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Peromyscus Populations as Related to Seasons and Vefetative Types at the Hardware Ranch, Cache County, Utah

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PEROMYSCUS POPULATIONS AS RELATED TO SEASONS AND VEGETATIVE TYPES AT THE HARDWARE RANCH, CACHE COUNTY, UTAH

by

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INTRODUCTION

Members of the genus Peromyscus, White-footed Mice, are known to occur in nearly all habitats of North America. Because of their numerical abundance and widespread distribution, these mice are extensively used in the study of the dynamics of animal populations. Thus, information pertaining to the local distribution and activities of these mice is of value to the more comprehensive studies that are being carried out in the field of zoological research.

Various species of this genus are known to display preferences for certain vegetative types. These preferences affect the number, distribution, and possibly other relationships among mice. Seasonal changes are also thought to influence the foregoing factors.

This study has been conducted at the Hardware Ranch, on the Blacksmith Fork River, Cache County, Utah, to determine the degree of preference shown by these rodents for the vegetative types which are present. In addition, the sex, age, pregnancy, and distribution of the mice trapped were investigated.

The information was obtained through a series of controlled trapping periods conducted during the spring and fall months of 1948.

REVIEW OF LITERATURE

Related fields of endeavor are necessarily united to present a comprehensive picture of population dynamics. A study of an authoritative introduction into the field such as given by Elton (9, 10) must precede any sincere attempt to obtain new information. Although much has been written on the fluctuation of rodent populations, only that information pertaining to the genus Peromyscus will be dealt with here.

The life history of these mice must be familiar to the student before research is begun. Svihla's (25) comprehensive work on the genus combined with the popular studies done by Seton (22) and Cahalane (6) offer an excellent background to the more concentrated field and laboratory research done by other men. These intensive studies may include: distribution, as treated widely by Osgood (19) and locally by Barnes (3) and Rasmussen (20); food, as studied by Hamilton (11), and Seton (22); cover, as a factor in delimiting the range of these mice is described by Johnson (17), Dice (7), and Burt (5); reproduction, as a basis for population fluctuations is treated by Howell (15), and Scheffer (21).

Techniques of former workers must be studied to insure the proper procedure for a prospective study. The transect method for determining population densities has been denounced by both Stickle (23) and Hayne (13). Stickle (24) and Bole (4) claim the quadrat method of sampling populations is better for this purpose. The transect method is recognized by Dice (8) and Jameson (16) as a valid means for obtaining an index

to the relative abundance of small mammals in an area through different trapping periods. Consequently, the research done on this problem, being a comparative study of mouse distribution, employed the transect method.

DESCRIPTION OF AREA

Physiography

The locality studied is in the northwestern portion of the Wasatch Mountains, Cache National Forest, Utah. The Curtis, Rock, and Sheep creeks join to form the headwaters of the Blacksmith Fork within the boundaries of this area. The elevation ranges from 5370 feet at the extreme western boundary, to 6700 feet on the highest ridge (fig. 1).

The ranch is situated in the northern tip of a long shallow valley extending north from Monte Cristo, Weber County, Utah. This depression was called the Cambrian Plateau by Hague (18), but is locally referred to as Ant Valley (26). The mineral content of the soil is composed of a series of gray and brown quartzites and is geologically known as Brigham Quartzite.

A number of knolls and ridges interspersed with open, relatively flat areas provide a variety of habitats for various plant communities within the ranch.

Climatology

The climatological recording instruments to be used in this study were damaged in transit. Thus, no recordings were

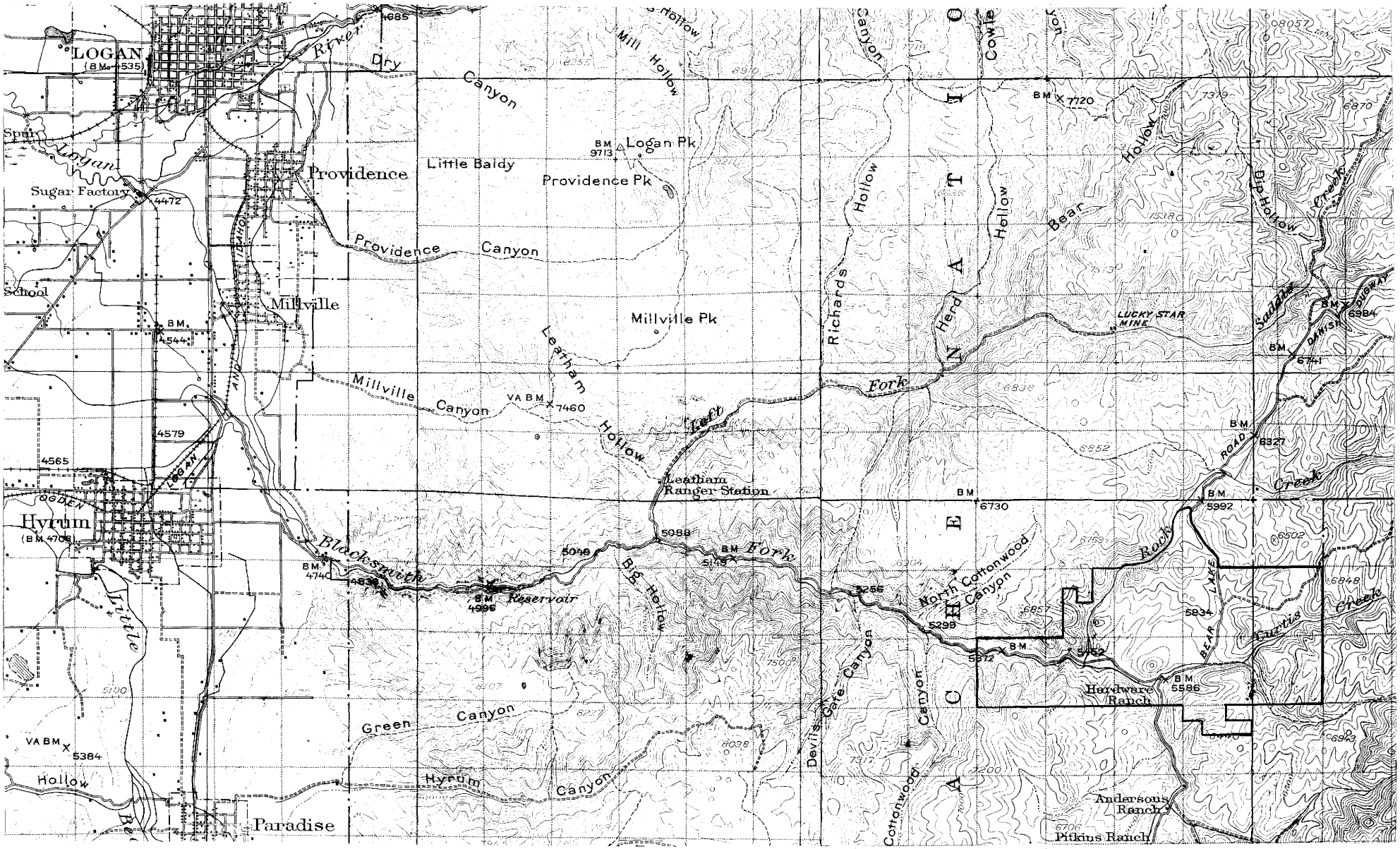


Figure 1. Portion of Logan quadrangle, showing the location and topography of the Hardware Ranch, 1949.

made during the trapping periods.

In order to give the reader some understanding of the climatic conditions of the surrounding region, a 40 year climatic summary for Logan, Cache County, Utah, is presented (table 1). The city of Logan is situated 14 miles northwest of the western most boundary of the ranch. The city is 1033 feet lower than the lowest Bench Mark on the ranch. An open depression 30 miles long with a greatest width of 17 miles characterizes the valley in which Logan is situated. A rather broken shallow valley approximately 20 miles long and 3 miles wide at its greatest width depicts the area in which the Hardware Ranch is located.

A maximum temperature of 77° F. and a minimum of 37° F. was recorded in Logan for the spring trapping period (April 30 - May 11). During the fall trapping period (Sept. 10 - Sept. 22) a maximum of 80° F. was obtained. An increase in elevation of over 1000 feet would indicate lower maximum-minimum temperatures for these days at the Hardware Ranch.

A total precipitation of 3.11 inches was registered for the spring trapping period, while none was recorded for the fall period. It is thought that a greater amount of precipitation would be recorded at the Hardware Ranch due to its higher location.

Wildlife

An abundance of wildlife is found in this relatively wild area. The great variety of rodent life which, according

Table 1. Climatic summary for Logan, Cache County, Utah, 1937-41. (Revised from Climate and Man, Yearbook of Agriculture, Washington, D. C., 1941)

Temperature:	
Length of record (Yrs.)	40
January average (°F)	24.3°
July average (°F)	75.1°
Maximum (°F)	102°
Minimum (°F)	-25
Killing frost average dates:	
Length of record (Yrs.)	30
Last in spring	May 7
First in fall	October 11
Growing season (Days)	157
Average precipitation:	
Length of record (Yrs.)	40
January (Inches)	1.60
February "	1.57
March "	1.93
April "	1.80
May "	1.91
June "	0.83
July "	0.65
August "	0.70
September "	1.14
October "	1.71
November "	1.25
December "	1.30
Annual	16.46

to species distribution, may be found in the general vicinity of this ranch is indicated in the appendix. Those rodents which were caught or observed during the study are marked with a double asterisk in the appendix list. Further information on mammalian life in northern Utah can be obtained from Barnes' "Mammals of Utah" (3), and Hayward's "Bibliography of Utah Mammalogy" (14).

Use

The Hardware Ranch was purchased by the Utah State Fish and Game Commission in 1946 to be used as a big game refuge. Approximately 250 acres of the 6000 acres comprising the ranch are under cultivation. The hay crop obtained from this cultivated area is used as winter feed for elk. A trout rearing pond is also located on the ranch.

The land surrounding the ranch is utilized as sheep and cattle range, although much of this range is too rugged for extensive commercial use and remains as excellent cover for wildlife.

Three buildings, housing the employees, and a barn are located on a gravel road near the southern boundary of the ranch (fig. 1). The road is primarily used by ranchers to reach their lands, but it also serves as a secondary route connecting Cache Valley, Bear Lake, and the Ogden area.

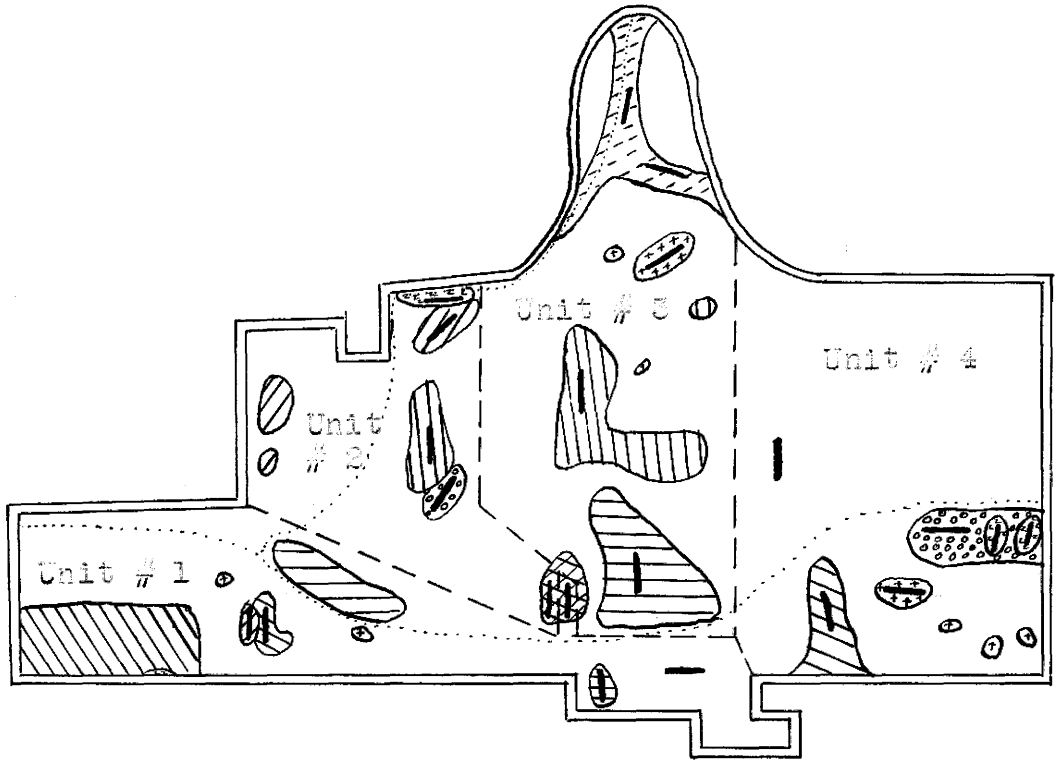
Vegetative Types

The area studied contains ten distinct vegetative communities (fig. 2). Many of these communities are found in two or more localities. Gradient, direction of slope, and rock outcroppings seem to be the basic factors delimiting plant distribution. The most abundant plants for each community are included in the following discussion. The plant species are divided into three major groupings, i. e., grasses, forbs, and browse, and are referred to by their generic names (table 2).

All plant communities are classified as to relative densities. The terms dense, medium, and sparse are used to denote the ocular appearance of the vegetation. This system of classification is used to designate the extent of utilization that the cover presents for the mice.

The general physiography for each community is given to afford a better appreciation of its growing conditions. Total acreages are included to indicate the relative areas covered by each vegetative type.

Meadow community. This type is located in depressions caused by flowing streams or marshy seepages. Few browse plants are present, especially in the marshy regions. Poa, Festuca, and Agropyron are the predominant grasses, while Wyethia, Achillea, and Aster are the forbs found. Vegetation is classified as being dense, becoming more so with an increase of



Sagebrush
Meadow
Pasture
Aspen
Mahogany
Maple
Annuals
Douglas-fir
Bitterbrush-sagebrush-serviceberry
Bitterbrush-sagebrush

Trap line
Creek
Trapping unit boundary
Ranch boundary

Figure 3. A vegetative cover map showing the approximate positions of traplines used at the Turchaire Ranch, 1943. (From unpublished cover type map by Silcock, Simpson, and Sherry, Wildlife Research, Unit, Utah State Agricultural College, Utah, 1943).

Table 2. Dominant plants in vegetative cover types at the Hardware Ranch (Revised from unpublished range survey by Silcock, Simpson, and Sharp, Wildlife Research Unit, Utah State Agricultural College, Utah, 1946)

	Dominant plants		
	Grasses	Forbs	Browse
Meadow	Poa sp. Festuca ovina Agropyron spicatum	Mysthis amplexicaulis Achillea lanulosa Aster sp.	Artemisia tridentata Chrysothamnus viscidiflorus Artemisia sp.
pasture	Alopecurus pratensis Phleum pratense	Trifolium sp.	
Maple	Agropyron spicatum Poa sp. Agropyron subsecundum	Eriogonum sp. Achillea lanulosa Helianthella sp.	Acer sp. Artemisia tridentata Purshia tridentata
Annuals	Agropyron spicatum	Mint sp. Erigeron sp. Lactuca sp.	Artemisia tridentata Acer sp.

moisture. This community covers an area of approximately 50 acres.

Pasture community. This type is located in open, relatively flat expanses, and in close proximity to running water. Irrigation is practised where needed. The hay crop is mowed annually during the month of August. Grasses, Alopecurus, Phleum, and the forb, Trifolium comprise the total vegetation. Vegetation is classified as being dense throughout the area. The pasture covers approximately 240 acres.

Sagebrush community. This type constitutes the major community for the entire ranch. Neither elevation or direction of slope seems to limit its distribution. Nearly all other plant communities are surrounded by this group. Artemisia, Chrysothamnus, and Purshia constitute the major browse plants; while Wyethia, Eriogonum, Agropyron, and Poa compose the predominant forb and grass plants. The density of this vegetation is classified as medium to sparse. Approximately 3880 acres are covered by this plant community.

Maple community. This type is located in ravines and on slopes generally facing north. Acer, Artemisia, and Purshia make up the greater portion of browse plants. Eriogonum and Achillea along with Agropyron and Poa compose the majority of the forbs and grasses. Vegetation is classified as medium to sparse. Although, appearing dense along the perimeter, the interior of

such communities has a rather thin plant population. This vegetative type covers approximately 400 acres.

Annuals community. This type is concentrated almost entirely on the east facing slope of a small knoll. Although these plants are found in a number of places this is the only location warranting their classification as a group. Eriogeron, mints, and Lactuca comprise the majority of annuals. Agropyron and Artemisia are perennials prominant in this community. The vegetation is classified as dense to sparse, due to the degree of moisture and area of rock outcroppings. Fifteen acres of this vegetative type are located on the ranch.

Bitterbrush-sagebrush-serviceberry community. This type is usually located on abrupt, north facing slopes. Artemisia, Purshia, and Amelanchier are the predominant browse plants in the community. Agropyron, Poa, and Carex, along with Eriogonum, Camandra, and Balsamorhiza constitute the majority of grasses and forbs. Vegetation is classified as medium to dense. Rocky projections in some localities limit plant distribution. The community covers an area of approximately 45 acres.

Bitterbrush-sagebrush community. This type is located in two large, south sloping expanses. Artemisia, Purshia, and Chrysothamnus constitute the

principal browse plants. Agropyron and Poa, along with Wyethia, Achillea, and Aster make up the dominant grass and forb populations. Vegetation is classified as medium. An area of 510 acres is covered by this community.

Mahogany community. This type is established on the summits of knolls which extend above 5800 feet in elevation. Cercocarpus, Artemisia, and Acer compose the major browse plants. Wyethia and Achillea, in addition to Agropyron, Poa, and Stipa constitute the most abundant forbs and grasses. The vegetation is classified as sparse to medium. Approximately 130 acres are composed of this plant group.

Aspen community. This type is situated in moist locations on north facing slopes. Populus, Symphoricarpos, and Prunus are the predominant browse type of plants. Agropyron and Poa, along with Thalictrum, Geranium, and Achillea compose the grass and forb cover. Vegetation is classified as dense to medium, depending on the amount of moisture and sunlight obtained by the plants. This vegetative type covers approximately 75 acres.

Douglas-fir community. This type is located on sharply inclining, north facing slopes. Pseudotsuga, Cercocarpus, and Acer compose the overhead and browse type of plants. Agropyron and Poa, in addition to

Eriogonum and Achillea are found as grass and forbs in this community. The vegetation is classified as sparse to medium, due to the large areas of rock-slike, rock outcroppings, and steep slope. Approximately 60 acres are covered by this plant community.

METHOD OF PROCEDURE

The area selected for this research contains ten widely distributed plant communities (fig. 2). These communities were sampled during the spring (April 30 - May 11) and fall (Sept. 10 - Sept. 22) of 1949. The area under observation covers approximately ten square miles. This region is divided into 4 trapping units on the basis of topography and vegetative types. Each unit contains at least 5 distinct plant communities.

A mouse trap station was placed every 50 feet in a transect of 1250 feet in each community. A station consisted of 2 Museum special type traps located approximately 5 feet apart. A minimum of 6250 feet of trap-lines using 250 traps was maintained in each unit for a period of 3 trap nights.

In order to obtain a truer sampling, each plant community was trapped twice during different 3 day periods and in different trapping units, with the exceptions of the meadow, where distance and inaccessability made only one period of trapping possible, and the annuals type, where only one area present was of sufficient size for a trap line. A total of 100 traps over a distance of 2500 feet was used to sample each community during a single season. A

total of 12 nights was spent during each season and the same transects were trapped both times.

Traps were easily located by tying a small rectangular piece of white cloth on a plant near every second trapping station. Bait used for the project was taken from H. E. Anthony's (3) suggestion of 2 parts peanut butter, one part raisins, one part bacon, and enough oatmeal to lend a putty-like consistency to the mixture. The oily nature of this bait was sufficient to make it last for a 5 day period regardless of inclement weather. Re-baiting was necessitated only when the traps were moved or when the bait was taken.

ANIMALS TRAPPED

Out of the 105 species of rodents found in the state of Utah 27 are thought to have home ranges which might extend into the Hardware Ranch area (see appendix).

During the entire problem a total of 6000 trap exposures were made over a distance of 30,000 feet, resulting in a total catch of 387 Peromyscus maniculatus sonoriensis and only 30 other animals. The other animals trapped were: Microtus longicaudus mordax, Eutamias minimus, Eutamias umbrinus, Zapus princeps cinereus, and Sorex vagrans monticola (table 3).

The predominant number of White-footed Mice which were caught, demonstrates their abundance in this area. This abundance prompted the present study of these rodents.

Osgood (19) describes the genus Peromyscus as follows:

> Form murine; tail long, at least more than one-third of total length, often decidedly more than half; tail with scaly annulations and thinly clothed with hair; soles of hind

Table 8. Distribution by cover types of mammals caught at the Hardware Ranch, 1949

Cover types	Number of mammals										
	Spring					Fall					
	Peromyscus	Microtus	Eutamias	Zapous	Sorex	Peromyscus	Microtus	Eutamias	Zapus	Sorex	Total
Meadow		1			1		8			1	11
Pasture	2						1			1	4
Maple	12					22					34
Annuals	16					54					70
Bitterbrush-sagebrush-serviceberry	21			2		27					50
Bitterbrush-sagebrush	3	1				16					20
Mahogany	24		3			14					41
Aspen	18		2			25		1			46
Douglas-fir	23	1	3			33					60
Sagebrush	26		4			30					60
Total	145	3	12	2	1	222	9	1	0	2	396

5-6-tuberculate, hairy proximally or naked medially to calcaneum; mammae 2/2 or 3/3.

Skull with braincase rather thin-walled, smooth, and but little ridged; supraorbital border smoothly rounded, sharp-angled, or beaded; interparietal well developed; zygomata slender, depressed to level of palate; infraorbital foramen compressed-triangular, bounded on the outside by a broad thin plate; anterior palatine foramina long, slitlike, and separated by a thin bony septum; posterior border of palate squared or rounded, without lateral pits, and situated about even with plane of posterior roots of last molars; audital bullae more or less inflated and obliquely situated. Ramus of mandible relatively long, slender, and straightened; coronoid process (except in Baiomys) short and slightly developed; mandible but slightly expanded by base of root of lower incisor. Molars rather weak, brachyodont and tuberculate, the tubercles in two longitudinal series consisting of two principal median series and two much subordinated lateral series; upper molars 3-rooted, lower 2-rooted; molar series decreasing in size from before backward, the third upper molar subcircular and usually less than half as large as the second; first upper molar with 5 principal tubercles, an anterior median one and two pairs of lateral ones (the anterior one partially divided in Megadontomys), with or without subsidiary tubercles in the salient angles; upper incisors without grooves.

DISCUSSION

Peromyscus

Peromyscus are chiefly seed eaters (6, 23). Thus, the presence of those plants producing the least quantity of edible seeds, is thought to be the principal limiting factor for these mice[1]. The kinds of seed most utilized

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1. Liebig's law of the minimum (as applied to animal life): That habitat factor present in the least quantity limits the number of animals able to survive in a given area.

by Peromyscus in this area are not known. However, a survey of the plants found on the Hardware Ranch shows that the same few species have become the dominant plants for all 10 cover types (table 2). Thus, little correlation is shown between the species of plants in this area and the number of mice trapped. It is noted, however, that the least number of mice was trapped in those communities with the least number of browse and forb species, i. e., meadow and pasture. A high water table and periodic flooding of these two communities appeared to be major factors limiting the presence of browse and forb plants. Also, during the fall season the greatest number of mice was trapped in the annual community, which has an herbaceous canopy cover that is 3 times as dense as the grass cover. In support of the foregoing observations, Burt (5) found in southern Michigan that Peromyscus preferred that section of woodland with an herbaceous cover rather than a grass cover.

In a comparison of the total number of Peromyscus caught during the fall and spring seasons, an increase of 53 percent was indicated for the fall season (table 3). During the fall season an average catch for the total number of cover types was found to be 22.2 mice. The corresponding average catch for the spring period was 14.5 mice. The following five cover types (annuals, bitterbrush-sagebrush-serviceberry, aspen, Douglas-fir, and sagebrush)[1] produced a better than average catch for both seasons.

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1. These 5 cover types will, hereafter, be referred to as group A.

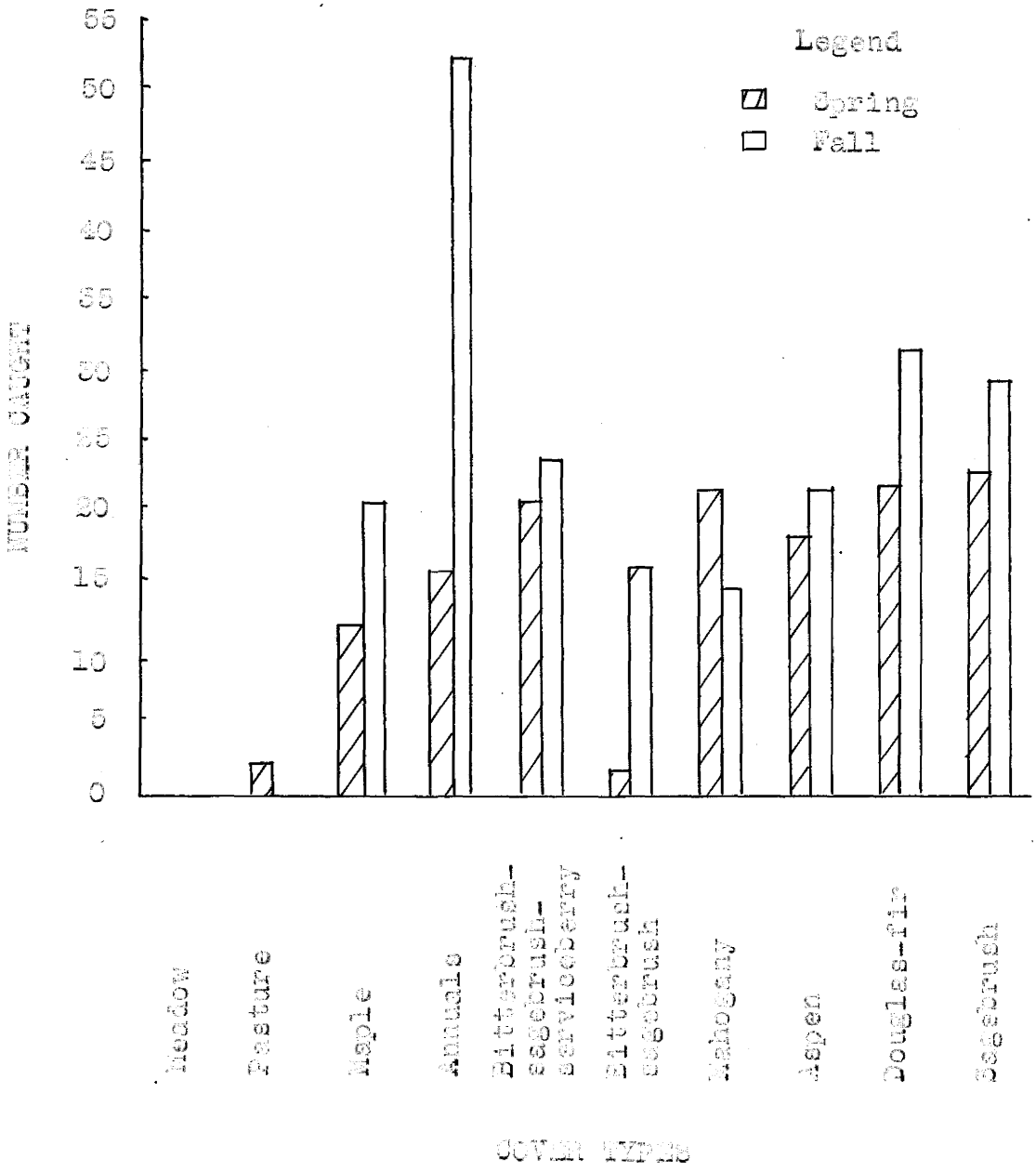

Figure 5. Distribution of Peromyscus caught in each cover type during the spring and fall seasons, at the Hardware Ranch, 1948

During the spring, the greatest number of mice was caught in the sagebrush community (fig. 3). This catch was 9 percent greater than that of any other community during this season. During the fall period the catch for the annual vegetation was 63 percent greater than that of any other type. Both of these plant types produced a better than average catch during both seasons. Throughout these seasons no Peromyscus were caught in the meadow, while a total of 2 were taken in the pasture community.

The sex ratio, males to females, for the 5 most productive cover types (group A) was found to be 110:100; whereas that of the other 5 cover types (mahogany, bitterbrush-sagebrush, meadow, pasture, and maple)[1] was 166:100 (table 4).

During the spring, the sex ratio of the Peromyscus caught was nearly 100:100 for the total number of vegetative types trapped. Such a ratio was not found for the mice trapped during the fall. Instead, a 36 percent greater male than female catch was recorded. Thus, an approximate ratio of 136:100 was exhibited during this season.

The number of pregnant mice trapped was recorded during the study period. The data entered under this category were derived from external observations. Pregnancy was determined by abdominal distension, overweight condition, and presence of fetuses as indicated by handling the adults, and not by dissection. Thus, only those mice obviously carrying

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1. These 5 cover types will, hereafter, be referred to as group B.

Table 4. Sex ratio and distribution of Peromyscus at the Hardware Ranch, 1949

Cover types	Total number			
	Spring		Fall	
	Female	Male	Female	Male
Meadow	0	0	0	0
Pasture	1	1	0	0
Maple	4	8	6	16
Annuals	10	6	22	33
Bitterbrush-sagebrush-serviceberry	7	14	17	10
Bitterbrush-sagebrush	1	3	4	12
Mahogany	13	11	6	8
Aspen	10	8	14	11
Douglas-fir	13	10	15	20
Sagebrush	13	13	12	18
Total	72	73	94	128

young were listed. Sixty of the 166 female Peromyscus counted in the two trapping seasons were considered pregnant. From these data, the spring pregnancies were 40 percent greater than thos observed furing the fall. A slightly greater number of pregnancies were recorded for group A than for group B.

A pregnancy period of from 21 - 25 days usually occurs before the birth of a litter of Peromyscus. A subsequent time lapse of 1 to 2 months is required before the first traces of adult (or post-juvenile) pelage are found[1]. Therefore, an approximate span of 3 months between conception and adult status of the offspring is found in Peromyscus (6). In this study a period of 4 months elapsed between trapping seasons. Therefore, it is probable that none of the offspring from mice pregnant in the spring would be caught, in their juvenile pelage, during the fall trapping period.

It is seen (p. 18) that there was a 53 percent increase in animals caught in the fall over the number obtained during the spring. This increase in population would suggest a high fertility following the spring samling with a subsequent increase in the juvenile mice population for the fall trapping.

The total number of adult animals caught during the two seasons was 502 percent greater than the total juvenile catch (table 5). A plurality of adults was shown in all comparisons made. The insignificant number of juvenile animals

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1. In recording the adult and juvenile mice trapped, a criterion for separating these animals had to be adopted. Thus, any mouse with a trace of adult pelage (yellow-brown) was classified as an adult; while only those animals which were completely blue-grey in color were classified as juveniles.

Table 5. Distribution of adult and juvenile Peromyscus at the Hardware Ranch, 1949

Cover types	Age distribution			
	Spring		Fall	
	Adults	Juveniles	Adults	Juveniles
Meadow	0	0	0	0
Pasture	2	0	0	0
Douglas-fir	23	0	30	3
Maple	16	0	21	1
Annuals	10	6	35	10
Bitterbrush-snowbrush-serviceberry	11	5	23	1
Bitterbrush-sagebrush	9	1	16	4
Mahogany	21	3	10	3
Aspen	17	2	25	0
Sagebrush	23	2	25	4
Total	139	19	184	36

trapped made a comprehensive analysis of their distribution difficult. However, it was found that group A had an overall ratio of approximately 18 (juveniles):100 (adults); while, in group B a 15 (juveniles):100 (adults) ratio was exhibited. In a seasonal comparison it was found that an approximate 15 (juveniles):100 (adults) ratio was shown during the spring; while, an 18 (juveniles):100 (adults) ratio was seen during the fall.

It is interesting to note, that although in group A a 182 percent greater total catch was taken that in group B, there was very little change in the proportion of juvenile to adult mice. A similar situation is noted in a seasonal comparison. The fall catch indicated only a very slight increase in the proportion of juveniles to adults; whereas, a 53 percent increase in the total fall population over that of the spring was shown. The foregoing observations indicate a tendency for these rodent populations to maintain a constant balance in the juvenile adult ratio no matter how the total populations may fluctuate.

Other Animals

Microtus populations were far below those noticed in this area during 1947 (18). A total of 12 *Microtus* was taken during the entire trapping procedure, 3 being taken in the spring and 9 during the fall. Nine of these were caught in the meadow, 1 during the spring and 8 in the fall. The bitterbrush-sagebrush, Douglas-fir, and pasture growths produced 1 mouse each (table 3).

Eutamias were found only in mahogany, aspen, Douglas-fir, and sagebrush. These animals appeared more plentiful during the spring (12 caught) than in the fall (1 caught).

Two Sorex were taken during the fall, 1 each in meadow and pasture growths. Spring trapping produced only 1 individual, it being taken in the meadow.

Two Zapus were trapped during the spring in the bittebrush-sagebrush-serviceberry community. None was taken during the fall.

SUMMARY

1. Various vegetative communities were systematically trapped during the spring and fall seasons of 1949 as a means of investigating the influence of these factors on resident populations of White-footed Mice, Peromyscus maniculatus sonoriensis.

2. A modification of the transect trapping method was employed in this study. Seasonal trapping periods in a variety of cover types resulted in the information treated in this thesis.

3. The area studied was located in a shallow valley, at about 6000 feet elevation, with many low knolls and ridges. An invigorating climate typifies this section of the Wasatch Mountains.

4. The Hardware Ranch is utilized by the Utah State Fish and Game Department as a big game refuge. It harbors a large variety of wildlife, of which elk and deer are the most prominent.

5. Ten distinct vegetative cover types are found within the boundaries of the ranch. The dominant grasses, forbs, and browse found in these cover types are listed in the text.

6. A relatively few species of plants were consistently dominant in all vegetative types, indicating that food preference is not the major limiting factor for the distribution of Peromyscus. Instead, observations by the author and others suggest that the type of cover in an area may have a greater influence than the kind or quantity of food

present.

7. Members of the genus Peromyscus far outnumbered the members of any other genus of animals (Eutamias, Microtus, Lepus, and Sorex) trapped during the study.

8. A definite increase was shown in the number of mice caught during the fall as compared to the number caught during the spring. Out of the 10 cover types, 5 of these (group A) (annuals, bitterbrush-sagebrush-serviceberry, aspen, Douglas-fir, and sagebrush) consistently produced a greater catch than the remaining 5 (group B) (mahogany, bitterbrush-sagebrush, meadow, pasture, and maple).

9. Throughout both seasons a greater number of male than female mice was caught in each vegetative type. There was a better balance in the sex ratio of mice trapped in group A than in group B. A more balanced ratio was found in both groups during the spring as compared to the fall.

10. A comparison of the pregnant Peromyscus to the total number of female animals caught in each cover type disclosed a higher frequency of pregnant mice in group A as compared to group B. It was also observed that a greater number of pregnant mice was trapped in both groups during the spring than was trapped during the fall.

11. The number of adult mice trapped outnumbered the total juvenile catch in all vegetative types and during both seasons. The proportionate juvenile to adult mice trapped in both vegetative groups was greater in the fall than in the spring. A greater proportionate number of juveniles to adults was also observed in group A as compared

to group B.

12. From the foregoing evidence it is seen that, in general, the greatest population, the more balanced sex ratio, the highest frequency of pregnant animals, and highest frequency of juvenile mice were obtained in the same 5 cover types throughout both seasons.

It is also seen, that during the spring the more balanced sex ratio and the greatest number of pregnancies were obtained; while, during the fall, the greatest total catch, and the highest frequency of juveniles were obtained.

APPENDIX

RODENTS OF UTAH (14)

Sciuridae
- Marmota flaviventris engelhardti **
- Citellus variegatus utah *
- Citellus variegatus grammurus
- Citellus lateralis lateralis *
- Citellus lateralis castanurus *
- Citellus lateralis grandis
- Citellus armatus *
- Citellus mollis mollis
- Citellus tridecemlineatus parvus *
- Citellus leucurus leucurus
- Citellus leucurus cinnamomeus
- Citellus leucurus pennipes
- Citellus spilosoma cryptospilotus
- Citellus townsendii mollis
- Citellus tridecemlineatus parvus
- Cynomys leucurus
- Cynomys parvidens
- Cynomys gunnisoni gunnisonii
- Eutamias quadrivittatus inyoensis
- Eutamias umbrinus **
- Eutamias dorsalis
- Eutamias dorsalis utahensis *
- Eutamias minimus leptus *
- Eutamias minimus operarius **
- Eutamias minimus scrutator
- Tamiasciurus hudsonicus ventorum *
- Tamiasciurus fremonti fremonti
- Glaucomys sabrinus lucifugus *

Geomyidae
- Thomomys uinta *
- Thomomys talpoides uinta
- Thomomys talpoides macrocalvis
- Thomomys talpoides monoi
- Thomomys talpoides levis
- Thomomys umbrinus aureilis
- Thomomys bottae albatus
- Thomomys bottae bridgeri
- Thomomys bottae centralis
- Thomomys bottae semotus
- Thomomys bottae aldinoestris
- Thomomys fossor
- Thomomys fossor levis
- Thomomys fossor monoi
- Thomomys fossor macrocalvis

Note - The distribution of those animals marked with an asterisk (*) indicates that they may be found on the Hardware Ranch (1 and 3); while, those marked with a double asterisk (**) indicates that they were seen or trapped on the Ranch.

Heteromyidae
- Perognathus longimembris arizonensis
- Perognathus longimembris gulosus
- Perognathus longimembris nevadensis
- Perognathus longimembris virginis
- Perognathus parvus olerus
- Perognathus formosus formosus
- Dipodomys ordii atahensis *
- Dipodomys ordii marshalli
- Dipodomys ordii celeripes
- Dipodomys ordii cinereoeus
- Dipodomys ordii columbianus
- Dipodomys ordii ensidinous
- Dipodomys ordii fetosus
- Dipodomys merriami merriami
- Dipodomys merriami frenatus
- Dipodomys microps elfredi
- Dipodomys microps bonnevillei
- Dipodomys microps celsus
- Dipodomys microps leviges
- Dipodomys microps russeolus
- Dipodomys microps subtenuis

Castoridae
- Castor canadensis *
- Castor canadensis repentinus

Cricetidae
- Onychomys leucogaster brevicaudus
- Onychomys leucogaster melanophrys
- Onychomys leucogaster utahensis
- Onychomys torridus longicaudus
- Neotrodontomys megalotis megalotis
- Neotrodontomys megalotis navus
- Peromyscus maniculatus gunnisoni
- Peromyscus maniculatus irolarus
- Peromyscus maniculatus osgoodi
- Peromyscus maniculatus sonoriensis **
- Peromyscus boylii rowleyi
- Peromyscus truei truei
- Peromyscus crinitus crinitus
- Peromyscus crinitus auripectus
- Peromyscus crinitus peninsulae
- Peromyscus crinitus pergracilis
- Peromyscus eremicus eremicus
- Neotoma albigula brevicauda
- Neotoma lepida monstrabilis
- Neotoma lepida marshalli
- Neotoma cinerea cinerea **
- Neotoma cinerea acrita
- Neotoma cinerea arizonae
- Clethrionomys gapperi wintaensis *
- Microtus montanus *
- Microtus montanus micronus *
- Microtus montanus amosus
- Microtus montanus nexus
- Microtus montanus vivularis

Microtus longicaudus mordax **
Microtus longicaudus latus
Ondatra zibethica goldmani *
Ondatra zibethica mergens
Muridae
Mus musculus musculus *
Rattus norvegicus *
Rattus rattus rattus
Zapodidae
Zapus princeps cinereus **
Erethizontidae
Erethizon epixanthum epixanthum *

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