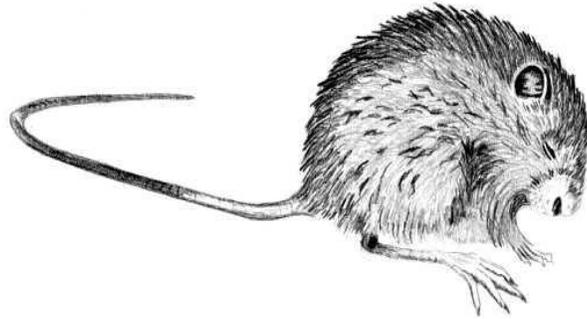


**SURVEY FOR PREBLE'S MEADOW JUMPING MICE
(*Zapus hudsonius preblei*) ON F.E. WARREN AIR FORCE
BASE, WYOMING:**



2013 PROJECT REPORT

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INTRODUCTION

This report details results of a small mammal survey targeting Preble's meadow jumping mouse (*Zapus hudsonius preblei*; hereafter Preble's) performed between 10 June and 12 July 2013, along Crow Creek on F.E. Warren Air Force Base (hereafter FEWAFB) near Cheyenne, Wyoming. This is the twelfth such survey performed by the Wyoming Natural Diversity Database (WYNDD; University of Wyoming) at this site (Garber 1995, Beauvais 1998, Keinath 2001, Dark-Smiley and Keinath 2002, Beauvais 2003b, Beauvais and Gruver 2004, Beauvais and Smith 2005a, b, Beauvais and Keinath 2007, Beauvais and Griscom 2009). These reports, in addition to Elliot (1996), Schuerman and Pague (1997), Travsky (1997), and Young et al. (2000) represent a total of fourteen years of Preble's surveys and research on FEWAFB.

As in previous reports, we acknowledge the ongoing taxonomic uncertainty of the Preble's subspecies and the difficulty of identifying *Zapus* to species and subspecies from physical characteristics alone by referring to individuals of *Zapus* documented on FEWAFB as "suspected" Preble's. Within the WYNDD database, there are a total of 46 *Zapus* occurrence records on FEWAFB. Of these, eight have undergone genetic analysis following the methods of King et al. (2006) (N=7) and Ramey et al. (2005) (N=1). Results of these analyses indicate that these eight *Zapus* captured on FEWAFB were in fact *Zapus princeps*, not *Zapus hudsonius* as would be expected (Bowe and Beauvais 2012). This should NOT be taken as evidence that all *Zapus* on FEWAFB are *Zapus princeps* as evidence suggests the two species may co-occur (Bowe and Beauvais 2012).

Preble's meadow jumping mouse is a relict subspecies isolated to riparian environments on the Front Range of the Rocky Mountains in southern Wyoming and northern Colorado, and has experienced population and range declines over the past few decades (Beauvais 2001, U.S. Fish and Wildlife Service 2002b, Beauvais 2003a, U.S. Fish and Wildlife Service 2008). Preble's was listed as Threatened under the U.S. Endangered Species Act in May 1998 (U.S. Fish and Wildlife Service 1998), with subsequent actions by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2001b, a, 2002b, a, 2008, 2011, 2012, 2013) modifying details of the taxon's status and management. Currently, Preble's is listed as Threatened by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2013)

Over the past 20 years there has been substantial controversy regarding the taxonomic validity of the subspecies, which has greatly complicated management and policy-making. One genetic study (Ramey et al. 2005) suggested that the taxon was not unique enough to retain subspecific status and recommended synonymy with other, more widespread subspecies of *Z. hudsonius*. However, a more recent genetic study (that included a re-evaluation and critique of Ramey et al. (2005)) concluded that the taxon is unique and should retain subspecific identity (King et al. 2006). The latter study is generally given precedence over the former by mammalogists and regional ecologists, and the U.S. Fish and Wildlife Service reinstated Threatened Status of the subspecies largely based on these findings.

Although these recent investigations clarify some of the taxonomic confusion regarding Preble's as a whole, there remains some uncertainty over the taxon in the northern portion of its range. Presumed Preble's in the North Platte River basin appear to overlap more in morphology, genetics, and range with western jumping mice (*Z. princeps*) than do presumed Preble's to the south (Long 1965, Clark and Stromberg 1987, Riggs et al. 1997, Conner and Shenk 2003), raising the possibility of species-level hybridization in the north (Hafner 1997, Pague and Grunau 2000, Schorr 2001, Beauvais 2003a).

The latest action by the U.S. Fish and Wildlife Service relevant to Preble's was to maintain the Threatened Status across all of the subspecies' range (U.S. Fish and Wildlife Service 2013). Prior to this, the U.S. Fish and Wildlife Service de-listed the subspecies in the Wyoming portion of its range, but retention of Threatened status in Colorado (U.S. Fish and Wildlife Service 2007, 2008). The main reason for the Wyoming de-listing was an assumed lower prevalence and severity of threats to the taxon in Wyoming relative to Colorado. Following this, Threatened status was reinstated across the subspecies range (U.S. Fish and Wildlife Service 2011).

The purpose of this work was to resume small mammal surveys that began on FEWAFB in 1995, with the specific intent of documenting the occurrence of suspected Preble's.

METHODS

Study area

Our work was conducted along Crow Creek on FEWAFB near the town of Cheyenne, Wyoming (Figure 1). Crow Creek is the only perennial stream on FEWAFB, and as such supports the primary corridor of habitat suitable for Preble's. Several studies have detailed the composition

and structure of vegetation in this area (Marriott and Jones 1988). Briefly, the Crow Creek corridor supports stands of willow (typically *Salix exigua*) with scattered cottonwoods (typically *Populus deltoides*), marshy areas dominated primarily by *Typha latifolia* and *Scirpus validus*, and herbaceous communities characterized by sedges (*Carex* spp.), Baltic rush (*Juncus balticus*), and several grasses. Adjacent uplands support true grasslands. Invasive weeds, most notably Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), houndstongue (*Cynoglossum officinale*), and crested wheatgrass (*Agropyron cristatum*), are abundant and widespread throughout FEWAFB in general and the Crow Creek corridor in particular.

Small mammal surveys

The study was designed primarily to determine the presence or absence of *Zapus* species on FEWAFB. As in previous years, we began by concentrating trapping efforts on Crow Creek above the Family Campground where suspected Preble's have been most reliably captured in the past.

Trapping surveys were conducted on 11 transects for four nights each placed along Crow Creek between 10 June and 12 July 2013 (Figure 2). Trapping methods followed guidelines established by the U.S. Fish and Wildlife Service (2004). Briefly, each transect consisted of two parallel lines of 25 Sherman live traps (one line on either side of the stream); traps were placed 5m apart and were less than 10m from a stream channel. All traps contained polyester bedding material, were baited with 3-way livestock feed, and were set in the evening and checked early the following morning. Captured animals were identified in the field and released at the capture site. Tissue samples were collected from *Zapus* captures and results will be posted as an addendum to this report when available. No animals deliberately sacrificed for specimen examination purposes. Animals that died in the traps were retained and later identified to species in the laboratory.

Disturbance of traps by raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*) has been a problem during past small mammal surveys on FEWAFB, and baited Tomahawk live traps have been employed to minimize such disturbance. Our general strategy has been to deploy Tomahawk traps only after substantial trap disturbance is recorded, to avoid unwittingly attracting predators to the trap lines.

RESULTS AND DISCUSSION

Small mammal trapping

Trapping was conducted over 8 nights for a total of 2,200 raw trap-nights. After accounting for disturbed traps damaged or moved by large animals (n=9), undisturbed traps that were closed but empty (n=62), and traps that captured animals (n=57), we estimated a corrected sampling effort of 2136 net trap-nights (using the technique of Beauvais and Buskirk (1999); Table 1).

Trap disturbance was very low in 2013. As a result, we did not deploy any Tomahawk traps, and no raccoons, skunks, or other medium-sized predators were captured.

In 2013, we observed a capture rate of 3.75 suspected Preble's / 1000 net trap-nights. This represents a relatively high capture rate (5th highest) when considering all surveys performed on FEWAFB since 1996 (Figure 3). We observed 27.16 total animal captures per 1000 net trap nights (Table 1). This represents a low capture rate compared to previous surveys. While entirely speculative, there are potential temporal and climatic explanations for this observation. First, surveys in 2013 occurred earlier in the year than in previous years. Typically, local small mammal densities increase through the summer season. Second, the Lower Platte River Drainage experienced below average precipitation in 2012, receiving only 63% of the 1885 – 2012 average water year precipitation (Wyoming State Climate Office Water Resources Data System 2013). In temperate ecosystems, small mammal densities are often reduced in the year following drought conditions (Thibault et al. 2010). It is important to note that capture rates of suspected Preble's was relatively high compared to previous years and did not follow patterns of observed capture rates of other small mammal taxa.

Fifty-eight individual small mammals were caught, representing four taxonomic groups: deer mice (*Peromyscus maniculatus*), jumping mice (*Zapus* sp.), voles (*Microtus* spp.), and shrews (*Sorex* spp.; Table 1). Deer mice were more abundant than voles in 2013, following the patterns recorded in 2005, 2006, and 2007, but opposite that of 2008.

From 14 years of surveys on FEWAFB, the annual abundances of voles and deer mice were significantly correlated (Pearson correlation coefficient 0.60, P=0.023); neither was correlated with abundance of suspected Preble's (*Zapus* X *Microtus* Pearson correlation coefficient -0.27, P=0.351; *Zapus* X *Peromyscus* Pearson correlation coefficient -0.068, P=0.812), nor was the combined abundance of voles and deer mice correlated with abundance of suspected Preble's (Pearson correlation coefficient -0.21, P=0.471). As noted by Dark-Smiley

and Keinath (2002), this lack of correlation generally supports Whitaker's (1972) contention that other species of small mammals do not limit jumping mice.

Beauvais (2003b) suggested that the abundances of these three taxa may be related via a threshold effect such that abundances of all three vary in concert with general environmental conditions and do not substantially influence one another during most years. Furthermore, during some years, the numbers of voles and deer mice increase greatly and suppress numbers of Preble's. The first part of this hypothesis - numbers of the three taxa vary in concert during most years - is not strongly supported by the data. Although numbers of deer mice and voles are positively correlated, neither correlate well with the relative abundance of suspected Preble's, even when years of unusually high deer mice and vole numbers (2000 and 2003) are removed from the analysis. The second part of the hypothesis - in some years numbers of voles and deer mice increase greatly and suppress numbers of Preble's - is supported by trapping data from 2000 and 2003, although more years of similar numbers will be needed before the pattern can be established with confidence. Alternatively, high capture rates of *Peromyscus* and *Microtus* may simply reduce the probability of capturing *Zapus*. It remains apparent that *Zapus* sp. populations on FEWAFFB are not limited by the same factors which limit vole and deer mouse populations.

The 2013 captures support the general habitat preferences outlined in more detail in previous years' reports. Jumping mice were found in dense and tall vegetation with some woody overstory, and apparently did not strongly avoid stands of exotic weeds. No effort was made in 2013 to more intensively analyze habitat selection by *Zapus* on FEWAFFB.

MONITORING RECOMMENDATIONS

The recent decision to retain the Threatened status of Preble's across its range (U.S. Fish and Wildlife Service 2013) highlights the need to continue monitoring the presence of the taxon on FEWAFFB. As with most listing/ de-listing decisions, it is possible that this decision may be challenged in court, and Preble's may be delisted again in Wyoming. Additionally, future declines in Wyoming populations, or increases in threats in Wyoming, would also support the continuation of Preble's Threatened Status. These are only a few of the many scenarios and information streams that managers must integrate in deciding on future monitoring efforts. It is not the intent of this report to advocate for either continuation or discontinuation of monitoring.

In the event that field surveys for suspected Preble's continue on FEWAFB, we recommend that they proceed in a standardized fashion utilizing the techniques outlined by the U.S. Fish and Wildlife Service (2004) and the transect system illustrated in Figure 2. As time and budget permit, we recommend splitting trapping efforts between areas where Preble's have been reliably captured in the past (transects 1-3, 7, 12 and 16; Figure 2) to document continued presence of *Zapus* on FEWAFB, and areas without previous captures to document local range expansion. We recognize that FEWAFB personnel may be pursuing specific projects that can be informed by trapping efforts, and that such projects may dictate where trapping takes place in any given year. Ideally, trapping should be conducted at about the same time every year, and efforts to minimize disturbance to traps (i.e. placing Tomahawk live traps for raccoon and striped skunk) should be employed. Results should be reported in the same manner every year, with special attention to reporting trapping effort as the number of net trap-nights (e.g. Beauvais and Buskirk 1999).

Pre-2006 trapping efforts were substantially affected by trap disturbance from raccoons, striped-skunks, and possibly feral cats, suggesting that depredation from such predators may significantly limit the distribution and abundance of several mammals and birds in the riparian habitats of FEWAFB. Predator disturbance during post-2006 has remained low, and consultations with FEWAFB staff may reveal whether this was a result of active predator control or other factors. It may be prudent to continue, or initiate, such control in the future.

As one of the largest areas of occupied habitat under a single management regime within the range of Preble's, FEWAFB should provide a unique opportunity to study population dynamics and habitat selection. However, the chronically low numbers of suspected Preble's captured here (Figure 3) suggests that a rather large amount of trapping effort would be needed to acquire the amount of data necessary for robust statistical analyses.

A more appropriate commitment of resources may be to continue monitoring *Zapus* while simultaneously attempting to improve habitat for and widen the distribution of the taxon on FEWAFB. This is the general approach forwarded by the FEWAFB management plan for Preble's meadow jumping mouse and Colorado butterfly plant (*Gaura neomexicana* var. *coloradensis*) (Grunau et al. 2004).

ACKNOWLEDGEMENTS

We extend our gratitude to Andy McKinley and Travis Beckwith of the 90th Civil Engineer Squadron Environmental Element at FEWAFB for logistical support. Field work was conducted by Claudia Strijek, Cormac Martinez del Rio, Wendy Estes-Zumpf, and Ian Abernethy, under the direct supervision of Ian Abernethy.

LITERATURE CITED

- Beauvais, G. P. 1998. Survey for Preble's meadow jumping mouse (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Wyoming, September 1998. Report prepared for the U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Beauvais, G. P. 2001. Preble's meadow jumping mouse (*Zapus hudsonius preblei*) in Wyoming: status report, July 2001. Report Prepared by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Beauvais, G. P. 2003a. Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) in Wyoming: Status report, July 2003. Wyoming Natural Diversity Database, University of Wyoming, Laramie, WY.
- Beauvais, G. P. 2003b. Survey for Preble's meadow jumping mouse (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Cheyenne, Wyoming - 2002 project report. Report prepared for the U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Beauvais, G. P., and S. W. Buskirk. 1999. Modifying estimates of sampling effort to account for sprung traps. *Wildlife Society Bulletin* 27.
- Beauvais, G. P., and H. Griscom. 2009. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Wyoming: 2008 project report. Report prepared for U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Beauvais, G. P., and J. Gruver. 2004. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Wyoming: 2003 project report. Report prepared for U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Beauvais, G. P., and D. Keinath. 2007. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Wyoming: 2006 project report. Report prepared for U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Beauvais, G. P., and H. Smith. 2005a. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Wyoming: 2004 project report. Report prepared for U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Beauvais, G. P., and H. Smith. 2005b. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Wyoming: 2005 project report. Report prepared for U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Bowe, A., and G. P. Beauvais. 2012. An assessment of species and subspecies of *Zapus* in Wyoming. Report prepared for the USDI Fish and Wildlife Service - Wyoming Field Office by the Wyoming Natural Diversity Database., University of Wyoming, Laramie, WY.
- Clark, T. W., and M. R. Stromberg. 1987. *Mammals in Wyoming*. University of Kansas Press, Lawrence, Kansas.
- Compton, S. A., and R. D. Hugie. 1993. Status report on *Zapus hudsonius preblei*, a Candidate Endangered subspecies. Report prepared for the USDI Fish and Wildlife Service by Pioneer Environmental Consulting Services, Logan, Utah.
- Conner, M. M., and T. M. Shenk. 2003. Distinguishing *Zapus hudsonius preblei* from *Zapus princeps* princeps by using repeated cranial measurements. *Journal of Mammalogy* 84:1456-1463.
- Dark-Smiley, D., and D. A. Keinath. 2002. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Cheyenne, Wyoming. Report prepared for U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- Elliott, A. G. 1996. Diversity and factors affecting diversity of small mammals, stream macroinvertebrates, reptiles and amphibians within F.E. Warren AFB, Cheyenne, Wyoming. M.S. Thesis, University of Wyoming.
- Garber, C. S. 1995. A status survey for Preble's jumping mouse (*Zapus hudsonius preblei*) in southeastern Wyoming, including F.E. Warren Air Force Base. Report prepared for the USDI Fish and Wildlife Service - Region 6 Office by the Wyoming Natural Diversity Database, Laramie, Wyoming.

- Grunau, L., R. Schorr, and J. Hankwerk. 2004. Conservation and Management plan for Colorado butterfly plant and Preble's meadow jumping mouse on F.E. Warren Air Force Base. Report prepared for the U.S. Air Force - F.E. Warren Air Force Base by the Colorado Natural Heritage Program - Colorado State University, Ft. Collins, Colorado.
- Hafner, D. J. 1997. Evaluation of the taxonomic, genetic, and conservation status of Preble's meadow jumping mouse, *Zapus hudsonius preblei*, and associated subspecies. Report prepared for the Colorado Division of Wildlife, Ft. Collins, Colorado.
- Keinath, D. A. 2001. Survey for Preble's meadow jumping mice (*Zapus hudsonius preblei*) on F.E. Warren Air Force Base, Cheyenne, Wyoming, 2000. Report prepared for U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database - University of Wyoming, Laramie, Wyoming.
- King, T. L., J. F. Switzer, C. L. Morrison, M. S. Eackles, C. C. Young, B. A. Lubinski, and P. Cryan. 2006. Comprehensive genetic analyses reveal evolutionary distinction of a mouse (*Zapus hudsonius preblei*) proposed for delisting from the US Endangered Species Act. *Molecular Ecology* 15.
- Long, C. A. 1965. *The Mammals of Wyoming*. University of Kansas Museum of Natural History Publication, Lawrence, Kansas.
- Marriott, H., and G. P. Jones. 1988. Preserve design package for a proposed Colorado Butterfly Plant Research Natural Area. Report prepared for the U.S. Air Force - F.E. Warren Air Force Base by the Wyoming Natural Diversity Database, Laramie, Wyoming.
- Pague, C., and L. Grunau. 2000. Factbook on the Preble's meadow jumping mouse (*Zapus hudsonius preblei*): 9 January 2000 draft. Preble's Meadow Jumping Mouse Science Team, Boulder, Colorado.
- Ramey, R. R., H.-P. Liu, C. W. Epps, L. M. Carpenter, and J. D. Wehausen. 2005. Genetic relatedness of the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) to nearby subspecies of *Z. hudsonius* as inferred from variation in cranial morphology, mitochondrial DNA and microsatellite DNA: implications for taxonomy and conservation. *Animal Conservation* 8.
- Riggs, R. R., J. M. Dempcy, and C. Orrego. 1997. Evaluating distinctness and evolutionary significance of Preble's meadow jumping mouse: phylogeography of mitochondrial DNA non-coding region variation. Colorado Division of Wildlife, Denver, Colorado.
- Schorr, R. A. 2001. Meadow jumping mice (*Zapus hudsonius preblei*) on the U. S. Air Force Academy El Paso County, Colorado. U.S. Air Force Academy, Colorado.
- Schuerman, P. T., and C. A. Pague. 1997. Natural Heritage targeted inventory for the Preble's meadow jumping mouse: *Zapus hudsonius preblei*. Report prepared for the U.S. Air Force - F.E. Warren Air Force Base by the Colorado Natural Heritage Program, Ft. Collins, Colorado.
- Thibault, K. M., S. K. M. Ernest, E. P. White, J. H. Brown, and J. R. Goheen. 2010. Long-term insights into the influence of precipitation on community dynamics in desert rodents. *Journal of Mammalogy* 91:787-797.
- Travsky, A. L. 1997. F.E. Warren Air Force Base: surveys for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*). Report prepared for the U.S. Air Force - F.E. Warren Air Force Base by Real West Natural Resource Consulting, Laramie, Wyoming.
- U.S. Fish and Wildlife Service. 1998. Endangered and Threatened Wildlife and Plants; Final rule to list the Preble's meadow jumping mouse as a threatened species. *Federal Register* 63.
- U.S. Fish and Wildlife Service. 2001a. Endangered and Threatened Wildlife and Plants: final special regulations for the Preble's meadow jumping mouse. *Federal Register* 66:28125-28131.
- U.S. Fish and Wildlife Service. 2001b. Endangered and Threatened Wildlife and Plants: proposed special regulations for the Preble's meadow jumping mouse. *Federal Register* 66:45829-45833.
- U.S. Fish and Wildlife Service. 2002a. Draft environmental assessment: proposal of critical habitat for Preble's meadow jumping mouse. U.S. Fish and Wildlife Service Ecological Services Office, Cheyenne, Wyoming.
- U.S. Fish and Wildlife Service. 2002b. Endangered and Threatened Wildlife and Plants: designation of critical habitat for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*); proposed rule. Pages 47154-47210, *Federal Register*.
- U.S. Fish and Wildlife Service. 2008. Endangered and Threatened Wildlife and Plants; Final rule to amend the listing for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) to specify over what portion of its range the subspecies is threatened. *Federal Register* 73.
- U.S. Fish and Wildlife Service. 2011. Endangered and threatened wildlife and plants; Reinstatement of listing protections for the Preble's meadow jumping mouse. *Federal Register* 76.

- U.S. Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; Initiation of status review and 5-year review of the Preble's meadow jumping mouse. Federal Review 77.
- U.S. Fish and Wildlife Service. 2013. Endangered and threatened wildlife and plants; 12-month finding on two petitions to delist the Preble's meadow jumping mouse. Federal Register 78:31680-31712.
- U.S. Fish and Wildlife Service Mountain-Prairie Region. 2004. Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) survey guidelines. United States Fish and Wildlife Service, <http://www.fws.gov/mountain-prairie/species/mammals/preble/CONSULTANTS/SCPindex.htm>.
- Whitaker, J. O., Jr. 1972. *Zapus hudsonius*. Mammalian Species No. 11:1-7.
- Wyoming State Climate Office Water Resources Data System. 2013. Wyoming Precipitation Charts and Data. http://www.wrds.uwyo.edu/sco/data/divisional_precip/WaterYr_5yrRun_LowerPlatte.csv.
- Young, D. P., W. P. Erickson, and J. C. Gruver. 2000. Investigation of management and effects of structure, composition and distribution of riparian vegetation on Preble's meadow jumping mouse: 1999 annual survey and habitat selection study. Report prepared for the U.S. Air Force - F.E. Warren Air Force Base by Western Ecosystems Technology Incorporated, Cheyenne, Wyoming.

TABLES

Table 1. Summary of small mammal captures along Crow Creek on F.E. Warren Air Force Base, Wyoming, 2013. Numbers in parentheses are captures per 1000 net trap-nights.

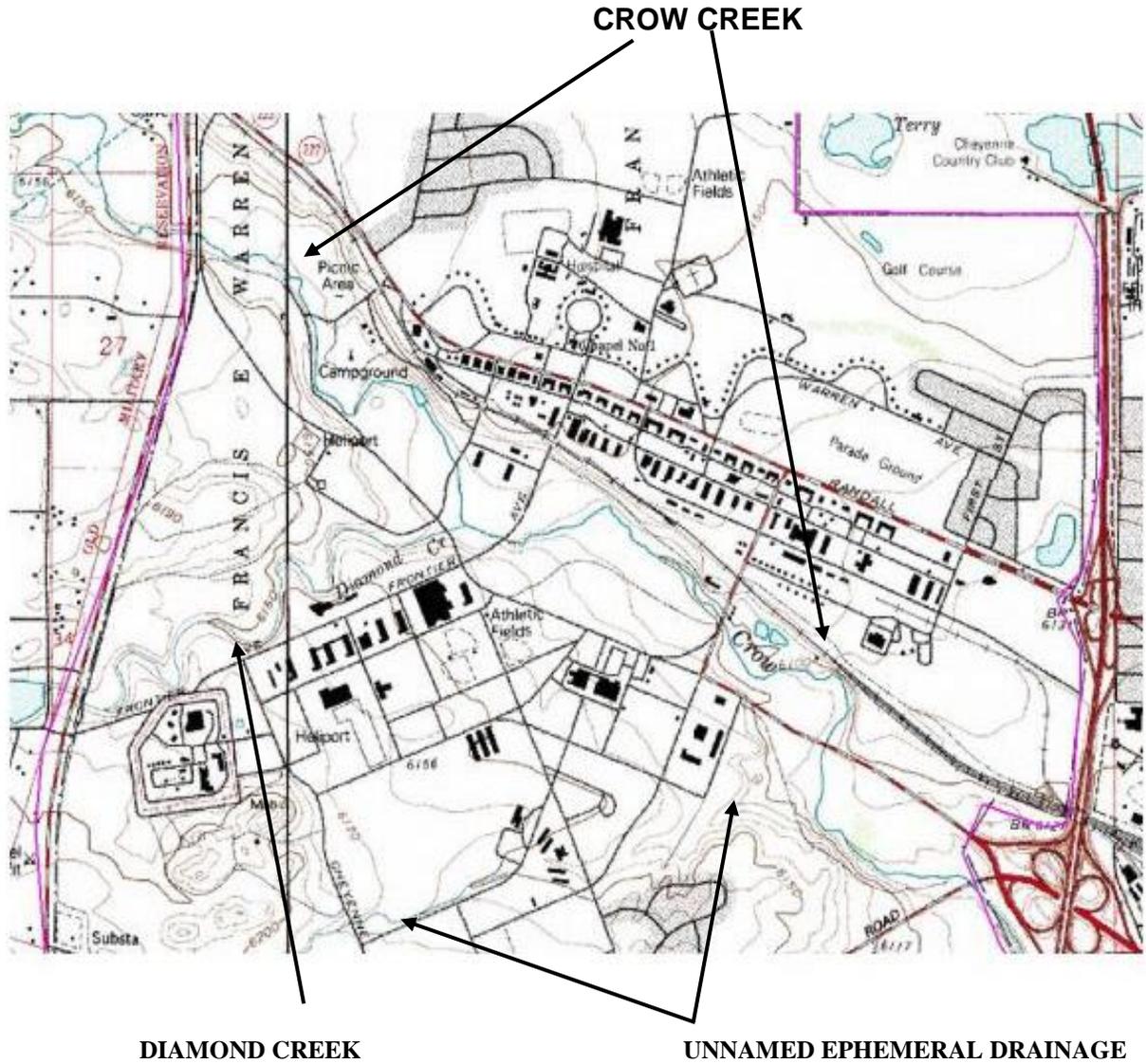
Species	Transect											Total
	1	2	3	4	6	7	8	9	10	11	12	
Jumping mouse (<i>Zapus</i> sp.) ^a	5	3	0	0	0	0	0	0	0	0	0	8
Vole (<i>Microtus</i> spp.)	0	0	0	2	0	3	3	1	0	9	1	19
Deer mouse (<i>Peromyscus maniculatus</i>)	1	0	6	1	0	4	0	5	9	3	0	29
Shrews (<i>Sorex</i> spp.) ^b	0	0	0	0	0	0	0	0	1	0	0	1
Total captures	6	3	6	3	0	7	3	6	10	12	1	
Raw trap-nights	200	200	200	200	200	200	200	200	200	200	200	2200
Net trap-nights [raw -(0.5 * sprung traps)]	194.5	193	193.5	195	195.5	191.5	197	194.5	192.5	190	198	2136

a) *Zapus* sp. here are assumed to be Preble's meadow jumping mice (*Z. hudsonius preblei*), based primarily on geographic location. Genetic analyses indicate that *Z. princeps* occurs on FEWAFB

b) *Sorex* spp. were identified only to genus in the field. In previous years, all trap mortalities were later keyed to dusky shrew (*Sorex monticolus*).

FIGURES

Figure 1. F. E. Warren Air Force Base, Wyoming. Major riparian corridors denoting potential Preble's habitat are noted.
(— = base boundary).



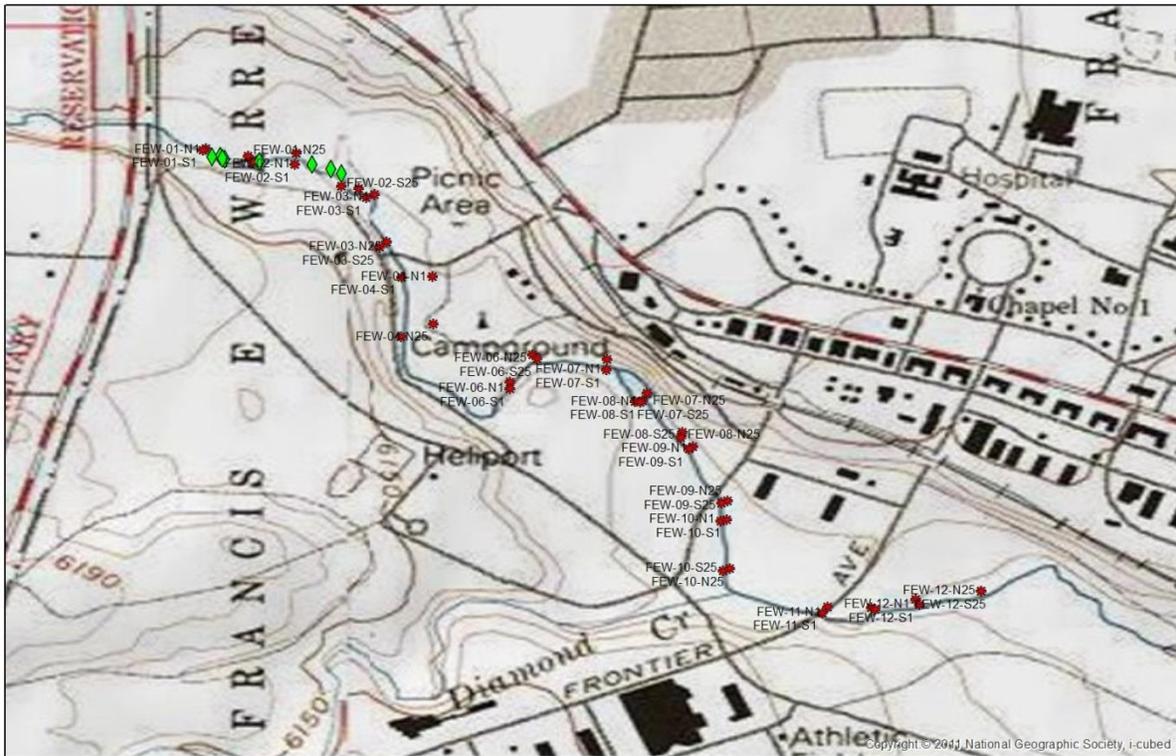


Figure 2. Distribution of survey effort and captures of suspected Preble's mice (*Zapus hudsonius preblei*) on F. E. Warren Air Force Base, Wyoming in 2013.

Legend

- * FEWAFB Transects
- ◆ Zapus captures

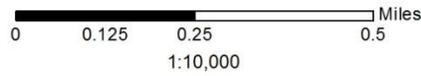
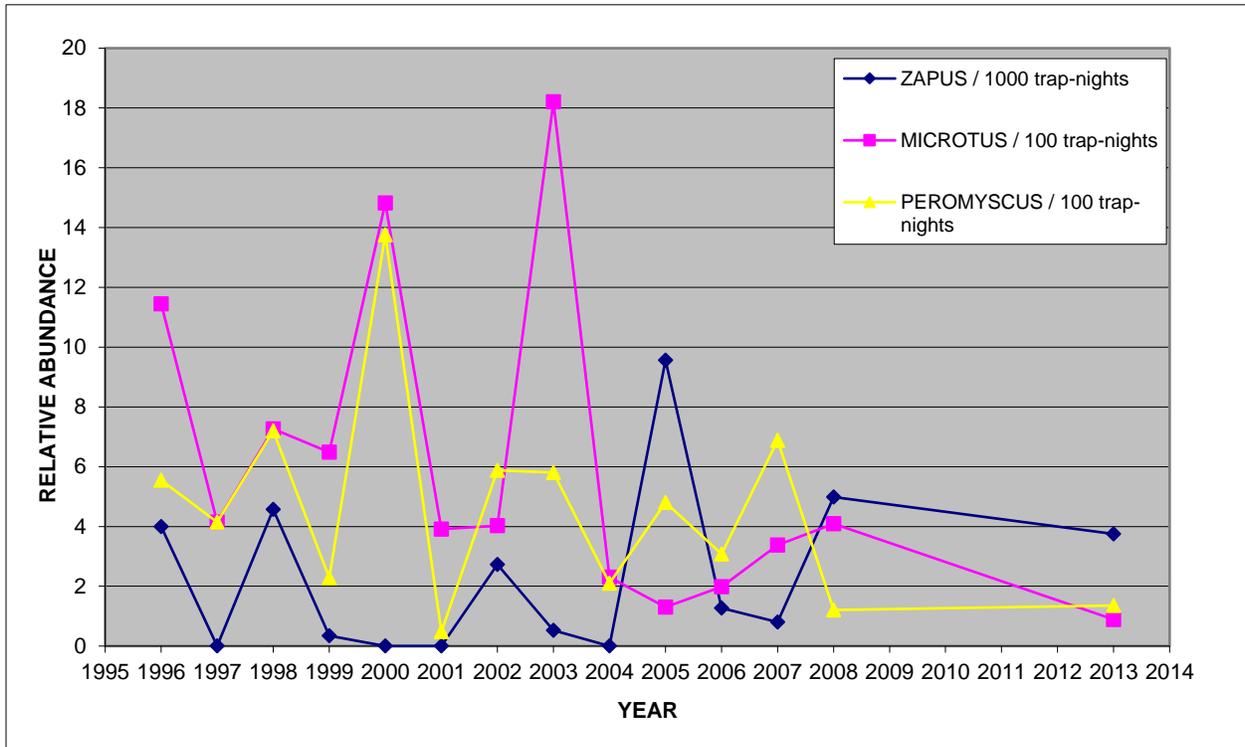


Figure 3. Annual small mammal capture rates on F.E. Warren Air Force Base, Wyoming. ^a



^a) Includes all years for which complete survey data are available ((Schuerman and Pague 1997, Travsky 1997, Beauvais 1998, Young et al. 2000, Keinath 2001, Dark-Smiley and Keinath 2002, Beauvais 2003b, Beauvais and Gruver 2004, Beauvais and Smith 2005b, a, Beauvais and Keinath 2007, Beauvais and Griscom 2009), and this report. Studies of jumping mice in southeast Wyoming took place from 1993 to 1995, sometimes including F.E. Warren Air Force Base, but no *Zapus* were found there during this period and capture rates for other taxa were not reported (e.g., (Compton and Hugie 1993, Garber 1995).