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THE MEADOW JUMPING MOUSE IN NEW MEXICO: HABITAT PREFERENCES AND MANAGEMENT RECOMMENDATIONS

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Abstract: I studied the meadow jumping mouse (*Zapus hudsonius luteus*) in New Mexico. Habitat characteristics where populations were found included permanent running water, moist soils, vegetative cover ≥0.5 m tall, diverse plant communities, and proximity to dry ground that provides suitable sites for nesting and hibernation. Populations were found in both streamside riparian and wet meadow habitats at high and low elevations. Though structurally different, these 2 habitats did not differ significantly in vegetative composition, being comprised primarily of grasses and forbs. Sites where jumping mice were not found had significantly higher mean percent coverage of sedges and rushes than mean percent coverage of grasses and forbs. Because of this subspecies' sensitivity to loss of natural riparian and meadow habitat, emphasis should be placed on protecting known populations and preventing further fragmentation or loss of remaining habitats.

Key words: cover, grasses, grazing, habitat, hibernation, jumping mouse, management, New Mexico, riparian, running water.

The meadow jumping mouse, is common throughout the eastern United States and has been well studied in this region (Sheldon 1938, Quimby 1951, Whitaker 1963, Nichols and Conley 1982). The southwestern subspecies (*Z. hudsonius luteus*) occurs only in isolated locations in New Mexico and Arizona (Fig. 1), where it is found in mesic habitats in lowland valleys and the riparian zone along montane streams (Findley et al. 1975, Hafner et al. 1981, Hoffmeister 1986). These southwestern populations have only recently been recognized as a subspecies of the meadow jumping mouse (Hafner et al. 1981); earlier they were recognized as a subspecies of the western jumping mouse (*Z. princeps*) (Krutzsch 1954).

The meadow jumping mouse and the western jumping mouse occupy different ecological zones throughout their geographic ranges (Hafner et al. 1981). The western jumping mouse is widespread throughout the Rocky Mountains, primarily inhabiting dense willow (*Salix* spp.) or aspen (*Populus* spp.) thickets in the riparian zone along montane streams (Brown 1967, 1970; Clark 1971; Stinson 1977; Cranford 1983). The meadow jumping mouse in the eastern United States is typically found in moist grasslands and meadows, and in marshes along ponds (Quimby 1951, Whitaker 1963). In their examination of evolutionary relationships of southwestern jumping mice, Hafner et al. (1981) reported sympatric populations of western and meadow jumping mice in the Sangre de Cristo Mountains of northern New Mexico (Fig. 1). Here and at other high elevation sites where meadow jumping mice were found, the habitat was similar to that typically inhabited by western jumping mice. In contrast, habitat at low elevation sites along the Rio Grande valley where jumping mice were found (Hafner et al. 1981) was similar to that typically inhabited by meadow jumping mice in the eastern United States. This led Hafner et al. (1981) to suggest that the traditional habitat separation normally observed between western and meadow jumping mice may not hold up in isolated southwestern populations. This finding, combined with the recent reclassification of the southwestern subspecies has prompted renewed interest in habitat preferences of southwestern meadow jumping mice.

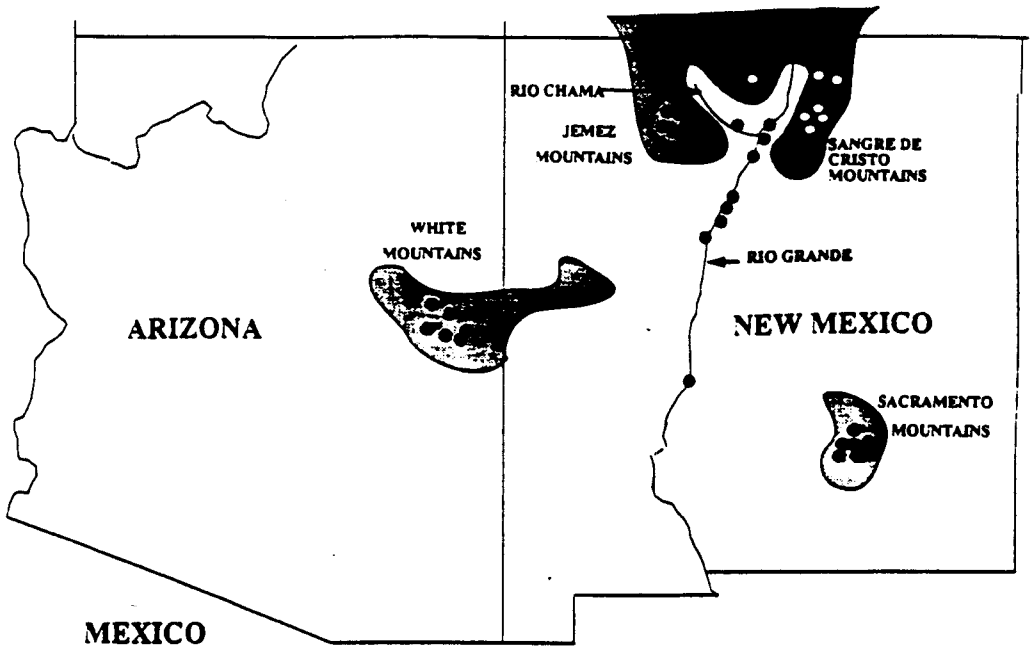

Fig. 1. Location of jumping mouse populations in the southwestern United States. Closed circles represent populations of the southwestern subspecies of the meadow jumping mouse and open circles represent populations of the western jumping mouse.

Further interest in meadow jumping mice in the southwest has been prompted by the recent concern that populations have been declining due to disappearance of their natural riparian habitat. Since the 1930's, modern agricultural and industrial development has altered or eliminated much of the natural riparian habitat along the Rio Grande valley in New Mexico (Hafner et al. 1981; Ohmart, R. D. and V. C. Hink, Middle Rio Grande Biological Survey – Final Report, Center for Environmental Studies, Arizona State University, Tempe, 193 pp, 1984). In addition, increasing levels of recreational and range management activities on public lands in montane regions may be currently threatening these isolated populations.

Historically, little was known of the habitat requirements, life history, or population status of the southwestern subspecies of the meadow jumping mouse, thus, relationships between man-induced impacts and mouse populations were poorly documented and understood. My objectives were to describe the habitat of meadow jumping mice in New Mexico, primarily to document how their presence related to vegetative cover and composition, and to identify important management concerns.

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STUDY AREAS AND METHODS

From 1985 through 1989, trapping surveys for meadow jumping mice were conducted at 50 different sites, primarily in meadow and streamside riparian habitats, throughout New Mexico. The sites chosen were locations of historic records or in nearby areas where habitat appeared suitable for the species. Jumping mice are most frequently captured near waterways (J. L. Morrison, unpubl. data) so survey transects were located in these areas. At each site, 500-m traplines with 25 to 30 museum special traps/trapline were established within 2 m of the waterway. Each trapline was run for ≤4 nights or until jumping mice were found. At 3 sites where the suitable habitat was large (approx. 5 ha), I established live-trap grids (200 traps each) to collect additional data on the species' habitat use and breeding season phenology.

Habitat analyses were conducted at all sites where populations were found. At live-trapping sites, distances from each station where jumping mice were captured to the nearest permanent running water were measured in m. At all sites, I collected and identified major plant species. To compare habitats where jumping mice were found, I described vegetation following Daubenmire (1959). One hundred thirty-four 0.1 m^2 plots were taken in streamside riparian habitat and 120 plots in meadow habitat. In each plot, all plant species were identified and their percent canopy coverage (Daubenmire 1959) was determined by visually quantifying the total area covered by each species. Vegetative cover (related to ht and density of vegetative growth) and soil moisture were qualitatively expressed for each plot using methods adapted from Clark (1971) and Cranford (1983).

In 1988, I assessed differences between habitats where jumping mice were found and where they were not found. In the Sacramento Mountains, 10 Daubenmire (1959) plots were taken at each of 10 sites where jumping mice were present, and 10 plots were taken at each of 5 sites where I conducted survey trapping but where jumping mice were not found.

To evaluate differences between habitats, means of percent coverage of grasses and percent coverage of forbs within all plots in streamside riparian and wet meadow habitats were compared using an unpaired *t*-test ($\alpha = 0.05$). Percent coverage of sedges and rushes was additionally compared in plots taken in the Sacramento Mountains where mice were and were not present. Statistics were calculated using the Minitab statistical program (Schaefer and Anderson 1989).

RESULTS

Meadow jumping mice were found in 2 structurally different habitats: the riparian zone along streams and ditches, and wet meadows adjacent to cattail (*Typha latifolia*) marshes associated with major rivers. Nineteen populations were found in the former habitat at higher elevations (>2,121 m) in the Jemez and Sacramento mountains. Two populatons were located at lower elevations (1,212 - 1,515 m) in habitat similar to the streamside riparian zone, along irrigation ditches within the Rio Grande floodplain. Three populations were found in wet meadow habitat at lower elevations (1,515 - 1,818 m) along the Rio Chama and Rio Grande valleys, one was found in this habitat at 2,303 m in the Jemez Mountains, and one was found at 2,273 m in the Sacramento Mountains. All

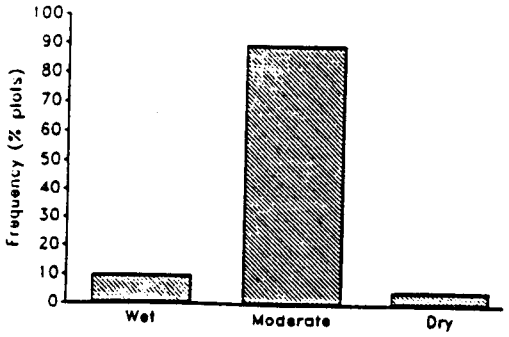

Fig. 2. Soil moisture characteristics at jumping mouse population sites in New Mexico. Wet = standing water, moderate = soil moist or soggy but no standing water, dry = soil dry or nearly so (after Cranford 1983).

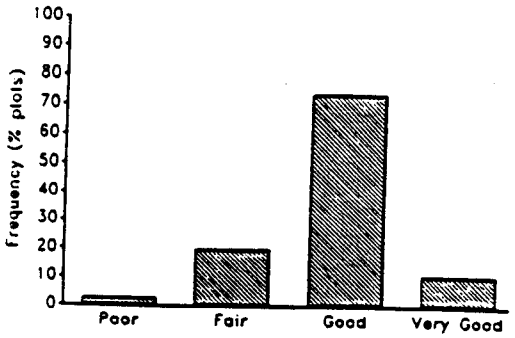

Fig. 3. Vegetative cover characteristics at jumping mouse population sites in New Mexico. Poor = little vegetation or vegetation very thin (a mouse would have difficulty moving about without being seen from above), fair = ground incompletely covered by vegetation or vegetation not too tall or dense (a mouse could find hiding places but would not be able to move about freely without being seen from above), good = ground covered by dense vegetation ≥0.5 m high (a mouse would not be visible from above), very good = cover very dense and usually ≥1.0 m high (after Cranford 1983).

jumping mice captured during this study were *Z. hudsonius luteus*.

All jumping mouse population sites were close to permanent free-flowing water. Distances to the nearest running water from live trapping stations where jumping mice were caught (based on repeated captures of 83 mice) averaged 13.7 m (range = 0 - 45.7 m). Forty percent of captures were made at trap stations within 7.5 m from the waterway, 14% were between 7.6 m and 15.2 m, 10% were between 15.3 m and 22.7 m, 11% were between 22.8 m and 30.3 m, and 24% of captures occurred at distances >30.3 m. Because many of the captures at distances >30.3 m occurred during the mid to late portion of the species' active season, these individuals may have been near nests or seeking a hibernation site on higher, dry ground. At all population sites, within 30.3 m of the waterways, the ground sloped up and soils were sandier, looser, and drier, not being as immediately influenced by the water regime. This dry habitat provides nest sites and hibernacula for jumping mice.

While streamside riparian habitats were generally narrow and linear along the stream or ditch, wet meadows were usually larger in size and not linear, and were on slightly higher ground above the marshes. Though different in physical location, size, and shape, these 2 habitats were similar in character with respect to soil moisture, cover, and vegetative composition. Soil moisture was moderate (soil moist or damp underfoot but no standing water [Clark 1971]) in most plots (Fig. 2). Plant growth at most sites was tall (≥0.5 m) and dense, particularly immediately adjacent to waterways, thus vegetative cover was good or very good (vegetation ≥0.5 m tall and a mouse would not easily be seen from above [Clark 1971]) (Fig. 3).

Vegetative communities were comprised of many plant species (most sites had ≤12 grass species and ≤50 species of forbs) each with ≤50% canopy coverage (Daubenmire 1959), rather than few species with greater coverage. Vegetation at all sites was dominated by grasses and forbs, with some willow, alder (*Alnus* spp.), and rose (*Rosa*

spp.). There were no significant differences ($\alpha = 0.05$) in mean percent coverage of grasses or mean percent coverage of forbs between these 2 habitats (Table 1).

Common grasses in both habitats included scratchgrass (*Muhlenbergia arenacea*), fescue (*Festuca* spp.), saltgrass (*Distichlis stricta*), Johnson grass (*Sorghum halepense*), foxtail barley (*Hordeum jubatum*), brome (*Bromus* spp.), wheatgrass (*Agropyron* spp.), redtop (*Agrostis alba*), bluegrass (*Poa* spp.), manna (*Glyceria* spp.), rye (*Elymus* spp.), and timothy (*Phleum pratense*). Sedges (*Carex* spp.), rushes (*Juncus* spp. and *Scirpus* spp.), and horsetail (*Equisetum* spp.) appeared with less frequency in jumping mouse habitats. Forbs commonly found included clover (*Trifolium* spp.), yarrow (*Achillea millefolium*), field mint (*Mentha arvense*), sunflower (*Helianthus* spp.), dock (*Rumex* spp.), plantain (*Plantago major*), yerba mansa (*Anemopsis californica*), morning glory (*Convulvulus arvense*), cinquefoil (*Potentilla* spp.), daisy (*Erigeron* spp.), primrose (*Epilobium* spp.), vetch (*Vicia* spp.), geranium (*Geranium* spp.), and self-heal (*Prunella vulgaris*).

Vegetation characteristics differed between sites in the Sacramento Mountains where jumping mice were and were not found during 1988. Significant differences were found in the mean percent coverage of grasses ($t = 3.14$, $P < 0.05$), mean percent coverage of forbs ($t = -2.34$, $P < 0.05$) and mean percent coverage of sedges and rushes ($t = 6.45$, $P < 0.05$) between these sites. Sites where the mice were absent had significantly lower ($t = -3.01$, $P < 0.05$) mean percent coverage of grasses and forbs than mean percent coverage of sedges and rushes (Table 2).

Table 1. Differences in vegetation characteristics between streamside riparian ($n = 134$) and wet meadow ($n = 120$) habitats where meadow jumping mice were found in New Mexico.

	$\bar{x}$			
	% coverage		% coverage,	
Habitat	Grasses	SE	Forbs	SE
Streamside riparian	37.40	2.6	31.40	2.5
Wet meadow	30.90	2.6	36.50	2.8

DISCUSSION

Habitat of the meadow jumping mouse in the southwest can be defined as close to permanent free-flowing water; diverse vegetative communities comprised primarily of grasses and forbs; tall, dense plant growth providing thick cover; and close to higher dry ground that provides sites suitable for nesting and hibernation. This description is consistent with habitats of western and meadow jumping mice throughout their ranges (Quimby 1951, Whitaker 1963, Brown 1967, Clark 1971, Cranford 1983). Results of this study show that generally in New Mexico, low elevation (<1,818 m) populations of the meadow jumping mouse occupy habitat typical of the eastern meadow jumping mouse, while mountain populations (>1,818 m) inhabit

Table 2. Vegetation characteristics at sites in the Sacramento Mountains, New Mexico, where meadow jumping mice were found ($n = 100$) and were not found ($n = 50$), 1988.

	$\bar{x}$					
	% coverage grasses	SE	% coverage forbs	SE	% coverage Sedges/rushes	SE
Presence	39.00	3.0[a]	37.85	2.8[a]	11.55	2.1[a]
Absence	22.90	4.2[a]	27.05	3.5[a]	44.55	5.9[a]

[a] $P < 0.05$

exemplary western jumping mouse habitat. The location of populations in streamside riparian habitat along the Rio Grande valley and in wet meadow habitat in montane regions, however, supports the observation of Hafner et al. (1981) that southwestern populations of jumping mice occupy habitats characteristic of both species.

Jumping mice are most often found in moist areas (Quimby 1951, Getz 1961, Whitaker 1963), suggesting that the presence of permanent water may be a critical habitat element. Clark (1971) and Cranford (1983), however, argue that water is important for its effect on soil moisture, which influences the quality and type of vegetation. In both habitats where jumping mice were found in New Mexico, regular flooding of meadows and streambanks occurs, resulting in loamy, hydric soils that support tall, dense plant growth. These numerous plant species provide a wide variety of food and excellent cover for jumping mice, which may be more important than the presence of free running water (Cranford 1983).

Although jumping mice are most often found in moist areas, they do not frequent swampy areas where there is standing water or soggy soils. Such areas are often characterized by stagnant water and large homogeneous stands of cattail, bulrush (*Scirpus americanus*), or sedges. I never captured jumping mice in this habitat. Whitaker (1963) found swampy areas to be devoid of jumping mice; however, when they dried up, they became covered with a wider variety of vegetative species and were then invaded by jumping mice. Cranford (1983) also determined that pure sedge environments, though having good cover, did not support high densities of western jumping mice. These findings again suggest that water or moist soils may not be as important as the composition of the associated vegetative community.

The importance of the quality and type of vegetation in jumping mouse habitat may be related to the species' life history, specifically their food requirements. Jumping mice have a short active season: 3 to 4 months at high elevations for the western jumping mouse (Brown 1967, 1970; Cranford 1983), 6 to 7 months for the eastern meadow jumping mouse (Sheldon 1938, Quimby 1951, Whitaker 1963), and 4 to 5 months for the meadow jumping mouse in New Mexico (J. L. Morrison, unpubl. data). Myers (1969) and Cranford (1983) suggested that the 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. 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. In habitats where vegetative growth is dense and many plant species are present, adequate food is available and cover requirements are fulfilled.

Jumping mice feed primarily on seeds of grasses and forbs (Whitaker 1963, Jones et al. 1978, Vaughan and Weil 1980) while seeds of sedges, bulrush, and cattail were eaten infrequently (Quimby 1951). Results of this study show that grasses and forbs comprise the majority of vegetation at all sites where jumping mice were found, perhaps suggesting the importance of these vegetation types to the southwestern subspecies as well. In contrast, habitats where jumping mice were absent had low percent coverage of grasses and forbs and were comprised primarily of sedges and rushes. Perhaps this suggests that these habitats do not provide suitable food resources, thus the presence of sedges and rushes at these sites may not be as important a factor in the absence of jumping mice as the reduced coverage of grasses and forbs.

MANAGEMENT RECOMMENDATIONS

Because meadow jumping mice in the southwest occupy riparian habitats, some activities could have a negative effect on mice populations. Certain recreational activities, stream improvement projects, and ditch cleaning, all of which concentrate in these habitats, should be carefully monitored to prevent habitat degradation in areas where jumping mice exist. Grazing probably has the highest potential for impact on streamside riparian and wet meadow habitats. Impact caused by grazing includes loss of 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 pressures, habitat could be destroyed. Because moderate grazing was ongoing at some sites where jumping mice were found, carefully monitored grazing and persistence of jumping mouse populations may be compatible. Deferred or rotational entry into certain areas would lessen impacts from trampling and would permit plant maturation, seed production, establishment of seedlings, and restoration of plant vigor, thus insuring perpetuation of the native vegetative community. In addition, fencing selected sections of habitat along permanent streams where jumping mice exist would assure protection of suitable jumping mouse habitat yet permit cattle access to water.

The location of historic populations and documentation of new populations of meadow jumping mice in New Mexico suggest that the species is not threatened with extinction. Discovery of a population along a farm ditch south of Albuquerque (J. L. Morrison, unpubl. data) suggests that the species may be more widespread and adaptable than originally believed. Despite this apparent adaptability, concern for the continued existence of meadow jumping mice in the Southwest is warranted because of the reduction of riparian and meadow habitat. Emphasis should be placed on protecting known populations and preventing further fragmentation or loss of remaining habitat.

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