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AN ABSTRACT OF THE THESIS OF Brent D. Frazier for the Master of Science
in Biology presented February 18, 1977.

Title: A Study of the Home Range of Neotoma fuscipes in Two Colonies in
Klamath County, Oregon.

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

Richard B. Forbes, Chairman

Robert O. Tinnin

John H. Wirtz

Home ranges of dusky-footed woodrats (Neotoma fuscipes) were determined by the exclusive boundary strip method in two colonies 630 m apart in Klamath County, Oregon. The mean home range area was $1800 - 1900 \text{ m}^2$. Densities of trees and shrubs were determined on selected home ranges and densities of woodrat houses and nests were determined on all home ranges. No significant correlation was found between home range areas and densities of various trees and shrubs, home range areas and densities of woodrat houses and nests, or home range areas and weights of woodrats in those areas.

No movement between colonies was observed.

A STUDY OF HOME RANGE IN TWO NEOTOMA FUSCIPES
COLONIES IN KLAMATH COUNTY, OREGON

by

BRENT D. FRAZIER

A thesis submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE
in
BIOLOGY

Portland State University
1977

TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH:

The members of the Committee approve the thesis of
Brent D. Frazier presented February 18, 1977.

Richard B. Forbes, Chairman

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INTRODUCTION

Burt (1943) defined home range as that area transversed by the individual in its normal activities of food gathering, mating, and caring for young. Hayne (1949), Stickel (1954), Calhoun and Casby (1958), and Ambrose (1969) reviewed and discussed methods of calculating home ranges of small mammals. Many factors may influence the size of home range including sex, age, season, population density (Burt 1943), weight of mammal (McNab 1963), food supply, cover, territoriality, and other factors (Stickel 1954).

Much has been published about the natural history of woodrats (Dixon 1919, English 1923, Gander 1929, Donat 1933, Vestal 1938, Lay and Baker 1938, Horton and Wright 1944, Pearson 1952, Fitch and Rainey (1956), Rainey 1956, Vogl 1967, Stones and Hayward 1968, Cameron 1971, Cameron and Rainey 1972). Home ranges and movements of the dusky-footed woodrat, Neotoma fuscipes (Vestal 1938, Linsdale and Tevis 1951, Smith 1965), and other woodrats (Dixon 1919, Lay and Baker 1938, Pearson 1952, Fitch and Rainey 1956, Ireland and Hays 1969) have been studied. I found no studies that attempted to determine which factors influence the home range size of woodrats. Vegetation provides food (English 1923, Gander 1929, Horton and Wright 1944) and cover (Horton and Wright 1944, Fitch and Rainey 1956) for the woodrats. Vegetation also provides material for the structures called "houses" or "lodges" constructed by the woodrats and material and shelter for nests not in woodrat houses (English 1923, Horton and Wright 1944, Linsdale and Tevis 1956, Nettleton 1957, Vogl 1967, Hammer

and Maser (1973). The density and the size of the vegetation may influence the location of woodrats (Murray and Barnes 1969). Woodrats appear to be colonial (Pearson 1952) yet I could find no statement in the literature concerning movement between colonies.

In Oregon (see Figure 1), the dusky-footed woodrat, Neotoma fuscipes, ranges from near the Columbia River south to California west of the Cascade crest (Hooper 1938). East of the Cascades this species ranges east to western Lake County and north to the Sprague River (Hammer and Maser 1973). In western Oregon, N. fuscipes occupies brush thickets along streams and roads and mixed coniferous forest or dense oak woodland. East of the Cascades N. fuscipes occupies primarily juniper (Juniperus sp.) woodland (Hammer and Maser 1973).

Figure 1. Map illustrating the distribution in Oregon of Neotoma fuscipes. Adapted from Hooper (1938) and Hammer and Maser (1973). The black dot indicates the approximate location of the study area.

DESCRIPTION OF STUDY AREA AND METHODS

DESCRIPTION OF STUDY AREA

I selected the study area because I was familiar with it through working for the Vector Control Section, Oregon State Health Division. The study area is located approximately 1.6 km via jeep trail north of Notch Corral, 6.4 km east of Willow Valley Reservoir via Willow Valley Road, Klamath County, Oregon (sections 21 and 22, T21S, R11E, W. M.). The jeep trail runs west of Brady Butte at the eastern base of a small unnamed butte. The study area includes part of the small butte, the slope to Brady Butte, and the western side of Brady Butte (see Figure 2).

Figure 2. Map of study area illustrating positions of grids.

The elevation varies from approximately 1475 m at the top of the small butte to 1463 m at the jeep trail to 1524 m on the side of Brady Butte. The profile of the area is illustrated (Figure 3).

Figure 3. Profile of the study area looking to the North.
The horizontal base line indicates 1463 m elevation.

The vegetation in the area consists primarily of juniper (Juniperus occidentalis Hook.) and mountain mahogany (Cercocarpus ledifolius Nutt.) on the buttes and juniper and big sagebrush (Artemesia tridentata Nutt.) on the slope between the buttes.

METHOD

Three 180 m by 180 m grids were laid out (see Figure 2). Grid A was located at a concentration of woodrat houses on the small butte. The position of Grid B was selected by following a compass reading of 45° (declination not considered) from Grid A to a landmark, a juniper with a diamond-shaped top, on Brady Butte until a concentration of woodrat houses was reached. Grid C was located at the midpoint between Grids A and B by pacing so that the center of the grid was 315 m from the midpoint of the eastern edge of Grid A. Each grid consisted of 100 marked trap stations dividing the grid into eighty-one 20 m by 20 m quadrats.

Only 100 three inch by four inch rigid aluminum Sherman live traps were available. I divided these between the grids, moving the extra trap daily so each trap station was trapped once during each three night trapping period. Bait was peanut butter mixed with rolled oats.

The traps were checked and tripped each morning and reset in the evening during seven trapping periods between 24 April 1976 and 12 August 1976. Dates of trapping periods are shown in Table I. Each captured dusky-footed woodrat was anesthetized with diethyl ether, uniquely toe-clipped, its sex and reproductive status determined, weighed with an Ohaus model 8014 dial spring scale, examined for parasites and injuries, and its behavior observed upon release. The distinction between adult, subadult, and juvenile was made on the bases of pelage coloration and weight. Males were considered scrotal only if testes were palpable. Females were considered lactating if nipples were enlarged and surrounded by bare or flaky skin, and pregnant if the abdomen was distended and nipples enlarged. Other animals were identified and released.

Living and dead trees and living shrubs were counted for each quadrat. Tree diameters were measured 20 - 30 cm from ground level (limbs made chest level measurement difficult). Grasses and small herbaceous plants were identified using Hayes and Garrison (1960), Hitchcock and Cronquist (1973), and Taylor and Valum (1974), but were not counted. A collection of plants was not made.

Because the number of woodrat houses and nests could be a means of estimating woodrat density and could be related to home range size, they were mapped for each grid and if they were within 20 m of the grid edges. Activity was determined by the presence of fresh scats and vegetation clippings, the condition of the house, and woodrat noise as discussed by Stones and Hayward (1968). Materials used in the houses were noted.

METHODS OF DATA ANALYSIS

The widely accepted method of home range calculation, a density probability function (Calhoun and Casby 1958) assumes a circular home range. In this case this is unlikely because woodrats probably do not forage randomly in all directions from the house (Fitch and Rainey 1956). Also, this method does not lend itself to the mapping of items within the determined range. Accordingly, I decided to use the exclusive boundary strip method described by Stickel (1954). Home ranges were mapped for each N. fuscipes with two or more different capture points and approximate densities of counted vegetation were determined for each home range by multiplying the absolute number of a particular tree or shrub in a quadrat by the portion of that quadrat included in the home range and adding the portions to obtain a density for the total home range.

This does not take into account clumping of vegetation but alternatives were too time consuming for this study.

Woodrat houses and nests were mapped for each grid so the number of houses and nests per home range was readily determined by drawing the home range shape over the appropriate map of houses and nests.

RESULTS

Table I lists the trapping results during the survey.

HOME RANGE

In 700 trap nights per grid, 26 different dusky-footed woodrats were captured in Grid A (two died of exposure), 38 were captured in Grid B, and 1 was captured in Grid C. A single capture cannot determine a home range so only Grid A and Grid B are considered in calculating home ranges. Of the 26 N. fuscipes captured in Grid A, 11 were captured at two or more trap stations and home ranges could be determined. Of the 38 captured in Grid B, 13 could be used to calculate home ranges. No range changes were noted among those woodrats with enough recapture data to determine a home range. The individual home ranges are listed in Table II.

It was possible that those ranges not completely enclosed by the grids (i.e. one or more sides of the range border or extend outside the grid) were smaller than those completely enclosed, so enclosed ranges for each grid were compared with those not enclosed using the Student's-t test. Home range areas were transformed by the square root method (Skellam 1951). No significant difference was found between the mean of enclosed A and the mean of not enclosed A ($t=0.28$), or between the mean of enclosed B and the mean of not enclosed B home ranges ($t=0.27$). Since there was no significant difference between the enclosed and the not enclosed area, I considered all home ranges of each grid in comparing

TABLE I
NUMBERS OF VARIOUS MAMMALS CAPTURED DURING THE SURVEY

Dates	<u>Grid A</u>							<u>Grid B</u>						<u>Grid C</u>		
	N.f.	N.c.	P.m.	D.h.	S.n.	P.p.	TTE	N.f.	N.c.	P.m.	D.h.	E.a.	TTE	N.f.	P.m.	TTE
Apr 24-26	5	-	23	1	1	1	3	1	-	16	-	-	8	-	23	-
May 8-10	3	-	17	-	-	-	10	1	-	21	-	1	6	-	23	1
May 22-24	10	-	24	-	-	-	14	14	-	32	-	-	8	-	25	3
Jun 5-7	10	-	28	-	-	-	12	23	-	29	-	-	17	1	27	1
Jun 17-19	13	-	24	-	-	-	8	23	-	26	-	-	18	-	34	1
Jul 12-14	12	1	20	2	-	-	7	12	-	23	-	-	13	-	23	3
Aug 10-12	7	-	33	-	-	-	11	10	1	37	1	-	13	-	29	3

N.f. -- Neotoma fuscipes

N.c. -- Neotoma cinerea

P.m. -- Peromyscus maniculatus

D.h. -- Dipodomys heermanni

S.n. -- Sylvilagus nuttallii

P.p. -- Perognathus parvus

E.a. -- Eutamias amoenus

TTE -- Traps tripped empty

TABLE II

HOME RANGE AREAS OF INDIVIDUAL N. FUSCIPES IN GRID A AND IN GRID B

<u>Grid A</u>			<u>Grid B</u>		
Woodrat No:	Status	Home range area (m ²)	Animal	Status	Home range area (m ²)
2A	Adult ♀, preg.	3000	1B	Adult ♀	2800
3A*	Adult ♀, lact.	4000	2B	Adult ♀, lact.	1200
4A*	Adult ♀, preg.	2000	3B*	Adult ♀, preg.	1200
5A*	Subadult ♀	2400	5B	Juvenile ♀	1200
6A	Adult ♀, preg.	1400	7B*	Adult ♀	3400
7A*	Adult ♀	800	8B*	Adult ♀	2000
13A*	Subadult ♂	2400	99B	Adult ♀	2000
16A	Subadult ♀	1200	11B	Adult ♀, preg.	3800
17A*	Adult ♀	800	12B*	Adult ♀, preg	1400
19A	Juvenile ♂	1200	14B*	Subadult ♂	2000
21A*	Adult ♀	1200	16B*	Adult ♀	1200
			18B	Adult ♀	800
			21B	Subadult ♀	800

* Home range completely enclosed within grid.

the means of the home ranges of the two grids. No significant difference was found ($t=0.04$). The mean home range area of N. fuscipes is calculated to be between 1800 and 1900 m² with a minimum of 800 m² and a maximum of 4000 m².

The vegetation identified for the study area is listed in Table III. To test the possible interaction between vegetation density and home range area, only enclosed home ranges were considered (see Table IV). Using product-moment correlation, no significant correlation was found between home range areas and the densities of all junipers ($r=0.29$), live junipers ($r=0.07$), all junipers with diameter greater than 35 cm ($r=0.38$), live mountain mahogany ($r=-0.01$), all mountain mahogany ($r=0.01$), currant ($r=0.03$), green rabbitbrush ($r=-0.34$), grey rabbitbrush ($r=0.09$), bitterbrush ($r=-0.29$), or big sagebrush ($r=0.24$). Ponderosa pine, serviceberry, and Klamath plum were not included because they were present in Grid B only.

All home ranges were used in finding if home range size is related to woodrat house and nest densities (Table V). The density of all houses and nests, active and inactive in each home range, was used. No significant correlation was found ($r=-0.08$).

There was no significant correlation ($r=0.02$) between all home range areas and the average weight of the animals in those home ranges (Table V).

All three grids were compared with regard to measured vegetation. The grids were each divided into nine rows of quadrats and the densities of vegetation determined for each row. The grids were compared using the F-test and least difference between the means (Table VI).

TABLE III
VEGETATION IDENTIFIED FOR THE STUDY AREA

Name	In grids:
Western juniper (<u>Juniperus occidentalis</u> Hook.)*	A,B,C
Mountain mahogany (<u>Cercocarpus ledifolius</u> Nutt.)*	A,B
Ponderosa pine (<u>Pinus ponderosa</u> Dougl.)*	B
Currant (<u>Ribes</u> sp.)*	A,B
Green rabbitbrush (<u>Chrysothamnus viscidiflorus</u> (Hook.) Nutt.)*	A,B,C
Grey rabbitbrush (<u>C. nauseosus</u> (Pall.) Britt.)*	A,B
Bitterbrush (<u>Purshia tridentata</u> (Pursh) DDC)*	A,B,C
Big sagebrush (<u>Artemisia tridentata</u> Nutt.)*	A,B,C
Serviceberry (<u>Amelanchier alnifolia</u> Nutt.)*	B
Klamath plum (<u>Prunus subcordata</u> Benth.)*	B
Sagebrush buttercup (<u>Ranunculus glaberrimus</u> Hook.)	B
Common larkspur (<u>Delphinium nuttallianum</u> Pritz.)	A,B,C
Yellow bells (<u>Fritillaria pudica</u> (Pursh) Spreng.)	A,B,C
Death camas (<u>Zygadenus venenosus</u> Wats.)	A,B,C
Blepharipappus (<u>Blepharipappus</u> sp.)	A,B,C
Gold star (<u>Crocidium multicaule</u> Hook.)	A,B,C
Rayless daisy (<u>Erigeron linearis</u> (Hook.) Piper)	C
Scorched penstemon (<u>Penstemon deustus</u> Dougl.)	B
Rock penstemon (<u>P. gairdneri</u> Hook.)	B,C
Dwarf waterleaf (<u>Hydrophyllum capitatum</u> Dougl.)	B
Narrow-leafed phacelia (<u>Phacelia linearis</u> (Pursh) Holz.)	C
Phlox (<u>Phlox</u> sp.)	A,B,C
Desert parsley (<u>Lomatium</u> sp.)	A,B,C
Daggerpod (<u>Phoenicaulis cheiranthoides</u> Nutt.)	A,C
Prairie star flower (<u>Lithophragma bulbifera</u> Rydb.)	A,B,C
Large-headed clover (<u>Trifolium macrocephalum</u> (Pursh) Poiret)	A,C
White thistle (<u>Cirsium hookerianum</u> Nutt.)	A
False dandelion (<u>Agoseris glauca</u> (Pursh) Raf.)	C
Locoweed (<u>Astragalus purshii</u> Dougl.)	C
Desert pansy (<u>Viola trinervata</u> Howell)	A,C
Cheat grass (<u>Bromus tectorum</u> L.)	A,B,C
Japanese brome (<u>Bromus japonicus</u> Thunb.)	A,B,C
Idaho fescue (<u>Festuca idahoensis</u> Elmer)	A,B,C
Sandberg's bluegrass (<u>Poa sandbergii</u> Vasey)	A,B,C
Bluebunch grass (<u>Agropyron spicatum</u> (Pursh) Scribn. & Smith)	A,B,C

* Mapped for the survey.

TABLE IV
DENSITIES OF SELECTED VEGETATION (PLANTS/100 m²) FOR HOME RANGES OF N. FUSCIPES

Woodrat No:	Enclosed Range Areas	Vegetation										
		1	2	3	4	5	6	7	8	9	10	11*
3A	4000	2.18	2.12	0.68	0.75	0.98	2.08	0.18	8.08	0.12	0.41	12.18
4A	2000	1.80	1.57	0.88	0.13	0.21	2.35	0.29	15.20	0.15	0.97	20.66
5A	2400	2.33	2.33	0.60	0.57	1.00	0.75	0.10	3.50	0.30	1.81	9.43
7A	800	1.84	1.84	0.31	0.97	1.05	0.47	0.19	0.56	0.31	13.03	17.40
13A	2400	1.85	1.75	0.73	0.36	0.72	1.91	0.31	6.18	0.36	5.17	16.10
17A	800	2.13	2.10	0.08	0.81	1.22	1.47	2.03	5.12	0.09	0.22	11.84
21A	1200	1.39	1.22	0.70	0.15	0.15	3.53	0.20	13.21	0.02	0.24	18.61
3B	1600	2.91	2.64	1.17	1.23	1.50	0.27	0.00	0.38	0.16	0.56	5.40
7B	3400	2.44	2.44	0.67	1.87	2.85	0.10	0.26	0.24	0.28	2.43	8.69
8B	2000	2.71	2.69	0.96	1.54	1.75	0.12	0.01	0.22	0.36	0.98	6.02
12B	1400	3.90	3.83	0.72	0.72	2.10	0.12	0.04	0.44	1.44	0.54	7.17
14B	2000	2.84	2.59	1.06	0.60	0.69	0.26	0.00	0.18	0.40	0.22	4.30
16B	1200	2.17	2.17	0.67	2.50	3.49	0.07	0.00	0.24	0.08	0.06	9.59

1...All juniper	5...All mountain mahogany	9...Bitterbrush
2...Live juniper	6...Currant	10...Big sagebrush
3...Juniper, diameter 35 cm	7...Green rabbitbrush	11...Total
4...Live mountain mahogany	8...Grey rabbitbrush	

* Figures include densities of Klamath plum, serviceberry, and Ponderosa pine.

TABLE V

DENSITY OF HOUSES AND NESTS FOR HOME RANGE AREAS OF N. FUSCIPES
AND AVERAGE WEIGHT OF INDIVIDUALS

Woodrat No:	Status	Home range area (m ²)	House and nest density (100 m ²)	Average Weight (gm)
2A	Adult ♀, preg.	3000	0.17	231
3A	Adult ♀, lact.	4000	0.40	314
4A	Adult ♀, preg.	2000	0.45	292
5A	Subadult ♀	2400	0.08	199
6A	Adult ♀, preg.	1400	0.14	265
7A	Adult ♀	800	0.25	400
13A	Subadult ♂	2400	0.25	184
16A	Subadult ♀	1200	0.08	158
17A	Adult ♀	800	0.38	355
19A	Juvenile ♂	1200	0.08	118
21A	Adult ♀	1200	0.67	308
1B	Adult ♀	2800	0.18	298
2B	Adult ♀, lact.	1200	0.25	290
3B	Adult ♀, preg.	1200	0.50	282
5B	Juvenile ♀	1200	0.08	139
7B	Adult ♀	3400	0.12	273
8B	Adult ♀	2000	0.15	278
9B	Adult ♀	2000	0.10	259
11B	Adult ♀, preg.	3800	0.13	248
12B	Adult ♀, preg.	1400	0.07	308
14B	Subadult ♂	2000	0.25	113
16B	Adult ♀	1200	0.25	272
18B	Adult ♀	800	0	202
21B	Subadult ♀	800	0.25	160

TABLE VI

RESULTS OF THE COMPARISON OF THE DENSITIES OF VARIOUS ITEMS OF
ALL THREE GRIDS USING F-TEST AND LEAST DIFFERENCE
BETWEEN THE MEANS

Item	Comparison results
All junipers	B > A > C
Live Junipers	B > A > C
Junipers with D > 35 cm	B > A > C
All mountain mahogany	B > A > C
Live mountain mahogany	B > A > C
Currant	A > B > C
Green rabbitbrush	A > B ≈ C
Grey rabbitbrush	A > B ≈ C
Bitterbrush	B > A ≈ C
Big sagebrush	C > A > B
All living trees and shrubs*	C > A > B
Woodrat houses and nests	A ≈ B > C

* Includes Ponderosa pine, serviceberry and Klamath plum.

MOVEMENT BETWEEN COLONIES

No movement between colonies was observed.

BEHAVIORAL OBSERVATIONS

Upon release, several dusky-footed woodrats ran to and entered houses, others climbed juniper or mountain mahogany trees. Many could not be followed any great distance before they were lost to view in the brush. Two of the woodrats were observed to dust and groom themselves when they were released. They dusted in depressions beneath or to the

sides of logs or at the sides of houses. One woodrat was observed eating dried juniper and mountain mahogany leaves.

OTHER OBSERVATIONS

Population

The numbers of dusky-footed woodrats by sex, age, and reproductive status are listed for each grid in Table VII.

Only a rough estimate of the density of N. fuscipes per grid can be determined. Using the Lincoln Index, it was found that Grid A supported about 25 woodrats or 7.7 per hectare. I could not determine a density for Grid B using the Lincoln Index because new woodrats were being caught up to the end of trapping. There were no recaptures in Grid C. Inspection of Table VIII shows no evident relationship between house and nest density and the numbers of woodrats.

Woodrat Houses and Nests

Figures 4, 5, and 6 illustrate the positions of houses and nests in the grids. Houses were found in various stages of development from large masses of sticks to platforms or layers of sticks on the ground or in trees. Nests without houses were usually in a hollow juniper with the entrance a hole where there once was a limb, but were also found in logs and crevices in rocks. Table IX lists the numbers of types of houses and nests in the grids.

Houses were constructed of material close at hand. Dry twigs and pieces of juniper logs, fresh clippings of juniper, dry rabbitbrush and bitterbrush twigs, dry cow dung, pine cones, and mountain mahogany twigs were evident. Juniper material was most common. No houses were opened so only two actual nests were observed. One, in Grid B, was visible

TABLE VII

SEX, AGE, AND REPRODUCTIVE STATUS OF N. FUSCIPES FOR EACH GRID

	<u>Male</u>				<u>Female</u>				
	<u>Adult</u>		<u>Juvenile</u>	<u>Subadult</u>	<u>Adult</u>		<u>Juvenile</u>	<u>Subadult</u>	
	Scrotal	Not scrotal			Pregnant	Lactating			Unknown
Grid A	0	1	1	1	5	3	7	3	5
Grid B	1	6	2	3	4	3	9	2	8
Grid C	0	0	0	0	0	0	0	0	1

TABLE VIII

NUMBERS OF WOODRATS AND WOODRAT HOUSES AND NESTS IN THE GRIDS

	Number <u>N. fuscipes</u> captured	Active houses and nests	Inactive houses and nests	Total houses and nests
Grid A	26	32	24	56
Grid B	38	24	13	37
Grid C	1	16	0	16

Figure 4. Map of Grid A illustrating the positions of houses and nests. Small dots represent trap stations. Upper case letters indicate active houses or nests, lower case letters indicate inactivity. Meaning of the letter symbols are as follows: E,e, houses on the ground; U,u, houses in trees; N,n, nests in ground, rocks or logs; and T,t, nests in trees.

*Destroyed house, see text.

Figure 5. Map of Grid B illustrating the positions of houses and nests. Small dots represent trap stations. Upper case letters indicate active houses or nests, lower case letters indicate inactivity. Meaning of the letter symbols are as follows: E,e, houses on the ground; U,u, houses in trees; N,n, nests in ground, rocks or logs; and T,t, nests in trees.

TABLE IX
NUMBERS OF TYPES OF HOUSES AND NESTS IN THE GRIDS

	<u>Nests</u>		<u>Houses in trees</u>		<u>Houses on ground</u>	
	Active	Inactive	Active	Inactive	Active	Inactive
Grid A	2	1	4	13	26	10
Grid B	4	2	4	6	16	5
Grid C	15	0	0	0	2	0

within a house in the fork of a juniper. The nest was a spherical mass of finely shredded juniper bark with an entrance hole in the side. The other nest was observed in Grid A (See Figure 4). A conical open-ground house was observed to have been torn apart and the nest cavity exposed. Coyote tracks were evident in soft soil around the house. The nest was made of finely shredded juniper bark and was located slightly below ground level. The house was being reconstructed from the original house materials two weeks later.

Parasites

Of all of the N. fuscipes captured, 12 were parasitized by bot (Cuterebra) larvae. In all cases, the larvae were located in the throat region just above the line of the shoulders (Figure 7). Table X shows the time sequence of larval appearance.

No ticks were seen on any of the animals, even though ticks were found crawling upon myself and my dog. None of the animals were combed for fleas but two N. fuscipes were observed to have a large number of fleas visible upon them. One was a female weighing 250 gm, the other a male weighing 185 gm. Both were recaptures when the fleas were observed on 18 June and 19 June, respectively. The male had a suppurating abscess on its hip at that time. Neither woodrat was recaptured again.

Figure 7. Photograph of N. fuscipes with bot larva.

TABLE X

NUMBER AND SEQUENCE OF APPEARANCE OF CUTEREBRA LARVAE ON N. FUSCIPES

Woodrat No:	Apr 24-26	May 8-10	May 22-24	June 5-7	June 17-19	July 12-13	Aug 10-12
1A	1	-	-	-	-	-	-
4A	0	0	0	-	4	-	1
8A	-	-	1	-	1	-	-
10A	-	-	1	-	-	-	-
14A	-	-	-	-	1	-	-
6B	-	-	1	-	-	-	-
8B	-	-	0	0	1	-	-
9B	-	-	1	1	0	-	-
11B	-	-	-	1	0	0	0
22B	-	-	-	-	1	0	-
37B	-	-	-	-	-	-	1
38B	-	-	-	-	-	-	1

- ... Woodrat not captured

0 ... Woodrat captured, no larvae

DISCUSSION AND CONCLUSIONS

Vestal (1938) observed that Neotoma fuscipes foraged within 100 feet of their houses. Fitch and Rainey (1956) observed that the foraging distance of N. floridana was less than 75 feet. Ireland and Hays (1969) found that N. floridana carried foil balls 175 feet to their nests. Pearson (1952) observed that the average distance between points of release and recapture was 178 feet for N. floridana. Lay and Baker (1938) had found this distance to be 108 feet for the same species. If one assumes a circular home range, the home range determined for N. fuscipes in this study ($1800 \text{ m}^2 - 1900 \text{ m}^2$) is close to the home range of Neotoma floridana found by Fitch and Rainey (1956).

The area of an individual home range appears to be unrelated to the densities of the trees and shrubs in that home range. There appears to be no relationship between an individual N. fuscipes home range area and the number of woodrat houses and nests in that area, though one would expect an increasing number of houses and nests as home range area increases. In these cases it is possible that a combination of variables may influence home range size or than none of the tested variables were small enough to limit the home range area. Further evidence supporting the conclusion that home range area may not be influenced by the densities of the trees and shrubs in the home range is the comparison between the grids. In all cases, colony grids A and B were dissimilar in regard to the densities of various trees and shrubs, yet the home ranges were not significantly different.

McNab (1963) suggested a relationship between the weight of a mammal and the home range of that mammal. Using his formula to determine range, $R = 6.76W^{0.63}$, where R is the home range in acres and W is the weight of the mammal in kilograms, one obtains for N. fuscipes, average weight 0.247 kg for those with calculated home ranges, a range of 0.93 acres or 3764 m². This figure is twice as large as the mean home range of 1800 - 1900 m², but is within the 4000 m² maximum. Since no significant correlation was found between individual weights and home ranges, McNab's hypothesis probably should not be applied to individuals.

Although Neotoma fuscipes has a dispersal capacity of from 660 m (Linsdale and Tevis 1951) to 885 m (Smith 1965) and the distance between colonies (630 m) was less than these values, no movement was noted between the colonies. The juvenile woodrat captured in Grid C may have been an immigrant from Grid B but could have originated in Grid C. Since it was unmarked when captured and was not recaptured, no conclusion can be made in regards to this particular woodrat.

Conclusions that can be made from this study are that Neotoma fuscipes has an average home range area of from 1800 m² to 1900 m² using the exclusive boundary strip method, the densities of trees and shrubs do not appear to influence home range size, woodrat house and nest density within a home range is not related to the size of the home range, and that movement between colonies is infrequent even though the distance is within the dispersal capacity of the woodrats.

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