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DISTRIBUTION OF THE EASTERN WOODRAT (*NEOTOMA FLORIDANA CAMPESTRIS*) IN SOUTHERN NEBRASKA

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ABSTRACT.—The eastern woodrat (*Neotoma floridana*) occurs throughout eastern and central parts of the United States. In Nebraska, 3 of 9 subspecies inhabit the state, including *N. f. campestris*, *N. f. attwateri*, and *N. f. baileyi*. We determined distributional limits of *N. f. campestris* along 2 river systems in southern Nebraska. As observed with other mammalian species in the Great Plains, we suspected that the distribution of woodrats likely had expanded, reflecting continued regulation of rivers and the concomitant increase in forests along them. We documented *N. f. campestris* at 7 sites in 5 counties, including a recent (since the 1960s) eastward expansion along the Republican River. We observed little movement along the Platte River. The greatest concentration of houses constructed by woodrats occurred in a shelterbelt near the Republican River; otherwise, abundances of houses tended to be greater along the Platte River. We suspect that the distribution of woodrats will continue to change in Nebraska unless breaks exist or are established in riparian forests along the Platte and Republican rivers.

Key words: *Neotoma floridana campestris*, eastern woodrat, Nebraska, distribution, shifting distribution, abundance.

As a result of both climatic and physical changes to ecosystems in the Great Plains, distributions of many mammalian species have changed during the last half of the century. For example, about 26% of native mammalian species in Nebraska have undergone changes since the early 1960s (Benedict et al. 2000). Some species have moved northward or southward, but others have moved eastward or westward, primarily along rivers. Two species that have moved northward into Nebraska from the south include the nine-banded armadillo (*Dasypus novemcinctus*; Freeman and Genoways 1998) and hispid cotton rat (*Sigmodon hispidus*; Jones 1960, Genoways and Schlitter 1967, Farney 1975). Another recent arrival to the state from the south is a subspecies of eastern woodrat (*Neotoma floridana attwateri*; Clausen 1999). Species moving eastward or westward along Nebraskan rivers include the least shrew (*Cryptotis parva*; Geluso et al. 2004), evening bat (*Nycticeius humeralis*; Geluso et al. 2008, Serbousek and Geluso 2009), eastern fox squirrel (*Sciurus niger*; Jones 1964), woodchuck (*Marmota monax*; Benedict et al. 2000), and white-footed mouse (*Peromyscus leucopus*; Benedict et al. 2000).

For this study, we investigated the distribution of the eastern woodrat (*Neotoma floridana*) in southern Nebraska. The eastern woodrat

occurs throughout eastern and central parts of the United States (Wiley 1980, Hall 1981), and in Nebraska 3 of 9 subspecies are known, including *N. f. campestris*, *N. f. attwateri*, and *N. f. baileyi*. In southwestern Nebraska, *N. f. campestris* occurs from the Platte River south to the Kansas border, where it inhabits floodplain forests along waterways and rocky habitats in canyons (Jones 1964). In southeastern Nebraska, *N. f. attwateri* occurs in Gage and Jefferson counties along the Big Blue and Little Blue rivers (Clausen 1999). This subspecies occupies wooded, riverine systems surrounded by cornfields and pastures (Benedict et al. 2000). The third subspecies, *N. f. baileyi*, has a small, disjunct distribution in extreme north-central Nebraska. This subspecies only is known from 2 counties of Nebraska (Cherry and Brown counties) and inhabits forested areas along parts of the Niobrara River and its tributaries (Jones 1964).

Specifically, we examined whether the geographic range of *N. f. campestris* has changed during the last 4 decades in wooded, riparian habitats of the Republican and Platte rivers. Additionally, we report on the relative abundance of woodrats along these rivers. Our research provides a benchmark survey of localities where this subspecies currently occurs and where it does not occur, allowing future

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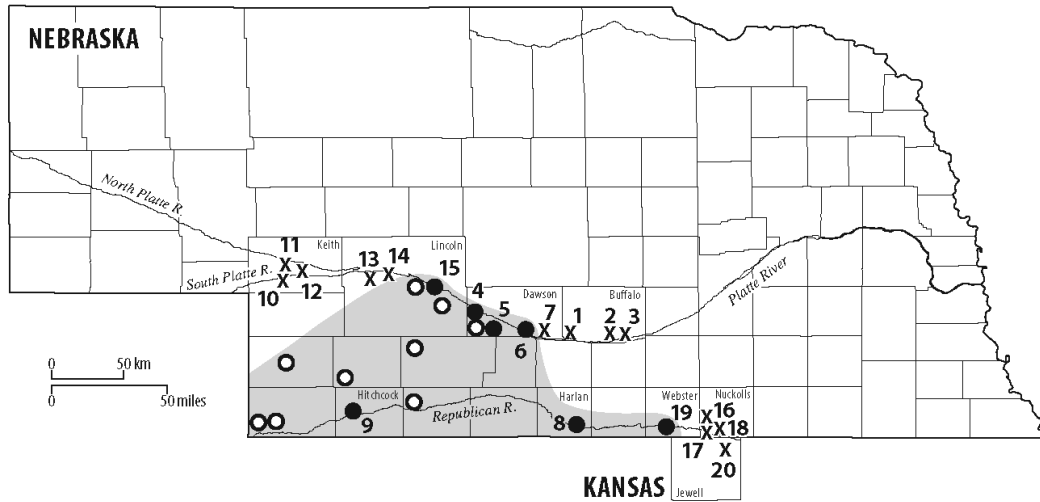


Fig. 1. Occurrence of the eastern woodrat (*Neotoma floridana campestris*) in southern Nebraska. Open circles represent localities where woodrats were reported by Jones (1964), closed circles represent localities where we observed woodrats in 2005–2007, and X's represent localities where we did not observe woodrats. The shaded area represents the current distribution of *N. f. campestris* in Nebraska. Numbers refer to descriptions of localities in the Appendix. Number 20 represents 2 sites in Kansas.

studies to accurately determine changes in its distribution in Nebraska.

METHODS

In 2005–2007, we determined the geographic distribution of *N. f. campestris* in Nebraska by searching for houses constructed by woodrats on public and private property. Presence of conspicuous houses is diagnostic evidence that woodrats are present in the area (Jones et al. 1983), and this feature of their behavior enabled us to conduct visual surveys during the day. To delineate its northern distribution, we searched 4 sites in Dawson County, 3 sites in Lincoln County, 3 sites in Keith County, and 3 sites in Buffalo County along the North Platte, South Platte, and Platte rivers (Appendix). To examine the southern distribution along the Republican River, we searched 1 site in Hitchcock County, 1 site in Harlan County, 1 site in Webster County, and 3 sites in Nuckolls County (Appendix). We also visited 2 sites in Jewell County, Kansas.

At each site, we determined the relative abundance of woodrats in riparian forests by walking for 30 minutes and recording all houses in view. In Hitchcock County, we also determined abundance of houses along a shelterbelt of trees adjacent to the riparian forest. For each

house observed, we recorded its composition and general placement. We also inspected each woodrat house to ensure it was actively used. Signs of activity included fresh cuttings of eastern redcedar (*Juniperus virginiana*) and other plants, entrances of houses without spider webs, and recent fecal droppings near houses. Any house that did not appear actively used was not counted in our study.

Coordinates of localities were determined with handheld global positioning units using North American Datum 1983. At a few sites without previous documentation of woodrats, we captured individuals with Tomahawk live traps (Tomahawk Live Trap Company, Tomahawk, WI). Voucher specimens were prepared and deposited in the natural history collection at the University of Nebraska State Museum (UNSM), University of Nebraska at Lincoln (Appendix).

RESULTS

We searched for *N. f. campestris* at 19 sites in 8 counties in Nebraska and at 2 sites in 1 county in Kansas. We observed the presence of eastern woodrats at 7 sites in 5 counties in Nebraska (Fig. 1). Of these 5 counties, Hitchcock, Harlan, and Webster represent new county records for *N. f. campestris* along the

Republican River in southern Nebraska. The easternmost record was at Indian Creek State Wildlife Management Area in Webster County (Fig. 1). Along the Platte River, we observed eastern woodrats only in Lincoln and Dawson counties (Fig. 1, Appendix). The easternmost record was observed along Darr Road in Dawson County, and the westernmost record was observed at the Platte State Wildlife Management Area in eastern Lincoln County (Fig. 1).

Where houses of woodrats were present along the Republican River, dominant vegetation consisted of deciduous forests typically containing cottonwood (*Populus deltoides*), Russian olive (*Elaeagnus angustifolia*), mulberry (*Morus*), ash (*Fraxinus*), walnut (*Juglans*), locust (*Robinia*), and hackberry (*Celtis*). A few eastern redcedars also were mixed into some of the forests. Each site contained a unique combination of trees, but density of eastern redcedars decreased from west to east, while relative abundance of deciduous trees, other than cottonwoods and Russian olives, increased west to east. The hand-planted shelterbelt in Hitchcock County consisted of mainly cottonwoods and eastern redcedars, with a few scattered Russian olives. At locations without eastern woodrats in Nuckolls and Jewell counties, habitats appeared relatively similar to those with woodrats in Webster and Harlan counties.

Along the Platte and North Platte rivers, localities contained relatively similar combinations of trees, including mainly cottonwoods and eastern redcedars. Habitats along these 2 rivers revealed no apparent directional pattern of increase or decrease in trees. At locations without eastern woodrats in Buffalo, Dawson, Lincoln, and Keith counties, habitats appeared similar to those with woodrats. The locality along the South Platte River in Keith County (Locality 10 in Fig. 1) had noticeably fewer trees and more open areas without any evidence of woodrats.

Along the Republican River, abundance of houses constructed by *N. f. campestris* was similar west to east, with 9 houses observed in 30 minutes in Hitchcock County, 6 in Harlan County, and 11 in Webster County. Along the Platte River, abundances also were similar west to east (17 in Lincoln County, 18 in Dawson County). Overall, abundances of active houses we observed tended to be greater along the Platte River compared to the Republican River.

However, the greatest concentration of houses was observed in the shelterbelt in Hitchcock County near the Republican River (40 houses in 30 minutes).

Placement and composition of houses were dependent upon vegetation present at the sites. Eastern woodrats most often placed houses at bases of eastern redcedars or around fallen logs. The numerous dead branches on lower portions of eastern redcedars provided a rigid frame for many houses. Across our study area, houses were constructed mostly of sticks and bark. If cottonwoods were present in the area, almost all debris was composed of sticks and bark from cottonwoods.

DISCUSSION

Before Europeans settled on the Great Plains in the mid 1800s, the primary landscape across the region was native prairie. Following settlement, many prairie ecosystems underwent drastic human-induced changes for agricultural purposes (Benedict et al. 2000). Many waterways in the Great Plains also were transformed. It is suspected that in the past, isolated patches of trees or relatively fewer trees existed along prairie rivers. Today, these same river systems have more trees, many forming continuous bands of forests along edges of riverine systems (Johnson 1994). Recent increases in riparian forests have resulted from reduction in prairie fires, absence of native grazers, and changes in flow patterns of rivers (Johnson 1994). For example, installment of dams along waterways channelizes river flows, prevents seasonal flooding, and prevents scouring of woody vegetation by spring ice jams. Past research shows that human-induced changes to riverine environments have enabled mammalian species to expand their geographic ranges across the Great Plains (e.g., Benedict et al. 2000, Sparks and Choate 2000, Geluso 2004).

In southern Nebraska, our observations showed that *N. f. campestris* has embarked on a recent eastward expansion along the Republican River into Harlan and Webster counties. Searches farther east in Nuckolls County, Nebraska, and Jewell County, Kansas, revealed no sign of woodrats (Fig. 1). Although Jones (1964) noted that woodrats could potentially inhabit eastern parts of the Republican River in Nebraska, he reported no evidence of woodrats from the area. We suspect that he

would have commented on the presence of woodrats if conspicuous houses had been observed, based on his observations of other species in the book. Additionally, we obtained field notes from 3 study sites where *Peromyscus leucopus*, another woodland species, was captured along or near the Republican River in Harlan, Franklin, and Webster counties (Jones 1964). None of those notes from the 1950s reported sightings of woodrat houses, but today woodrats are present in the region.

Unlike populations along the Republican River, our observations suggest that *N. f. campestris* has not moved significantly in gallery forests along the Platte River from the distribution reported by Jones (1964). In that region, we observed woodrats only in counties with prior records. In Dawson County, Jones (1964) reported woodrats from a single site in a canyon south of the floodplain of the Platte River. However, we observed woodrats in gallery forests at 3 locations in this county. Woodrats likely have expanded their distribution only slightly into these riparian forests in Dawson County. We expect that the distribution of woodrats will continue to shift eastward through time on the Platte River unless breaks are established in the continuous band of trees along the river.

Along the South Platte River in Keith County, we observed no evidence of woodrats, likely a result of unsuitable habitats for eastern woodrats. These environments contained few trees with almost no ground cover. Locations with and without woodrats along the North Platte and Platte rivers, however, contained greater densities of trees as well as understory vegetation that likely could provide sources of food and protection. We suspect eastern woodrats will move farther west along these rivers in the future. If this shift does not occur, this area would provide an important place to study factors that limit the distribution of *N. f. campestris*.

Conclusion

As a result of past management decisions, many prairie ecosystems, especially those along rivers, have undergone dramatic changes across the Great Plains. These actions have provided many species the opportunity to expand their geographic range into regions where they previously did not occur. Without additional management of forested habitats along prairie rivers in the future, we suspect woodrats and

other species likely will continue to expand their distributions throughout the state.

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APPENDIX. Localities examined for eastern woodrats (*Neotoma floridana campestris*) in southern Nebraska and north-central Kansas, 2005–2007. Numbers preceding locations correspond to locations in Fig. 1. Parentheses following localities include dates of observations, presence or absence of woodrats, and museum numbers of vouchers housed at the University of Nebraska State Museum (UNSM).

NEBRASKA: *Buffalo County*: (1) Blue Hole Wildlife Management Area (WMA; 5 March 2006, no woodrats); (2) Bassway Strip WMA, 40°41.185'N, 098°56.909'W (4 September 2006, no woodrats); and (3) Rowe Sanctuary & The Iain Nicolson Audubon Center, T8N, R14W, NW 1/4 Sec 15 (21 January 2006, no woodrats). *Dawson County*: (4) 1 mi S, 2 mi E of Gothenburg, 40°55.123'N, 100°12.446'W (31 July 2007, woodrats present); (5) 5.4 mi W, 0.5 mi N of intersection NE Hwy. 21 and County Road 750, on County Road 414, 40°42.447'N, 100°06.150'W (16 August 2007, woodrats present); (6) 7 mi W Lexington, near Darr Road and Platte River, 40°46.667'N, 099°52.026'W (13 July 2007, woodrats present); and (7) Dogwood WMA, 40°42.036'N, 099°38.151'W (11 October 2007, no woodrats). *Harlan County*: (8) Prairie Dog Creek, Harlan County Reservoir, 40°00.797'N, 099°21.874'W and 40°01.191'N, 099°21.867'W (3 November 2005, 28 February 2006, 29 September 2006, 26 June 2007, woodrats present, UNSM 28943–28946). *Hitchcock County*: (9) Swanson Reservoir WMA, 40°09.318'N, 101°10.522'W (26 June 2007, woodrats present). *Keith County*: (10) Ogallala Strip WMA, South Platte River, 41°06.981'N, 101°44.279'W (22 September 2007, no woodrats); (11) Arthur Bay State Recreation Area, 41°15.183'N, 101°43.854'W (15 August 2007, no woodrats); and (12) 1 mi E of Lake McConaughy, Cedar Point Biological Station, 41°12.583'N, 101°38.881'W (16 August 2007, no woodrats). *Lincoln County*: (13) North River WMA, 41°11.944'N, 101°00.098'W (22 September 2007, no woodrats); (14) Muskrat Run WMA, 41°11.497'N, 100°53.715'W (22 September 2007, no woodrats); and (15) Platte WMA, 41°05.481'N, 100°39.001'W (31 July 2007, woodrats present). *Nuckolls County*: (16) 7 mi W, 1.5 mi N of Superior, Road 2900 and Republican River, 40°02.654'N, 098°11.914'W (11 July 2007, no woodrats); (17) 4.5 mi W of Superior, Road B and Republican River, 40°01.137'N, 098°09.616'W (11 July 2007, no woodrats); and (18) Lost Creek and Lincoln Park Campground Complex, Superior, 40°01.197'N, 098°05.096'W (11 July 2007, no woodrats). *Webster County*: (19) Indian Creek WMA, 40°03.695'N, 098°31.189'W and 40°03.747'N, 098°31.162'W (5 November 2005, 26 June 2007, woodrats present, UNSM 28941, 28942, 28947, 28948).

KANSAS: *Jewell County*: (20) Lovewell Reservoir and State Park, 39°53.044'N, 098°01.322'W and 39°54.375'N, 098°01.600'W, respectively (11 July 2007, no woodrats).