University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Mammalogy Papers: University of Nebraska State Museum

Museum, University of Nebraska State

9-1-1997

Diet of a Relict Population of the Eastern Woodrat in Nebraska

Hugh H. Genoways
University of Nebraska-Lincoln, h.h.genoways@gmail.com

Patricia W. Freeman
University of Nebraska-Lincoln, pfreeman1@unl.edu

Mary K. Clausen
La Vista, NE

Follow this and additional works at: http://digitalcommons.unl.edu/museummammalogy

Part of the Zoology Commons

Genoways, Hugh H.; Freeman, Patricia W.; and Clausen, Mary K., "Diet of a Relict Population of the Eastern Woodrat in Nebraska" (1997). *Mammalogy Papers: University of Nebraska State Museum.* Paper 3.
http://digitalcommons.unl.edu/museummammalogy/3

This Article is brought to you for free and open access by the Museum, University of Nebraska State at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Mammalogy Papers: University of Nebraska State Museum by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

From:

The Prairie Naturalist 29:3 (September 1997), pp. 171–178.

Published by the Great Plains Natural Science Society; used by permission.
http://www.fhsu.edu/biology/pn/prairienat.htm

Diet of a Relict Population of the Eastern Woodrat in Nebraska

HUGH H. GENOWAYS, PATRICIA W. FREEMAN, AND MARY K. CLAUSEN

University of Nebraska State Museum, W436 Nebraska Hall, University of Nebraska-Lincoln, Lincoln. NE 68588-0514 (HHG. PWF)

7707 Edgewood Blvd. La Vista, NE 68128 (MKC)

ABSTRACT: The relict population of *Neotoma floridana* occurring along the Niobrara River in north-central Nebraska was found to have a diet composed of 38 types of food items of which 37 types were plants. Unique features of the summer diet of this population were a higher than expected use of red cedar (*Juniperus virginiana*) and invertebrates as food items.

Key words: Nebraska, *Neotoma floridana baileyi,* diet, relict population, mammals, eastern woodrat.

An isolated population of the eastern woodrat (*Neotoma floridana baileyi*) occurs along a narrow segment (140 km west to east along the river; Birney 1973) of the Niobrara River in north-central Nebraska. The population is believed to be a Pleistocene relict confined to the cool canyons along the river, representing a time when tree cover along the Niobrara and Missouri rivers to the east was more extensive (Jones 1964). *Neotoma f. baileyi* is separated from other populations of the eastern woodrat in northeastern Kansas (*N. f. attwateri*) by at least 900 km, and along the Platte River in Nebraska (*N. f. campestris*) by about 300 km across the Nebraska Sand Hills. Overhead cover seems to be one of the important factors along with rocky outcrops, limiting the distribution of the eastern woodrat (Rainey 1956:636-637). For populations in northeastern Kansas, *N. f. attwateri,* the important overhead cover is primarily trees, whereas for the more westerly populations, *N, f. campestris,* rock shelters, tree cactus, and large bushes seem to be the important cover components (Finley 1958:500-501). In this ecological parameter, *N. f. baileyi* appears to more closely resemble populations in northeastern Kansas.

As discussed by Primack (1993), populations with limited geographical ranges and specialized niche requirements are vulnerable to extinction. To obtain a better understanding of the niche requirements of this relict population, we undertook a number of ecological studies to describe its

parameters. These data are vital to the conservation biology of this population in the face of changing environmental conditions and increased human development within its geographical range. Below we describe the diet of *N. f. baileyi.* The survival of this population will depend on our knowledge of the key plants and animals in its environment.

STUDY AREA

The present study was conducted between 13 and 29 July 1982 on the Niobrara Valley Preserve of The Nature Conservancy, which is located 30 km (18 miles) north of Johnstown, Brown County, Nebraska, and occupies portions of Brown, Cherry, and Keya Paha counties. The area is known for its unique mix of six habitat types (Bleed 1990, Kaul 1990)—Rocky Mountain pine forest, eastern deciduous forest, northern boreal forest, mixed grass prairie, sandhills prairie, and tallgrass prairie. The specific area in which dietary studies were conducted consisted of a patchy habitat along the floodplain of the Niobrara River. The habitat changed as the area sloped from the river toward the tableland north of the river. Initially, the habitat was dominated by mixed prairie with needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), and thread-leaved sedge (*Carex filifolia*), changing to woody shrubs dominated by smooth sumac (*Rhus glabra*), eastern deciduous forest dominated by bur oak (*Quercus macrocarpa*) and red cedar (*Juniperus virginiana*), and finally to a drier mixed prairie with yucca (*Yucca glauca*) as one of the dominant species.

METHODS

Fecal samples were obtained from 25 traps containing *Neotoma floridana baileyi.* These samples and samples of reference plant material were dried and ground with a mortar. The samples were washed on a 105^ mesh sieve to remove very small particles and dirt. A small amount of the samples was placed on microscope slides and was cleared with several drops of Hertwig's Solution (Baumgartner and Martin 1939). The Hertwig's Solution was evaporated with a hot plate and the residue was evenly distributed over the slide. Permanent slides were prepared by addition of several drops of Permount and protection with a cover slip.

The slides were examined and scored under a compound microscope. Twenty nonoverlapping fields were observed on two slides per sample. The first field on each slide was located randomly, and the next 19 fields were located systematically (Wydeven and Dahlgren 1982). Plant species were identified by epidermal cells and trichomes in comparison with the reference materials (Sparks and Malechek 1967, Riegert and Singh 1982). The scientific and common names of plants follow the taxonomy of the Great Plain Flora Association (1986). The presence of an item in each field, not the number of pieces, was recorded. Percent frequency (number of fields in which a species occurs/total number of fields examined x 100) and the percent relative frequency of occurrence of a food item (frequency of a species/sum of frequency for all species x 100) were calculated (Curtis and McIntosh 1950).

RESULTS

Table 1 gives the results of the dietary analysis of *Neotoma floridana baileyi.* Thirty-eight types of food items were identified; of these, 37 types were plants. Nineteen of the plants were identified to species. Seventeen of the food items (10 known types and seven unknowns) occurred in the diet with a percent frequency and percent relative frequency above 1.0%. The three types of plants appearing in the diet of this woodrat most frequently were red cedar, smooth sumac, and prickly pear. Chitin from remains of insects and related animals was the fourth-most abundant food item, approaching 10% frequency.

DISCUSSION

Using stored food items in house middens as the basis of determination, food habits of the eastern woodrat have been extensively studied throughout much of its geographical range. These studies have indicated that *Neotoma floridana* is extremely versatile in its food habits (Birney 1973) with food preferences varying substantially among populations (Wiley 1980). Comparison of the food habits of geographically proximate populations in Kansas, Colorado, and Oklahoma with the relict Nebraska population revealed interesting similarities as well as unique features. Birney (1973) has made the only previous remarks concerning the diet of *N. f. baileyi when* he stated "In April, the bark and cambium layers of woody twigs appeared to serve as the primary source of food." Our work in the summer confirms, at least in part. this observation. The two most abundant food sources (red cedar and smooth sumac) and at least eight other identified species are woody plants.

In eastern Kansas, Rainey (1956) recorded 31 species of plant food items used by eastern woodrats, with the Osage orange (*Maclura pomifera*) by far the most important single species (Fitch and Rainey, 1956). Post et al. (1993) found 15 types of plant material in food caches of the eastern woodrat in Riley County, Kansas, with heavy use of fruits and seeds of *Prunus americana* and leaf material from dicots. Comparing the dietary items of the eastern woodrats in the study by Rainey (1956) with the population from Nebraska, six

Table 1. Dietary analysis of *Neotoma floridana baileyi* as indicated by frequency of plant fragments in fecal samples.

Dietary Items	Percent Frequency	Percent Relative Frequency
Red cedar (*Juniperus virginiana)*	53.2	37.10
Smooth sumac (*Rhus glabra)*	18.8	13.11
Prickly pear (*Opuntia* sp.)	10.5	7.32
Chitin	9.9	6.90
Peppergrass (*Lepidium densiflorum)*	8.8	6.14
River-bank grape (*Vitis riparia)*	4.9	3.42
Unknown grasses	4.5	3.07
Common sunflower (*Helianthus annuus*}	4.2	2.93
Cottonwood (*Populus deltoides)*	4.2	2.93
Buffalo currant (*Ribes odoratum*}	3.9	2.72
Wild bergamot (*Monarda fistulosa)*	0.9	0.63
Bur oak (*Quercus macrocarpa*)	0.7	0.49
Poison ivy (*Toxicodendron radicans)*	0.6	0.42
Maple-leaved goosefoot (*Chenopodium gigantospermum)*	0.5	0.35
Hackberry (*Celtis occidentalis*)	0.4	0.28
Catnip (*Nepeta cataria)*	0.3	0.21
Prairie wild rose (*Rosa arkansana*)	0.2	0.14
Yucca (*Yucca glauca)*	0.2	0.14
American elm (*Ulmus americana)*	0.1	0.07
Pennsylvania pellitory (*Parietaria pensylvanica*)	0.1	0.07
Wild plum (*Prunus americana*)	0.1	0.07
17 types of unknown plants (range)	16.4 (0.1–3.8)	11.4 (0.07-2.65)

species (or groups) are found in common including hackberry, wild plum, bur oak, smooth sumac, poison ivy, and unknown grasses, and congeneric species from Chenopodium, Ribes, and Vitis. The population from Riley County was using only four species in common with the Nebraska population (wild plum, American elm, smooth sumac, and red cedar) for food.

Post (1991), studying the winter food habits of the eastern woodrat in Riley County, Kansas, found that 95.71% of diet was composed of red cedar leaves, dogwood fruits (*Cornus drummondii),* coralberry fruit (*Symphoricaropos orbiculatus),* and redbud seed (*Cercis canadensis).* The remaining dietary items

were dicot (2.62%), insects (1.35%), and grass (0.10%). No single species in the dicot category accounted for more than 1% of the total diet. This category included smooth sumac leaves, fragrant sumac leaves (*Rhus aromatica),* green ash fruits (*Fraxinus pennsylvanica),* and wild plum fruits. The Nebraska population's summer diet included five types of food in common (red cedar, smooth sumac, insects, grass, and wild plum) with the winter diet of the Riley County population.

Two studies have been undertaken on the food habits of another population of *N. f. attwateri* located in Payne County, Oklahoma (Murphy 1952. McMurray et al. 1993). Murphy (1952) listed 20 species of woody plants present in the study area including red cedar, bur oak, smooth sumac, poison ivy, wild grape, cottonwood, and wild plum that were also present at the Nebraska site. He described the diet of this population of eastern woodrats as consisting of mainly grasses in early summer, acorns, sumac bark, fruit of sumac, poison ivy, and dogwood in later summer, and in winter, acorns, sumac bark, and seeds of redbud, Kentucky coffee-tree (*Gymnocladus dioica),* and sumac. Murphy (1952) also found the remains of animals (scorpion, snail of the genus *Succinea,* and grasshopper) in three stomachs of the 55 that he examined. McMurray et al. (1993) studied the diet of the eastern woodrat at several sites in the Cross Timbers area that were undergoing brush manipulation using herbicides and prescribed burning. The Cross Timbers area was composed of upland forest and interspersed grassland-cedar savannas. The upland forests were dominated by post oak (*Quercus stellata)* and blackjack oak (*Q. marilandica)* with an understory of red cedar, American elm, and redbud. The investigators identified 23 plants species in the summer and winter diet of this population of eastern woodrats. Of the woody plants, elm (*Ulmus* sp.) dominated the summer diet along with three species of forbs not recorded in the diet of the Nebraska population, pokeweed (*Phytolacca americana),* tickclover (*Desmodium* sp.), and western ragweed (*Ambrosia psilostachya).* The winter diet was dominated by red cedar, which composed between 67 to 94% of the diet of woodrats on the six sample sites, and the fort) *Potentilla* sp. Red cedar was found in the food of eastern woodrats at only two sites in the summer and composed 1.3% and 3.9% of the diet. Representatives of three other woody plant genera (*Vitis, Celtis, and Prunus)* were in the relict population's diet, but none of the forb species was shared between these two populations.

Western populations of the eastern woodrat were extensively studied in Colorado by Finley (1958). He found 31 species of plants stored as food items

by these populations of *N. f. campestris.* Succulent joints of cactus were found to be an important food item where it was abundant, although no single species of plant provided the majority of the diet. The six most-preferred food items in the Colorado population were tree cholla (*Opuntia imbricata),* fragrant sumac (*Rhus aromatica),* buffalo gourd (*Cucurbita foetidissima),* plains prickly pear (*Opuntia polyacantha),* yucca (*Yucca glauca),* and Russian-thistle (*Salsola iberica).* One of these species, Yucca *glauca,* also is found in the diet of the Nebraska population as are representatives of two of the other genera (*Opuntia* and *Rhus*\ Table 1). Examining the remainder of the diet of the Colorado population (Finley 1958: 508-512), three additional species (wild plum, poison ivy, and sunflower) are found in common with the Nebraska population as are representatives of four additional genera (Rosa, *Populus, Vitis, and Ribes).* Among trees, hackberry was reported from the study areas in Colorado, but red cedar, bur oak, and American elm were not reported.

Our study confirms the broad range of plants that the eastern woodrat is capable of using as food items. The Nebraska population ate a total of 21 identifiable species or groups of food items of which the following percentages are shared (percentage of total shared congeneric taxa or groups in parentheses) with the five populations discussed above: eastern Kansas (Rainey, 1956), 29% (43%); winter Riley County, Kansas (Post 1991), 23% (29%); Riley County. Kansas (Post et al. 1993). 19% (19%); Oklahoma (Murphy 1952), 19% (24%); Oklahoma (McMurray et al. 1993), 10% (29%); and Colorado (Finley 1958), 24% (57%) Therefore, the Nebraska population is using 19% or more of the same food items at the generic level as the other populations with grasses, poison ivy, and sumac of the genus *Rhus* receiving the most widespread use. The diet of the Nebraska population most closely resembles the diet of the Colorado population, although the eastern Kansas population is similar.

The Nebraska population of the eastern woodrat is the only one known to make heavy use of red cedar as a food item in the summer. Red cedar was available to eastern woodrats at both sites in Payne County, Oklahoma, but it was heavily used by eastern woodrats only in the winter on the manipulation study sites (Murphy 1952, McMurray et al. 1993). Red cedar made up a small part of the diet of animals from Riley County, Kansas, with at most 10% of the stored food representing this species (Post et al. 1993); however, in the winter red cedar represented 44.02% of the diet of this population (Post 1991). The Nebraska population also appears to make greater use of invertebrates for food, although winter Riley County, Kansas, population (Post 1991) and the Oklahoma population studied by Murphy (1952) were using them as well. Studies that depend solely on stored food items to determine diet of woodrats may significantly underestimate the number of invertebrates taken as food. This could be a significant oversight because

invertebrates should be excellent sources of protein and moisture. Based upon the results of our study, it is clear that red cedar, smooth sumac, prickly pear, and invertebrates are important components of the diet for the relict population, *N. f. baileyi,* in Nebraska.

ACKNOWLEDGMENTS

We thank C. Lemen, who served as advisor for the Master's project for Clausen from which these data were extracted; S. Churchill, who provided botanical advice; and The Nature Conservancy, which provided support for the project and access to the Niobrara River Valley Preserve.

LITERATURE CITED

Baumgartner, L. L, and A. C. Martin. 1939. Plant histology as an aid in squirrel food-habit studies. J. Wildl. Manage. 3:266-268.

Birney, E. C. 1973. Systematics of three species of woodrats (genus *Neotoma)* in central North America. Mis. Publ. Mus. Nat. Hist., Univ. Kansas 58:1-173.

Bleed, A. 1990. Introduction to plants and animals. Pp. 123-126 *in* An Atlas of the Sand Hills, second ed. (A. Bleed and C. Flowerday, eds.). Univ. Nebraska-Lincoln, Lincoln.

Curtis, J. T., and R. P. McIntosh. 1950. The interrelations of certain analytic and synthetic phytosociological characters. Ecology 3:434-455.

Finley, R. B., Jr. 1958. The wood rats of Colorado: Distribution and ecology. Univ. Kansas Publ., Mus. Nat. Hist. 10:213-552.

Fitch, H. S., and D. G. Rainey. 1956. Ecological observations on the woodrat, *Neotoma floridana.* Univ. Kansas Publ., Mus. Nat. Hist. 8:499-533.

Great Plains Flora Association. 1986. Flora of the Great Plains. Univ. Press of Kansas, Lawrence.

Jones, J. K., Jr. 1964. Distribution and taxonomy of mammals of Nebraska. Univ. Kansas Publ., Mus. Nat. Hist. 16:1-35

Kaul. R. 1990. Plants. Pp. 127-142 *in* An Atlas of the Sand Hills, second ed. (A. Bleed and C. Flowerday, eds.). Univ. Nebraska-Lincoln, Lincoln.

McMurray, S. T., R. L. Lochmiller, J. F. Boggs, D. M. Leslie, Jr., and D. M. Engle. 1993. Opportunistic foraging of eastern woodrats (*Neotoma floridana)* in manipulated habitats. Am. Midl. Nat. 130:325-337.

Murphy, M. F. 1952. Ecology and helminths of the Osage wood rat, *Neotoma floridana osagensis,* including the description of *Longistriata neotoma n.* sp. (Trichostrongylidae). Am. Midl. Nat. 48:204-218.

Post, D. M. 1991. An analysis of factors affecting cache use behavior by eastern woodrats. Ph.D. Dissertation. Kansas State Univ., Manhattan, KS.

Post, D. M., 0. J. Reichman, and D. E. Wooster. 1993. Characteristics and significance of the caches of eastern woodrat (*Neotoma floridana).* J. Mammal. 74:688-692.

Primack, R. B. 1993. Essentials of conservation biology. Sinauer Assoc. Inc., Sunderland, MA.

Rainey, D. G. 1956. Eastern woodrat, *Neotoma floridana:* Life history and ecology. Univ. Kansas Publ., Mus. Nat. Hist. 8:535-646.

Riegert, P. W., and N. Singh. 1982. A key to identify epidermal fragments of Saskatchewan rangeland plants. Canadian J. Bot. 60:2461-2468.

Sparks, D. R., and J. C. Malechek. 1967. Estimating percentage dry weights in diets. J. Mammal. 56:731-751.

Wiley, R. W. 1980. *Neotoma floridana.* Mammalian Species 139:1-7.

Wydeven, P. R., and R. B. Dahlgren. 1982. A comparison of prairie dog stomach contents and feces using a microhistological technique. J. Wildl. Manage. 46:1104-1108.

Received 11/8/96 Accepted 5/2/98