

Supplemental Text S1

History of studies reporting records of *Zapus hudsonius luteus* in the White Mountains, Arizona

The first records of *Z. h. luteus* in Arizona were 3 locations in the White Mountains reported by Hall and Davis (1934; sites 12 and 17), although two of those likely referred to the same location (Hannagan Creek, 8,200 ft elevation; Frey 2011). Over the next ca 50 years, subsequent taxonomic revisions and regional faunal studies reported specimens from eight additional locations (sites 1, 2, 4, 6, 16, 19, 20, 21; Krutzsch 1954, Cockrum 1960, Hafner et al. 1981, Hoffmeister 1986). Due to differences in locality descriptions, it was not always possible to determine if records were from the exact same location or not. For instance, site 12 includes 4 different locality descriptions, and while all appear to be from the same river and same general vicinity, it is possible that the actual collection locations were different. Duszynski et al. (1982) examined coccidian parasites from 13 wild-captured *Z. h. luteus* from Apache County, Arizona, which are almost certainly the same series of specimens reported by Hafner et al. (1981) from site 12. Haldeman et al. (1978) surveyed small mammals at 12 sites representing 6 different vegetation types; *Z. h. luteus* was documented at one of the two riparian sites (site 3). Hoffmeister's (1986) monograph on the mammals of Arizona failed to report several known records, including those published by Hall and Davis (1934) as well as museum specimens from sites 9 and 10.

Beginning in the 1980s several field studies occurred that attempted to provide information on distribution and status of *Z. h. luteus* in the White Mountains (Mills 1981, Dodd 1987, Morrison 1991, Koloszar and Ingraldi 1997). However, most of those studies did not adequately document survey methods or results making it difficult to glean complete and accurate information from those resources. In 1981 the Arizona Heritage Program evaluated potential habitat for *Z. h. luteus* at 17 riparian areas, which including most historical locations then known (Mills 1981). Although no detailed methods or results were provided, apparently trapping occurred at some sites and specimens of *Z. h. luteus* were collected at three new sites (site 5, 11, 18; at least one historical location [site 6] was trapped unsuccessfully). In 1987 the Arizona Game and Fish Department (AGFD) conducted a study at two sites (site 4 [moderate grazing] and site 10 [no grazing area and heaving grazing area]) to evaluate relationships between small mammal diversity with livestock grazing and riparian condition (Dodd 1987). Jumping mice were captured at both sites (ungrazed area of site 10) and there was a positive relation between riparian condition with diversity and abundance of the small mammal community and abundance of *Z. h. luteus* (Dodd 1987).

The first intensive field survey aimed at determining the distribution of *Z. h. luteus* in the White Mountains included surveys at 24 sites using 4,527 trap-nights (trap-night is a measure of effort wherein one trap-night is equivalent to one trap set for one night) during 1991 (Morrison 1991). Specific locations surveyed during that study could not always be determined, but it appears sampling occurred at two of the then known historical locations (site 4 and 6) and at 20 new sites with potential habitat. Morrison's survey location on Hannagan Creek was not at the historical site. Morrison regarded site 8 as historical but I found no evidence of a prior record from this location. Hoffmeister (1986) mentioned a specimen from the East Fork of the Black River, but he did not include such a specimen in his list of specimens examined and no such

specimens was found by me during my museum queries (see Methods). It is possible that this was a lapses and that Hoffmeister was referring to a specimen taken from either the West Fork of the Black River or the East Fork of the Little Colorado River. Morrison captured *Z. h. luteus* at five (21%) of the 24 sites sampled, including one historical site (site 6) and four new sites (sites 7, 8, 13, 14). Morrison (1991) concluded that the species had disappeared from many areas of its former range, that remaining populations appeared small and fragmented, and that some areas of seemingly suitable habitat were not occupied by the species. She identified livestock grazing as the primary cause for this decline, although she noted that recreation also might be a factor. During 1995-1996 AGFD conducted surveys for *Z. h. luteus* using 2,769 trap-nights at 16 study areas (Kolozsar and Ingraldi 1997). Detailed information on survey locations in that study were not reported, but it appears at least some of the sites had been previously surveyed by Dodd (1987) and Morrison (1991). *Z. h. luteus* was captured at four of the 16 sites, of which three appear to have been taken at historical sites (sites 8, 10, 14). However, I believe the fourth location (site 15) was new despite their claims it was a historical sites.

During 2006-2007 AGFD conducted limited surveys for *Z. h. luteus* at historical locations (J. Underwood, Arizona Department of Game and Fish, personal communication). During 2006 Underwood surveyed eight historical locations where recent workers (Mills 1981, Dodd 1987, Morrison 1991) had captured jumping mice (sites 4, 5, 6, 7, 8, 10, 13, 14), but jumping mice were only captured at one (site 8). During 2007, jumping mice were again captured at Three Forks, as well as at another historical location (site 12); however, the number and location of any other surveys is unknown. *Z. h. luteus* is difficult to capture and survey effort at sites during 2006-2007 may not have been intensive enough to establish absence (J. Underwood, Arizona Department of Game and Fish, personal communication).

Results of the current study were first reported in Frey (2011). Results included a complete review of all museum specimens and other reports of *Z. h. luteus* from Arizona, field surveys at 33 survey sites using 10,706 trap-nights during 2008-2009, and analysis of quantitative habitat data at capture and non-capture sites. I documented 123 prior records of *Z. h. luteus* from ca 21 locations in the White Mountains and captured *Z. h. luteus* at 12 locations, including six of 12 historical locations surveyed (sites 7, 8, 10, 11, 13, 14) and six new locations (sites E, K, L, M, O, Q). A confidentiality agreement with Arizona Game and Fish Department precludes reporting details about capture locations. The Arizona Game and Fish Department maintains a confidential file associated with the Frey (2011) report that contains details for all museum specimens other records of *Z. h. luteus*, and the survey sites and capture locations of all *Z. h. luteus* during the current study.

References

- Cockrum EL. 1960. The Recent mammals of Arizona. Tucson: The University of Arizona Press
- Dodd, N. 1987. Riparian mammal, live trapping results, relationships to riparian conditions. Phoenix: Arizona Game and Fish Department. Unpublished report.
- Duszynski DW, Eastham G, Yates TL. 1982. *Eimeria* from jumping mice (*Zapus* spp.: a new species and genetic and geographic features of *Z. hudsonius luteus*. Journal of Parasitology 68:1146-1148.
- Frey JK. 2011. Inventory of the meadow jumping mouse in Arizona. Report to Arizona Game and Fish, Phoenix. Reference R2.

- Hafner DJ, Petersen KE, Yates TL. 1981. Evolutionary relationships of jumping mice (Genus *Zapus*) of the southwestern United States. *Journal of Mammalogy* 62:501-512.
- Haldeman JR, Bartmess GG, Czapski N. 1978. Non-game wildlife inventory in eight vegetation types within the Little Colorado land use Planning Area, Apache-Sitgreaves National forest, Apache and Navajo Counties, Arizona. Report to Apache-Sitgreaves National Forest.
- Hall ER, Davis WB. 1934. Notes on Arizona rodents. *Proceedings of the Biological Society of Washington* 47:51-56.
- Hoffmeister DF. 1986. *Mammals of Arizona*. Tucson: University of Arizona Press.
- Kolozar JG, Ingraldi MF. 1997. Summary report for water shrew and jumping mouse surveys conducted in the White Mountains of eastern Arizona (1995 and 1996). Pinetop, Arizona: Arizona Game and Fish Department. Unpublished report.
- Krutzsch, P.H. 1954. North American jumping mice (Genus *Zapus*). *University of Kansas Publications, Museum of Natural History* 7:349-472.
- Mills GS. 1981. Areas with apparently suitable habitat for *Zapus princeps* and evaluation of areas where they have been caught previously. Phoenix: Arizona Heritage Program. Unpublished report.
- Morrison JL. 1991. Distribution and status of the meadow jumping mouse, *Zapus hudsonius luteus* on the Apache-Sitgreaves National Forest, 1991. Report to Apache-Sitgreaves National Forest.

Table 1 in Supplemental Text S1. Chronology of studies pertaining to the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) in the White Mountains, Arizona.

Citation	Type of study	Notes	Field Survey Results		
			Number of riparian sites surveyed	Number of locations where <i>Z. h. luteus</i> captured	Total effort (trap-nights)
Hall and Davis (1934)	Synopsis of existing museum specimens	Reported 11 specimens (as <i>Zapus luteus luteus</i>) from 3 locations; 2 of the reported locations likely were the same site			
Krutzsch (1954)	Taxonomic revision	Assigned <i>Z. luteus</i> as a subspecies of the western jumping mouse, <i>Z. princeps luteus</i>			
Cockrum (1960)	Synopsis of existing museum specimens	Reported 4 locations based on 43 specimens			
Haldeman et al. (1978)	Field surveys of small mammals in 8 vegetation types	Study included 2 riparian sites of 16 total sites	2	1	3,000
Hoffmeister (1986)	Synopsis of existing museum specimens	Reported 63 specimens from 9 locations (considering Alpine at 8,000 ft and 8,500 ft elevation as separate locations). Did not include some prior museum and published records.			
Hafner et al. (1981)	Taxonomic revision	Included specimens from 3 locations in White Mountains. Reassigned <i>luteus</i> as subspecies of <i>Z. hudsonius</i>			
Mills (1981)	Field survey for <i>Z.h. luteus</i>	Study details not fully reported. Evaluated 17 sites for potential habitat. Trapped at least 4 sites, with a museum specimen collected from each of 3 sites.	4	3	unknown
Dodd (1987)	Field study on effects of livestock grazing on riparian small mammals	Study details not fully reported.	2 (one site with two study areas)	2	ca 840
Morrison (1991)	Field survey for <i>Z.h. luteus</i>		24	5	4,527

Kolozar and Ingraldi (1997)	Field survey for <i>Z.h. luteus</i> and <i>Sorex palustris</i>	Details on survey locations not reported.	16	4	2,769
J. Underwood, Arizona Game and Fish Department, personal communication	Field survey for <i>Z.h. luteus</i>	Study details not fully reported.	ca 9	2	ca 740
Current	Field survey for <i>Z.h. luteus</i>		33	12	10,706