AN ABSTRACT OF THE THESIS OF

Kelly S. Conrad for the Master of Science

in Biology presented on 9 January 1995

Title: Value of eastern woodrat (Neotoma floridana) houses

Abstract Approved: Elmer J. Finck

The eastern woodrat (Neotoma floridana) builds houses which are constructed via the successive combined efforts of many occupants, and are unequal in size and structure. Because not all houses are equal, I attempted to establish that houses are of unequal value, and hence are not occupied randomly. I assumed that reproductive females should occupy higher quality houses because these individuals should incur the highest cost in occupying poor quality houses. A poor quality house would put the health and safety of the female and her litter at risk. House quality can be determined by quantifying the degree to which the house fulfills the needs of the occupant. I examined house quality with regard to three variables: 1) house insulation, 2) distance to closest neighbor, and 3) house volume. The dependent variables of house insulation, distance between houses, and house volume cannot be predicted by the independent variables of sex, weight, and reproductive stage of house occupant. However, adult female woodrats occupied houses significantly more than predicted, based on the sex ratio of all woodrats trapped. Thus, house occupancy could be a major factor in assessing house value. Key words: Eastern woodrat, Neotoma

floridana, territory value, sex ratio.

VALUE OF EASTERN WOODRAT

(<u>NEOTOMA FLORIDANA</u>) HOUSES

A Thesis

Submitted to

the Division of Biological Sciences

Emporia State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Kelly S. Conrad

May 1995

Thesis
1995
C

Elmer J. Finck
Approved by Major Advisor

David K. Saunders
Approved by Committee Member

Stephen F. Davis
Approved by Committee Member

Gaylen Neufeld
Approved by Committee Member

David K. Saunders
Approved for Major Department

John O. Schwenn
Approved for Graduate Council

ACKNOWLEDGEMENTS

I express my sincere thanks to the members of my graduate committee, Elmer Finck, Stephen Davis, Gaylen Neufeld, and David Saunders, for their helpful suggestions, criticism, and encouragement. Thanks also to Kate McGrath, who helped develop the pilot study. My gratitude to Dwight Moore, who aided in data analysis. Thanks also to Elizabeth Yanik for assistance in determining the volume of a woodrat house. Special thanks to my parents, Marvin and Terry Conrad, who provided me not only with financial support, but also with copious love and strength. Thanks also to Steven Bender, who modified the traps to make them "raccoon-resistant," aided in several trapping excursions, and provided unlimited encouragement. Funding for this research was provided by Emporia State University.

Preface

I intend to submit my thesis to Behavioral Ecology, the journal of the International Society for Behavioral Ecology. Therefore, my thesis is written in the format of that journal.

TABLE OF CONTENTS

List of Tables

List of Figures

The eastern woodrat (Neotoma floridana) constructs large structures that function as shelter and for food storage. These structures are composed mainly of sticks ranging in size from less than 0.9 to 404 g (McGinley, 1984). Other items added to the house include stems and leaves of various species, unidentifiable organic matter, and odd objects such as metal wire, shredded cloth, and dried cow manure, which are found in proximity to the house site (Conrad KS, personal observations). In east-central Kansas, houses are located in wooded areas, edge habitats including fencerows and windbreaks, and in rocky outcrops. House sites typically are constructed in places that are "sheltered, such as matted thickets of undergrowth, root tangles exposed along eroded gully banks, hollow stumps or tree trunks, bases of thorny trees with multiple trunks for support, thick tops of fallen trees, or, especially, rock outcrops with deep crevices" (Fitch and Rainey, 1956). Houses may also be found meters above the ground, where they are supported by the limbs of trees. A typical house is parabolic or dome-shaped and has several entrances, tunnels, and compartments. The compartments may be used for nesting, nurseries, or food storage. Houses are not constructed by a single woodrat, but represent the pooled efforts of several successive, as opposed to concurrent, occupants that contribute material to the house.

McGinley (1984) established that the eastern woodrat favors the use of different sized sticks at particular stages of the construction of the house. Initially, the woodrat selects a large object or collection of objects to establish a frame for the house. After the frame is established, the woodrat selects medium sized sticks (10 - 50 g) and transports them to the established frame to fill in the structure. During the warm months, the woodrat allows the house to settle and become more loose. However, in the cold months, the woodrat carefully maintains the house as a tight, sturdy structure (Conrad KS, personal observation). At this time, the woodrat probably uses small sticks (< 0.9 - 9.9 g) to better insulate the house. This behavior of choosing particular classes of sticks during certain stages of construction and periods of time indicates that the construction of the house and the choice of house material is a non-random process. Bushy-tailed woodrat (Neotoma cinerea) middens provide additional support of this theory. Middens are collections of materials stored in the woodrat house, and were thought to be indicators of an area's vegetation. However, bushy-tailed woodrat middens do not constitute a random sample of the available vegetation (Frase BA, unpublished data). Since woodrats are selective in the choice of materials used in the construction of the house and collected in the midden, their houses can be assumed to be of unequal value. Corroborating this view, Fitch and Rainey (1956) found that during a period of low woodrat density, houses became more distinct with regard to favorability. Some houses were allowed to fall into a state of disrepair and were occupied only sporadically, while other houses were well maintained and were continuously occupied over several generations. These data provide additional support for the hypothesis that different microhabitats, specifically different woodrat houses, are of unequal value.

Post et al. (1993) found that energy content of caches was positively correlated with body mass, but not sex, of the individual cache owner. This finding suggests that a subset of individuals occupy enhanced quality houses. Morris (1992) found that female white-footed mice (Peromyscus leucopus) produced litters of different sizes in different habitats, suggesting that habitat enhances female fecundity. Thus, females should secure enhanced quality habitats in order to successfully produce larger and more healthy litters.

Previous studies that found no difference in house selection by male and female woodrats (Post et al., 1993), may have examined houses during non-breeding and/or non-caching seasons, when house selection may not be as crucial to the woodrat. Also, these studies have not differentiated among the reproductive conditions of males and females. Since selectivity may only be important to a particular subset of rats, such as reproductive females, this nondiscriminate pooling of data may have negated the detection of differences in house selection.

Houses may differ in value based on intrinsic and extrinsic factors. Intrinsic factors are directly related to the house itself. These may include insulation, house volume, house construction material, and midden contents. Extrinsic factors are those that are indirectly related to the house. They may include the house's proximity to food sources, distance to nearest non-adjacent house, and degree of exposure to weather extremes.

Female woodrats potentially experience several factors that limit reproductive activity and success. These factors include energy (a female can produce x amount of offspring per unit energy), time (a female must acquire an appropriate house before pups are born because of encumbered movement after birth of the litter, and must wean young before winter), safety (the female must live in order to reproduce), competition (with other females for adequate nest sites and food), and temperature (pups are temporarily not thermoregulatory). Females must also gain enough energy to produce upcoming litters or recuperate from recently weaned litters. Males do not have these energy needs. Assuming males do not entice females to copulate based on the quality of the male's house and that any house will provide basic survival needs during the breeding season, it is not advantageous for a male woodrat to spend time and energy acquiring a higher quality house. Based on these factors, female woodrats, especially those in reproductive condition, should select houses which fully satisfy the needs of the woodrat and her pups.

Based on these considerations, I hypothesize that three factors, two intrinsic and one extrinsic, are indices of house quality to the eastern woodrat. These factors include 1) ability to insulate against temperature extremes, 2) volume of the woodrat house, and 3) distance between house and nearest
non-adjacent house. By assessing the predictive value of each of the variables of occupant's sex, weight, and reproductive stage on each of the house value indices, I attempted to establish a model to determine the value of a woodrat house.

METHODS

Study Site

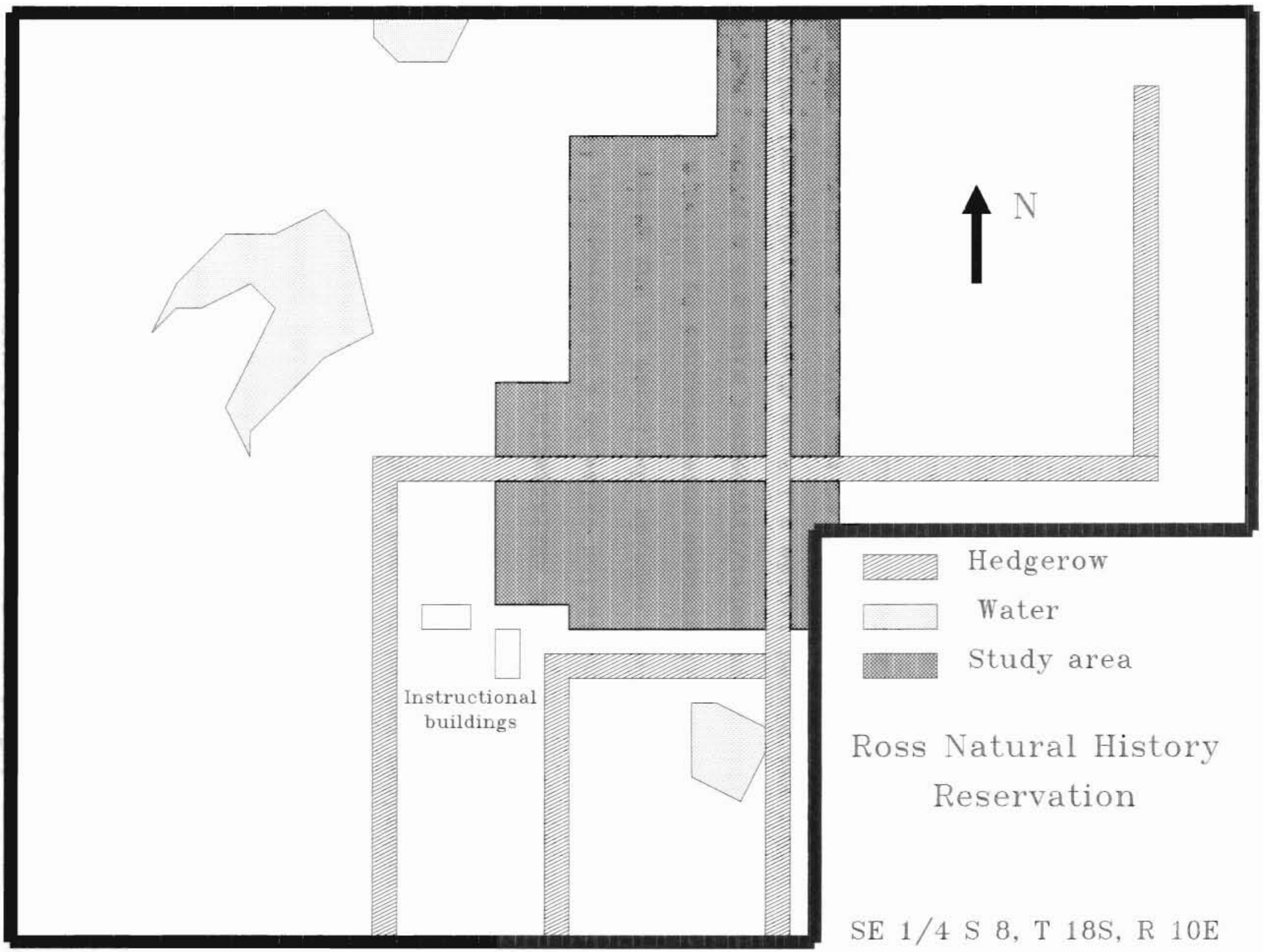
I studied woodrats on the Ross Natural History Reservation, 4.8 km southwest of Americus, Kansas. The Ross Reservation is an 80 ha area located on the eastern edge of the Flint Hills region of east-central Kansas (Figure 1). The area is a mosaic of Kansas habitat types, and consists of native and non-native grassland, edge habitats, woody areas, and riparian zones. Most of the grasslands are bordered by Osage orange (*Maclura pomifera*) or red cedar (*Juniperus* virginiana) hedgerows and windbreaks. Woody vegetation includes larger trees such as cottonwood (Populus deltoides), Osage orange, American elm (Ulmus americana), hackberry (Celtis occidentalis), and green ash (Fraxinus pennsylvanica), as well as shrubby vegetation such as fragrant sumac (Rhus aromatica), rough-leaved dogwood (Cornus drummondii), wild plum (Prunus americana), gooseberry (Ribes missouriense), and buckbrush (Symphoricarpos orbiculatus). Nomenclature of plants follows The Flora of the Great Plains (Great Plains Floral Association, 1986).

The 12.3 hectare study area was divided into 4 subplots measuring 3.6 ha, 800 m^2, 5700 m^2, and 1200 m^2 (Figure 1). The remaining area did not contain substantial groups of woodrat houses, but did connect the study sites. The subplots were divided on the basis of naturally occurring groups of woodrat houses, and usually contained 10 houses each. One plot contained 5 houses. Each plot was treated as equally as possible with regard to trapping regime and house variable measurement.

Trapping procedure

I trapped woodrats from 7 June through 9 September 1994. Using Tomahawk and HaveaHeart traps measuring 483 x 160 x 160 mm, woodrats were trapped with a bait of mixed oatmeal and peanut butter scattered in a line from a house entrance

Figure 1. Map of the study area at the Ross Natural History Reservation


N
Hedgerow
Water
Study area
Instructional buildings
Ross Natural History Reservation
SE 1/4 S 8, T 18S, R 10E

to the end of the trap. Two traps were usually used for each house. Each trap was placed along a path within 50 cm of the house entrance. Traps were set each evening between 1700 and 1900 and picked up between 0600 and 0730 the next morning. Traps were never left unattended more than 16 hours. Each house was trapped for 4 or 5 non-consecutive nights over a 2 week period. Trapping consecutive nights and trapping more than 5 nights were avoided, as these practices tended to lead to depredation of the trapped woodrats.

Measurement of house characteristics

I quantified insulation value as a difference in temperature (°C) inside versus outside the house at any given time. Temperatures differences were obtained by using a Fisher Scientific Thermometer/Hygrometer with a 3 m probe. The probe was placed inside a 1.9 cm diameter polyvinyl chloride (PVC) pipe. The far end of the pipe was drilled to provide 15 ventilation holes. Behind the ventilation holes, pipe insulation was placed inside the PVC pipe to prevent external temperatures from interfering with internal readings. The ends of the pipe were capped to prevent house debris from interfering with the probe sensor. The probe and unit were allowed to stabilize outside the house for 6 minutes before the beginning of each trial. Once stabilized, the probe was inserted into the house to a depth as close to the center and house floor as possible. The probe was again allowed to stabilize for 6 minutes before a temperature reading was taken. An attempt was made to ensure that the probe was inside a nest, passageway, or other cavity rather than in the organic debris within the house. In this way, I hoped to measure the temperature of the woodrat's environment, rather than the temperature of the house material. Four measurements were taken at each house for a total of 140 observations. Each measurement was taken between the hours of 1100 and 1600, when the ambient temperature varied no more than 5°C from the median 25°C. Each measurement was recorded to the nearest 0.1°C.

A Roll-a-Wheel measuring device was used to obtain distance to the nearest non-adjacent house to the nearest meter. Some houses had an additional structure which was connected to the main house. Since it was not clear whether these were distinct, separately occupied houses or extensions of the main house, distance was measure to the "nearest non-adjacent house," which refers to any house which is does not touch the house being studied. A systematic search was conducted in order to obtain distance to the nearest house, regardless of whether the house was used in my study.

The dimensions of house diameter, house height, and house circumference were measured to the nearest centimeter. House diameter was measured at 2 perpendicular axes. House height was measured from the highest point of the house. House circumference was obtained by placing a string around the base of the house and measuring the resulting distance. House volume was calculated by dividing the house into 2 parts and calculating the volume of 1/2 a cone for each part. The 2 volumes were then added together to obtain the total volume of the house. In this way I hoped to partially account for irregularities in slope that are inherent in the houses. To make house volume differences consistent with the estimated precision of a woodrat's perception, I rounded volumes to the nearest 100,000 cc increment and categorized the volume based on that increment. For example, a house with a measured volume of 123,333 cc was rounded to 100,000 cc, then placed in Category 1.

Occupant characteristics

Characteristics of each house occupant were obtained upon trapping. Handling was minimized to decrease subject disturbance, which could lead to house and litter abandonment or a change of reproductive stage or receptivity. Upon capture, each woodrat was marked with a unique number via the toe-clip method (Ad Hoc Committee on Acceptable Field Methods in Mammalogy, 1987). The subject was then weighed and the sex was determined. In addition, its stage of reproduction was assessed. The weight and reproductive condition of each individual was determined upon each capture. Reproductive condition (established as a gradient of stages of reproduction) was expected to serve as an indicator of reproductive capability, rather than as an indicator of actual reproductive actions.

Occupancy was established for each house by examining trapping records and determining the most common inhabitant of that house. If trapping records indicated one adult female and one or several juveniles were trapped at a single house, then I assumed the adult female was the primary occupant and the juveniles were her offspring. If one adult female and one or several adult males were trapped at a house, I assumed that the female was the resident and the male or males were making copulatory visits. If several adult or juvenile woodrats were trapped at a house and no reasonable pattern could be established, I concluded that occupancy could not be determined and left such houses out of any analysis concerning occupant characteristics.

Male woodrat reproductive condition was determined by scrotal sac presence and position as well as by degree of hair loss along the ventral midline (Fitch and Rainey, 1956). "Fully scrotal" referred to males with a prominent scrotal sac; testes could not readily be moved out of the scrotal sac and into the abdomen. "Partially scrotal" referred to males with testes in the scrotal sac that could be readily moved into and out of the scrotal sac. "Nonscrotal" referred to males which had no visible scrotal sac. Hair loss along the midline was also determined. "Hair loss" referred to the condition of having a strip of bare skin, roughly 0.5 - 1.0 cm wide and 5 cm long, running anterior-posteriorly along the specialized midventral gland described by Clarke (1973). Hair loss in this region is indicative of an adult, reproductively active male (Rainey, 1956). The stage of reproduction which was most representative of the subject's condition during the trapping period was used in data analysis. Hair loss and scrotal data were combined to yield the following scale of reproductive stages:

1. Nonscrotal, subadult or juvenile
2. Nonscrotal, adult
3. Partially scrotal, no hair loss
4. Partially scrotal, hair loss
5. Fully scrotal, no hair loss
6. Fully scrotal, hair loss

In order to accentuate important stages of reproductive activity for data analysis, I truncated this scale. Males were classified as either 1) non-reproductive, scale numbers 1-2, 2) potentially capable of insemination, scale numbers 3-4, or 3) capable of insemination, scale numbers 5-6. Males in category 1 were considered "non-reproductive," and males in categories 2 and 3 were considered "reproductive."

Female reproductive condition was determined by assessing teat condition and hair abundance on the abdominal area (Rainey, 1956). Teats were classified as "visible," "apparent," or "prominent" according to their size. Hair abundance was classified as "no hair loss," "some hair loss," or "complete hair loss" on the abdomen and around the teats. These data were compiled to form the following scale which represents stage of reproductive activity:

1. Teats visible, incomplete hair loss
2. Teats apparent, incomplete hair loss
3. Teats apparent, complete hair loss
4. Teats prominent, incomplete hair loss
5. Teats prominent, complete hair loss

In order to accentuate important stages of reproduction for data analysis, I truncated this scale. Females were classified as either 1) non-reproductive, scale numbers 1-2, 2) potentially reproductive, scale number 3, or 3) reproductive, scale numbers 4-5. Females in category 1 were considered "non-reproductive," and females in categories 2 and 3 were considered "reproductive."

Data were analyzed using parametric and non-parametric tests as appropriate relative to the assumptions of the test statistic. Means +/- SE are listed throughout the paper. A significance value of $p = 0.05$ was used for all statistical tests.

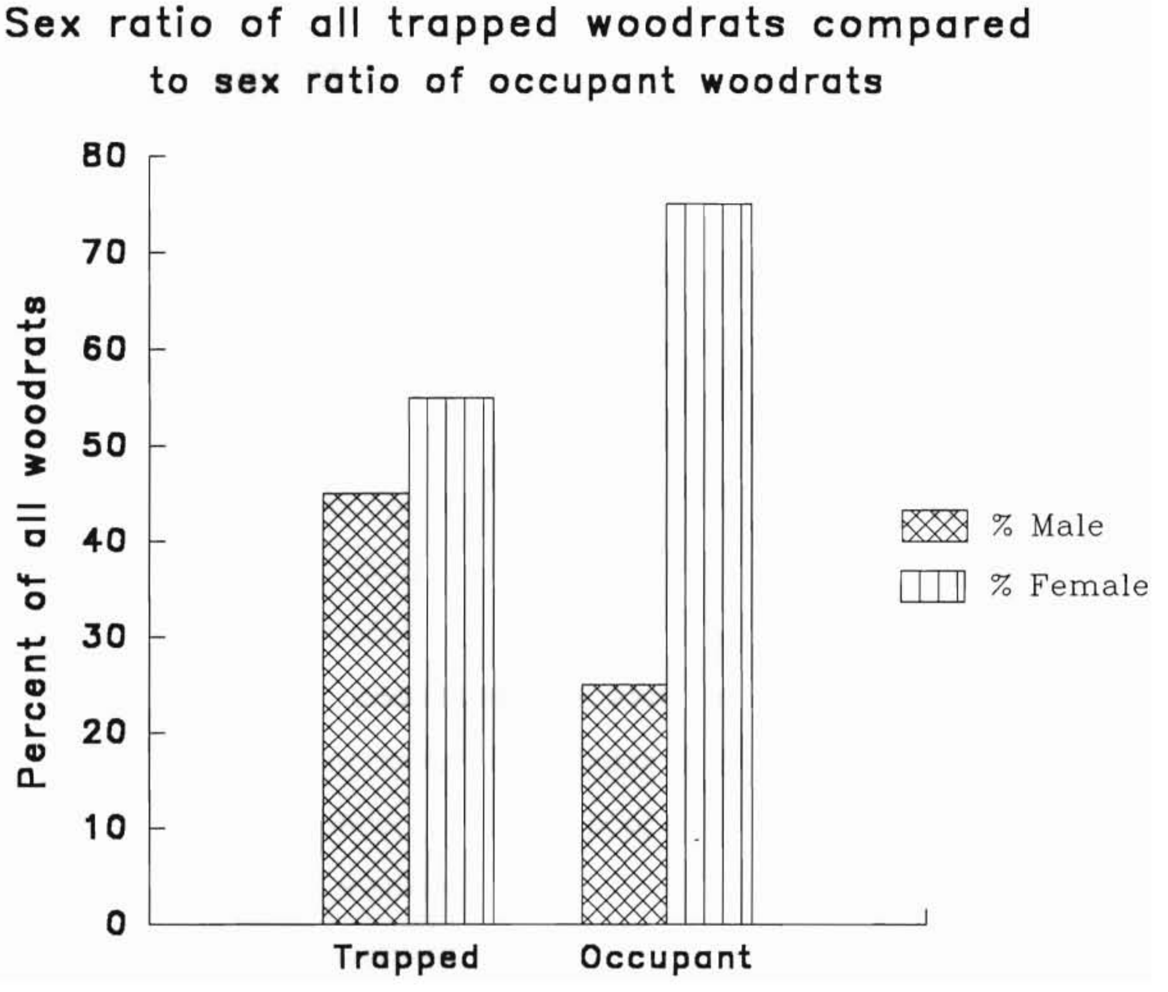
RESULTS

One hundred sixty-six woodrat captures were made during 316 trap nights. Trapping success was 52%. Fifty-two individual rats were caught, in addition to 6 cotton rats (Sigmodon hispidus) and 3 opossum (Didelphis virginiana). Of these 52 woodrats, 29 were adult females, 20 were adult males, and three were juveniles. The sex ratio of trapped woodrats did not differ significantly from 1:1 (Chi-square analysis, $X^2 = 1.65$, df = 1, $p > 0.05$; Figure 2). Six houses were occupied by males, 18 were occupied by females, and 3 were unoccupied. Eight of the houses studied were discarded from occupant analysis because of uncertainty of resident status, or because the resident was a subadult. The occupant sex ratio was not only significantly different from 1:1 (Chi-square, $X^2 = 6.00$, df = 1, $p < 0.05$), but was also significantly different from the actual distribution of 55% female and 45% male woodrats trapped (Chi-square, $X^2 = 3.88$, df = 1, $p < 0.05$; Figure 2).

All statistical tests were two tailed, and an alpha level of 0.05 was used to determine significance. Mean values were used in parametric statistical analyses, and median values were used in non-parametric alternative statistical analyses.

The mean and median of each individual woodrat's weight was calculated for use in analyses of woodrat weight. The average weight of all woodrats was 203 g +/- 14, the average

Figure 2. Sex ratio of captured population compared to sex ratio of occupant woodrats


Sex ratio of all trapped woodrats compared
to sex ratio of occupant woodrats
Percent of all woodrats
80
70
60
50
40
30
20
10
0
Trapped
Occupant
% Male
% Female

weight of females was 184 g +/- 12 and the average weight of males was 263 g +/- 37. The weights of male and female woodrats were not significantly different (Student's t-test, $t = 1.64$, $p = 0.113$). The median weight of reproductive females was 215 g, and the median weight of non-reproductive females was 133 g. The median weights of reproductive and non-reproductive females were significantly different (Mann-Whitney rank sum test, $U_{14,15} = 124$, $p < 0.001$). The median weight of reproductive males was 240 g, whereas the median weight of non-reproductive males was 135 g. The median weights of reproductive and non-reproductive males were significantly different (Mann-Whitney rank sum test, $U_{9,12} = 48$, $p < 0.001$). The average stage of reproductive condition of all woodrats was 3.6 +/- 0.4 (Category 2). The average stage of reproductive condition of males was 4.1 +/- 0.9 (Category 2), and the average stage of reproductive condition of females was 3.4 +/- 0.5 (Category 2).

The mean and median indices of house value for adult male and female reproductive and non-reproductive woodrats are listed in Table 1. In all insulation measurement trials, the temperatures inside the woodrat house were cooler than the ambient temperature ($n = 140$). The medians of the insulation value of occupied and unoccupied houses (Table 2) were not significantly different (Mann-Whitney rank sum test, $U_{11,24} = 202$, $p = 0.901$). The means of the

Table 1. Mean and median of house characteristics for each reproductive category

Category	Insulation (in - out °C)		Volume (class)		Distance (m)	
	mean	median	mean	median	mean	median
All females	3.6 +/- 0.2	3.3	6.2 +/- 1.1	5.5	17 +/- 3	12
Reproductive females	3.5 +/- 0.7	3.3	4.6 +/- 0.8	3.6	16 +/- 4	12
Non-reproductive females	3.5 +/- 0.4	3.3	9.2 +/- 3.2	5.7	18 +/- 7	11
All males	3.4 +/- 0.6	2.9	6.0 +/- 1.3	6.5	16 +/- 5	14
Reproductive males	3.5 +/- 0.7	3.2	6.7 +/- 1.2	7.7	18 +/- 5	20
Non-reproductive males	2.6 +/- 0.0	2.6	2.0 +/- 0.0	2.0	6 +/- 0.0	6

insulation values of male versus female houses were not different (Student's t-test, $t = -0.268$, $p = 0.791$). To compare the insulation of houses of reproductive and non-reproductive males and females, I ran a Kruskal-Wallis one-way ANOVA of ranks. The mean values of the groups were not significantly different ($H = 1.252$, $p = 0.741$).

The means of the volume of male and female houses were not different (Student's t-test, $t = -0.110$, $p = 0.940$). The mean house volume values among reproductive and non-reproductive males and females were not significantly different (one-way ANOVA, $F = 1.883$, $df = 3$, $p = 0.165$). I ran linear regression analysis to determine the effect of house height and radius on the volume of the house. The dependent variable of house volume can be predicted from the independent variables of house height ($F = 15.65$, $R^2 = 0.322$, $p < 0.001$) and radius ($F = 44.94$, $R^2 = 0.737$, $p < 0.001$).

The means of distances between houses occupied by males and females were not significantly different (Student's t-test, $t = -0.211$, $p = 0.830$, $n = 24$). To compare the distance between houses of reproductive and non-reproductive males and females, I ran a Kruskal-Wallis one-way ANOVA of ranks. The means of the groups were not significantly different ($H = 1.959$, $p = 0.581$).

In order to assess the predictive value of the occupant

Table 2. House value indices for unoccupied and occupied woodrat houses

Class	Insulation (in - out °C)		Volume (class)		Distance (m)	
	mean	median	mean	median	mean	median
All occupied houses	3.5 +/- 0.2	3.5	5.9 +/- 0.9	5.2	16 +/- 3	12
Unoccupied houses	3.7 +/- 0.6	3.5	4.6 +/- 1.2	2.7	19 +/- 6.1	14

characteristics of sex, weight, and stage of reproduction on each of the dependent variables of house insulation, housevolume, and distance between houses, I ran a multiple linear regression. The linear combination of the independent variables of occupant sex, stage of reproduction, and weight did not predict the variables of house insulation ($F = 0.120$, $p = 0.947$, $R^2 = 0.018$), house volume ($F = 0.143$, $p = 0.933$, $R^2 = 0.021$), or distance between houses ($F = 0.271$, $p = 0.846$, $R^2 = 0.039$).

DISCUSSION

My results do not support the hypothesis that woodrat house value, based on house volume, insulation, and distance from a non-adjacent house, can be predicted from house occupant variables of sex, weight, and stage of reproduction. Also, the house value, based on volume, insulation, and distance, does not differ among reproductive and non-reproductive adult males and females. However, the eastern woodrat maintains and defends a centralized territory, the house, within its home range. The only justification for defending a territory is if the benefits obtained from the territory exceed the cost of maintaining it (Brown, 1964). Therefore, there must be some benefit derived from a defended house. Post et al. (1993) found that woodrats with a larger body mass occupied houses which had higher energy caches, which implies that one benefit derived from the house is an advantage in food caching. I suggest, however, that since the woodrat uses the house for activities other than for food storage, such as for nesting and for shelter, food storage is not the only benefit derived from ownership of the house.

While the sex ratio of this woodrat population did not differ significantly from 1:1, the sex ratio of house occupants was 1:3 (male:female). This relationship indicates that house occupation is not random. If house occupation is not random, then there must be some variable or variables that predict which individuals will occupy houses and which houses those individuals will occupy. The possible next step in this research program could be to separate individuals of the population into groups of "occupants" and "non-occupants." Are all females and some subset of males occupying houses? Is there a subset of both sexes that occupies houses? By determining characteristics of individuals that are occupying houses, researchers could identify possible factors that are beneficial to those subsets. Future research could use these factors to determine variables that most affect the value of eastern woodrat houses.

REFERENCES

Ad Hoc Committee on Acceptable Field Methods in Mammalogy, 1987. Acceptable field methods in mammalogy: preliminary guidelines approved by the American Society of Mammalogists. Journal of Mammalogy 68:S1-S8.

Brown JL, 1964. The evolution of diversity in avian territorial systems. Wilson Bulletin 76:160-169.

Clarke JW, 1973. The specialized midventral gland of the eastern woodrat Neotoma floridana osagensis. (MS Thesis) Emporia, Kansas: Kansas State Teachers College.

Fitch HS, Rainey DG, 1956. Ecological observations of the woodrat (Neotoma floridana). University of Kansas Publications. Museum of Natural History 8:449-533.

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

McGinley MA, 1984. Central place foraging for non-food items: Determination of stick size-value relationship of house building materials collected by eastern woodrats. The American Naturalist 123:841-853.

Morris DW, 1992. Environmental networks, compensating life histories and habitat selection by white-footed mice. Evolutionary Ecology 6:1-14.

Post DM, Reichman OJ, Wooster DE, 1993. Characteristics and significance of the caches of eastern woodrats (Neotoma floridana). Journal of Mammalogy 74:688-692.

Rainey DG, 1956. Eastern woodrat, Neotoma floridana: Life history and ecology. University of Kansas Publications.

Museum of Natural History 8:535-646.

Kelly S. Conrad

Signature of Graduate Student

Elmer J. Finck

Signature of Major Advisor

I, Kelly S. Conrad, hereby submit this thesis to Emporia State University as partial fulfillment of the requirements for an advanced degree. I agree that the Library of the University may make it available for use in accordance with its regulations governing materials of this type. I further agree that quoting, photocopying, or other reproduction of this document is allowed for private study, scholarship (including teaching) and research purposes of a nonprofit nature. No copying which involves potential financial gain will be allowed without written permission of the author.

Kelly S. Conrad

Signature of Author

9 January 1995

Date

Value of eastern woodrat (Neotoma floridana) houses

Title of Thesis

Doug Cooper

Signature of Graduate Office Staff Member

May 11, 1995

Date Received