# FIVE YEAR STUDY OF FACTORS AFFECTING JUMPING MICE (*Zapus*) ON THE MEDICINE BOW NATIONAL FOREST, WYOMING:

## *FIVE YEAR PROJECT REPORT, 2008*


Prepared by:

**Hannah Griscom, Assistant Zoologist**
**Doug Keinath, Zoologist**
**Joy Handley, Assistant Botanist**

Wyoming Natural Diversity Database
University of Wyoming
1000 E. University Ave // Department 3381
Laramie, Wyoming 82071


Prepared for:
Alan Williamson
Forest Wildlife Biologist
Medicine Bow-Routt NF's &
Thunder Basin NG
2468 Jackson Street
Laramie, WY 82070

**October 2008**

## *TABLE OF CONTENTS*

## *INTRODUCTION*

This report details the results of a small mammal survey performed in 2008 as part of an ongoing administrative study aimed at Preble's meadow jumping mouse (*Zapus hudsonius preblei*). Surveys were conducted on the Douglas and Laramie Ranger Districts of the Medicine Bow National Forest which represent the northern and southern ends of the subspecies' range within Wyoming. The 5-7 year project is intended to inventory and monitor Preble's populations at fixed points, correlate population trends with general habitat characteristics, and measure population responses to fire and livestock grazing. In addition to a detailed report of trapping results from 2008, a summary of findings since the project's inception in 2004 is discussed here.

Under the Endangered Species Act, *Zapus hudsonius preblei* was listed by the USFWS as Threatened on May 13, 1998. Recently finding that the subspecies was sufficiently secure within the Wyoming portion of its range, the USFWS delisted *Zapus hudsonius preblei* within Wyoming on July 10, 2008 (USFWS, 2008). Given the morphological similarities between Preble's meadow jumping mice and sympatric jumping mouse species, there is some uncertainty about species identification when processing animals in the field. For that reason, we refer to individuals of *Zapus* documented on the Medicine Bow National Forest, and elsewhere in the region, as "suspected" Preble's meadow jumping mice or simply *Zapus*.

## *METHODS*

### Study Area

Survey effort was divided equally between the Laramie Peak Unit of the Douglas Ranger District and Pole Mountain Unit of the Laramie Ranger District. In 2004, collaboration with District Biologists (Tim Byer and Steve Kozlowski) and Rangeland Management Specialists (Charlie Bradshaw and Darin Jons) resulted in the selection of appropriate study sites where the effects of variation in grazing pressure and fire application could be assessed. This resulted in annual survey of eight perennial stream reaches, four in each District (Figure 1, Table 1). Within the

Laramie Peak Unit, transects are located along Friend Creek, Cottonwood Creek, and two tributaries of Cottonwood Creek. Pole Mountain Unit transects are located on Middle Lodgepole Creek, South Lodgepole Creek, Middle Crow Creek and South Fork Middle Crow Creek (see Appendix for maps and aerial photos of the transects).

## Monitoring Zapus Populations at Fixed Locations

The first year of the study (2004) was primarily an inventory year, designed to confirm presence or absence of *Zapus* in habitats where management impacts could be monitored. Three transect locations were modified in the second year (2005) to capture more jumping mice, but all 8 transects have remained the same since then, and are expected to remain so for the duration of the project. Trapping methods conform to the guidelines established by the U.S. Fish and Wildlife Service (USFWS, 1999) and have stayed the same since the beginning of the project.

Each transect surveys consist of two lines of 100 Sherman live traps (H. B. Sherman Traps, Inc., Tallahassee, Florida), one line on either side of the stream. Traps are placed five meters apart and are staggered alternately in vegetation adjacent to the creek bank and in upland vegetation approximately five meters from the stream channel. No traps are set greater than ten meters from a stream channel. All traps contain polyester bedding material, 3-way livestock feed, and are set in the evening and checked early the following morning. Captured animals are identified in the field and released at the capture site. To determine the exact number of jumping mice captured, each *Zapus* is marked individually with semi-permanent paint. The paint colors persist throughout the week of trapping so recaptured animals can be identified. Photos are taken of each jumping mouse, sex is recorded, and geographic coordinates of the capture location are logged with a GPS unit.

One baited, open trap is equivalent to one raw trap night. Therefore, one evening of trapping effort on each transect is equivalent to 200 raw trap nights (2 lines with 100 traps each). Each transect is surveyed for approximately 800 raw trap nights (over four consecutive nights). For analyses, raw effort per transect was corrected for disturbed (i.e., tripped-but-empty) and occupied traps using the technique of Beauvais and Buskirk (1999) and reported as adjusted, or net trap nights. Adjusted trap night figures are based on an assumed probability of trap

availability prior to closure. Therefore, the number of closed traps per night (disturbed + captures) is divided in half and subtracted from the total number of traps that remained open during the trapping effort.

For the purpose of tracking basic *Zapus* population trends, the number of individual jumping mice captured per transect was also standardized by the linear length of riparian habitat sampled (yielding number of *Zapus* per linear kilometer). For most analyses this number is used instead of raw *Zapus* numbers because, although the starting point for each transect is the same between years, the end point can vary depending on the field crew and stream sinuosity.

## Habitat Characteristics and Zapus Populations

In 2004, WYNDD collected detailed vegetation measurements along the 8 small mammal trapping transects in an attempt to capture the habitat variables which favor *Zapus* presence and abundance. Methods for measuring vegetation were adapted from the Preble's Meadow Jumping Mouse Habitat Monitoring Protocol (Ruggles et al. 2004). Along transects running perpendicular to the stream, relative and absolute cover classes of forbs, graminoids, litter, trees, shrubs, subshrubs, and bare ground were measured at 0, 15, 25, and 50 meters from the stream bed. In WYNDD's 2004 report, Smith et al. stated that he had low confidence that this method had captured the vertical structure and complexity likely to be most important to *Zapus*. For this reason, the vegetation methods used in 2004 were not repeated in subsequent years. Now, after compiling 5 years of *Zapus* monitoring data, we revisited the 2004 vegetation data in search of cover variables that might explain differences in average *Zapus* abundance between sites. Regression was used between cover variables and average *Zapus* density (across years) to determine if there was any relationship. The assumption for this analysis was that the compositional and structural differences between transects which affect *Zapus* have remained the same since 2004.

## Fire and Zapus Populations

During the initial site selection and study design period in 2004, it appeared likely that at least one transect on the Laramie Peak Unit (Hubbard's Cupboard) would undergo a control burn in

subsequent years. Forest Service Biologists were curious about the potential interactions between fire and grazing and its effects on Preble's Meadow Jumping Mouse populations. Since 2004, no prescribed burns have occurred within any of the transects, nor does it appear likely that they will in the next five years. We propose, therefore, that this question be suspended from the list of objectives for this project, and instead continue to focus on monitoring of *Zapus* trends and potential impacts from livestock grazing.

## Grazing Intensity and Zapus Populations

Determining the impacts of livestock grazing season and intensity on Preble's meadow jumping mouse populations is a major objective of this project. Forest Service lessees generally graze cattle on Medicine Bow National Forest allotments every year from approximately June through September, and rotate cattle once approximate levels of utilization have been met. We have not been able to control for season of grazing, but based on pasture utilization data made available to us by John Lamman, Rangeland Management Specialist and Steve Kozlowski, District Biologist, we are able to tentatively investigate the effects of grazing intensity within the Pole Mountain Unit.

Pasture utilization data are collected by USFS range specialists in mid-summer by quantitatively comparing standing biomass inside and outside ungulate exclosures and calculating the percent of biomass (mostly grass) grazed by cattle and wild ungulates in each fenced pasture. This data is currently not collected on the Laramie Peak Unit. Each of the four Pole Mountain Unit transects surveyed by WYNDD has at least one exclosure cage within 1 km for which percent utilization is available, beginning in 2004. By regressing percent utilization against associated *Zapus* densities, we can assess the relationship between jumping mouse abundance and grazing intensity. In the cases when more than one utilization cage was proximate to a *Zapus* transect (i.e., MCC, SFMCC, MLC), average percent utilization of the cages was used. Although this method does not identify the habitat-specific mechanisms affecting changes in *Zapus* density, it does assess the direct impact of grazing intensity on jumping mouse abundance.

At any particular site, above-ground graminoid biomass will vary from year-to-year depending on precipitation and grazing levels. In order to account for the potentially confounding impact of precipitation on grass biomass and habitat quality, we also regressed precipitation with *Zapus* densities to see if there was a relationship. Cumulative precipitation from Jan-July, (Cheyenne, WY, Station 7E, 30 mi. east) was obtained from the Wyoming State Climate Office for the analysis.

## *RESULTS AND DISCUSSION*

### Monitoring Zapus Populations at Fixed Locations

During the fifth project year (2008), trapping surveys were conducted between July 9 and July 29. The small mammal trapping effort included data collection from roughly 3.9 kilometers of streamside habitat; 2.0 km on the Laramie Peak Unit and 1.9 km on the Pole Mountain Unit. A total of 68 individual meadow jumping mice (*Zapus*) were captured in 2008 with at least one captured at each transect (Table 2). *Zapus* was more abundant in 2008 than any other year since the beginning of monitoring (39 in 2005, 43 in 2006, and 38 in 2007; Figure 2). Pole Mountain transects have always yielded more *Zapus* than those on Laramie Peak, but the number of captures on Laramie Peak increased significantly from 13 individuals in 2007 to 30 individuals in 2008 (Figure 2). The Friend Park and South Lodgepole Creek transects had the highest number of individuals captured (25, 23) and the highest densities (37, 33 *Zapus*/km) (Table 2). Lowest densities were seen at the Schoolhouse and Middle Lodgepole Creek transects (both had 2 *Zapus*/km).

The composition of small mammal species trapped in 2008 (Table 3) was similar to previous years with the addition of the short-tailed weasel (*Mustela erminea*) which was caught 3 times on the Pole Mountain Unit in 2008. Red squirrels (*Tamiasciurus hudsonicus)* and bushy-tailed woodrats (*Neotoma cinerea*), which were captured frequently in 2007, were not captured at all in 2008. Compared to 2007, vole and shrew abundance increased and deer mouse and least chipmunk abundance decreased. As in previous years, deer mice (*Peromyscus maniculatus*) were by far the most abundant small mammal captured with voles (primarily *Microtus* spp.)

being the second most abundant (Table 3; Figure 3). *Zapus* was the third most abundant small mammal captured. Keinath and Beauvais (2007) reported a weak inverse relationship between *Zapus* and deer mice/voles abundance based on data from 2004 to 2006. However, subsequent year of data have not supported the trend (Figure 5).

## Habitat Characteristics and Zapus Populations

None of the vegetation cover variables we measured at 0-15m from stream center in 2004 was effective at explaining *Zapus* densities over the last 5 years. However, cover variables have been shown in other studies to affect Preble's meadow jumping mouse densities (Trainor et al., 2007; Meaney et al., 1997) so it is likely that the methods we used were not collected at a sufficiently fine scale to capture *Zapus* habitat selection. Working approximately 50 miles south of Denver, Colorado, Trainor et al. (2007) used radio-tagged Preble's meadow jumping mice to delineate high-use and low-use areas within the riparian zone which were then measured for microhabitat variables. Although their general approach to measuring vegetation cover was similar to ours, cover was measured in absolute percent, instead of percent 'class', and Daubenmire (1959) plots were placed closer together, centered around high-use and low-use areas. After performing a multi-variate analysis, Trainor et al. found that high-use areas had greater cover of shrub, grass, and woody debris than low-use areas. In addition, grass cover was 3 times more abundant than forbs and the high-use sites tended to be very close to stream edges. Their results highlight the species' concentrated use of microhabitat patches (often with many mice sharing the same patch) while ignoring the rest of the landscape. Since WYNDD was measuring vegetation transects randomly, and perpendicular to the stream, we were not adequately centering in on patches most used by jumping mice. Trainor et al. (2007) conclude that species conservation efforts should focus on encouraging recruitment and growth of willows (*Salix* spp.), native wetland grasses, sedges (*Carex* spp.), and rushes (*Juncus* spp.) in riparian areas within the species' range. We believe their research adequately addresses one of the original objectives of this study; to characterize high-quality Preble's meadow jumping mouse habitat.

## Grazing Intensity and Zapus Populations

Characterizing high quality *Zapus hudsonius preblei* habitat as abundant in wetland vegetation cover helps explain the negative trend shown by regressing grazing intensity with *Zapus* density during the same year (Figure 6). Data for the figure are from Middle Crow Creek (exclosures G9, G10), Middle Lodgepole Creek (exclosures N5, N8), South Fork of Middle Crow Creek (exclosures G15, G18), and South Lodgepole Creek (exclosure C3). The relationship is not strongly correlated ($R^2 = 0.49$) and is only constructed from the 19 available data points, but the trend is clear. The inverse relationship also remains in effect when the data are parsed by year and transect. It is especially telling that the trend holds true in the face of differences in hydrology, soils, topography and dominant cover between transects. Given these tentative results, it appears that cattle grazing reduces the cover components which provide good habitat for Zapus. There is a possible threshold response seen at approximately 50% utilization, beyond which Zapus densities drop dramatically, however, we do not have enough data to be sure of that threshold at this time.

Because of the potentially confounding effect of differences in precipitation levels on wetland vegetation, cumulative precipitation from January through July was regressed against *Zapus* densities (from the same year) on the 4 Pole Mountain transects. The analysis yielded to no relationship ($R^2 = 0.0098$; Figure 7). This lack of relationship between precipitation and *Zapus* abundance is also clear in 7 years of data from surveys conducted on the F.E. Warren Air Force Base in Cheyenne, Wyoming (WYNDD, unpublished data). Despite the lack of relationship in this analysis, we suggest that it is incorrect to conclude that *Zapus* populations do not respond to precipitation or climate variables. Rather, there are a variety of ways small mammal populations could respond to climate that cannot be effectively discerned using a transect-level relative abundance data. Nevertheless, it appears that grazing intensity is a much stronger predictor of *Zapus* abundance than cumulative precipitation.

## *CONCLUSIONS*

2008 was the most productive year since 2004 for suspected Preble's meadow jumping mice populations along fixed transects on the Medicine Bow National Forest. The cause(s) of this increase in abundance is unknown. The most consistently productive transects sampled since 2005 are Friend Creek (near Friend Park Campground), Middle Crow Creek, and South Lodgepole Creek. WYNDD's 2004 attempt to capture important habitat variables for Zapus were unsuccessful due to the patchy nature of high-use habitat along streams. However, subsequent intensive research conducted by other institutions has highlighted the importance of managing for high cover of native grasses, sedges, rushes, willows, and woody debris in riparian areas to maintain or increase *Zapus hudsonius preblei* populations within their range.

A preliminary analysis of grazing intensity on the Pole Mountain Unit shows that as percent utilization increases, nearby jumping mouse density decreases. This inverse relationship suggests that high levels of livestock grazing (above approximately 50% removal of low-growing biomass) in riparian areas of the Medicine Bow National Forest may directly impact *Zapus* production by reducing available habitat. When eight graphs are created by parsing the data by year (across transects) and by transect (across years), a negative relationship is also apparent in each of the graphs. If the Medicine Bow National Forest would like to continue investigating the role of grazing intensity on *Zapus* production, it would be beneficial to install a similar grazing utilization monitoring program on the Laramie Peak Unit, at least within the pastures that contain our small mammal monitoring transects. This would add valuable data to the analysis while testing the trend on a different part of the Forest.

Although *Zapus hudsonius preblei* was recently delisted in Wyoming, WYNDD would welcome continued collaboration with the Medicine Bow National Forest on this project. It would be valuable to maintain the continuity of the monitoring program, especially in light of the delisting and ensuing litigation. In addition, continuing to gather additional data on the relationship between grazing intensity and *Zapus* density will potentially contribute important information for future management decisions. There may be other questions that Forest Biologists would like to pursue with respect to Preble's meadow jumping mice, and we would be happy to discuss them over the next few months and implement them in 2009.

## *ACKNOWLEDGEMENTS*

We would like to thank Julianne Koval, Lindsay Schaffner, Timothy Banks, Forrest Rowland, and Makenzie Goodman for conducting the field work in 2008. Their hard work and attention to detail made this project possible.

## *LITERATURE CITED*

Beauvais, G.P. and S.W. Buskirk. 1999. Modifying estimates of sampling effort to account for sprung traps. Wildlife Society Bulletin 27:39-43.

Daubenmire, R. 1959. A canopy-coverage method of vegetational analysis. Northwest Science 33:43-64.

Keinath, D. A. and G. P. Beauvais. 2007. Five year study of factors affecting jumping mice (Zapus) on the Medicine Bow National Forest, Wyoming; Three year project report. Report prepared by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming. 16 pp.

Meaney, C.A., N.W. Clippinger, A. Deans, and M. O'Shea-Stone. 1997. Habitat preferences of Preble's meadow jumping mouse in Colorado. U.S. Fish and Wildlife Service and Colorado Divisions of Wildlife, Denver, USA.

Ruggles, A.K., L. S. Whittemore, J. Armstrong, and N. Clippinger. 2004. Preble's meadow jumping mouse habitat monitoring protocol. Prepared for United States Air Force Academy, Colorado Springs, CO. 82pp + CD Rom.

Smith, H., G.P. Beauvais, and D. Keinath. 2004. Five year study of factors affecting jumping mice (Zapus) on the Medicine Bow National Forest, Wyoming; One year project report. Report prepared by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming. 24 pp.

Trainor, A.M., T.M. Shenk, and K.R. Wilson. 2007. Microhabitat characteristics of Preble's meadow jumping mouse high-use areas. J. Wildlife Management 71 (2): 469-477.

USFWS. 1999. Interim survey guidelines for Preble's meadow jumping mouse; revised May 19, 1999. USDI Fish and Wildlife Service - Region 6 Office, Lakewood, Colorado.

USFWS. 2008. Final Rule To Amend the Listing for the Preble's Meadow Jumping Mouse (Zapus hudsonius preblei). http://ecos.fws.gov/speciesProfile/SpeciesReport.do?spcode=A0C2 (accessed 10/30/08)

## *TABLES*

**Table 1.** Transect Trap Line Endpoint Coordinates (Universal Transverse Mercator projection, Zone 13, North American Datum of 1983). Where: FS1 = First trapping Station on one side of stream; FS2 = First trapping Station on opposite side of stream; LS1 = Last trapping Station on one side of stream; LS2 = Last trapping Station on opposite side of stream; UTME = Easting coordinate in meters; UTMN = Northing coordinate in meters.

| Transect | FS1 UTME | FS1 UTMN | FS2 UTME | FS2 UTMN | LS1 UTME | LS1 UTMN | LS2 UTME | LS2 UTMN |
|---|---|---|---|---|---|---|---|---|
| **Douglas Ranger District - Laramie Peak Unit** | | | | | | | | |
| Cottonwood Creek (CWC) | 0471685 | 4683670 | 0471654 | 4683547 | 0471727 | 4683400 | 0471731 | 4683371 |
| Hubbard's Cupboard (HC) | 0471132 | 4682691 | 0471141 | 4682732 | 0471299 | 4682503 | 0471310 | 4682504 |
| Friend Park (FP) | 0459967 | 4678128 | 0459964 | 4678120 | 0460048 | 4678197 | 0460050 | 4678198 |
| School House Creek (SH) | 0470718 | 4681994 | 0470718 | 4681989 | 0470561 | 4681980 | 0470563 | 4681971 |
| **Laramie Range District - Pole Mountain Unit** | | | | | | | | |
| Middle Lodgepole Creek (MLC) | 0473778 | 4569563 | 0473774 | 4569548 | 0474043 | 4569692 | 0474057 | 4569682 |
| South Lodgepole Creek (SLC) | 0471210 | 4568079 | 0471230 | 4568047 | 0471439 | 4568049 | 0471446 | 4568035 |
| Middle Crow Creek (MCC) | 0475341 | 4558354 | 0475355 | 4558346 | 0475518 | 4558355 | 0475525 | 4558353 |
| South Fork Middle Crow Creek (SFMCC) | 0474317 | 4555784 | 0474315 | 4555777 | 0474419 | 4555761 | 0474418 | 4555746 |

**Table 2.** Summary of Zapus captured during small mammal trapping efforts on the Medicine Bow National Forest in the summer of 2008.

| **Transect Results - 2008** (sampling dates) | Trap Nights | | Zapus Captured | | Meters Trapped (+- 50 m) | Zapus per km |
|---|---|---|---|---|---|---|
| | Raw | Adjusted | Total | Unique | | |
| **Douglas Ranger District - Laramie Peak Unit** | | | | | | |
| **Cottonwood Creek** (July 16-20) | 800 | 742 | 8 | 6 | 500 | 12 |
| **Friend Park** (July 16-20) | 755* | 710 | 25 | 13 | 350 | 37 |
| **Hubbard's Cupboard** (July 23-27) | 800 | 753 | 15 | 10 | 720 | 14 |
| **Schoolhouse** (July 23-27) | 800 | 786 | 1 | 1 | 420 | 2 |
| **Laramie Range District - Pole Mountain Unit** | | | | | | |
| **Middle Crow Creek** (July 9-13) | 800 | 676 | 12 | 11 | 450 | 24 |
| **Middle Lodgepole Creek** (June 25-29) | 800 | 742 | 1 | 1 | 641 | 2 |
| **South Fork Middle Crow Creek** (July 9-13) | 800 | 745 | 17 | 10 | 330 | 30 |
| **South Lodgepole Creek** (June 25-29) | 800 | 768 | 23 | 16 | 480 | 33 |

* only 155 traps were set the first night

**Table 3.** All captures by species and transect, during summer 2008 surveys for jumping mice (Zapus) on the Medicine Bow National Forest.

| | Douglas Ranger District Laramie Peak Unit | | | | Laramie Ranger District Pole Mountain Unit | | | |
|---|---|---|---|---|---|---|---|---|
| Species | **CWC** | **FP** | **HC** | **SH** | **MCC** | **MLC** | **SFMCC** | **SLC** |
| **Deer mouse** (*Peromyscus maniculatus*) | 69 | 32 | 46 | 10 | 175 | 48 | 3 | 15 |
| **Unidentified microtus vole** (*Microtus* sp.) | 6 | 8 | 9 | | 39 | 7 | 67 | 1 |
| **Suspected Preble's meadow jumping mouse** (*Zapus hudsonius preblei*) | 8 | 25 | 15 | 1 | 12 | 1 | 17 | 23 |
| **Unidentified Shrew** (*Sorex* sp.) | 1 | 2 | 2 | | 3 | 3 | 2 | 9 |
| **Red-backed vole** (*Clethrionomys gapperi*) | | | | | | 13 | | 4 |
| **Least chipmunk** (*Tamias minimus*) | 5 | 1 | 7 | 1 | | 11 | | 1 |
| **Short-tailed weasel** (*Mustela* erminea) | | | | | | | 1 | 2 |
| **Golden-mantled ground squirrel** (*Spermophilus lateralis*) | | | | | | 6 | | |
| **Non-target species:** | | | | | | | | |
| Leopard frog (*Rana pipiens*) seen | 6 | 1 | 10 | | | 2 | 30 | 15 |
| Song sparrow (*Melospiza lincolnii*) trapped | | | | | 1 | | | |
| | | | | | | | | |
| Total Trap Nights (Adjusted) | 742 | 710 | 753 | 786 | 676 | 742 | 745 | 768 |
| Captures per 100 trap nights | 12.0 | 9.7 | 10.5 | 1.5 | 34.0 | 12.0 | 12.1 | 7.2 |

Transect Codes: CWC = Cottonwood Creek
FP = Friend Park
HC = Hubbard's Cupboard
SH = Schoolhouse
MCC = Middle Crow Creek
MLC = Middle Lodgepole Creek
SFMCC = South Fork Middle Crow Creek
SLC = South Lodgepole Creek

## *FIGURES*

**Figure 1.** Study Area in the Medicine Bow National Forest showing locations of 8 survey transects for jumping mice (Zapus).

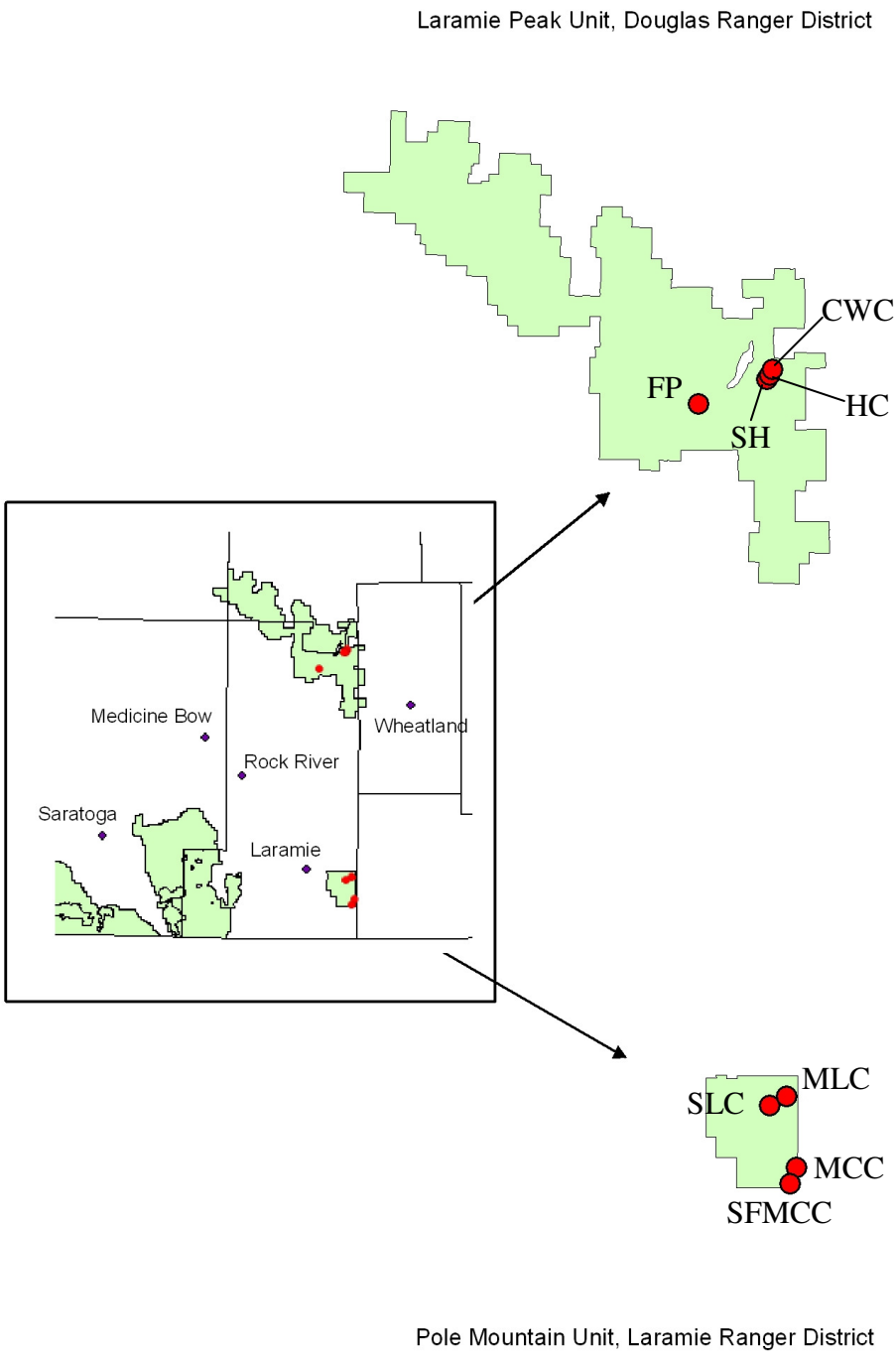

**Figure 2.** Abundance of Zapus on Laramie Peak Unit and Pole Mountain Unit transects from 2005-2008.

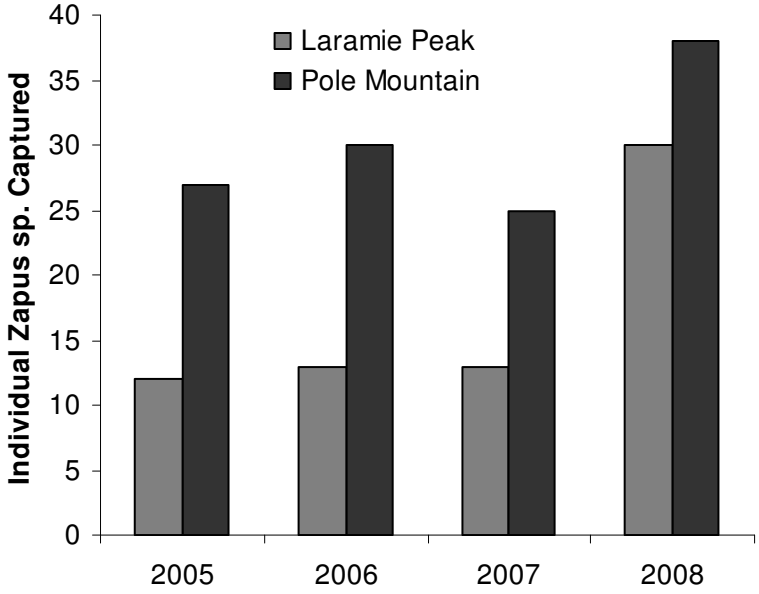


**Figure 3.** Captures of Deer Mice, Voles, Zapus, and other species at all eight fixed small mammal transects on the Medicine Bow National Forest.

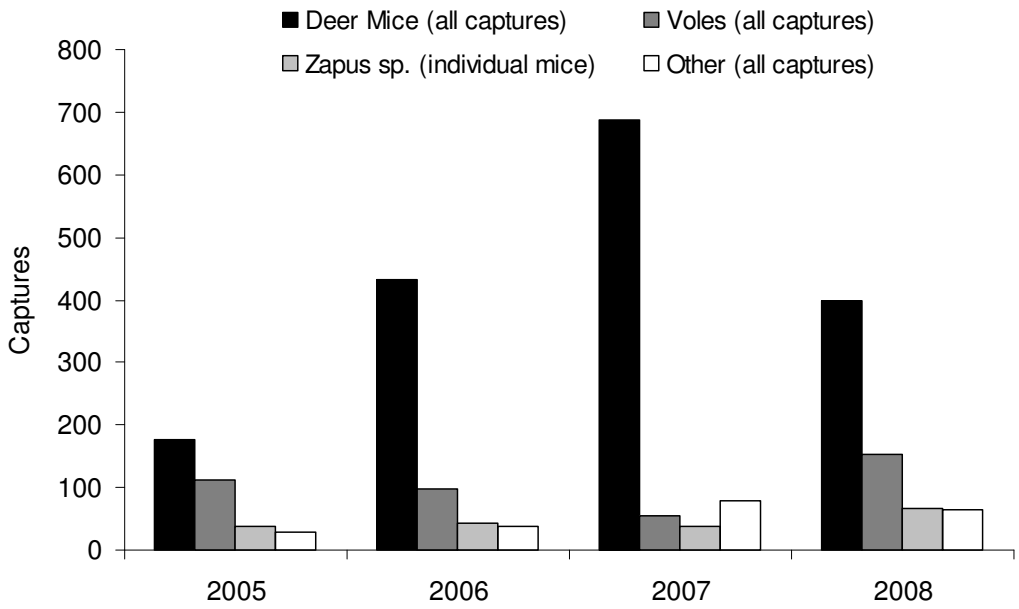

**Figure 4.** Number of Zapus captured at all eight fixed small mammal transects from 2005 to 2008 on the Medicine Bow National Forest.

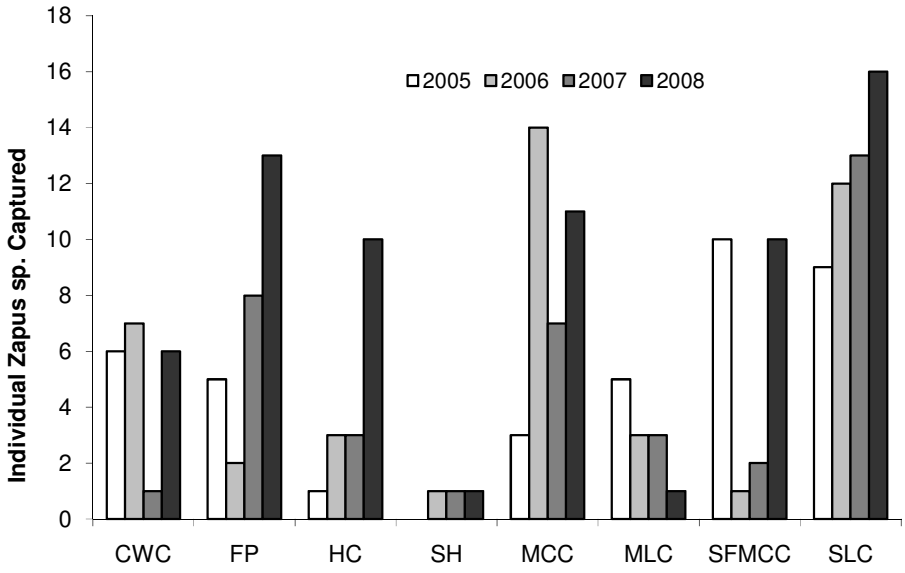


**Figure 5.** Zapus capture rates compared to those of voles & deer mice from 2005 to 2008 on all 8 transects on the Medicine Bow National Forest.

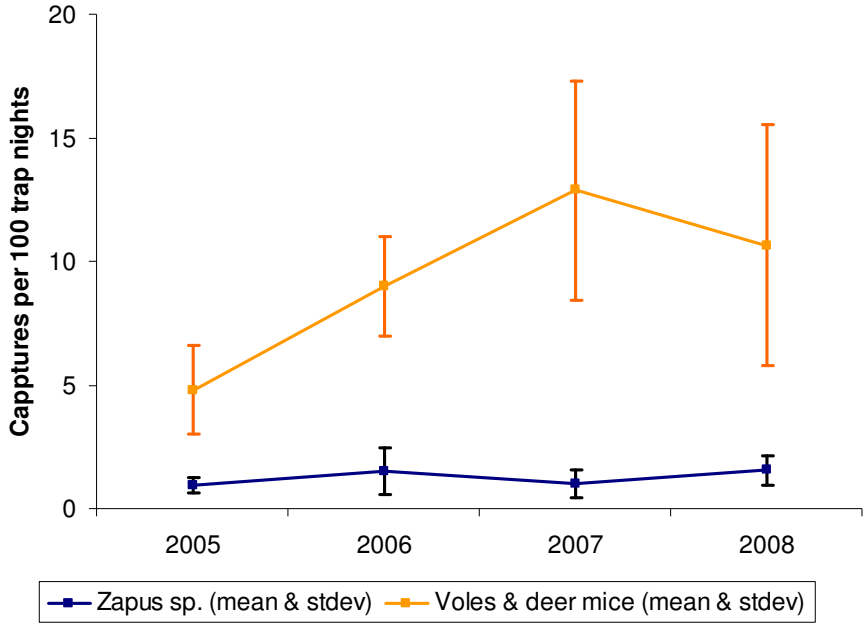

**Figure 6.** Density of Zapus as a function of grazing intensity in the same pasture. Data are from the Pole Mountain Unit transects from 2004-2008 on the Medicine Bow National Forest.

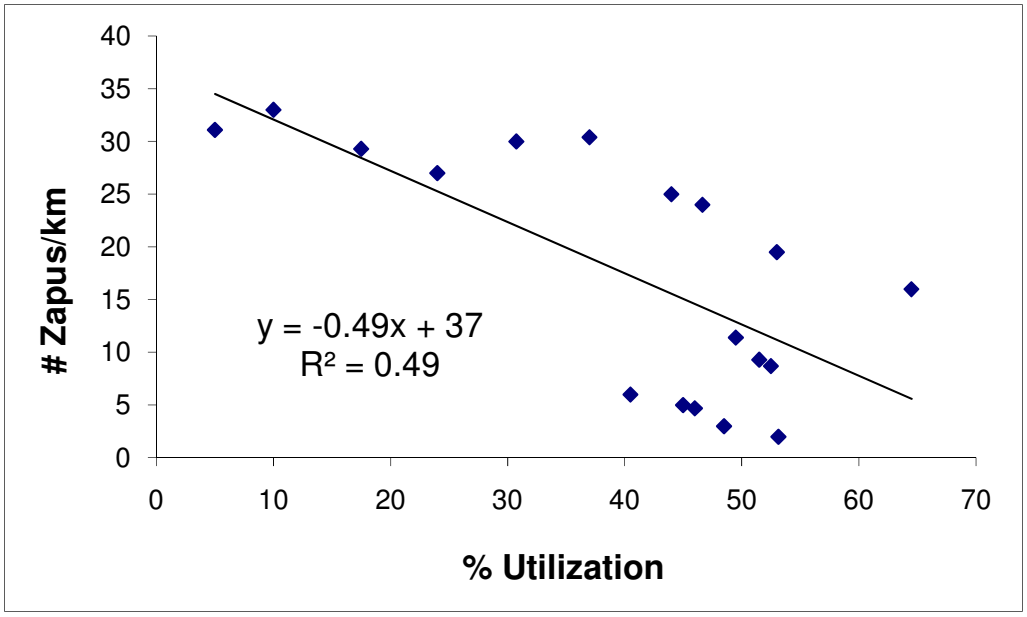


**Figure 7.** Density of Zapus as a function of Cheyenne precipitation in the same year. Data are from the Pole Mountain Unit transects from 2004-2008 on the Medicine Bow National Forest.