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**LEAST AND MERRIAM'S SHREWS FROM BANNER COUNTY, NEBRASKA**

—Four species of shrews occur in the panhandle of western Nebraska – the masked shrew (*Sorex cinereus*), Merriam's shrew (*S. merriami*), dwarf shrew (*S. nanus*), and least shrew (*Cryptotis parva*; Genoways et al. 2008). Little information is known regarding the distribution and habitat of those species due to few captures of individuals throughout the region (e.g., Jones 1964, Freeman et al. 1993, Benedict et al. 1999, 2000, Geluso et al. 2004). To date, no shrew has been reported from the southwestern part of the panhandle in Banner, Kimball, or Cheyenne counties. Here we present distributional records for the least shrew and Merriam's shrew from western Banner County, Nebraska. Records of shrews were obtained mainly from regurgitated owl pellets and a few subsequently by pitfall traps. Owl pellets can be used to better understand distributions of mammals because pellets contain identifiable bones of prey and reflect prey species located in territories of owls (Vernon 1972, Mikkola 1983). Owl pellets also can be important to document species (e.g., shrews) that are under-represented by some traditional trapping methods, such as Sherman live-traps (e.g., Whitaker 1974; K. Geluso, personal observation).

We collected pellets from a solitary adult barn owl (*Tyto alba*) residing in a barn in Banner County, Nebraska (5 km S, 18.7 km W Harrisburg, 41°30.476'N, 103°57.901'W; NAD 83). The barn was located in a grassy valley with ponderosa pines (*Pinus ponderosa*) and junipers (*Juniperus* spp.) interspersed on canyon slopes. Agricultural fields consisting mostly of wheat were located above canyons on flat terrain. We collected 24 pellets on 28 July, 43 pellets on 7 September, and 25 pellets on 2 October 2010. We dissected pellets and identified mammalian prey by cranial and dentary bones; shrews were identified via the keys in Carraway (1995) and Junge and Hoffmann (1981).

On 2 October 2010, we also set 40 Sherman live-traps (model type LFATDG, H.B. Sherman, Tallahassee, FL, USA) for a single night and placed 35 0.5-L plastic drinking cups flush with the ground as pitfall traps. We left pitfall traps open for three nights, checked traps each morning, and removed traps on 5 October 2010. We used trapping to briefly examine whether shrews were as common in the area as our observations suggested from prey items documented in owl pellets. Trapping and handling procedures for small mammals were approved by the Animal Care and Use Committee at the University of Nebraska at Kearney (#060408). We deposited all cranial and dentary materials of prey species collected in owl pellets as well as study skins and skeletons of least shrews captured in pitfall traps in the natural history collections, Division of Zoology, University of Nebraska State Museum, Lincoln, Nebraska, USA.

To identify the two species of shrews by cranial features, least shrews contained four unicuspid teeth (or their fossae if teeth were absent), whereas Merriam's shrews (or other *Sorex* spp. in the region) contained five unicuspid (or their

associated fossae). To distinguish shrews via dentary bones, least shrews on the labial side of each dentary had the alveolus of the first incisors extend posteriorly beneath the first molar (fourth tooth from anterior end of dentary), whereas for Merriam's shrews, alveolus of first incisors did not extend posteriorly beneath first molar (see Carraway 1995: Fig. 3). Additionally, internal temporal fossae of least shrews contained a bar that created an inferior opening separated from a superior depression (see Carraway 1995: Fig. 6). To distinguish Merriam's shrews from other potential *Sorex* spp. in western Nebraska, Merriam's shrews lacked a pigmented ridge on the lingual side of unicuspid (see Junge and Hoffmann 1981: Fig. 2), had third unicuspid larger than the fourth unicuspid, and lacked a medial tine on anterior lingual side of upper first incisors (Junge and Hoffmann 1981: Fig. 21). For dentary bones of *Sorex*, individuals keyed to Merriam's shrew via a number of features (Carraway 1995). When both cranial and dentary bones existed for Merriam's shrews (two of three individuals), both sets of features were in agreement on species identification.

We identified 439 prey items from barn owl pellets in summer and autumn 2010 (Table 1). At least eight species of mammals were present in pellets, including 50 least shrews and 3 Merriam's shrews (Table 1). We also captured four least shrews in pitfall traps near the roost site in runways of prairie voles (*Microtus ochrogaster*).

We observed 50 least shrews in owl pellets from Banner County (Table 1), demonstrating that this species is more widespread and more abundant in western Nebraska than previously reported. Additionally, we captured four individuals with limited effort in pitfall traps. Least shrews have been documented at four other localities in western Nebraska, including Dawes, Sheridan, and Scotts Bluff counties (Benedict et al. 2000, Geluso et al. 2004). Our site in Banner County is 54 km south of the closest occurrence in Nebraska (Scotts Bluff County; Geluso et al. 2004). Our study documented the expansion of the distribution of least shrews farther south into the panhandle of the state, suggesting the species may occur across the entire panhandle. Least shrews recently were reported from a single site in Wyoming (Goshen County; Marquardt et al. 2006), approximately 93 km northwest of our site. Our study site was 7.2 km east of the Wyoming border, thus least shrews likely may be more widespread in eastern Wyoming.

In recent decades, the distribution of least shrews has expanded westward across the Great Plains in Colorado (Choate and Reed 1988, Siemers et al. 2006), Kansas (Choate and Reed 1988), Nebraska (Benedict et al. 2000, Geluso et al. 2004), South Dakota (Backlund 2002), and Wyoming (Marquardt et al. 2006). Its expansion in Colorado was related to increased irrigation associated with agricultural practices (Armstrong 1972). In western Nebraska, least shrews likely traveled westward along riparian habitats associated with the North Platte River

(Geluso et al. 2004). In contrast, our site in Banner County was relatively arid, distant from any major river system, and surrounded by mostly dry-land agriculture, suggesting that other factors enabled least shrews to travel across the Great Plains.

Merriam's shrews occur across the western half of the United States, with the easternmost records reported from western parts of North Dakota, South Dakota, and Nebraska (Hall 1981, Mullican 1994). Distributional limits for this species are not well defined because relatively few captures are known throughout its distribution (Armstrong and Jones 1971). The first record in Nebraska was reported in Sheridan County in 1965 (McDaniel 1967). Since then nine additional individuals have been reported in northwestern Nebraska (Dawes, Sheridan, and Sioux counties; Freeman et al. 1993, Benedict et al. 1999).

We observed three Merriam's shrews in barn owl pellets from Banner County (Table 1), representing the southernmost records in Nebraska. Our site is 129 km southwest of the closest occurrence in Dawes County, Nebraska, and only the ninth reported locality in the state (Benedict et al. 1999). Our specimens also are 118 km east of the closest occurrence in Wyoming (Albany County; Clark and Stromberg 1987). Benedict et al. (1999) concluded that Merriam's shrew likely has a continuous distribution across northwestern Nebraska. We suspect that the range of this species extends across the entire panhandle of Nebraska south to Colorado, which is in agreement with records reported from north-central Colorado (Armstrong 1972).

Table 1. Number of prey items observed in regurgitated pellets of a barn owl (*Tyto alba*) from Banner County, Nebraska, USA, 2010.

Species	July <sup>a</sup>	September <sup>a</sup>	October <sup>a</sup>	Total
<i>Microtus ochrogaster</i>	54	88	51	193
<i>Reithrodontomys</i> spp. <sup>b</sup>	14	40	17	71
<i>Perognathus</i> spp. <sup>c</sup>	11	29	18	58
<i>Cryptotis parva</i>	11	15	24	50
<i>Chaetodipus hispidus</i>	5	17	8	30
<i>Peromyscus maniculatus</i>	3	8	10	21
<i>Onychomys leucogaster</i>	3	4	5	12
<i>Sorex merriami</i>	2	1	--	3
Bird spp.	--	1	--	1
TOTALS	103	203	133	439

<sup>a</sup>Twenty four pellets were collected in July, 43 in September, and 25 in October; <sup>b</sup>Probably includes both *Reithrodontomys megalotis* and *R. montanus*; <sup>c</sup>Potentially includes *Perognathus flavescens*, *P. fasciatus*, and *P. flavus*.

The landscape of Nebraska has changed dramatically since the mid-1800s when Europeans began settling the area, and many anthropogenic changes have resulted in shifts in distributions of mammals across the state (Benedict et al. 2000). For instance, agricultural practices have altered the face of Nebraska's prairies, even in western parts of the state where dry-land agriculture and center-pivot irrigation are common on flat terrains. With a number of studies reporting recent distributional changes for least shrews in the Great Plains (Choate and Reed 1988, Backlund 2002, Geluso et al. 2004, Marquardt et al. 2006, Siemers et al. 2006) and former trapping throughout the panhandle (Jones

1964), our records likely represent the further expansion of the least shrew's range in recent decades, which supports the range expansion hypothesis postulated by Frey (2009). The status for Merriam's shrew is unclear, but our records most likely represent a formally occurring, undocumented population representing a range extension. Additional surveys for shrews in the panhandle of Nebraska and eastern Wyoming are warranted to increase knowledge of distributional limits and habitat associations for both species in the region.

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