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DISTRIBUTION OF THE NORTHERN PYGMY MOUSE (*BAIOMYS TAYLORI*) IN SOUTHWESTERN NEW MEXICO, WITH NOTES ON REPRODUCTION

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ABSTRACT

The Northern Pygmy Mouse (*Baiomys taylori*) occurs from central Mexico north to southwestern and south-central parts of the United States. In Texas and New Mexico, the distribution of *B. taylori* likely has expanded into formerly unoccupied areas during recent decades. Herein, we report on new localities of occurrence for *B. taylori* in Grant, Hidalgo, and Luna counties, New Mexico, that increase its distribution over 100 km from previously published records in the state. Previously, little was known about reproductive aspects of this mouse in New Mexico. We documented that reproduction occurs at least from March to October in the state, corresponding best with populations in western Texas rather than in more southerly populations that reproduce throughout the year. Additional surveys in grassy habitats in southeastern Arizona, southwestern New Mexico, and eastern New Mexico likely will show that distributional limits of this mouse are more widespread than currently known.

Key words: *Baiomys taylori*, distribution, New Mexico, Northern Pygmy Mouse, reproduction

INTRODUCTION

The Northern Pygmy Mouse (*Baiomys taylori*) is one of the smallest rodents in North America, inhabiting grassland communities from south-central Mexico north to Texas, southeastern Arizona, and southwestern New Mexico (Hall 1981; Eshelman and Cameron 1987). The two northernmost populations in the United States are widely separated and represented by two subspecies, *B. t. ater* in New Mexico and Arizona and *B. t. taylori* in central and western Texas (Eshelman and Cameron 1987; Schmidly and Bradley 2016). In recent decades, distributional limits have expanded in northern parts of its range into new states such as Louisiana (Stevens 2015) and Oklahoma (e.g., Stangl

and Dalquest 1986; Roehrs et al. 2008) and into new regions of states, such as New Mexico (Stuart and Scott 1992) and Texas (e.g., Choate 1997; Green and Wilkins 2010; Schmidly and Bradley 2016). Expansion into formerly unoccupied areas presumably has been associated with various factors including a shift in climate, creation of grassy habitats along roadsides and railroad right-of-ways, and establishment of mesquite prairies with dense *Opuntia* due to heavy grazing and reduced fires (e.g., Stuart and Scott 1992; Choate 1997; Roehrs et al. 2008). Researchers predict that *B. taylori* will continue to expand its distribution, with future distributional limits being unclear (Choate et al. 1990).

Harsh winters likely will set back recently established populations from time to time in the newly expanded areas in northern parts of its distribution (Stangl and Dalquest 1986; Choate et al. 1990).

In New Mexico, *B. taylori* was first documented in Hidalgo County in 1956 (Packard 1959). Northern Pygmy Mice continued to be observed only in southwestern Hidalgo County for about three decades, where it was captured occasionally in that area (Findley et al. 1975; Cook 1986; Stuart and Scott 1992). Stuart and Scott (1992) reported on a possible range expansion for the species in New Mexico, with captures in grassy, roadside habitats in northeastern Luna County in April and May 1991. Dispersal routes to northeastern Luna

County potentially included foothill grasslands that border many of the highlands in the region (Stuart and Scott 1992).

In New Mexico, the Northern Pygmy Mouse was considered a Species of Greatest Conservation Need due to limited populations and threats to grassland habitats (NMDGF 2006); however, the species recently was not included as a species of concern in the latest State Wildlife Action Plan (NMDGF 2016). Information about the natural history of *B. taylori* is scant in the state. Herein, we report on the likely expansion of *B. taylori* in southwestern New Mexico and amass facets of its reproductive biology in the state.

METHODS

We used live traps (Model type LFATDG, H. B. Sherman Traps, Inc., Tallahassee, Florida) baited with a mixture of birdseed and whole grain rolled oats to survey for small mammals in southwestern New Mexico, during warmer months in 2014–2016. For each Northern Pygmy Mouse captured, we generally recorded sex, body weight, and reproductive condition (i.e., for females—lactating, near-term pregnancy, or not noticeably reproductive). We were able to confirm pregnancy in some females close to term by gently palpating the abdomen and feeling the fetuses. On a few occasions, we also examined discarded bottles along roadsides. Glass bottles can effectively trap and kill small vertebrates when openings of bottles are elevated upward on slopes (Pagels and French 1987; Benedict and Billeter 2004).

We deposited voucher specimens at the Museum of Southwestern Biology (MSB), University of New

Mexico, Albuquerque. Localities of occurrences were determined with a handheld GPS unit (Garmin GPS 12, Garmin International, Inc., Olathe, Kansas, USA) with map datum NAD 83. Methodologies used in this study were approved by the Institutional Animal Care and Use Committee at the University of Nebraska at Kearney (protocol #020614).

To search for additional unpublished records and to amass reproductive data for *B. taylori* from New Mexico, we accessed and examined electronic databases on VertNet (vertnet.org; accessed 20 December 2016). In 2016 and 2017, we also personally examined specimens and their skin tags at MSB and the natural history collection at Western New Mexico University (WNMU). We also contacted Eastern New Mexico University in 2017 for any records of *B. taylori* in its collection. Common and scientific names of mammals used within follow Bradley et al. (2014).

RESULTS AND DISCUSSION

From 2014 to 2016, we captured *B. taylori* at a total of six new localities in northern Grant and north-central Luna counties (Fig. 1, Appendix, Sites 1–4, 9, 10). We obtained an additional five unpublished localities via museum holdings that also enlarge the known distribution in the region (Fig. 1, Appendix, Sites 5–8, 11). Our northernmost record in northern Grant County

(Site 1, Fig. 1) represents an extension/expansion of 150 km from previously published records near Nutt in northeastern Luna County (Fig. 1, square symbol) and 125 km from records at the San Simon Cienega in west-central Hidalgo County (Stuart and Scott 1992). The new record from south-central Grant County (Site 5, Fig. 1) was obtained in 2008 whereas the other new

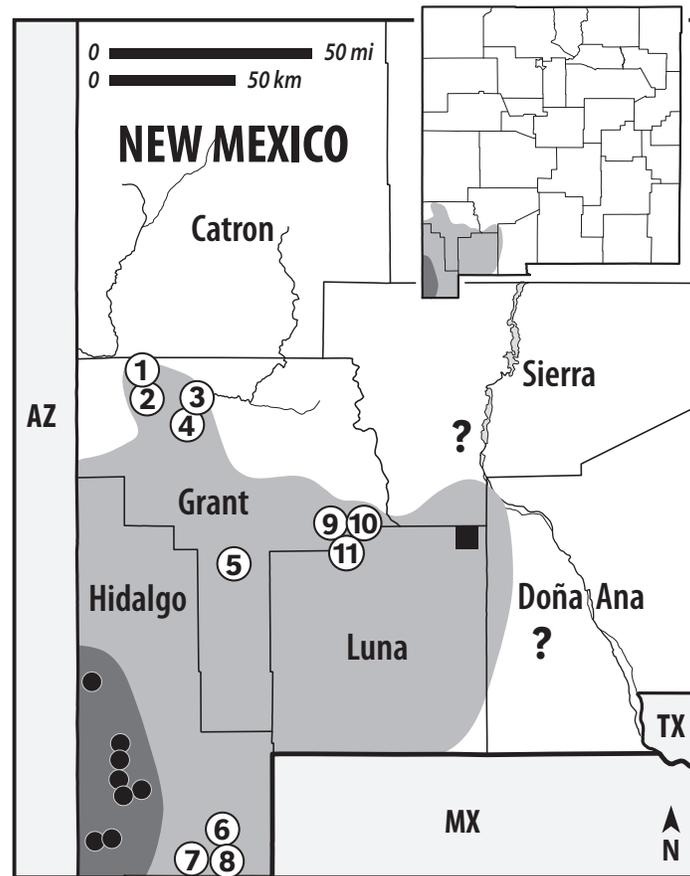


Figure 1. New localities of occurrence for the Northern Pygmy Mouse (*Baiomys taylori*) in southwestern New Mexico. Open circles with numbers represent new localities reported in this study, closed circles represent localities of occurrence prior to 1992 (Stuart and Scott 1992), and the closed square represents the locality published by Stuart and Scott (1992). The dark shaded area represents the known distribution prior to 1992, and the light shaded area represents the potential distribution currently occupied by *B. taylori* in southwestern New Mexico. Numbers associated with the open circles correspond to numbers in the Appendix. Question marks show two areas where *B. taylori* also might occur in southwestern New Mexico.

locality record from Luna County was from 2009 (Site 11, Fig. 1). Specimens from southeastern Hidalgo County were obtained in 1977 and 2007 (Sites 6–8, Fig. 1). Our attempts to capture *B. taylori* in northern Grant County only consisted of a single night of effort at two sites along US Highway 180, and we captured one individual at each site (total trap nights = 60, Sites 1 and 2, Fig. 1).

Small mammals captured in trap lines with *B. taylori* included the Western White-throated Woodrat (*Neotoma albigula*), Brush Deermouse (*Peromyscus boylii*), White-footed Deermouse (*Peromyscus leucopus*), Western Harvest Mouse (*Reithrodontomys megalotis*), Tawny-bellied Cotton Rat (*Sigmodon fulviventor*), Hispid Cotton Rat (*Sigmodon hispidus*), Yellow-nosed Cotton Rat (*Sigmodon ochrognathus*),

Ord's Kangaroo Rat (*Dipodomys ordii*), and Silky Pocket Mouse (*Perognathus flavus*). Many of these associated species also represent grassland species that have been captured with *B. taylori* at other localities throughout its distribution (Cook 1986; Choate et al. 1990; Stuart and Scott 1992; Choate 1997; Hayward et al. 1997; Schmidly and Bradley 2016).

In southwestern New Mexico, we only captured *B. taylori* in habitats with a dense ground cover consisting mostly of grasses. On 22 and 24 June 2014, we first documented the species along the edge of a flood-irrigated hay field in the floodplain of the Gila River (Site 4, Fig. 1). Individuals were captured in a narrow strip (1–2 m in width) of tall Johnson grass (*Sorghum halepense*) having a thick layer of thatch. We failed to capture *B. taylori* in the adjacent hay field after multiple attempts. Upstream, we captured individuals in an old field having a sandy, friable substrate near the confluence of the Gila River and Mogollon Creek (Site 3, Fig. 1). The field contained patches of Johnson grass and a variety of dense forbs. In northern Grant County, we captured *B. taylori* along the grassy roadside of US Highway 180 (Sites 1 and 2), which was dominated by side-oats grama (*Bouteloua curtipendula*). We also obtained two mummified individuals in a discarded glass bottle in northern Grant County (Site 2). In Luna County, we captured an individual as it swam across the Mimbres River in an area bordered on both sides by alkali sacaton (*Sporobolus airoides*; Site 9, Fig. 1). Other individuals were captured along the edge of an old field having a dense cover of grama grasses and sacaton (Site 10, Fig. 1). Throughout its distribution, *B. taylori* seems to require dense ground cover (Eshelman and Cameron 1987), which was present at all of our capture sites, except for the individual swimming in the river. Our observation of an individual swimming is not surprising because *B. taylori* is a good swimmer and known to cross rivers (Blair 1941; Stangl and Dalquest 1986).

With new distributional records of *B. taylori* farther north and more expansive than prior records in southwestern New Mexico, the question arises as to whether those records represent a recent expansion in the distribution of the species where populations have not occurred in recent times (i.e., a range expansion) or to whether those records represent formerly undetected populations that always have occurred in

the region, yet remained undetected due to a lack of historical sampling (i.e., a range extension; sensu Frey 2009). Although it is difficult to conclude with certainty whether new distributional records reflect an expansion or extension, past trapping records of “background taxa,” (i.e., those species likely to be captured by the same collecting methods as the species in question) can be used to surmise whether the species in question would have been documented in the region if it was present (Ponder et al. 2001; Frey 2009). If the species in question was not captured during past surveys in areas where background taxa were present, then new records of occurrence for the species of interest likely represent an expansion in distribution. Using the above method for examining between hypotheses of range expansion and range extension, we investigated the past occurrence of other grassland species (i.e., background taxa) in southwestern New Mexico on the basis of museum specimens reported by Findley et al. (1975).

With the use of different types of grassy habitats from disturbed to more natural ones in the region (Schmidly and Bradley 2016; this study), we examined locality data of other grassland species (i.e., background taxa) in southwestern New Mexico to help examine the conclusion of a range expansion or extension for *B. taylori* (see Ponder et al. 2001). We specifically examined locality data for the White-footed Deermouse, North American Deermouse (*Peromyscus maniculatus*), Tawny-bellied Cotton Rat, Hispid Cotton Rat, Chihuahuan Grasshopper Mouse (*Onychomys arenicola*), and Southern Grasshopper Mouse (*Onychomys torridus*), each of which is known to occur sympatrically with *B. taylori* (this study; Cook 1986; Choate et al. 1990; Stuart and Scott 1992; Choate 1997; Hayward et al. 1997; Schmidly and Bradley 2016). *Baiomys taylori* generally inhabits a variety of grassy habitats but also occurs within other habitats if ground cover is available (Schmidly and Bradley 2016), thus most localities of occurrence for the above background taxa likely provide appropriate habitat for *B. taylori*, if the species occupied the area. Within our proposed distribution for *B. taylori* (Fig. 1) in Grant County, Luna County, and the northern half of Hidalgo County, there were many localities of occurrence in the region for those grassland species: 7 for *P. leucopus*, 16 for *P. maniculatus*, 19 for *S. fulviventer*, 12 for *S. hispidus*, and 12 for *O. torridus/arenicola* (Findley et al. 1975). Additional localities of occurrence for those species from this area also can

be found on VertNet (vertnet.org) from the collections at Western New Mexico University, as its specimens were not included in Findley et al. (1975). The number of localities with past records of the background taxa but none for *B. taylori* lends support that *B. taylori* has expanded its distribution in the area.

We suspect that *B. taylori* is more widely established in Luna County, Grant County, and northern Hidalgo County (Fig. 1, light shaded area), and more trapping is warranted to further define the current distributional limits of the species in those counties and in other counties in New Mexico. For example, it is unclear how far east and north the species might occur, possibly occurring in parts of Sierra and Doña Ana counties (Fig. 1). Records of *B. taylori* also should be sought in eastern New Mexico because records from over a decade ago exist from adjacent counties in Texas (Deaf Smith and Yoakum), only 43 km from the New

Mexico border (Choate 1997; Schmidly and Bradley 2016). In adjacent southeastern Arizona, *B. taylori* also might inhabit grassy habitats in Greenlee and northern Graham counties because the species is known from areas to the south of that region (Hoffmeister 1986).

The only previously published data on reproduction for *B. taylori* in New Mexico consisted of a pregnant female captured in March from southern Hidalgo County (Cook 1986). Examination of data from more than 130 museum specimens (including MSB), from records discovered on electronic databases, and from individuals released during our survey demonstrated that pregnant individuals have been captured in March, May, June, and October and lactating individuals in March, June, and October (Table 1). This information indicates that females are reproductively active in the state from at least March through October. On the basis of 23 measurements, lengths of testes have

Table 1. Information on pregnant and lactating Northern Pygmy Mice (*Baiomys taylori*) from southwestern New Mexico. Numbers in parentheses (mm) represent greatest crown-to-rump length for fetuses or largest uterine swelling for embryos. Column labeled “Institution” indicates where the voucher specimen is housed—MSB (Museum of Southwestern Biology, University of New Mexico) and WNMU (Western New Mexico University).

Date of capture	Reproductive condition	Fetuses/Embryos	Institution
14 March 1982	lactating	---	MSB 48493
15 March 1982	lactating	---	MSB 48503
15 March 1982	pregnant	2 embryos (4)	MSB 48499 ¹
13 May 1956	pregnant	3 embryos (14.5)	MSB 1787
27 May 2015	pregnant ²	---	---
4 June 2015	pregnant	3 fetuses (17)	MSB 296506
6 June 2015	pregnant	4 fetuses (20)	MSB 296512
22 June 2014	lactating ³	3 embryos (5)	MSB 270096
22 June 2014	pregnant ²	---	---
3 October 2007	pregnant	3 embryos (2)	MSB 230845
7 October 1967	lactating	---	WNMU 1334
11 October 1988	lactating	---	WNMU 5220

¹This specimen was the only previously published information on reproduction for *B. taylori* in New Mexico (Cook 1986).

²Female obviously pregnant and was released (see Methods).

³Female was both lactating and pregnant at the same time.

been recorded from March to October in New Mexico. The longest lengths were 6 mm, and that length was recorded in both March and October. In Texas, peaks in reproduction have been observed in the late fall and early spring (Schmidly and Bradley 2016).

Having a gestation period of about 20–23 days (Eshelman and Cameron 1987) and noting a pregnant female on 15 March suggest that individuals of *B. taylori* in New Mexico are reproductively active at least as early as late February. The reproductive period of *B. taylori* in New Mexico is similar to that in the Llano Estacado of the High Plains region of western Texas where individuals are reproductive only in the warmer months (Choate 1997). In more southerly reaches of Texas, *B. taylori* reproduces nearly yearlong (Eshelman

and Cameron 1987; Schmidly and Bradley 2016). We note that relatively few captures of *B. taylori* are known from November to February in New Mexico, thus more information is needed to confirm or refute such conclusions regarding the period of reproduction in the state.

New capture records of *B. taylori* in southwestern New Mexico support the hypothesis that *B. taylori* likely has expanded its distribution northward in the state. More quantitative methods can help to support or refute such a conclusion (see Ponder et al. 2001; Tingley and Beissinger 2009), as such was not the goal of this research. Recent distributional records and evidence of reproductive activity suggest that populations of *B. taylori* are currently well-established in southwestern New Mexico.

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APPENDIX

New localities of occurrence for the Northern Pygmy Mouse (*Baiomys taylori*) in southwestern New Mexico. Numbers in parentheses before each locality correspond to numbered circles in Fig. 1. For individuals captured at each locality, date of capture, gender, and reproductive information are given as well as specimen numbers and institutional abbreviations, if kept as a voucher specimen. Institutional abbreviations are as follows: Museum of Southwestern Biology, University of New Mexico (MSB) and Western New Mexico University (WNMU). At the end of the Appendix, we also clarify information on previous records of *B. taylori* from Luna County.

Grant County:

- (1) 14.2 km N, 9.7 km W Buckhorn, 33.16458°N, 108.81476°W, NAD 83, 6 June 2015 (1 ♂ [MSB 296511, testes 5x3]);
- (2) 4.8 km N, 4.5 km W Buckhorn, 33.08095°N, 108.75848°W, NAD 83, 6 June 2015 (1 ♀ [MSB 296512, 4 fetuses, crown–rump length = 20 mm] and 2 unknown gender, mummies in bottle, not kept as vouchers);
- (3) 9.1 km N, 4.3 km E Gila, 33.04643°N, 108.53172°W, NAD 83, 27 May 2015 (2 ♀♀ [MSB 296434, no embryos; other individual released, pregnant]);
- (4) 5.7 km N, 2.1 km E Gila, 33.01422°N, 108.55598°W, NAD 83, 22 June 2014 (1 ♂ [MSB 270095, testes 6x4], 2 ♀♀ [MSB 270096, lactating & pregnant 3 embryos, 5 mm uterine swelling; other individual released, pregnant]) and 24 June 2014 (1 ♀ [released]); and
- (5) Burro Cienega on Pitchfork Ranch, 10.5 km N, 32.0 km E Lordsburg, 32.430616°N, 108.36304°W, WGS 84, 13 April 2008 (1 ♀ [WNMU 6916]).

Hidalgo County:

- (6) N side Alamo Hueco Mountains, T32S, R15W, Sec. 30, 2 July 1977 (1 ♀ and 1 ♂ [WNMU 4677 and 3534, respectively]);
- (7) Diamond A Ranch (formerly Gray Ranch), McKinney Flats, W of Antelope Wells, 11 July 2007 (7 unknown gender [MSB 231817–231821, 231824, and 231825]); and
- (8) Dog Mountains, Middle Mountain Tank, T34S, R15W, Sec. 8, 30 June 1977 (1 ♀ and 1 ♂ [WNMU 4680 and 4679, respectively]).

Luna County:

- (9) NMDGF River Ranch, 5.5 km S, 5.1 km W Faywood, 32.57869°N, 107.92329°W, NAD 83, 15 May 2015 (1 ♀ [MSB 296418, no embryos]);
- (10) NMDGF River Ranch, 4.1 km S, 4.4 km W Faywood, 32.58915°N, 107.91711°W, NAD 83, 4 June 2015 (2 ♀♀ [MSB 296506, 3 fetuses, crown–rump length = 17 mm; and other individual released, not noticeably pregnant]); and
- (11) Mimbres River, Highway 61, milepost 7, Simon Ranch (now the NMDGF River Ranch), 16 October 2009 (1 ♂ and 1 unknown gender [MSB 199576 and 199654, respectively]).

Extra notes on previous records from Luna County.—At MSB, there are six fluid-preserved specimens (numbers 98537–98542) of *B. taylori* from the “Deming Gap area” in Luna County, New Mexico. That locality is at the same

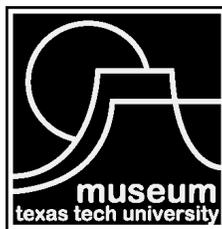
location, near the town of Nutt, as reported by Stuart and Scott (1992). Individuals were collected on 13 April and 10 May 1991, kept in captivity, and euthanized in May 1992 (W. L. Gannon and J. N. Stuart, pers. comm.).

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