, during wet periods that provide longer, more continuous stretches of suitable riparian habitat, the New Mexico meadow jumping mouse may have the potential to expand its distribution. However, during drought periods population [sic] could disappear along with shrinking habitat and become more isolated. Some areas of suitable habitat that persist may become so small and isolated that stochastic forces can result in extirpation of local populations. Such could be the case at the Upper Rio Peñasco [Sacramento Mountains]. Further, it is likely that drought effects on riparian vegetation are more extreme since the onset of intensive human land use, including fire suppression, irrigation, livestock grazing and development. Undoubtedly, there are synergistic effects between the influence of climate and grazing on the distribution and quality of riparian habitat. Thus, grazing should be more carefully controlled during drought periods. Given projected climate warming, it is expected that drought will become an increasing problem for the New Mexico meadow jumping mouse. *Id.* at p. 62.

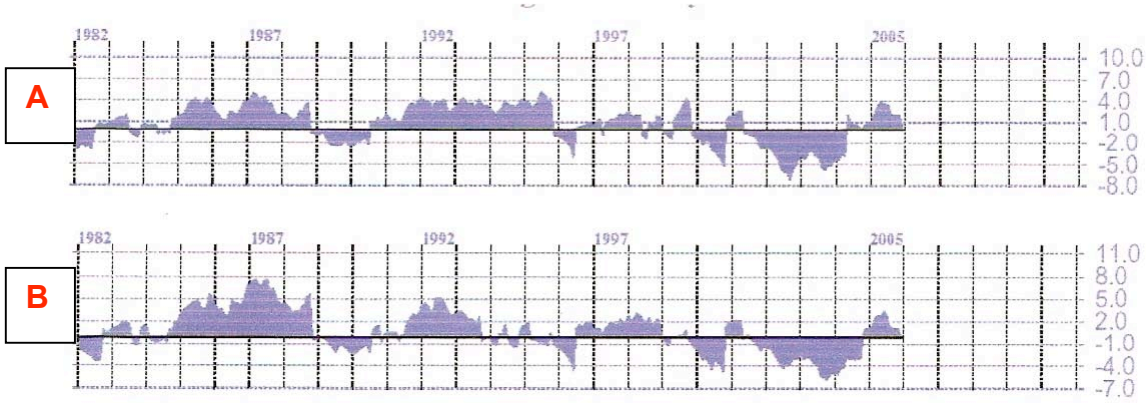

Figure 20: Monthly Palmer Drought Severity Index for A) region 2 which includes the Sangre de Cristo, San Juan, and Jemez Mountains, and B) region 6 which includes the Sacramento Mountains. An index of 0 = normal precipitation, -2 = moderate drought, -3 = severe drought, and -4 = extreme drought. Data are from the National Climate Data Center and graph excerpted from Frey (2005a).

An April 2008 report by The Nature Conservancy and Wildlife Conservation Society on climate change effects in New Mexico found that the Jemez Mountains is one of the state's areas to have experienced the greatest warming since 1991. In fact this area had the highest climate exposure ranking of any area statewide. The Sacramento Mountains also were in the highest climate exposure category. The report further found that most montane grasslands experienced warmer and drier conditions and cited the New Mexico meadow jumping mouse as a drought-sensitive species (Enquist & Gory 2008). This report therefore adds to the evidence of climate change being a factor that is imperiling the New Mexico meadow jumping mouse.

Beaver removal

New Mexico meadow jumping mouse habitat benefits from beaver activities, and the mouse is harmed by beaver removal. As Frey (2006b: page 56) states, "[t]he reduction in distribution and abundance of beaver in New Mexico has likely had a profound negative effect on *Z. h. luteus* [New Mexico meadow jumping mouse]." Beaver dams create complex wetland habitats, which provide specific habitat characteristics required by the meadow jumping mouse. *Id.* Herbaceous wetland communities experience the most dramatic declines due to loss of beaver. *Id.* By 1900 beaver were almost eliminated from New Mexico due to trapping, and it is likely that the loss of beaver dams in conjunction with livestock grazing, logging, and other land uses caused significant changes in the hydrology of many New Mexico streams (Huey 1956; Frey 2006b). Besides removal of beaver from streams there is also a perception that beaver have negative impacts on irrigation systems (Frey 2005a). Consequently, beaver are often persecuted by land managers and are thus rare or absent from these stream systems, reducing potential meadow jumping mouse habitat.

The presence of beaver-created wetlands often coincides with the presence of the meadow jumping mouse (Frey 2006c; Frey 2006k). In addition, beaver wetlands may provide protection from recreational activities. *Id*. The mouse was found at Coyote Creek State Park in the Sangre de Cristo Mountains, which is extensively used by humans for recreation. Although riparian habitat was degraded by human activity along accessible portions of the stream near a road, the mouse was found in a large wetland area created by beaver. Frey (2006b) noted that it was very difficult to move through the habitat due to the thick willows, small ponds, channels filled with water, and deep mud. She stated that "beaver created a situation that allowed for the coexistence of the New Mexico meadow jumping mouse and human recreation," and "beaver did this through creation of a complex network of microhabitats ideally suited for *Z. h. luteus* [New Mexico meadow jumping mouse] and a habitat that limited human use." *Id*. at p. 56.

Frey has also reported that at Fort Burgwin, where a historical population is no longer present, remnants of beaver activity were present (Frey 2006c). Approximately 50 beaver had been removed from that location. *Id*. In surveys conducted in the Jemez Mountains, mice were captured in areas in which beaver dams were present (Frey 2007a). Frey has stated that "even in the presence of some livestock grazing, extensive beaver activity may be able to maintain the habitat required by *Z. h. luteus*." *Id*. at p. 16. However, this may not hold true in situations where grazing pressure is heavy or where livestock are forced to graze disproportionately in riparian habitat (such as when upland forage is poor). *Id*.

SUMMARY

The New Mexico meadow jumping mouse merits listing as Endangered or Threatened under the Endangered Species Act. We believe this Petition shows the mouse deserves an Endangered designation and warrants emergency listing. This subspecies has suffered habitat degradation and fragmentation mostly due to human activities. The main threats to this subspecies are cattle grazing and the decrease of perennial water in riparian habitats. The New Mexico meadow jumping mouse has disappeared at a rate of 74% since the mid-1980s and early 1990s, and only 11 populations are confirmed as persisting. Current rates of suitable habitat degradation are likely compromising any unknown populations. No long-term monitoring programs, management plans, or mechanisms for protection or conservation exist for this species or habitats throughout its three-state range. Recent surveys provided data that convinced the State of New Mexico to uplist the species to Endangered. Populations in Arizona and Colorado are also considered imperiled or critically imperiled. FWS designated this subspecies as a candidate for ESA listing in December 2007 and recognized that it faces high-magnitude, imminent threats. This petition is submitted with the hope that FWS will expeditiously list the mouse under the ESA and take immediate steps to ensure its survival and recovery. We believe ESA listing is vital to provide adequate protections for this subspecies and its habitat.

NEED FOR ECOSYSTEM MANAGEMENT

Petitioners believe that classification of the meadow jumping mouse as an Endangered or Threatened species under the ESA will insure that state and federal agencies develop an effective form of ecosystem protection. The meadow jumping mouse is a riparian specialist. This ecosystem needs to be protected because it has high biological and economic value (Baker et al. 2001). In addition, this ecosystem is sensitive to environmental and climate changes, and closer attention must be paid to its management. The protection of ecosystems is stated as the very purpose of the ESA. Where single species play indicator roles, as does this mouse, the ESA's single-species protection provisions can correlate to ecosystem-wide protection (Miller et al. 1998/1999; Rosmarino 2002). A diverse and abundant riparian small mammal community is a desirable management goal. Because many small mammals are habitat specialists, such communities indicate a healthy functioning system. Further, these communities can provide for some of the highest animal biomasses found in any ecosystem. Such areas of concentrated animal biomass, especially of small mammals, are critical for maintaining terrestrial and avian predator populations. Riparian areas in the southwest are arteries of life for a broad suite of wildlife and deserve the highest protection.

REQUESTED DESIGNATION

WildEarth Guardians hereby petitions the U.S. Fish and Wildlife Service under the Department of Interior to list the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) as an Endangered or Threatened species pursuant to the Endangered Species Act. This taxon qualifies for Endangered status. Listing action is warranted, given the drastic decline in the distribution of the meadow jumping mouse and the current fragmentation and isolation of extant populations. This meadow jumping mouse subspecies is threatened by multiple listing factors, and especially by the present and threatened destruction, modification and curtailment of habitat and range, inadequate regulatory mechanisms to prevent its extinction, and the climate crisis.

CRITICAL HABITAT

This petition requests that critical habitat be designated for the New Mexico meadow jumping mouse concurrent with final ESA listing, given that the primary threat to this species is habitat loss and degradation. Much of this loss is occurring on federal public lands.

EMERGENCY LISTING REQUEST

Petitioner also requests that FWS emergency list the New Mexico meadow jumping mouse, which is threatened with extinction. FWS has the authority to promulgate an emergency listing rule for any subspecies when an emergency exists that poses a significant risk to the species. 16 U.S.C. § 1533(b)(7). In this case, livestock grazing, road-building, drought, climate change and other factors threaten the few populations that remain. Such rule shall take effect immediately upon publication in the Federal Register

and shall be effective for a maximum of 240 days. *Id*. When FWS designated this subspecies as a candidate for ESA listing in December 2007, it recognized that it faces high-magnitude, imminent threats. 72 Fed. Reg. 69034, 69036. The mouse therefore deserves emergency listing. FWS should proceed with standard listing while the mouse has interim protection from an emergency listing.

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