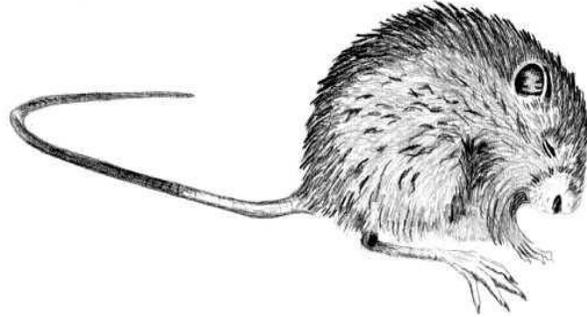


**SURVEY FOR PREBLE'S MEADOW JUMPING MICE
(*Zapus hudsonius preblei*) ON F.E. WARREN AIR FORCE
BASE, WYOMING:**



2014 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 4 August and 15 August 2014, on F.E. Warren Air Force Base (hereafter FEWAFB) near Cheyenne, Wyoming. This is the 13th 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, Abernethy and Beauvais 2014). These reports, in addition to Elliot (1996), Schuerman and Pague (1997), Travsky (1997), and Young et al. (2000) represent a total of 15 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 63 *Zapus* occurrence records on FEWAFB. Of these, 22 have undergone genetic analysis following the methods of King et al. (2006) (N=21) and Ramey et al. (2005) (N=1). Results of these analyses indicate that these 22 *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 and an unnamed tributary of 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 concentrated trapping efforts on Crow Creek above the Family Campground where suspected Preble's have been most reliably captured in the past. Additionally, we directed additional effort across previously established trapping transects within riparian habitats suitable for jumping mice but where suspected Preble's have not been documented in previous surveys.

Trapping surveys were conducted on 12 transects for four nights each placed along Crow Creek and the unnamed tributary between 4 August and 8 August 2014, and along Crow Creek in the vicinity of the Family Campground between 11 August and 15 August 2014 (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 2,400 raw trap-nights. After accounting for disturbed traps damaged or moved by large animals (n=58), undisturbed traps that were closed but empty (n=118), and traps that captured animals (n=701), we estimated a corrected sampling effort of 1,958.5 net trap-nights (using the technique of Beauvais and Buskirk (1999); Table 1).

Trap disturbance was relatively high in 2014. As a result, we deployed 2 Tomahawk live-traps between transects 19 and 20 for three consecutive nights but no raccoons, skunks, or other medium-sized predators were captured.

In 2014, we captured a total of 17 unique individual suspected Preble's. We observed a capture rate of 12.76 suspected Preble's / 1000 net trap-nights. This represents the highest capture rate ever when considering all surveys performed on FEWAFB since 1996 (Figure 3). We observed 357.93 total animal captures per 1000 net trap nights (Table 1). This represents the highest capture rate among all previous surveys. While entirely speculative, there are potential temporal and climatic explanations for this observation. First, surveys in 2014 occurred later in the year than in previous years. Typically, local small mammal densities increase through the summer season. Second, the Lower Platte River Drainage experienced above average precipitation in 2013, receiving over 105% of the 1885 – 2013 average water year precipitation (Wyoming State Climate Office Water Resources Data System 2014). In temperate ecosystems, small mammal densities are often reduced in the year following drought conditions and vice-versa (Thibault et al. 2010). It is important to note that capture rates of suspected Preble's was extraordinarily high compared to previous years, following patterns of observed capture rates of other small mammal taxa.

A total of 698 individual small mammals were caught, representing six taxonomic groups: deer mice (*Peromyscus maniculatus*), jumping mice (*Zapus* sp.), voles (*Microtus* spp.), least chipmunk (*Tamias minimus*), western harvest mice (*Reithrodontomys megalotis*), and shrews (*Sorex* spp.; Table 1). Only one least chipmunk and one western harvest mouse was

captured and are not referenced further. Voles were more abundant than deer mice in 2014, opposite of the pattern observed in 2013.

From 15 years of surveys on FEWAFB, the annual abundances of voles and deer mice were significantly correlated (Pearson correlation coefficient 0.73, $P=0.002$). However, the annual abundances of the major taxonomic groups of small mammals were not correlated with abundance of suspected Preble's (*Zapus X Microtus* Pearson correlation coefficient 0.24, $P=0.415$; *Zapus X Peromyscus* Pearson correlation coefficient 0.397, $P=0.158$), nor was the combined abundance of voles and deer mice correlated with abundance of suspected Preble's (Pearson correlation coefficient 0.32, $P=0.258$). 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 significantly 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, 2003, and 2014) 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, but not by trapping data from 2014. Alternatively, high capture rates of *Peromyscus* and *Microtus* may simply reduce the probability of capturing *Zapus*. This may be supported by trapping data from 2014, where vole and deer mouse abundance was much higher downstream of where Preble's are reliably captured but relatively low where Preble's have been captured in the past. It remains apparent that *Zapus* sp. populations on FEWAFB are not limited by the same factors which limit vole and deer mouse populations.

The 2014 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 2014 to more intensively analyze habitat selection by *Zapus* on FEWAFB.

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 FEWAFB. 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 relatively low along most, but not all, transects. 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).

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TABLES

Table 1. Summary of small mammal captures along Crow Creek on F.E. Warren Air Force Base, Wyoming, 2014.

Species	Transect												Totals
	1	2	3	4	5	6	15	16	17	18	19	20	
<i>Zapus</i> ^a	14	8	2	0	1	0	0	0	0	0	0	0	25^b
<i>Microtus</i> spp. ^c	18	21	5	7	22	12	29	72	52	29	89	23	379
<i>Peromyscus maniculatus</i>	32	18	18	5	10	17	29	53	31	39	29	5	286
<i>Sorex</i> spp. ^d	0	1	0	0	0	0	1	1	1	0	1	3	8
Total captures	64	48	25	12	33	29	59	126	84	68	119	31	698
Raw trap-nights	200	200	200	200	200	200	200	200	200	200	200	200	2400
Net trap-nights ^e	165.5	169.5	180	187	177	172	164	130	146	156.5	132	179	1958.5

^a *Zapus* spp. 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 A total of 17 unique *Zapus* were captured in 2014.

^c *Microtus* spp. Include all vole species in the genus.

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

^e Net trap-nights is calculated using the following formula: [raw trap-nights -(0.5 * sprung traps)].

FIGURES

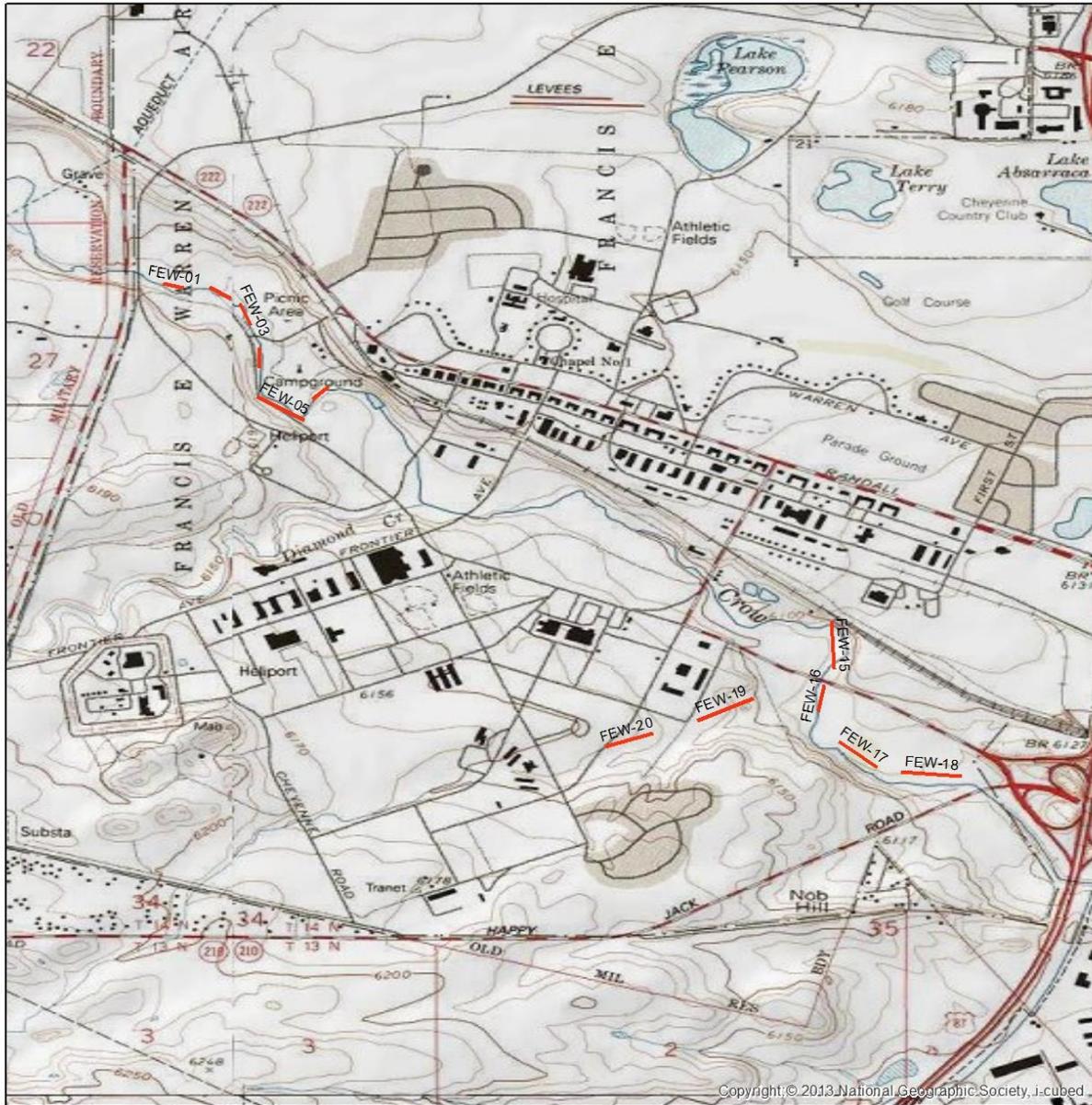
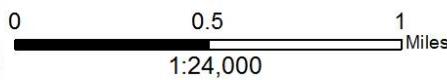
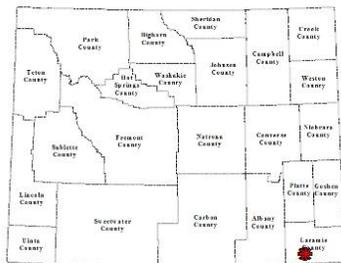


Figure 1. Map of live-trapping transects on F.E. Warren Air Force Base, Wyoming.



Legend

 Live-trapping Transects



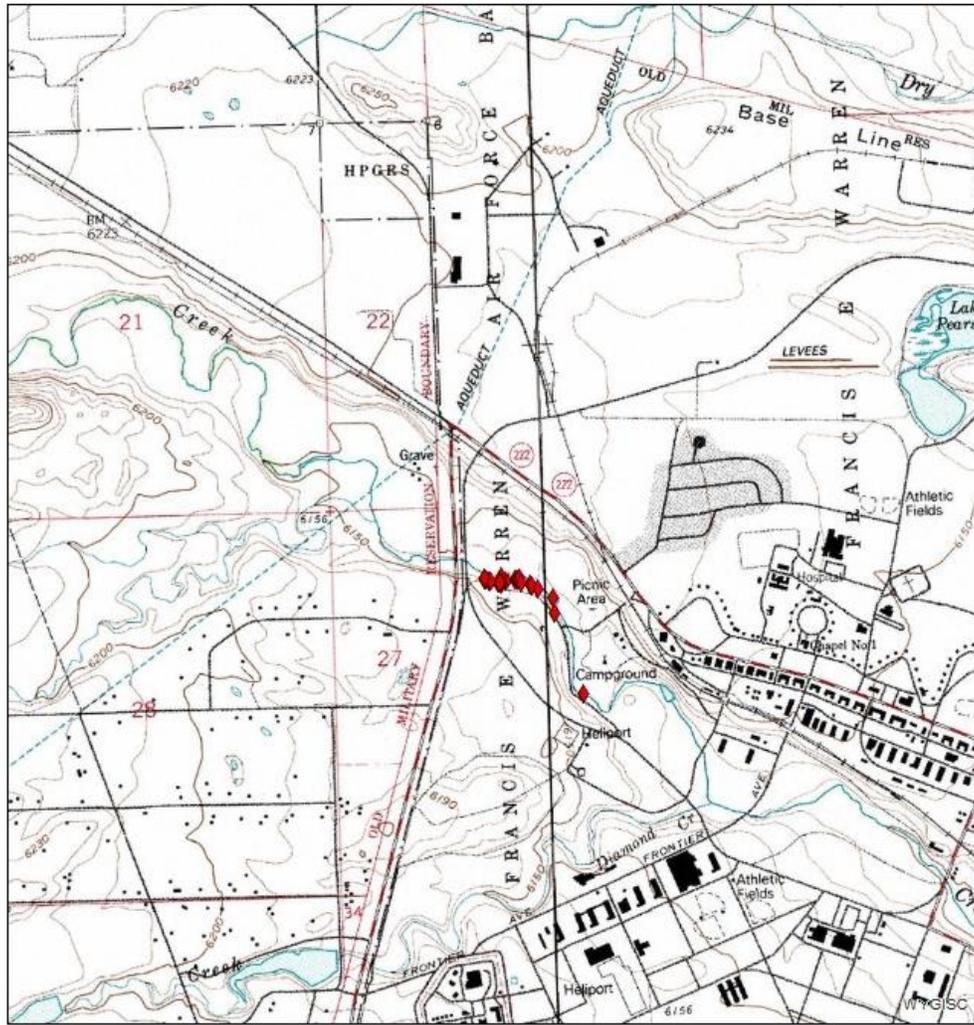
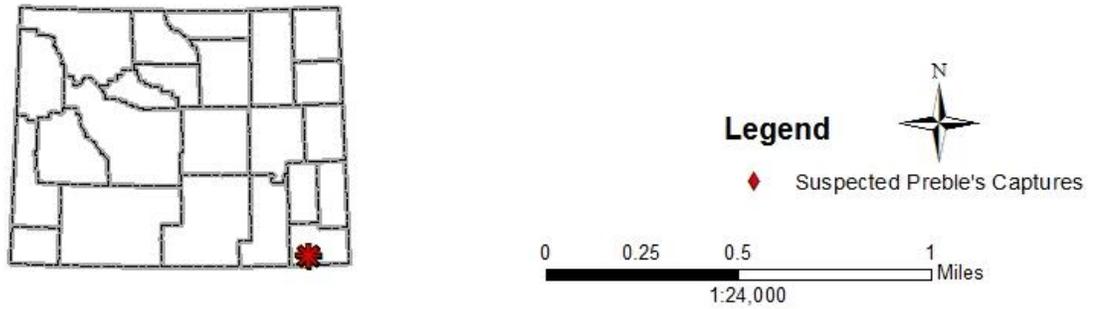


Figure 2. Suspected Preble's captures on FE Warren Air Force Base, Wyoming.



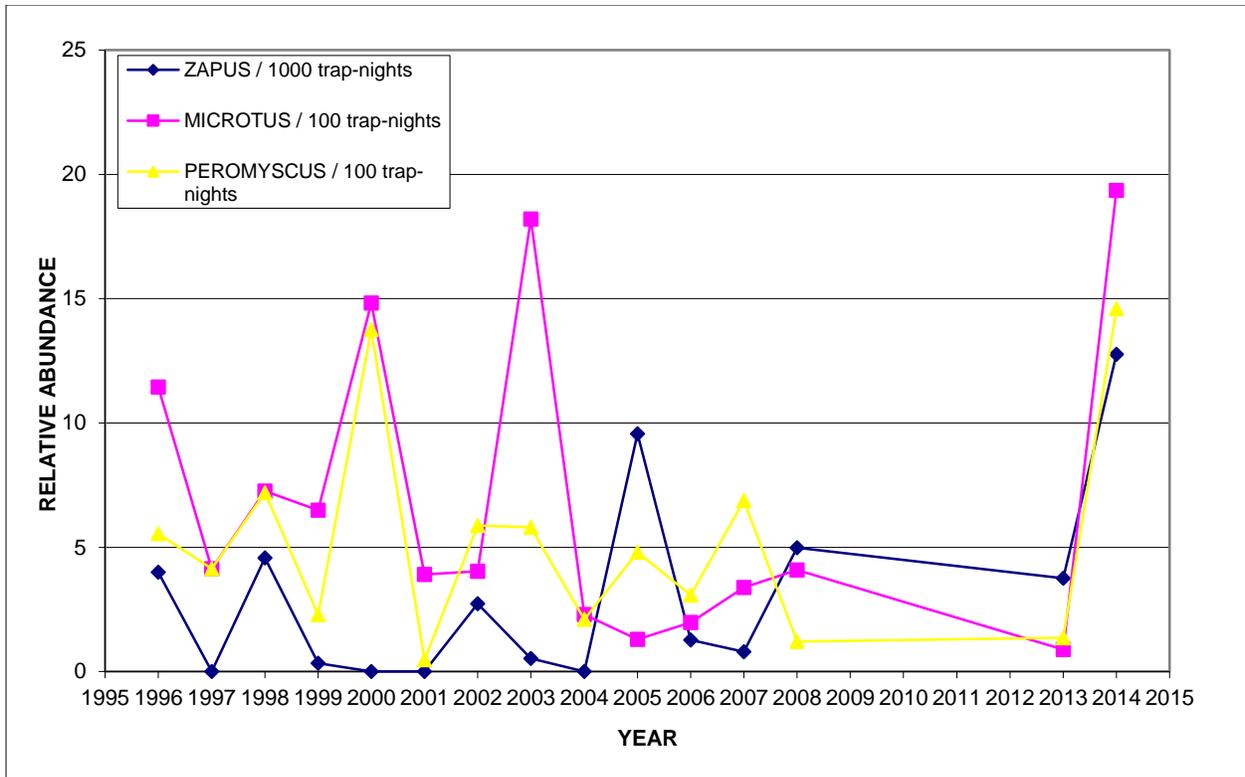


Figure 3. Annual small mammal capture rates on F.E. Warren Air Force Base, Wyoming. ^a

^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, Abernethy and Beauvais 2014), 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).